Fiscal Year 2009
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

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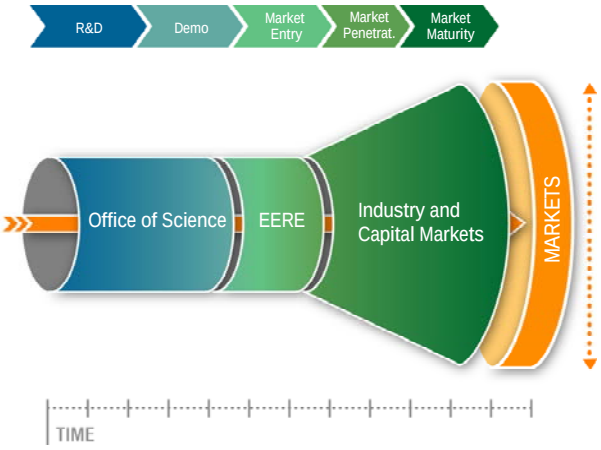
Preface

The Office of Energy Efficiency and Renewable Energy (EERE) manages America's investment in research, development and deployment of the Department of Energy's (DOE) diverse energy efficiency and renewable energy applied science portfolio.

Our **mission** is to develop and deploy renewable energy sources and conversion technologies, as well as identify efficiency best practices, regulations and technologies that collectively strengthens our economy, protects the environment and increases national security. The FY 2009 request of $1.255 billion for Fiscal Year (FY) 2009, approximately $19 million higher than the FY 2008 request, provides a balanced and diverse portfolio of solutions to address the urgent energy and environmental challenges facing our country today by: 1) researching, developing and deploying renewable energy technologies to dramatically increase the amount of clean energy produced in the United States; 2) advancing energy efficient technologies and practices that use less energy; and 3) providing information necessary to help enable large and rapid changes in energy systems. EERE will take aggressive steps to catalyze the rapid development, commercialization and deployment of this technology portfolio.



This budget request supports the President's State of the Union challenge to continue leading the way in developing and using clean and efficient technologies critical to reducing emissions, while still fostering economic growth and energy security. The budget continues the key elements of the *Advanced Energy Initiative*, changing the way we power our homes, businesses, and automobiles. It also continues progress towards the President's call to break our addiction to oil by reducing gasoline consumption by 20 percent within the decade, the "*Twenty in Ten*" goal, and will simultaneously enable us to meet our commitments to addressing climate change. This request builds upon work in progress in EERE, carries out key provisions of both the Energy Policy Act of 2005, and supports the mandates contained in the recently enacted Energy Independence and Security Act of 2007. Consistent with the AEI, we are funding two renewed programs: Water Power to assess and explore new ocean and river technology potentials and a refocused Geothermal Program that concentrates on Enhanced Geothermal Systems (EGS).

Accomplishing the EERE mission will benefit both the supply and demand sides of the Department's energy security equation, enabling more productive use of the energy we have, and accelerating the arrival and use of the new fuels and technologies that we need. These integrated programs directly contribute to the Departmental goal by: (1) reducing demand-side pressure on our energy markets (mitigates costs); (2) reducing oil imports; (3) diversifying the mix of domestic energy production; (4) providing smaller and decentralized alternative and non-fuel based sources of electricity generation that are inherently less susceptible to interruption or attack; and (5) resolving the technology and market components of barriers to widespread use of these solutions.

The balanced and diverse portfolio of RD&D is catalyzing unprecedented growth rates of renewable

energy and efficiency gains through adoption of technology cultivated by EERE. Renewable energy use has grown by 50% during this decade. Biofuels production has reached record levels, with the U.S. now leading the world—producing over 6 billion gallons annually (as a result of the 25% growth in the industry). In addition to energy supply gains, U.S. deployment of energy efficiency technologies has contributed to a reduction in energy intensity (energy consumption per dollar of gross domestic product) of 13% for the U.S. economy since 2000.

The achievement of EERE program goals could save consumers over $600 billion by the year 2030[1] and as much as $4 trillion by 2050 (cumulatively); and reduce annual costs to the electric power sector by $200 billion and $700 billion in by those years, respectively. Similarly, we expect that our portfolio will avoid 6 gigatons of carbon (GTC) by 2030 and nearly 50 GTC by 2050 (cumulatively). Finally, we expect that our portfolio will offset 5 billion barrels of imported oil by 2030 and more than 60 billion barrels by 2050, cumulatively and respectively, considerably diversifying our portfolio with substitutions for oil.

However, government funding alone will never be sufficient to address all the challenges of changing our Nation's energy portfolio. Our efforts today and onward need to be about developing and implementing solutions that leverage and stimulate the rapid and large-scale private actions and investment necessary to meet our Nation's needs.

With action plans, performance milestones, clearly articulated deliverables and continued performance EERE's budget request will strengthen our dynamic partnerships with private industry and academia that have grown our Nation's economic well-being. Our laboratory products and partnerships resulting in industry commercialization at unprecedented levels will bring clean energy technologies and sources to large-scale commercial viability in the foreseeable future

1 References to future years in these justification documents represent calendar years unless otherwise noted.

Highlights: Accelerating and Scaling-up Clean Energy Solutions

Advanced Fuels and Vehicles Solutions ($592.3M)

- Advancing essential RD&D projects to achieve cost competitive, commercial scale cellulosic ethanol production by 2012.
- Accelerating RD&D on lithium-ion batteries, plug-in hybrids, and drive-train electrification to diversify and make our nation's vehicles more efficient to reduce petroleum dependency.
- Continuing to research and develop critical hydrogen technologies that enable near-term commercialization pathways.
- Employing a "technology neutral" approach to transportation solutions that involves validating fuel infrastructure and vehicle testing; providing for safety, codes, and standards; and supporting education activities that will accelerate all new fuel and vehicle solutions to the market.

Renewable Power Solutions ($241.6M)

- Accelerating high penetration of wind and solar power by addressing the key integration and inter-connection challenges of intermittency and variability.*
- Fostering greater dispatchability and response for solar and wind by developing and evaluating energy storage solutions.**
- Enabling wind power to be on a pathway to produce up to 20% of the Nation's electricity by improving the performance of turbines, blades, and related components.
- Continuing Solar America Initiative to lower cost of photovoltaics to reach unsubsidized grid parity by 2015.
- Establishing demonstration sites for Enhanced Geothermal Systems and evaluating reservoir creation techniques.
- Benchmark testing of leading ocean, wave, and tidal technologies.

Energy Efficiency Solutions ($266.4M)

- Sustainably separate economic growth from growth in energy consumption.
- Transform the carbon footprint of the built environment through zero energy buildings.
  - Continuing fundamental and applied R&D for enabling technologies, such as solid state lighting and advanced windows;
  - Accelerating and elevating codes and appliance standards;
  - Expanding and modernizing *ENERGYSTAR*® program; and
  - Targeting the civic infrastructure (e.g., schools, hospitals, libraries, municipal facilities) to invest in Energy Smart solutions.

*(Cooperative programming with Office of Electricity Delivery and Energy Reliability (OE))

**(Cooperative programming with OE and Office of Science)

- Driving a 25% reduction in U.S. industrial energy intensity by 2017 in support of the EPACT 2005 and achieving at least an 18% reduction in U.S. carbon intensity by 2012.
  - Developing advanced manufacturing processes for energy-intensive industries such as iron and steel that can reduce energy intensity by 2.5% a year.
  - Developing clean and efficient crosscutting technologies applicable for manufacturing industries such as food, information technology, and fabricated metals;
  - Conducting Save Energy Now plant assessments and leveraging state resources to increase program impact;
  - Expanding partnerships with leading corporations across major manufacturing supply chains to enable dramatic energy savings.

Key Program Highlights:

- *Biomass Program*. The FY 2009 request includes a funding increase of $26.8 million to continue the President's AEI and "*Twenty in Ten"* commitments and to support the Energy Independence and Security Act of 2007. Specifically, the FY 2009 request strengthens the Departmental activities throughout the biofuels supply chain—from farm to vehicles—increasing its emphasis on feedstock accessibility and ramping up end use infrastructure activities for testing intermediate blends of ethanol. The Biomass Program will continue research, development and demonstration aimed at improving and validating the technical, economic, and environmental viability of the nascent biofuels industry.

- *Building Technologies.* By making new and existing homes and buildings more energy efficient, the Department is delivering significant primary energy savings today, with even greater future savings in the pipeline, increasing energy security and transforming the carbon footprint of the built environment. The FY 2009 request will allocate an additional $15 million to these high priority efforts. R&D for residential and commercial buildings integration is focused on reducing building energy requirements and integrating renewable energy systems to enable commercial production of net Zero Energy Homes and Buildings by 2020 and 2025, respectively. The portfolio of energy efficiency component research, aligned to reduce building electrical loads, includes solid state lighting**,** more affordable efficient windows, and more efficient heating, ventilation, air conditioning and refrigeration. The program pursues market transformation activities by developing *ENERGY STAR*® labels for major appliances such as windows, refrigerators, dishwashers and compact fluorescent lights and other clean energy products developed at the Department and by industry, such as solid state lighting, water heaters, photovoltaics, fuel cells, micro-wind turbines, combined heat and power. The Department is also developing and disseminating model building codes that are 30 percent more efficient than the current codes in both the residential and commercial sector. The Department will continue to clear the backlog of rulemakings for appliances and commercial equipment and meet all of the requirements of the Energy Policy Act (EPACT) of 2005 and the EISA.

- *Vehicle Technologies*. The Department is requesting an additional $8 million to prioritize RD&D for advanced batteries and plug-in hybrid vehicle technologies. Launched as part of the AEI, plug-in hybrid vehicles will reduce oil use beyond standard hybrid configurations by enabling electricity to become a significant transportation fuel. Accessing readily available energy drawn from the Nation's electricity grid at off-peak times to charge high energy batteries, plug-in hybrid vehicles can operate in electric only mode for up to 40 miles—meeting most drivers' needs for commuting and short distance driving with no tail-pipe emissions.

- *Solar Energy*. The President's Solar America Initiative (SAI), focuses on achieving cost competitiveness for solar electricity by 2015, is accelerating cost reductions by working with industry-led teams to aggressively deliver solar systems that are less expensive, more efficient, and highly reliable. Focusing on both manufacturing and systems integration issues, the industry will deploy 5 gigawatts (GW) of new grid-connected electricity generating capacity by 2015. The SAI also features the second year of market transformation activities to reduce market barriers and seize opportunities to promote rapid, large-scale solar deployment.

- *Wind Energy.* The slightly larger FY 2009 budget request of $52.5 million includes wind energy research to reduce costs, and additional focus to overcome barriers to large-scale use of wind power by addressing the key integration and inter-connection challenges of intermittency, power quality and variability. Wind is also fostering greater dispatchability by developing and evaluating energy storage solutions. Program outreach efforts continue to improve technology performance and reliability, and overcome barriers to market acceptance and electric power system integration.

- *Geothermal Technology.* The funds requested, an increase of over $10 million, focus on an exciting opportunity for extracting heat from the earth called Enhanced Geothermal Systems (EGS) that could provide 100,000 MW of electric power by 2050. The funds support research and demonstrations of EGS technology at different geological field sites to increase reservoir production rates and lifetimes.

- *Federal Energy Management Program.* Using the successful framework of the Secretary's Transformational Energy Action Management (TEAM) initiative, the FY 2009 request will support increased use of alternative financing, expanded use of alternative fuels, and signature energy saving projects at DOE facilities consistent with exceeding the requirements of Executive Order 13423 and EISA 2007.

- *Industrial Technology Programs.* The program request will partner with States to expand the Secretary of Energy's "Easy Ways to Save Energy" campaign through the "*Save Energy Now"* (SEN) industrial energy savings assessments at the Nation's most energy-intensive industrial facilities. Over 450 assessments have been completed (2006 through 2007), identifying opportunities to over 150 trillion Btus of energy, including more than 66 trillion Btus of natural gas, the amount used by nearly 1 million average U.S. homes.

This Budget-in-Brief summarizes the key activities and changes in each of the 14 program areas. A chart summarizing the FY 2009 budget request is on page 53. More detailed program information, including the EERE FY 2009 budget request, can be found at www.eere.energy.gov.

Biomass and Biorefinery Systems R&D Program

The mission of the Biomass and Biorefinery Systems R&D Program ("Biomass Program")[1] is to develop and transform our domestic, renewable, and abundant biomass resources into cost-competitive, high performance biofuels, bioproducts, and biopower through targeted RD&D leveraged by public and private partnerships. The Biomass Program's funding supports the *Biofuels Initiative* that was launched in 2006 as part of the *Advanced Energy Initiative* and is designed to achieve cost competitive cellulosic ethanol by 2012. The funding also supports the President's *"Twenty-in-Ten"* initiative, announced in the 2007 State of the Union, to reduce gasoline consumption by 20 percent by 2017. Elements of the President's initiative are now codified into law through the Energy Independence and Security Act of 2007.

The Program's funding request for these initiatives fits into three budget elements: (1) Feedstock Infrastructure to reduce the cost of feedstock logistics, including harvesting, storage, preprocessing and transportation and to validate the availability of sustainable, high quality, and readily accessible biomass resources; (2) Platforms R&D for efficiently converting feedstocks into cost competitive commodity liquid biofuels, like cellulosic ethanol, as well as products and power via biochemical and thermochemical processes; and (3) Utilization of Platform Outputs to demonstrate and validate integrated technologies that achieve commercially acceptable performance and cost pro forma targets through public-private partnerships. These biorefinery demonstration projects can alleviate the high technical risk and capital investment of commercial development. Additionally, in order to achieve large-scale market adoption of biofuels, the program will address significant infrastructure challenges, including distribution, storage, materials compatibility, fuel dispensing, and vehicle end use, in collaboration with other federal and state agencies and other key stakeholders.

FY 2009 Budget Request
Biomass and Biorefinery Systems R&D

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Feedstock Infrastructure	9,725	12,386	15,500
Platforms R&D	49,306	67,282	53,400
Utilization of Platform Outputs R&D....	137,246	113,557	156,100
Cellulosic Ethanol Reverse Auction	0	4,955	0
TOTAL	**196,277**	**198,180**	**225,000**

In Fiscal Year 2009, the Department is requesting $225 million for the Biomass Program, an increase of $26.8 million from the FY 2008 appropriation.

The program strategy is to continue to develop the "next generation" of feedstocks and conversion technology options that will be validated and demonstrated in integrated biorefineries at commercial

[1] 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 fuel, chemicals, and materials.

and 10% of commercial scale. This strategy balances the program's RD&D portfolio by encouraging technology transfer while maintaining core R&D funding for next generation technologies.

Feedstock Infrastructure

Biomass feedstocks are essential to achieving the program's overarching strategic goal because the amount, quality, sustainability, accessibility, and economics of biomass feedstocks will determine the growth of the U.S. bioindustry, and thus, biofuels production volumes. There are two main activities included in Feedstock Infrastructure: 1) the Regional Biomass Feedstock Development Partnerships and 2) Infrastructure R&D. The Regional Partnerships address barriers to accessing the biomass, including resource assessment, education and extension, sustainable agronomic systems development, and crop development. In FY 2009, the Regional Partnership efforts will include a GIS-based bioenergy decision tool providing biomass resource information to a wide variety of users to support biorefinery and crop development. Infrastructure R&D addresses barriers associated with accessing the feedstock supply including harvesting, collecting, preprocessing, storing, queuing, handling, and transporting all major feedstock categories of cellulosic biomass (i.e., wet, dry and woody). In FY 2009, the infrastructure R&D will continue to fund industrial partnerships with equipment manufacturers and universities to address the logistical barriers for transforming low bulk density biomass feedstocks for economical delivery to biorefineries on a year-round basis. ($15.5 million)

Platforms R&D

- The Thermochemical Platform conducts research, testing, integration, and feasibility studies to convert biomass to fuels, chemicals and power via gasification, pyrolysis and catalytic hydrotreating and hydrocracking processing technologies. The major technical challenges include: understanding feedstock requirements; improving conversion technologies to produce fuel intermediates such as clean synthesis gas and stable pyrolysis oils; improving catalysts and conversion technologies for production of fuels; process integration to optimize, intensify, and consolidate conversion processes; and understanding fundamentals and developing new concepts. This effort will help launch the next generation of biofuels and will support future biorefinery validation projects. ($20.4 million)
- The Biochemical Conversion Platform R&D is aimed at reducing the cost of converting lignocellulosic biomass to mixed, dilute sugars and then to liquid transportation fuels, such as ethanol. Activities include: feedstock interface, pretreatment and conditioning, hydrolysis and saccharification (sugars production), and process integration with the ultimate goal of reducing the cost of sugars. This effort will help launch the next generation of biofuels and will support future biorefinery validation projects. ($33.0 million)

Utilization of Platform Outputs R&D

- Integration of Biorefinery Technologies will continue to support industry's efforts to demonstrate integrated biorefinery technologies for the production of transportation fuels and co-products (such as materials and chemicals). The FY 2009 request continues funding for the commercial scale biorefinery demonstrations projects, as authorized by EPACT 2005, Section 932(d). These commercial scale demonstration facilities are critical to validate technologies and bench mark costs of the near-term biorefinery pathways for producing cellulosic ethanol. Additionally, FY 2009 request continues funding for several advanced biorefinery projects at approximately 10 percent of commercial scale that will validate technologies and economics of even more biomass conversion technologies and feedstocks. Activities in this budget area also

include analyses, testing and targeted R&D to ensure the cost effective transport, storage, distribution, and delivery of growing volumes of biofuels to end users throughout the nation. Specifically, testing of intermediate blends on vehicles, other engines, and infrastructure components will provide data on how these blends may affect materials, durability, performance, and emissions. ($140.0 million)

- Products Development focuses on the development of microorganisms, in addition to heat and chemical catalysts, to convert the intermediate streams -- released from Platform R&D intermediates (i.e. syngas, bio-oils, mixed sugars) -- into a suite of cost-competitive fuels, chemicals, and/or heat and power that can enhance the economics of a biorefinery. In FY 2009, the program will continue to fund the five public-private partnership projects selected for award in FY 2007 to develop of commercial microorganisms capable of fermenting biomass to cellulosic ethanol. Additionally, the funding level will allow the program to assess, prioritize, and initiate R&D for other bioproducts and biofuels. ($16.1 million)

Cellulosic Ethanol Reverse Auction

The Program is not requesting funds for a reverse auction in FY 2009. In FY 2008, the Program is establishing the framework for an ethanol reverse auction in accordance with Section 942 of EPACT 2005.

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 that will enable the design of net Zero Energy Buildings. The program also includes the development of building codes and appliance standards and successful education and market introduction programs, including *ENERGY STAR*® and EnergySmart Schools.

The Fiscal Year 2009 request for the Building Technologies Program is $123.8 million, an increase of $14.8 million from the FY 2008 appropriation.

FY 2009 Budget Request
Building Technologies

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Residential Buildings Integration	17,270	24,475	26,900
Commercial Buildings Integration	8,699	11,891	13,000
Emerging Technologies	41,840	37,413	39,465
Technology Validation and Market Introduction	18,249	13,239	24,400
Equipment Standards and Analysis	16,925	21,981	20,000
TOTAL	**102,983**	**108,999**	**123,765**

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)—homes that produce as much energy as they use on an annual basis—by 2020.

- Research and Development: Building America. This program will focus on reducing total energy use in a new home by 60 to 70 percent. During FY 2009, research for production-ready new residential buildings that are 40 percent more efficient will continue for three climate zones, with completion of the research in two of these zones. Activities will be carried out in partnership with designers, builders, and component manufacturers. ($26.9 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 will develop four packages of cost-effective technologies for small- to medium-sized (less than 25,000 square feet) commercial buildings to reach 30 percent energy savings over the American Society of Heating, Refrigerating, and Air-conditioning Engineers' (ASHRAE) Standard 90.1-2004. These commercial building energy efficiency improvement packages will describe the technologies, quantify the energy savings and costs, and provide design and construction guidelines for implementation in several climate regions of the United States. ($13.0 million)

BT's activities in the commercial sector are focused on alliances of leading market companies with national portfolios of buildings (retail chains, office buildings, real estate investment trusts (REITs), lodging chains, and multi-facility health care). BT will have direct engagement with the developers of these buildings which will provide BT the opportunity to better understand the business models and value propositions necessary to develop a strategy to significantly promote the construction of highly efficient commercial buildings. In addition, BT will benefit from participating in real whole-building design, construction, operation, and retrofit/rehabilitation experiences. These activities provide opportunities to test BT's guidelines for low energy and ZEB in actual buildings. DOE's role as convener of partnerships with developers and other key actors promotes leveraging of resources and encourages shared responsibility for market transformation activities.

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 enable reductions in building energy use 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. ($39.5 million)

- Solid State Lighting will develop technologies that can reduce commercial building lighting electricity consumption by at least 50 percent. Projects will be continued (from the Fiscal Years 2004 - 2008 solicitations) to develop general illumination technologies that achieve energy efficiencies of up to 107 lumens per Watt, through creation of a technical foundation to revolutionize the energy efficiency, appearance, visual comfort, and quality of lighting. These projects will include light-emitting diode (LED) core topics (semiconductor materials, phosphors, defect physics, and light extraction), LED product development topics (optical coupling & modeling, manufactured materials, packaging, thermal design, luminaire life, materials in devices, and light extraction from devices), organic light-emitting diode (OLED) core topics (novel materials, new architectures, light extraction, improved charge injection, and transparent electrodes), and OLED product development (application of materials in fabrication, applied light extraction, manufacture process optimization and device encapsulation & packaging). ($20.1 million)

- Space Conditioning and Refrigeration R&D will demonstrate up to three design concepts selected from initial prototypes developed in FY 2006 that have the long-term potential to

reduce annual heating, ventilation, and air-conditioning (HVAC) energy consumption by 50 percent in new residential buildings. These energy reductions are relative to 2003 Building America Benchmarks and have an estimated simple payback period of three years or less. These projects include the development of an air-to-air integrated heat pump (IHP) system that can meet the air heating, cooling, dehumidifying, ventilating, and water heating requirements of a tight-envelope mechanically ventilated near-zero-energy house and the development of a ground-source integrated heat pump (GSIHP). The design concepts must also address other critical Building America needs such as humidity control, uniform comfort, and indoor air quality. The R&D projects will emphasize modest cost premiums since very high efficiency equipment already exists, but high first cost premiums have resulted in low market penetration. ($3.8 million)

- Building Envelope R&D will develop new envelope materials to help meet Zero Energy Building goals. Specifically, this research will include phase change materials and thermochromic surfaces that adjust to optimize building performance. For example, the U.S. construction market uses predominantly light-weight walls that have low thermal storage. Historically, masonry walls have exhibited high heat storage capability that has buffered or reduced heating and cooling loads. DOE's research will allow our light-weight, low-cost construction practices to function similarly to heavy mass walls. In addition, DOE will continue competitive fundamental science research to develop the second generation of materials, chemical engineering applications, and advanced manufacturing processes that can offer "leap frog" reductions in cost for dynamic windows while maintaining a high level of reliability and durability with a broad range of optical properties. DOE will continue its research on highly insulating windows such as vacuum glazings that can achieve R10 performance, approximately three times that of today's *ENERGYSTAR*® windows. ($8.7 million)

- Analysis Tools and Design Strategies will conduct 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. ($3.1 million)

- Solar Heating and Cooling focuses on the challenges of integrating solar technologies into building systems and products. Activities will include developing a conceptual design for an integrated solar electric/thermal system sized for an average single-family home and the development of the prototype systems; providing technical support to states and cities interested in establishing a policy that encourages the use of solar water heaters as a method of saving energy and reducing greenhouse gas emissions; and support of a solar rating and certification system. ($3.7 million)

Equipment Standards and Analysis

The Equipment Standards and Analysis subprogram develops minimum energy efficiency standards that are technologically feasible and economically justified as required by law. Federal energy conservation standards that have gone into effect since 1988 are projected to save a cumulative total of 75 quadrillion Btus (quads) of energy by the year 2045 (in 2007, total annual U.S. consumption of primary energy was about 103 quads). During the FY 2005 through FY 2007 time period, the Department identified and carried out significant enhancements to rulemaking activities. The

Department has made a commitment to clear the backlog of delayed actions that accumulated during prior years, while simultaneously implementing all new requirements of EPACT 2005. EISA significantly increases the number of efficiency standards and test procedures DOE must develop. Energy conservation standards for 12 products were initiated in FY 2006 and 2007 that will continue in FY 2009. In FY 2008, efficiency standards rulemakings were initiated on five additional products that will continue in FY 2009. In FY 2009, test procedures for nine products will also be ongoing. The Department will continue to implement productivity enhancements that will allow multiple rulemaking activities to proceed simultaneously, while maintaining the rigorous technical and economic analysis required by statute. ($20.0 million)

Technology Validation and Market Introduction

The Technology Validation and Market Introduction subprogram funds activities that accelerate the adoption of clean, efficient, and domestic energy technologies. The major activities are: *ENERGYSTAR*®, EnergySmart Schools, and Hospitals, Commercial Lighting Initiative, National Builders' Challenge, Building Efficiency Application Centers and Building Energy Codes. *ENERGY STAR*® is a joint Department of Energy/Environmental Protection Agency activity designed to identify and promote energy efficient products.

- *ENERGYSTAR*® will continue to update criteria on selected products in accordance with EPACT 2005. For FY 2009, a three-pronged strategy will be used to support a full and growing portfolio of *ENERGYSTAR*® labeled clean energy technologies: 1) Developing and updating efficiency criteria for DOE-managed products in order to keep the label relevant and meaningful in the market, 2) Working with participating manufacturers, retailers, and energy efficiency program sponsors on product marketing and deployment activities; and 3) Conducting outreach campaigns and initiatives to educate consumers about *ENERGY STAR*® and the benefits of select products and technologies. ($8.0 million)

- Rebuild America, has been aligned with the Commercial Building Integration research and development activity to accelerate the adoption of advances in commercial building integrated design, software tools, practices and advanced controls, equipment and lighting. BT will continue implementation of the Commercial Lighting Initiative, EnergySmart Hospitals, EnergySmart Schools, the National Builders' Challenge, and the Building Efficiency Application Centers. To promote energy efficiency within the large number of existing homes, BT will initiate pilot projects for innovative service delivery for low and moderate income energy retrofits; retailer partnerships to promote energy efficient home remodeling and retrofits through innovative financing; and policies and program development for energy audits at the time of home resale. ($5.0 million)

- Building Energy Codes will support the development and uptake of model building energy codes such as the ASHRAE Standard 90.1 for commercial buildings, and the International Code Council's International Energy Conservation Code [IECC] for residential buildings. DOE will also provide determinations as required on new ASHRAE or IECC building codes, and update the code compliance software, REScheck and COMcheck, to efficiency levels in the current residential and commercial codes. ($8.0 million)

- Solar Decathlon, a high-profile university competition held biannually in Washington, D.C., promotes public awareness of highly efficient building technologies and zero-energy homes using solar energy. This competition will be held in 2009 to foster innovation and encourage

incorporation of new building technologies and design practices into engineering and architecture university curricula. ($3.4 million)

Federal Energy Management Program

Federal Energy Management Program (FEMP) enhances energy security, environmental stewardship and cost reduction within the Federal Government through reductions in energy intensity in buildings, increased use of renewable energy and greater conservation of water. These goals are accomplished by means of alternative financing contract support, technical assistance, coordination of Federal reporting and evaluation, supporting alternative fuel use in the Federal vehicle fleet and supporting the Secretary's Transformational Energy Action Management (TEAM) initiative. FEMP facilitates the award of alternative financing contracts between Federal agencies and the private sector, enabling agencies to install energy efficiency improvements quickly and pay off the costs incurred over a period of time using dollars they saved on energy bills. Federal energy managers receive technical assistance from FEMP so they can identify, design, and implement energy efficient and renewable energy technologies and practices. FEMP publishes an Annual Report to Congress on Federal energy efficiency and renewable energy use, and conducts an awards program to recognize individuals and groups within Federal agencies who achieve excellence in energy management. In a new effort this year, FEMP will support private sector development of alternative fuel stations at Federal sites, demonstrate opportunities for petroleum displacement to increase alternative fuel use, and conduct reporting and analysis of the Federal vehicle fleet. In addition, with DOE Specific Investments, FEMP will support the Secretary's Transformational Energy Action Management (TEAM) initiative which will establish DOE as the Federal agency leader in strengthening environmental, energy, and alternative fuels management. The TEAM initiative works with DOE programs to meet and exceed the Executive Order 13423 goals such as a reduction of energy intensity of 30 percent by the end of fiscal year 2015.

FY 2009 Budget Request

Federal Energy Management Program

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Project Financing	8,509	8,606	8,000
Technical Guidance and Assistance	6,519	8,153	4,000
Planning, Reporting and Evaluation	2,473	3,059	2,000
Departmental Energy Management	1,979	0	0
Federal Fleet	0	0	2,000
DOE Specific Investment	0	0	6,000
TOTAL	**19,480**	**19,818**	**22,000**

The Fiscal Year 2009 request is $22 million, which is an increase of $2.2 million from the FY 2008 appropriation.

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 (ESPCs) and Utility Energy Service Contracts (UESCs) to finance energy saving improvements without the use of current appropriations. 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 such as lighting upgrades, new heating and ventilation systems, and improved control systems. ($8.0 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. The Program also helps Federal facilities manage peak load requirements and deploy new technologies, including combined heat and power, distributed energy, and renewable technologies. Working with FEMP, agencies can acquire the most energy efficient products through procurement training, product efficiency recommendations, communications and outreach, and assistance in amending agency 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. Information and technical assistance will be provided to agencies to implement new Federal Building Performance Standards. ($4.0 million)

Planning Reporting and Evaluation

EPACT 2005 requires DOE to collect, verify, and report to Congress on the progress by Federal agencies, including DOE, toward the Federal energy management goals of reducing energy intensity in buildings, reducing petroleum usage, and conserving water. Data collection, verification, and reporting are centralized for the Federal agencies at FEMP, which will publish its Annual Report to Congress. In addition, FEMP will continue to recognize excellence through the Presidential and Federal awards program. Technical analysis will be conducted as required to respond to analytical reporting requirements involved with the Government Performance and Results Act (GPRA), multi-year planning, and other efforts. ($2.0 million)

Federal Fleet

Federal vehicle fleet activities will include the required tracking and reporting activities for the Federal fleet that were previously covered under Planning, Reporting and Evaluation. Additional activities include the promotion of the increased use of alternative fuel for Federal Agency sites. Federal vehicle fleet activities support the integration of buildings, electricity and electric vehicles or plug-in hybrid electric vehicles. FEMP would demonstrate opportunities for increased petroleum displacement through increased alternative fuel use. ($2.0 million)

DOE Specific Investments

DOE Specific Investments includes activities designed to implement the Energy Policy Act of 2005 and Executive Order (EO) 13423 for DOE sites. These activities support the Secretary's Transformational Energy Action Management initiative to establish DOE as the Federal agency leader in strengthening environmental, energy, and alternative fuels management. Because a core mission and responsibility of the Department of Energy is to lead the Nation in promoting and utilizing the best

available energy management technologies and practices, binding agreements will be set up throughout the program offices that ensure that agencies will meet, exceed and lead in the implementation of EO 13423 goals. FEMP efforts will include establishing an alternative fuel infrastructure for DOE vehicle fleets and furthering deployment of advanced energy efficiency, renewable energy, and water technologies. As DOE makes progress toward meeting its goals, it will broaden its efforts to enable other Federal Agencies meet the goals of EO 13423 by deploying lessons learned from DOE's experience. ($6.0 million)

Geothermal Technology Program

The Geothermal Technology Program works in partnership with industry to establish geothermal energy as an economically competitive contributor to the U.S. energy supply. Geothermal energy generates electricity or supplies 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 provide the Nation with sources of electricity that are highly reliable and cost competitive and do not add to the Nation'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 program focuses on an exciting opportunity called Enhanced Geothermal Systems (EGS), which are engineered reservoirs created to produce energy from geothermal resources deficient in economical amounts of water and/or permeability. EGS is a new pathway for producing geothermal energy by drilling wells into hot rock, fracturing the rock between the wells, and circulating a fluid through the fractured rock to extract the heat. While EGS reservoirs have been designed, built, and tested in various countries, a number of technical hurdles remain to be overcome—the most important involving creation of EGS reservoirs with commercial production rates and lifetimes. The Department's approach to overcoming the hurdles is to concentrate initially on technologies for reservoir creation, operation, and management. This strategy involves working with cost-sharing partners at existing geothermal fields to develop, test, and perfect the tools needed to fracture hot, impermeable rock and efficiently circulate fluids. The program also will employ a site dedicated to experimentation of innovative EGS technology. Technology development will rely on R&D and multiple field experiments in partnership with industry with support from various research institutions.

A feasibility study by the Massachusetts Institute of Technology (MIT) estimates that EGS could provide 100,000 MW of electric power by 2050—10 percent of currently installed electric capacity. This compares with today's 2800 MW of installed capacity at existing U.S. geothermal power plants using today's technology. Operating as a closed loop, EGS power plants will have no atmospheric or greenhouse gas emissions. Expected program outcomes will include creation of a commercial-scale geothermal reservoir and power plant (approximately 5 MW in generating capacity) capable of operating for 7 years by 2015. This initial plant, followed by others in differing geologic environments, should foster rapid growth in the use of geothermal energy as predicted by the MIT study.

FY 2009 Budget Request
Geothermal Technology

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Enhanced Geothermal Systems	2,000	19,818	30,000
Oil and Gas Well Co-Production and Resource Assessment	3,000	0	0
TOTAL	**5,000**	**19,818**	**30,000**

The Fiscal Year 2009 request is $30 million, which is an increase of $10.2 million from the FY 2008 appropriation.

In FY 2009, the program will work on EGS technology development at cost-shared field sites. This work encompasses possible drilling/recompletion of wells, reservoir fracturing, establishment of a fluid circulation loop, and long term reservoir testing. The program will demonstrate first generation geothermal well stimulation at the Desert Peak geothermal field in Nevada, and initiate two to four cost-shared EGS demonstration projects in various geological settings. Several field sites will be evaluated for selection of a site dedicated to experimentation of innovative EGS technology. Various research institutions will conduct supporting research in priority areas identified by an EGS technology evaluation. These areas include monitoring and logging tools, high temperature submersible pumps, reservoir predictive models, and zone isolation tools. ($30.0 million)

Hydrogen Technology Program

The Hydrogen Technology Program continues to be a significant component of the President's *Advanced Energy Initiative,* announced in 2006. The program is being realigned in FY 2009 after completion in FY 2008 of the President's original 5-year, $1.2 billion funding commitment to the *Hydrogen Fuel Initiative*. This realignment focuses the program on remaining critical-path barriers to the technology-readiness goals for 2015. Substantial increases are included for hydrogen storage R&D, to enable vehicles to have a greater than 300 mile driving range, for in fuel-cell R&D, particularly durable low-cost polymer components. To provide those increases, all funding for hydrogen production is deferred and systems analyses (of hydrogen pathways and infrastructure scenarios to assess the energy, environmental, and economic impacts of hydrogen and fuel cell technologies) continue at somewhat reduced funding levels.

The Fiscal Year 2009 budget request for Hydrogen Technology is $146.2 million, $64.8 million less than the FY 2008 appropriation, due in part to the movement of three activities totaling $31.5 million from the Hydrogen Technology program to the Vehicles Technology program. Consistent with the reprioritization of the EERE project portfolio, funding has increased for the highest risk technology barriers of Hydrogen Storage R&D and Fuel Cells. Concurrently, funding for Hydrogen Production and Delivery R&D and Manufacturing R&D has been deferred. Projects associated with Technology Validation, Safety and Codes and Standards, and Education will continue and are transferred to Vehicle Technologies.

FY 2009 Budget Request
Hydrogen Technology

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Hydrogen Production and Delivery R&D	33,702	39,636	0
Hydrogen Storage R&D	33,728	43,501	59,200
Fuel Cell Stack Component R&D	37,100	43,600	62,700
Technology Validation	39,413	29,727	0
Transportation Fuel Cell Systems	7,324	7,927	6,600
Distributed Energy Fuel Cell Systems	7,257	7,630	10,000
Fuel Processor R&D	3,952	2,973	0
Safety and Codes and Standards	13,492	15,854	0
Education	1,978	3,865	0
Systems Analysis	9,637	11,395	7,713
Manufacturing R&D	1,928	4,954	0
TOTAL	**189,511**	**211,062**	**146,213**

As another part of the program's realignment in FY 2009, several activities are moved to EERE's Vehicle Technologies Program, where they will be closely integrated between the Hydrogen program and complementary vehicle activities. These include technology validation ("learning demonstrations") of fuel-cell vehicles and hydrogen production and fueling systems under "real world" conditions to determine status toward targets and to help guide the R&D program; underlying safety research to support the development of codes and standards; and education and training of both the

general public and public safety and regulatory officials to facilitate near-term demonstrations and market transformation as well as long-term market acceptance.

Hydrogen Production and Delivery R&D

Consistent with the reprioritization of the EERE portfolio, Hydrogen Production and Delivery R&D will be deferred in FY 2009 ($0 million). The core technology readiness goals established for 2015 can be met with the technologies for producing hydrogen from natural gas that were developed in prior years, so although renewable hydrogen production will ultimately provide feedstock diversity and greater greenhouse gas benefits, near-term hydrogen production is no longer a critical-path barrier.

Hydrogen Storage R&D

Hydrogen Storage is one of the most technically challenging barriers to the widespread advancement of hydrogen and fuel cell technologies in the transportation sector. The overarching goal is lightweight, low-cost, low-pressure, and efficient on-board vehicular storage systems to achieve a driving range of greater than 300 miles, without impacting vehicular cargo or passenger space to be competitive with today's vehicles. The program will significantly increase investment in applied R&D of novel materials and breakthrough concepts with potential to meet on-board storage system performance targets. The program will conduct R&D through the framework of the "National Hydrogen Storage Project," consisting of both Centers of Excellence (which include teams of competitively selected university, industry and Federal laboratory partners) and competitively selected independent projects. The applied R&D investment in FY 2009 will be ramped up for both materials and engineering research involving a new Engineering Center of Excellence for hydrogen storage. The R&D will be closely coordinated with the DOE Office of Science basic research efforts in hydrogen. ($59.2 million)

Fuel Cell Stack Component R&D

To address the critical barriers of fuel cell cost and durability, the Program will significantly increase funding for Fuel Cell Stack Components R&D. Proton-conducting membranes that are low-cost, durable, and operate at low relative humidity will be developed. Non-precious metal and alloy catalysts will be identified and developed to lower the cost of fuel cell systems. New diagnostics tools will be developed to probe properties of the fuel cell and characterize fuel cell operation. Component development focuses on low-cost fabrication concepts. The program will scale-up development of metallic and carbon-based bipolar plates that perform as well as machined graphite plates. Gas diffusion layer physical properties and pore structure will be optimized to enhance fuel cell performance and ease external water management. Gas flow through the flow fields will be modeled and measured while fuel cells are in operation to ensure optimal gas and water distribution over the catalyst and membrane surface. Seals that ensure the integrity of the fuel cell stack will be made less susceptible to degradation. The Department will continue its participation in the International Partnership for the Hydrogen Economy (IPHE), working on such projects as the evaluation of fuel cell-related test protocols from different countries. ($62.7 million)

Technology Validation

In FY 2009, the Technology Validation activity is moved to the Vehicle Technologies (VT) program and is funded in the VT budget. Because the Vehicle Technologies program manages other vehicle demonstration activities (alternative fuels, plug-in hybrids) this move should produce beneficial operational synergies. ($0 million)

Transportation Fuel Cell Systems

Focused research, development, and analysis are needed to address key barriers to the commercialization of fuel cell systems for transportation applications, including cost and durability. This activity supports development of individual component technologies for air, water, and thermal management that are critical to systems integration. This effort also includes systems-level modeling activities that guide research, development, and integration activities and explore alternate systems configurations. Fuel cell system cost and trade-off analyses will be conducted to support technology readiness. Scenarios for operating fuel cell systems at low relative humidity and under sub-freezing conditions will be evaluated. The Transportation Systems activity also supports the development of auxiliary power units for heavy vehicle applications. ($6.6 million)

Distributed Energy Fuel Cell Systems

High-efficiency polymer electrolyte membrane and solid oxide-fuel cell power systems are being developed as an alternative power source to grid-based electricity for buildings, other stationary applications, and portable power applications. Stationary and portable applications will be first to become economically viable and represent an early market for fuel cells. Commercialization of fuel cells in these areas will aid in developing a manufacturing base and introduce the technology to consumers, thus paving the way for fuel cell systems being used in transportation applications. The Distributed Energy Fuel Cell Systems activity focuses on overcoming barriers to stationary fuel cell systems, which include improving durability, integrating systems, and achieving higher performance at lower cost by optimizing control schemes and scaling components for particular applications. These improvements will enable the widespread use of fuel cells in distributed energy and other small stationary applications and will help to accelerate commercialization of fuel cells by achieving durability of 40,000 hours at a cost of $750 per kW, making fuel cells competitive with conventional technologies.

Fuel processors for integrated stationary applications and catalysts suitable for a variety of fuel processing applications also are developed in this activity. The option of using natural gas, propane, diesel, and renewable biomass-derived fuels such as methanol, ethanol, or biodiesel to produce hydrogen or hydrogen-rich reformate will allow the environmental and efficiency advantages of hydrogen fuel cell technologies to be realized in an integrated stationary fuel cell system.

Distributed Energy Fuel Cell Systems include stationary fuel cell demonstration projects, involving international and intergovernmental partnerships, in support of the IPHE and the Hydrogen Interagency Task Force. The systems developed and built under this activity include components developed in the Fuel Cell Stack Component R&D activity. ($10.0 million)

Fuel Processor R&D

Fuel Processors for integrated stationary applications and catalysts suitable for a variety of fuel procession applications will continue to be developed in the Distributed Energy Fuel Cell Systems activity. ($0 million)

Safety and Codes and Standards

In FY 2009, the Safety and Codes and Standards activity, consisting mostly of applied R&D on hydrogen behavior and safety-related characteristics of fuel cells and hydrogen storage and distribution technologies, is continued in the Vehicle Technologies (VT) program, and is funded within VT's Technology Integration subprogram. ($0 million)

Education

In FY 2009, the Education activity to promote understanding and acceptance of hydrogen technologies among the general public and public safety and regulatory officials is continued in the Vehicle Technologies (VT) program and is funded within VT's Technology Integration subprogram. ($0 million)

Systems Analysis

Systems Analysis enables an understanding and assessment of 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 DOE Hydrogen Program will be far more challenging than any activity previously undertaken on the civilian energy side of the DOE."[1] Aligned with the NRC's recommendations, Systems Analysis activities identify the impacts of various hydrogen technology pathways, understand the resource limitations for hydrogen production, infrastructure constraints and requirements for hydrogen fuel deployment, determine key cost drivers and technology gaps, evaluate the significance of research results, and assist in the prioritization of research and development directions. Activities will also include analyzing the impact of hydrogen and fuel cells on climate change and the environment. ($7.7 million)

Manufacturing R&D

Consistent with the reprioritization of the EERE portfolio, Manufacturing R&D will be deferred in FY 2009. Manufacturing R&D is not a critical-path barrier to achieving the program's core technology-readiness goals for 2015; it will be one of the factors that industry will consider in making a decision whether to commercialize hydrogen technologies after that time. ($0 million)

[1] National Research Council and National Academy of Engineering, Committee on Alternatives and Strategies for Future Hydrogen Production and Use, *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs* (Washington, DC: National Academies Press, 2004).

Industrial Technologies Program

The Industrial Technologies Program (ITP) 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 contribute significantly to our national effort to reduce oil imports, natural gas demand, and the need for new power plants, while lowering harmful 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. ITP estimates that in 2005, ITP programs and technologies contributed to industrial energy savings of over $4.4 billion. To provide the best value and optimum use of public investments, ITP will continue the three-year process initiated in FY 2008 to increase crosscutting research. ITP will implement its deployment strategies including industry energy assessments which continue to deliver the results of ITP's R&D and energy-saving practices to industrial plants nationwide. The Energy Savings Assessments (ESA) effort reached its 24-month goal of conducting 450 assessments from 2006 through 2007 at the Nation's most energy-intensive industrial facilities. With 350 plants reporting results from the assessments, there were identified savings of over 150 trillion Btus of energy, including more than 66 trillion Btus of natural gas, the amount used by almost a million U.S. homes. If implemented, the improvements could save more than $680 million per year and reduce carbon dioxide emissions by 5.6 million metric tons annually; which is equivalent to taking over 1 million automobiles off the road.

The Fiscal Year 2009 budget request of $62.1 million for Industrial, which is $2.3 million less than the FY 2008 appropriation. Internal funding shifts reflect a continued strategy to emphasize more effective and efficient ways to increase energy efficiency among energy intensive industries. The shift toward more crosscutting and higher impact R&D activities will allow ITP to focus on fewer R&D projects with higher impacts for a broader set of industries.

FY 2009 Budget Request

Industrial Technologies

	Funding ($ in thousands)		
Activity	**FY 2007 Approp.**	**FY 2008 Approp.**	**FY 2009 Request**
Industries of the Future (Specific)	16,585	11,245	11,392
Industries of the Future (Crosscutting)	39,178	53,163	50,727
TOTAL	**55,763**	**64,408**	**62,119**

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. Future initiatives will be broader in application potential and enable ITP to shift toward higher impact R&D activities to dramatically improve the energy efficiency and environmental

performance of energy-intensive industries. This shift will sharpen ITP's focus on key programmatic objectives that support the Department's strategic goals, along with advancing the economic productivity goals of the American Competitiveness Initiative. ($11.4 million)

- Forest and Paper Products. This activity will focus on research to investigate avenues for the reduction of energy use. The program will continue activities in the areas of high efficiency pulping and innovative drying. Continued collaboration with the American Forest and Paper Association and other industry organizations to improve the Nation's forest and paper product companies' energy efficiency. ($1.5 million)

- Steel Industry. This activity will focus on processes that both reduce the use of natural gas and improve energy efficiency in iron and steelmaking. The program will continue to support the American Iron and Steel Institute, Steel Manufacturers Association, and other industry organizations to improve domestic steel companies' energy efficiency. ($2.3 million)

- Aluminum Industry. This activity will focus on plant assessments (through the Industrial Technical Assistance activity) to improve near term energy efficiency gains in this industry sector. Future R&D applicable to this and other industries will be conducted through the Energy-Intensive Process R&D activity. ($2.2 million)

- Metal Casting Industry. This activity will continue cost-effective activities in advanced melting and efficient net shape manufacturing processes and transfer of research and development results and technologies to industry. ($1.0 million)

- Chemicals. This activity will focus on development of alternative energy efficient chemical processes, oxidation reactions, hybrid distillations, and micro reactors. R&D in these areas will result in improved conversion of chemical processes, reduced feedstock consumption, and reduced generation of unneeded by-products and wastes. ($4.4 million)

Industries of the Future (Crosscutting)

The Industries of the Future (Crosscutting) activities work with industrial partners and suppliers to conduct cost-shared RD&D on technologies that have potential applications across many industries. Leveraging on its successful partnership with energy-intensive industries as well as its innovative technology transfer practices, ITP will continue the transition to more multi-industry application and transformational R&D activities in the Energy-Intensive Process R&D key activity. New research relating to industrial materials, combustion, robotics, sensors and automation will be merged into this activity and enable ITP to shift toward broader research areas with higher energy efficiency and environmental performance impacts for energy-intensive industries.

In addition, Fuel and Feedstock Flexibility activities will support development and deployment of alternative fuel and feedstock technologies to replace natural gas and oil. Deployment activities such as Industrial Assessment Centers and the Best Practices activities will continue to deliver the results of energy-efficiency R&D and energy-saving practices to industrial plants nationwide. ($50.7 million)

- Industrial Materials of the Future. This activity will support the development of nanocomposites and nanocoatings, materials for energy systems and materials for separations, and advanced materials solutions such as membranes for waste energy recovery; refractories for industrial systems. ITP will also conduct R&D on new high temperature corrosion-resistant

materials for energy-intensive applications and advanced manufacturing processes such as low cost titanium production. ($4.8 million)

- Combustion. Continue development of second generation ultra-high efficiency industrial boiler at over 94 percent fuel-to-steam efficiency at 2 ppm NO_x and CO_2 emissions by FY 2009. ($0.6 million)
- Industrial Technical Assistance
  - Industrial Assessment Centers. The ITP Industrial Assessment Centers (IAC) activity contributes to the Administration's goal of training more engineers and scientists in the energy field. IAC alumni are very much in demand by top firms as energy managers with real-world knowledge and experience, ready to work on projects immediately and improve the bottom line. The IAC funds a network of universities which send graduate engineering students out to small and medium-sized manufacturers to conduct free energy audits. These assessments identify a range of efficiency improvements, including no-cost and low-cost recommendations, and help U.S. manufacturers struggling to cope with high energy prices. In FY 2009, the program will perform 315 days of industrial assessments while providing energy, waste, and productivity training to another 120 engineering students at 26 universities. These efforts 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 saving energy in industry. ($4.0 million)
  - Best Practices. The Save Energy Now (SEN) initiative will partner with leading industrial companies, plants, and supply chains to reduce their energy intensity by 25% over a 10 year period as called for in EPACT 2005, Section 106 (reduce energy intensity by 2.5% per year from 2006 to 2016). Building upon the success of 450 Energy Savings Assessments (ESAs) conducted from 2006 through 2007, ITP will expand its partnership with leading corporations in energy management and will pilot a new voluntary ANSI-accredited standard to certify manufacturing facilities for energy efficiency through a third party verification process. ITP will work with the States to provide industrial Energy Savings Assessments, train and send energy experts to the Nation's most energy-intensive manufacturing facilities to identify immediate opportunities for saving energy and money. SEN will support energy-intensive plants and new emerging sectors (such as data centers) to implement cost-effective energy saving and carbon reducing technology solutions through the dissemination of energy assessments, tools, information, and training either directly or through state, utility and local partners. ($15.5 million)
- Energy-Intensive Process R&D. This activity will support multi-industry R&D in the four platform areas of: *Industrial Reaction and Separation* (including oxidation processes and advanced water removal), *High-Temperature Processing* (including high efficiency calcining and next-generation material processing), *Waste Energy Minimization and Recovery* (including high efficiency steam generation and combustion technologies and improved energy recovery technologies), and *Sustainable Manufacturing* (including near net shape processing and forming). Some research relating to industrial materials, combustion, robotics, sensors, and automation will be merged into this activity and enable ITP to shift toward broader research areas with higher energy efficiency and environmental performance impacts for energy-intensive industries. This shift will also expedite development of advanced energy-efficient technologies to serve a broader set of industries, including those identified by the National

Association of Manufacturers such as the food & beverage, computer and electronic, and fabricated metal products industries. ($15.3 million)

- Fuel and Feedstock Flexibility. This activity will assist industry to integrate alternative fuels into manufacturing processes, improving fuel flexibility to reduce the damaging effects of fossil fuel price hikes. FY2009 efforts will include technical analyses of advanced fuel and feedstock flexibility technology platforms and industrial process integration issues and R&D to increase market adoption of emerging energy technologies for the industrial sector. ($4.0 million)
- Nanomanufacturing and Other Inter-Agency Manufacturing R&D. This R&D activity will support the development of next-generation manufacturing processes to reduce the energy intensity of the U.S. manufacturing sector dramatically. Potential for next generation manufacturing concepts will be evaluated, such as nanomanufacturing technology (one of the technology platforms identified in the U.S. Climate Change Technology Program Strategic Plan 2006). The initial work is expected to include development of technologies and techniques and processes needed for nanomanufacturing, enabling the mass production and application of nano-scale materials, structures, devices, and systems to transform industrial processes that could provide energy savings and improve economic productivity. ($5.0 million)
- Inventions and Innovations. This activity will provide grants and assistance to private sector individuals, particularly independent inventors, and small start-up businesses. Initial focus areas will be early-stage technologies and concepts that reduce carbon and other greenhouse gases in industry. Based upon past success of investment in energy efficiency technology development with this activity, estimated energy savings in the year 2020 are 14 trillion Btus and carbon savings of 0.2 MMTCE. ($0 million)
- Industrial Distributed Energy. In collaboration with industry, ITP will continue to support development and adoption of Industrial Distributed Generation to include advanced reciprocating engine system research for clean, efficient, and fuel-flexible DG/CHP systems (<20 MW) for non-traditional CHP applications, such as untapped markets (medium-sized plants) in the industrial sector, including food processing plants and the growing data center sector. ($1.5 million)

Solar Energy Program

The mission of the Solar Energy Program ("Solar Program") is to conduct aggressive research, development, and deployment of solar energy technologies and systems. As part of the President's Advanced Energy Initiative, which seeks to change the ways we power our homes, businesses, and automobiles, the Solar Program is working to develop cost-competitive, unsubsidized photovoltaics across the Nation by 2015. Through the President's *Solar America Initiative* (SAI), announced in the 2006 State of the Union, the Solar Program will accelerate the market competitiveness of solar electricity as industry-led teams compete to deliver solar systems that are less expensive, more efficient and highly reliable. By focusing on manufacturing and systems integration issues, the SAI will support the deployment of 5 gigawatts (GW) of new grid-connected solar electricity generating capacity by 2015.

FY 2009 Budget Request
Solar Energy

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Photovoltaic Energy Systems	138,372	136,744	137,120
Concentrating Solar Power	15,696	29,727	19,000
Solar Heating and Lighting	2,960	1,982	0
TOTAL	**157,028**	**168,453**	**156,120**

The Fiscal Year 2009 budget request for Solar Energy is $156.1 million, $12.3 million less than the FY 2008 appropriation.

Targeting improved performance and reliability with reduced cost, the Solar Program focuses its research, development, and deployment activities in two technology areas: photovoltaics and concentrating solar power.

Photovoltaic Energy Systems

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

To lower costs more rapidly and improve performance, the Solar Program is focusing on PV technology pathways that have the greatest potential to reach cost competitiveness by 2015. Industry-led partnerships, known as "Technology Pathway Partnerships," will be continued in FY 2009 to

aggressively address the issues of cost, performance, and reliability associated with each pathway. Under the SAI, substantial work on PV modules, the heart of PV systems, as well as other "balance-of-system" (BOS) components will be conducted. The PV subprogram will also coordinate with the Building Technologies and the Federal Energy Management programs, and the DOE Office of Science on SAI activities.

The PV subprogram has four major research, development, and deployment activities:

- Applied Research. In FY 2009, emphasis will be on future generation research focused on semiconductor material, device and processing issues that benefit multiple companies and/or technologies. Applied Research supports the SAI through laboratory and university research that addresses the needs of the industry-led partnerships. Key to this support is the research activities in the new Process Development Integration Laboratory (PDIL) within the Science and Technology Facility (S&TF) at NREL. The research conducted in these laboratories is designed to shorten the time lag between laboratory bench results and the introduction of commercial technologies. ($36.5 million)

- System Development. System Development has three primary projects: Technology Pathway Partnerships (TPPs), the PV Incubator Project, and the University Process and Product Development. Under the TPPs, industry—led teams are funded to develop photovoltaic technologies, such as crystalline silicon and thin film modules, which have the greatest potential for cost-competitiveness by 2015. The TPPs will also consider development and testing of balance-of-system component designs that address emerging requirements for modularity, reliability, and decreased installation cost. The PV Incubator Project will bring start-up PV companies into the laboratory to work on module prototypes and pilot manufacturing processes. These joint lab/industry projects will deliver new module prototypes and demonstrate pilot production by 2010, reducing risk in capital investments for manufacturing capacity expansion. The University Process and Product Development is designed to recognize the essential expertise that universities hold in materials and device physics and use this to assist in the development of market applicable technologies directly related to the goals of the SAI. ($65.2 million)

- Technology Evaluation & Integration. These activities will focus on the evaluation of technical advances throughout the Solar Program using independent testing and analysis, including the evaluation of ongoing system-level progress of the TPPs. Technology Evaluation & Integration (TEI) activities include the development of models that predict system performance and cost based on industry data, and data taken from systems operating throughout the country. Also included are detailed analysis of industry's technology, manufacturing capability, and business plans. Many of these technical evaluation activities will be used to conduct the necessary stage-gate reviews and periodic downselects critical to the success of the SAI. TEI also features activities that promote the integration of solar systems into end use locations and the electricity grid. ($21.6 million)

- Technology Acceptance. This key activity is divided into four areas: Codes & Standards, Training & Certification, Technical Partnerships, and Technical Outreach. Under Codes & Standards, work includes providing assistance on interconnection standards, building codes and net metering regulations, and developing and promoting national module performance rating systems. Under Training & Certification, the program will continue to support the training and certification of solar installers and code officials, and work to create a sufficiently large and

qualified workforce that can install PV systems in sufficient quantities to meet the goals of the SAI. Under Technical Partnerships, the program provides technical assistance (not hardware) to large-scale, high-visibility installations, such as new building communities, big box retailer installations, and utility-scale solar. The two main Technical Partnership activities are Solar America Cities and Solar America Showcases. The Solar America Cities activity features assistance to U.S. cities that have committed to solar, while the Solar America Showcases effort provides technical assistance to companies, States, and other entities for large-scale, high-visibility solar projects. Under Technical Outreach, DOE provides assistance to utilities, builders, and states to facilitate wider adoption of solar technologies in all three markets. ($13.9 million)

Concentrating Solar Power

The focus of the CSP Subprogram is to develop concentrating solar technologies that will be cost competitive in the intermediate power market by 2015. A solicitation issued in FY 2007 resulted in 12 industry contract awards focused on establishing a U.S. manufacturing capability of low cost trough components and the technical feasibility of low cost thermal storage. In FY 2008, funds will be provided for Phase I of these contracts with the more promising contracts moving into Phase II in FY 2009. In addition, technical support will be provided to the 64 MW trough project in Nevada, which began operation during 2007 and is the world's largest solar power plant built since 1990.

One of the most important aspects of CSP is its ability to thermally store power for later use. In FY 2009, the development of advanced thermal energy storage technologies will be expanded to include single heat transfer fluid systems that eliminate the need for multiple heat exchangers and hence increase system efficiency and reduce cost. The development of advanced parabolic trough concentrators and receivers will continue and field validation will be conducted on new collector technology. For distributed applications, research in FY 2009 will continue on improving the reliability of dish systems through the operation and testing of multiple units at Sandia National Laboratory. Sandia will also assist industry in improving the manufacturability of dish systems in preparation for, a 1MW demonstration project likely to be in California. In addition, technical support will also be provided to the Western Governors' Association and several southwestern utilities to assist their CSP deployment activities. ($19.0 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 the U.S. Council for Automotive Research (USCAR) – representing the three domestic automobile manufacturers, five energy suppliers, and DOE for cooperative, pre-competitive research on automotive technologies having significant potential to reduce oil consumption. Vehicle Technologies Program activities in the *FreedomCAR and Fuel Partnership* focus on advanced, high-efficiency vehicle technologies such as advanced combustion engines and enabling fuels, hybrid vehicle systems (including plug-in hybrids), high-power and high-energy batteries, advanced lightweight materials, and power electronics. These critical technologies can lead to near-term oil savings when used in advanced combustion hybrid and plug-in hybrid electric vehicles. In FY 2009, emphasis will continue R&D needed for plug-in hybrid electric vehicles, such as high energy storage batteries.

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 and engine manufacturers) along with three other Federal agencies. The R&D centers on improving advanced combustion engine systems and fuels and on reducing vehicle parasitic losses.

FY 2009 Budget Request
Vehicle Technologies

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Hybrid Electric Systems	0	94,135	103,361
Vehicle Systems	13,006	0	0
Hybrid and Electric Propulsion	59,240	0	0
Advanced Combustion Engine R&D	48,346	44,591	33,600
Materials Technology	29,044	39,636	36,903
Fuels Technology	18,413	17,836	16,122
Technology Integration	0	16,845	31,100
Innovative Concepts	500	0	0
Technology Introduction	15,031	0	0
TOTAL	**183,580**	**213,043**	**221,086**

The Fiscal Year 2009 request is $221.1 million for the Vehicle Technologies Program, an $8 million increase over the FY 2008 appropriation. The FY 2009 request fully supports the FreedomCAR and Fuel Partnership goals for hybrid and internal combustion powertrain systems. In addition, Vehicle Technologies is devoting $50 million to plug-in hybrid electric vehicle (PHEV) R&D where the potential oil reduction benefits are significant. Three activities totaling $31.5 million are transferred from Hydrogen Technology to Vehicle Technologies to exploit synergies between similar activities among the Programs.

The Vehicle Technologies budget is modified in the FY 2009 request by transferring three activities from the Hydrogen Technology Program: Education; Technology Validation; and Safety and Codes and Standards. These activity areas have similar or congruent objectives with other efforts within the Vehicle Technologies Program and combining them within one program provides opportunities to be

more effective. The Program continues to place increasing emphasis on component technology R&D for plug-in hybrid electric vehicles (PHEV).

Hybrid Electric Systems

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

- The Vehicle and Systems Simulation and Testing (VSST) activity integrates modeling, systems analysis, and testing efforts to define technical targets and requirements, guide technology development, and validate performance of DOE-sponsored technologies for passenger and commercial vehicles. The activity develops and validates advanced computer models and simulation programs used to:
  - Develop performance targets for vehicle platforms and their components, and
  - Develop advanced control strategies to optimize the overall performance and efficiency of advanced hybrid electric, plug-in hybrid electric, and fuel cell vehicles.

  The activity also performs R&D on heavy vehicle systems to achieve the heavy commercial vehicle fuel efficiency goals of the 21st Century Truck Partnership by:
  - Developing advanced heavy vehicle systems models, and
  - Reducing non-engine parasitic energy losses from aerodynamic drag, friction and wear, under-hood thermal conditions, and accessory loads.

  In FY 2009, the subprogram will expand simulation and laboratory studies of advanced control strategies and components for plug-in hybrid electric vehicles (PHEV). Data collected during laboratory and field tests will be used to enhance vehicle and systems modeling capabilities and to validate the accuracy of the component models. PHEV activities also will include laboratory and closed track baseline testing and real-world monitored fleet demonstrations of advanced plug-in hybrid electric vehicles and in-use testing of vehicles equipped with advanced components developed by auto companies and suppliers (often with support from DOE). Such tests will help identify component and system performance and reliability weaknesses to be addressed through future R&D activities. Also to be evaluated are the effects of the infrastructure/vehicle interface and the potential impact of the use of plug-in hybrids on the electricity grid.

  The activity also will enhance engine emission models to determine the impact of future emission control requirements on the fuel economy of advanced flexible-fuel and hybrid passenger vehicle systems and will validate, in a systems environment, performance targets from the power electronics and energy storage technology research and development activities.

  VSST activities will continue to enhance the capabilities of the heavy vehicle systems model by:
  - incorporating data from on-road test and proprietary industry data, and
  - completing integration of turbulence and other computational fluid dynamics (CFD) models including their validation, as well as adding ancillary and under-hood thermal models.

  Activities will include the assessment of aerodynamic drag reduction devices, R&D to reduce drivetrain friction and wear, the evaluation of highly efficient cooling systems, and developing

under-hood thermal management approaches to improve vehicle efficiencies while increasing component reliability and life. ($21.4 million)

- The Technology Validation activity, moved from the Hydrogen Technology Program in FY 2009, is a critical component of the program. The effort is focused on validation of hydrogen infrastructure and fuel cell vehicles under "real world" operating conditions to assess progress toward targets, help guide research activities where needed, and to lay the foundation for wider public awareness and market transformation. This effort provides critical statistical data on progress toward meeting vehicle and infrastructure technology targets in the areas of fuel cell efficiency and durability, vehicle system range, and fuel cost. Technology Validation also provides essential information required to establish hydrogen application standards as well as feedback on vehicle and infrastructure safety. Through "50-50" cost-shared partnerships with the automotive and energy industries, FY 2009 activities include operating generation 2 fuel cell vehicles (which have more advanced fuel cells and storage systems) and advanced technology hydrogen fueling stations. The activities are integrated with the research efforts to ensure that important data is captured and fed back into research and development activities in the areas of hydrogen production, delivery, storage, and fuel cells. The activity will coordinate with similar efforts elsewhere within the Vehicles Technologies program. ($15.0 million)

- The Energy Storage R&D activity encompasses all battery research from the Energy Storage activity previously included in the Hybrid and Electric Propulsion subprogram. This activity supports long-term research, applied research, and technology development of advanced batteries for electric, hybrid-electric, and plug-in hybrid vehicle (EV, HEV and PHEV) applications. Federal advanced battery development is coordinated through the Interagency Advanced Power Group (DOE, NASA, Army, Navy, and the Air Force).

  Technology development is conducted with industry through the United States Advanced Battery Consortium (USABC). In FY 2009, the program will continue to develop full-sized lithium-ion modules using low-cost, thermally stable, high-performance anode and cathode materials. Lithium-ion batteries offer twice the performance in a lower-cost, lower-weight, and lower-volume package than the nickel metal hydride batteries used in today's hybrid electric vehicles. The emphasis is on driving down the cost and extending the life of lithium-ion batteries. Applied research will focus on the investigation of cell behavior, developing methodologies to more accurately predict battery life, understanding factors that limit the inherent abuse tolerance, investigating factors that limit low-temperature performance, and identifying approaches to overcome barriers to the introduction of lithium-ion batteries.

  In FY 2009, the program will continue to validate requirements and refine standardized testing procedures to evaluate performance and life of PHEV batteries, and will continue to identify areas for additional R&D to address the specific battery needs for these vehicles. The performance requirements of PHEVs challenge today's battery technology. PHEV batteries must perform a dual use function by providing electric drive range and engine power assist. As a result, materials with higher energy capacity, better thermal and electrochemical stability (for increased life and safety), and lower cost are needed.

  Long-term research is focused on developing advanced materials for the next generation of energy storage technologies. In FY 2009, the Energy Storage long-term activity will examine innovative materials and electrochemical couples that offer the potential for significant improvements over existing technologies for use in both hybrid, plug-in hybrid electric and all electric vehicles. 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.

The activity will also conduct benchmark testing and assessments of non-battery energy storage devices, such as ultracapacitors, that have applicability to hybrid vehicle systems. ($50.9 million)

- Advanced Power Electronics and Electric Motors R&D develops low-cost inverters, converters and electric motors needed for electric, hybrid-electric, and plug-in hybrid vehicle (EV, HEV and PHEV) applications. In FY 2009, key efforts will be focused on developing integrated inverters, advanced permanent magnet motors, DC/DC converters, SiC components, low-cost permanent magnet materials, capacitors, advanced thermal systems, and motor control systems to meet passenger vehicle requirements. Existing work in these areas will be expanded to address the different demands created by plug-in hybrid vehicle (PHEV) systems. The PHEV electrical system could potentially be simplified by using the integrated inverter to perform off-board vehicle charging, thus reducing cost, weight and volume, and eliminating the requirement for a separate on-board vehicle charger. Preliminary deliverables will be tested at National Laboratories for conformance to specifications. ($16.1 million)

Advanced Combustion Engine 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 objectives.

- The Combustion and Emission Control R&D activity supports the Vehicle Technologies Program goal to enable energy-efficient, clean vehicles powered by advanced internal combustion engines using clean, petroleum- and non-petroleum-based fuels and hydrogen**.** The purpose of this activity is to develop technologies for advanced engines, with the goal of improving thermal efficiency by optimizing combustion, fuel injection, emission control, and waste heat recovery systems, along with reducing friction and pumping losses while ensuring that no new air toxic compounds are generated. There will be a continued emphasis on research in advanced combustion regimes (Homogeneous Charge Compression Ignition and other modes of low temperature combustion) that have the potential to achieve the efficiency goals for cars and trucks while maintaining cost and durability with near-zero emissions of NO_x and particulate matter. These combustion regimes will allow the use of lower-cost emission control systems with little or no energy consumption and greater durability. By overcoming these challenges, more efficient combustion engines can be cost-competitive with current gasoline engines in passenger vehicles, and further improve the efficiency and reduce the cost of engines used in commercial vehicles. The health impacts research will continue to evaluate the relative toxicity and consequent human health implications of emissions from new combustion technologies, new fuels derived from unconventional feedstocks, and new blending agents such as biodiesel and hydroisomerized vegetable oils. ($29.6 million)

- Solid State Energy Conversion activity develops technologies to convert waste heat from engines and other sources to electrical energy or work to improve overall thermal efficiency and reduce emissions. This activity will continue cost-shared cooperative agreements awarded in FY 2004 to develop and fabricate high efficiency thermoelectric devices that will recover from 1 to 3kW of electric power from engine waste heat for passenger vehicle and up to 5kW for commercial vehicle application. These improvements could increase vehicle fuel economy by up to 10 percent. For these waste heat applications, the research will demonstrate conversion efficiencies greater than 15

percent using direct energy conversion methods, such as nano-scale high-efficiency thermoelectrics, thermionics, or other innovative concepts. ($4.0 million)

Materials Technology

The Materials Technologies subprogram supports the development of cost-effective materials and materials manufacturing processes that can contribute to fuel-efficient passenger and commercial vehicles. This subprogram is a critical enabler for advanced vehicles and other technologies presented elsewhere in the Vehicle Technologies budget. The subprogram consists of three activities: Propulsion Materials Technology, Lightweight Materials Technology, and the High Temperature Materials Laboratory (HTML). The three activities contribute to the VT Program goal by developing higher performing, cost-effective materials that will make lighter vehicle structures and more efficient power systems possible. Lighter vehicles require less energy to operate and thus reduce fuel consumption. Likewise, better propulsion materials can enable more efficient power systems that will contribute to a vehicle's reduced energy consumption. ($36.9 million)

- Propulsion Materials Technology focuses on research that is critical to removing barriers to improved hybrid-electric drives, advanced combustion engines, high efficiency drive-trains, and emission control technologies. The activity will develop materials necessary for critical engine control sensors, high efficiency motor controllers, high efficiency clean combustion engines, addressing advanced fuel (hydrogen and ethanol) compatibility issues, and developing treatments (coating and surface modifications) for high efficiency gear-trains. Using new analytical and simulation methods, Propulsion Materials will formulate, characterize, and stabilize nano-materials for improved energy storage, energy recovery, and emission control devices for transportation applications. ($11.1 million)
- The Lightweight Materials Technology activity develops metal processing technologies, composite materials, recycling systems, and technical data to reduce vehicle weight while maintaining safety, performance, and reducing cost. It will emphasize technologies for manufacturing lightweight components made from the various materials researched and developed in previous years, especially carbon-fiber-reinforced polymer-matrix composites and magnesium. The purpose will be to lower the costs even further toward cost neutrality. The activity will pursue five areas of research: manufacturability, design data and test methods, joining, recycling/repair, and cost reduction. Reducing vehicle weight through improved design and increased use of lightweight materials is one of the most effective means of improving vehicle fuel economy. Because the single greatest barrier to the use of lightweight materials is their high cost, priority is given to activities aimed at reducing cost through development of new materials, forming technologies, and manufacturing processes. ($20.0 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 and structural conditions of metals, alloys, ceramics, and novel materials under development for vehicle applications. The facility's Aberration Corrected Electron Microscope, which has both sub-angstrom level clear imaging and chemical analysis capabilities, is being used to explore and characterize materials for solid state energy conversion, high efficiency engines, and high energy batteries. ($5.8 million)

Fuels Technology

The Fuels Technology subprogram supports R&D that will provide vehicle users with cost-competitive fuel options that enable high fuel economy, deliver low emissions, and contribute to petroleum displacement. There are two major aspects of the work, the first of which is to assess the fuel-related impacts on advanced combustion engines envisioned for the post-2010 timeframe. Such engines will provide high efficiency, comparable to diesel engines, with significantly less engine-out emissions than current diesel engines produce. The second aspect is to address the direct displacement of petroleum-based fuel components by non-petroleum based alternatives in fuels for current vehicles as well as in post-2010 advanced vehicles. Subprogram activities are grouped according to these two primary approaches to petroleum displacement: Advanced Petroleum-Based Fuels (APBF) and Non-Petroleum-Based Fuels and Lubricants (NPBFL). ($16.1 million)

- The Advanced Petroleum-Based Fuels activity in FY 2009 will continue awards made under the two High Efficiency Clean Combustion solicitations (in FY 2005 and FY 2006) and these will account for a significant portion of APBF activities. The on-going work under these awards is intended to identify fuel property requirements of post-2010 passenger vehicle and heavy vehicle advanced internal combustion engines. The activity will continue development of predictive tools that relate molecular structure to ignition behavior and heat release of fuels in advanced internal combustion engines. Through the combined industry/Government effort, kinetic modeling of base fuel properties that affect advanced combustion regime engine operation will be expanded. ($6.0 million)

- The Non-Petroleum-Based Fuels and Lubricants activity in FY 2009 will continue development of baseline data on the relationships between molecular structure and bulk fuel properties, ignition behavior, and heat release for renewable and synthetic fuels in advanced combustion regime engines, and will continue development of a predictive model based on this data. The activity also will develop and optimize vehicle engines, such as optimized E85 ethanol flexible fuel engines, that take advantage of the fuel properties of high ethanol blends or other non-petroleum-based fuels in order to improve fuel economy or other performance issues associated with their use. ($10.1 million)

Technology Integration

The Technology Integration subprogram accelerates the adoption and use of alternative fuel and advanced technology vehicles to help meet national energy and environmental goals and accelerate dissemination of advanced vehicle technologies through demonstrations and education. Deployment activities linked to R&D also provide early market feedback to emerging R&D. The regulatory elements include legislative, rulemaking, and compliance activities associated with alternative fuel requirements identified within the Energy Policy Acts of 1992 and 2005. Also included are the Advanced Vehicle Competitions and Graduate Automotive Technology Education activities that support the development of students with technical skills in the same areas of technology where the program is engaged in advanced R&D. ($31.1 million)

- The Graduate Automotive Technology Education (GATE) activity in FY 2009 will fund eight GATE Centers of Excellence (competitively selected) to develop new curricula and provide research fellowships for approximately 25 students for research in advanced automotive technologies, including hybrid fuel cell and plug-in hybrid electric vehicles. ($0.7 million)

- The Advanced Vehicle Competitions. In FY 2009 there will be an EcoCAR Challenge, a three-year competition that builds on the 19-year history of DOE advanced vehicle technology competitions by giving engineering students the chance to design and build advanced vehicles that

demonstrate leading-edge automotive technologies, with the goal of minimizing the environmental impact of personal transportation and illustrating pathways to a sustainable transportation future. DOE has again joined General Motors, Natural Resources Canada, and other sponsors for this new competition series. Argonne National Laboratory, a DOE research and development facility, will organize and operate the EcoCAR Challenge. ($1.5 million)

- The Education activity is transferred from the Hydrogen Technologies program to Vehicles Technologies in FY 2009. It funds efforts to increase understanding of hydrogen and fuel cell technologies among the public, safety officials, and government regulators. Improving understanding and acceptance of hydrogen and fuel cell technologies among consumers and government officials will facilitate the successful implementation of hydrogen and fuel cell demonstration projects and early market transformation. It also lays the foundation for future market adoption and acceptance, which are required to realize the long-term benefits of using hydrogen as an energy carrier. FY 2009 activities will ramp up the development and distribution of educational materials and training for safety and code officials, state and local governments, and potential end-users to support the program's overall market transformation efforts and related provisions in EPACT 2005. In coordination with technology validation projects, funding will support public education and outreach, with an emphasis on understanding the facts about hydrogen safety. Activities will also include the development and expansion of hydrogen and fuel cell programs at colleges and universities, as well as hands-on activities and teacher training at the middle and high school levels. ($4.0 million)

- The Safety and Codes and Standards activity, also transferred from the Hydrogen Technologies Program, facilitates the development of codes and standards for hydrogen applications through R&D that provides a scientific basis for standards requirement and by supporting Standards Development Organizations (SDOs) and Code Development Organizations (CDOs) to conduct their established consensus processes. 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. In FY 2009, increased emphasis will be placed on codes and standards for near-term hydrogen applications such as forklifts, back-up power and portable devices. R&D will also focus on the development of critical standards such as hydrogen quality and high pressure refueling. In 2009, activities that support the promulgation of safety information include the publishing of an on-line Best Practices Handbook, independent safety evaluations of ongoing hydrogen projects, and updating of the "H_2 Incidents" and hydrogen safety bibliographic websites ($12.5 million)

- The Legislative and Rulemaking activity consists of implementation of the State and Alternative Fuel Provider Regulatory Program, alternative fuel designations, the Private and Local Government Fleet Regulatory Program, and implementation of other EPACT requirements including reports and rulemaking, analyses of the impacts from other regulatory and pending legislative activities, and the implementation of legislative changes to the EPACT fleet activities as they occur. The fleet programs require selected covered fleets to procure alternative fuel passenger vehicles annually. ($1.8 million)

- The Vehicle Technologies Deployment activity will continue to promote the adoption and use of petroleum reduction technologies and practices by working with local Clean Cities coalitions and their stakeholders, industry partners, fuel providers, and end-users. Technology focus areas include: alternative fuel vehicles, alternative fuel infrastructure development, idling reduction for commercial trucks and buses, expanded use of non-petroleum and renewable fuel blends such as

E85, hybrid vehicles, driving practices for improved efficiency, and engine/vehicle technologies that maximize fuel economy. The program also will continue efforts to provide technical assistance for early adopters of technologies and provide education, training, and workshops to coalitions, public safety officials, and stakeholders related to infrastructure development and targeted niche market opportunities. The program will identify and support opportunities to showcase the technology focus areas and continue to build national and regional alliances to promote petroleum reduction strategies and will support further expansion of ethanol infrastructure deployment. Demonstration and deployment of other alternative-fuel and advanced combustion and emission control technologies developed by DOE will also be supported. ($10.1 million)

- Biennial Peer Reviews - In FY 2009 there will be a biennial review of the 21st Century Truck FreedomCAR and Fuel Partnership activities. The review will be conducted by an independent party to evaluate progress and program direction. ($0.5 million)

Water Power Program

The mission of the Water Power Program is to explore and develop innovative and effective technologies capable of harnessing hydrokinetic (i.e., energy from the motion of fluids) energy resources, including ocean wave and current (ocean and tidal) energy.

Following its initial FY 2008 appropriation, EERE proposes in FY 2009 to continue Water Power as a multi-year effort. Funding will focus on performing a comprehensive technology assessment of water power in the United States, including wave and current (ocean and tidal) resources; conducting technology characterizations to identify manufacturers, performance limits and issues, known environmental impacts and issues, and other relevant technical and market variables; continuing Cooperative Research and Development Agreements to advance water power technology development and demonstration; and engaging in key collaborative international activities to assure that U.S. interests are protected and that new standards take into consideration the unique environment and regulatory requirements that govern deployment in U.S. waters.

This budget request of $3.0 million will support initial R&D activities and follows an initial Congressional appropriation of $9.9 million in FY 2008. A $6.9 million decrease is proposed for FY 2009, as the program needs to evaluate the findings of the FY 2008 resource and technology assessments (which will continue into FY 2009) before commencing R&D.

FY 2009 Budget Request

Water Power

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Water Power	0	9,909	3,000

Wind Energy Program

The mission of the Wind Energy Program is to support the Advanced Energy Initiative objective to maximize wind energy resource utilization in the United States by leading the Nation's R&D efforts to improve wind energy generation technology, and to address barriers to the use of wind energy in coordination with stakeholders. Fulfilling this mission will result in greater energy security and enhanced domestic economic benefit through more diverse, clean, reliable, affordable, and secure domestic electricity supplies.

In the AEI, the President recognized wind energy's potential contribution with the following comments:

> *"Areas with good wind resources have the potential to supply up to 20 percent of the electricity consumption of the United States."* [Advanced Energy Initiative, February 2006, p. 13]

In response to the AEI and EPACT 2005, the Wind Energy Program has increased focus on near-term actions to significantly accelerate use of wind energy technologies, thus reducing the Nation's dependence on imported and environmentally damaging energy sources. The Wind Energy Program contributes directly to EERE's and DOE's mission of improving national, energy, and economic security and addresses the call set forth by the President's National Energy Policy, the AEI, and EPACT 2005 for increasing the diversity of our Nation's energy resources.

Since 2000, wind energy has demonstrated significant expansion and promise as an affordable energy supply, increasing from about 2.5 GW to nearly 15 GW by the end of 2007. Dramatic growth has occurred on an annual percentage basis. With further research, the existing untapped wind resource offers immense opportunity for the future. The Wind Program recognizes that wind energy is at a transitional point, particularly for large land-based wind systems, that is shifting the areas of focus for the Federal effort. The program is concentrating on reducing risks that undermine the growth potential of wind energy in the United States by focusing on improving cost, performance, and reliability of large scale land-based technology; facilitating wind energy's rapid market expansion by anticipating and addressing potential barriers (i.e., interconnection into the electric grid, siting, permitting, environmental issues); and investigating wind energy's application to other areas-including distributed and community-owned wind projects.

The FY 2009 budget request for Wind Energy is $52.5 million, an increase of $3.0 million from the FY 2008 appropriation. The program will increase laboratory-based Supporting Research and Testing to help mitigate reliability concerns with existing technology and improve technology components for new technology applications. In addition, the program will continue its increased efforts (begun in FY 2008) to address interconnection with the grid, a key barrier to increased wind use. Such focus on reliability and interconnection issues is considered necessary if the United States is to significantly increase the use of wind energy.

FY 2009 Budget Request

Wind Energy

	Funding ($ in thousands)		
Activity	**FY 2007 Approp.**	**FY 2008 Approp.**	**FY 2009 Request**
Technology Viability	30,589	26,952	31,000
Technology Application	18,070	22,593	21,500
TOTAL	**48,659**	**49,545**	**52,500**

The program's new focus also includes energy storage efforts to maximize wind energy resource utilization, thereby increasing and diversifying the domestic energy supply while enhancing system reliability. This expansion will deliver environmental benefits by avoiding pollutant emissions, and strengthen the Nation's economy by reducing effects of fuel price and supply disruptions.

Technology Viability

Technology Viability activities are aimed at advancing wind turbine components and systems, through targeted research and development projects using competitively selected public/private partnerships and CRADAs. All work is closely coordinated with Supporting Research and Testing conducted by National Laboratories.

Low Wind Speed Technology (LWST). The focus of the Low Wind Speed Technology activity is to improve the cost and performance of land-based and offshore wind turbines (turbines over 100 kW) to achieve the following goals:

- 3.6 cents/kWh for land-based systems in Class 4 winds by 2012;
- 7 cents/kWh for shallow water offshore systems in Class 6 winds by 2014.

Land-based systems are supported through public/private partnerships and CRADAs to increase industry adoption of technology developments and emerging innovation. This work is accomplished in collaboration with national laboratory expertise and selected through a series of three LWST competitive solicitations. Phase I (FY 2002-FY 2009) and Phase II (FY 2004-2010) concentrate on three technical areas: 1) conceptual design studies; 2) component development and testing; and 3) full turbine prototype development and testing.
Phase III was a CRADA solicitation for industry partnerships to address component improvements to existing large wind turbine designs. Phase III was awarded in FY 2008.

Through FY 2009, the program will apply limited resources to offshore wind technology research. Activities will focus on obtaining and evaluating the information needed to allow a programmatic go/no-go decision in FY 2009 or FY 2010 regarding future offshore wind technology development. ($2.8 Million)

Distributed Wind Technology FY 2009 activities will continue a new effort begun in FY 2008 for distributed wind systems that targets accelerating the full range of wind technology applications on the distribution side of electric power systems--residential, small commercial, farm, and community wind markets, often served by older generation technology. Effort will be focused on independent laboratory field testing of new and redesigned systems; initiation of partnerships to develop a mid-scale turbine prototype; and continuation of efforts to evaluate technologies from small-scale turbines. ($3.6 million)

- Supporting Research and Testing (SR&T) provides laboratory-based, targeted research and testing to improve the reliability, efficiency and performance of wind turbines, in support of achieving the program's cost of energy goals. Through the National Laboratories, specialized technical expertise, comprehensive design and analysis tools, and unique testing facilities are brought to bear on problems that industry is or will encounter in bringing new turbine technology to the marketplace. Activities are continuously coordinated with industry and other research institutions to facilitate technology transfer and transition of designs and component improvements into full systems. Large turbine projects are periodically reviewed against

analytically established performance measures to provide the basis for funding and planning adjustments needed to optimize the portfolio for success. ($24.7 million)

Technology Application

This effort addresses opportunities and barriers, other than turbine cost of energy, concerning use of wind energy systems. This work helps to prepare and accelerate the market for significantly broader application of wind technologies. To be responsive to EPACT 2005 and its directive to increase domestic energy supplies and to meet the objectives of the President's AEI, which recognized that areas with good wind resources have the potential to supply up to 20 percent of the electricity consumption of the United States, this area of the program requires expansion. ($21.5 million)

- Systems Integration focuses on anticipating and overcoming technical and operational issues associated with interconnecting greater amounts of wind energy and other renewables into the electricity system. FY 2009 efforts will continue the expanded effort begun in FY 2008 to provide: (1) renewable resource characterizations to areas around the country with high levels of wind potential; (2) operations and analysis support needed by electric system operators to understand the dynamic interaction between wind generators and the rest of the utility electric system; (3) renewable interconnection planning support to assist transmission planners with long-term integrated resource planning; (4) storage technologies to increase the availability and improve the quality of wind power; and (5) wind energy systems simulation and application analysis to gather data to provide a centralized source of technical information on wind energy interconnection. The program will work with DOE's Office of Electricity Delivery and Energy Reliability on a range of issues to help facilitate wind integration into electric power systems. on the electric. ($14.5 million)

- Technology Acceptance focuses on resolving institutional issues; providing state, regional, local, and tribal energy sector outreach; and investigating and mitigating social environmental and wildlife issues associated with wind energy development. Wind Powering America is aimed at facilitating the deployment of wind technology to increase the use of wind energy in the United States; bringing economic and environmental benefits to the country; and stimulating a sustainable tribal and rural-based energy sectors. In FY 2009, there will be an increased emphasis on efforts to assess and mitigate effects of wind turbines on Federal mission areas and the environment and on enhancing the regional wind support effort that was started in FY 2007. Technology Acceptance also supports cooperative activities with utility-based and other key stakeholder organizations. These activities include expanding access to wind resource information and providing data on technical and institutional barriers to wind power development and other topical issues. ($7.0 million)

Weatherization and Intergovernmental Activities Program

The Weatherization and Intergovernmental Program promotes and accelerates the adoption of energy efficiency, renewable energy, and oil displacement technologies and practices. Stakeholders and partners include State and local governments, Native American Tribes, utilities, and international agencies and governments.

FY 2009 Budget Request

Weatherization and Intergovernmental Activities

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Weatherization Assistance Program Grants	204,550	227,222	0
State Energy Program Grants	49,457	44,095	50,000
State Energy Activities	9,348	0	0
International Renewable Energy Program	9,473	0	0
Tribal Energy Activities	3,957	5,945	1,000
Renewable Energy Production Incentive	4,946	4,955	0
Asia Pacific Partnership	0	0	7,500
TOTAL	**281,731**	**282,217**	**58,500**

The Fiscal Year 2009 request for Weatherization and Intergovernmental Activities is $58.5 million, increasing State Energy and Asia Pacific programs.

* In FY 2007, Funding for Asia Pacific was included within Hydrogen, Buildings, Industry, Weatherization, and Program Direction.

Significant changes include: increases for the State Energy Program and the Asia Pacific Partnership; a refocusing for Tribal Energy Activities; and conclusion of funding for the Weatherization Assistance Program and the Renewable Energy Production Incentive. The program will be refocused on high-return State and Local programs through competitive grants that prioritize scaling of energy efficiency and renewable energy to dramatically reduce U.S. dependence on foreign energy sources and decrease greenhouse gas emissions.

State Energy Program

The State Energy Program enables state governments to target their high priority energy needs and expand clean energy choices for their citizens and businesses. Benefits include reduced energy use and costs, environmentally conscious economic development, increased renewable energy generation capacity, and lessened reliance on imported oil. A combination of technical assistance, outreach, and financial assistance support effective program implementation of the National Action Plan for Energy Efficiency and provisions of EPACT 2005 and the Energy Independence and Security Act of 2007. ($50.0 million)

State Energy Program Financial Assistance

- Awards formula grants to 50 states, DC, and territories for energy efficiency and renewable energy projects and programs. This ensures all States have energy programs and services for citizens, improves energy emergency preparedness, and maintains the core capabilities of State Energy Offices. ($25.0 million)
- Awards competitive grants to support States in accelerating market penetration of renewable and efficiency technologies and increasing available capital for energy projects. Project areas include energy efficiency, performance contracting, renewable energy certificates, market-oriented regional consortiums, and air quality and utility-based energy efficiency initiatives. ($25.0 million)

Tribal Energy Activities

The Tribal Energy Program encourages tribal energy self-sufficiency and fosters employment and economic development on America's tribal lands. In partnership with Native American Tribes, the program provides a mix of technical and competitive financial assistance to improve energy efficiency and renewable energy project planning and development. A high priority in FY 2009 is the broad dissemination and application of uniform investment contracts and other financial tools to rapidly expand renewable project development on Tribal lands. ($1.0 million)

Asia Pacific Partnership

The Asia Pacific Partnership stimulates clean energy technology deployment to achieve energy security, air quality, and climate change goals in ways that promote sustainable economic growth and poverty reduction. The seven partner countries – Australia, Canada, china, India, Japan, South Korea, and the United States – represent about half of the world's economy, population, and energy use. An important EERE contribution is promoting the adoption of best practices through the public-private partnerships in the industry, buildings and appliances, and renewable energy generation sectors. ($7.5 million)

Weatherization Assistance Grants

Weatherization Assistance is designed to provide small-scale ($3,500 per home or less) energy retrofits for homes of low-income families, thereby reducing energy bills of the occupants and reducing the need for low-income energy assistance from Federal, State, and utility programs. The results of weatherization activities are little changed in the last two decades—providing positive limited benefits to selected recipients—but failing to catalyze broader solutions for the tens of millions of eligible homes which have never received retro-fits. The Department requests no funding for Weatherization activities; however, States can continue to support weatherization assistance activities with resources provided by the Low-Income Home Energy Assistance Program at the Department of Health and Human Services. Concluding the program at DOE will allow the Department to focus on state, local, and utility energy projects, programs, and policies to decouple energy demand from economic growth. ($0.0 million)

Renewable Energy Production Incentive

Through FY 2008, the Renewable Energy Production Incentive provided financial incentive payments to publicly owned utilities, not-for-profit electric cooperatives, and Tribal Governments and native corporations that own and operate qualifying facilities generating renewable electricity. The incentive value of REPI has diminished over time as renewable energy technologies have become competitive.

Also the steadily growing pool of eligible applicants has resulted in increasingly smaller amounts which can be paid out, given the limited availability of funds to distribute. ($0.0 million)

Facilities and Infrastructure

The budget request for Facilities and Infrastructure supports operations and maintenance (O&M) for the National Renewable Energy Laboratory (NREL), a single-purpose laboratory dedicated to R&D for energy efficiency, renewable energy, and related technologies. The request for FY 2009 is $14.0 million –$10.0 million for core operations and maintenance (a $3.1 million increase) and $4.0 million required to complete Phase I construction of the Energy Systems Integration Facility (ESIF). This budget request represents a decrease of $62.2 million compared to the FY 2008 appropriation, primarily a reflection of Congress' FY 2008 provision of $54.5 million to initiate construction activities for the ESIF and to begin additional site infrastructure work ($6.8 million). The remainder of the decrease is a result of including requested solar research capital equipment replacements within the Solar Energy Program budget, where such equipment is typically funded.

FY 2009 Budget Request
Facilities and Infrastructure
National Renewable Energy Laboratory

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Operation and Maintenance			
General Plant Projects	3,957	3,331	3,576
General Capital Equipment	20,078	3,587	6,406
Science and Technology Facility (STF)/Solar Energy Research Facility (SERF)	0	7,927	0
Total, Operation and Maintenance	**24,035**	**14,845**	**9,982**
Construction			
Research Support Facilities	63,000	0	0
Integrated Biorefinery Research Facility	20,000	0	0
South Table Mountain Infrastructure	0	6,831	0
Energy Systems Integration Facility	0	54,500	4,000
Total, Construction	**83,000**	**61,331**	**4,000**
TOTAL	**107,035**	**76,176**	**13,982**

In Fiscal Year 2009, the Department is requesting $13.9 million for NREL Facilities and Infrastructure, a decrease of $62.2 million from the FY 2008 appropriation.

Sponsored by EERE as a Federally-Funded Research and Development Center, NREL provides EERE, as well as DOE's Office of Science and the Office of Electricity Delivery and Energy Reliability, with world-class R&D, expert advice, and objective programmatic counsel. The NREL complex is home to 1,100 researchers, engineers, analysts, and administrative staff, plus visiting professionals, graduate students, and interns on a 632-acre campus located at three major sites near Golden, Colorado.

Operation and Maintenance

Maintaining EERE's state-of-the-art research facilities at NREL is critical to EERE's R&D mission. Technology-specific capital equipment required by EERE programs is budgeted separately and not included in the general maintenance and repair request.

The Plant Projects portion of the O&M request supports the annual investment necessary to maintain and extend the capabilities of EERE's existing real property and related infrastructure at NREL to meet the President's Management Agenda Real Property Initiative. Projects include safety and security improvements, site utilities and infrastructure, and reconfiguration of existing buildings to accommodate changes or growth in R&D research support needs. The Capital Equipment portion of the O&M request maintains EERE's general scientific and administrative equipment through maintenance, repair, or replacement. Included are scientific equipment with multiple program uses across NREL, information technology, site safety and security equipment, and other multiple purpose equipment.

Construction

Research Support Facility (RSF). The Research Support Facility will enable significant staff space consolidations and resultant cost savings by moving personnel out of long-term leased space, which costs an average of $5 million per year. The Request for Proposals for the RSF has been released and proposals are due April 4, 2008. Contractor selection and project award is expected May 2, 2008. Fully funded at $72.9 million (appropriations of $9.9 million in FY 2006 and $63.0 million in FY 2007), the RSF will be a LEED™ Platinum facility with energy requirements that exceed *Executive Order 13423*. The facility will serve as a showcase for the Nation's commercial building sector, demonstrating outstanding applications of day lighting and energy efficiency technologies. When completed in April 2010, the RSF will house up to 800 Federal and Contractor personnel in approximately 220,000 square feet

Integrated Biorefinery Research Facility (IBRF). Fully funded in FY 2007 at $20.0 million, the IBRF will accelerate NREL's capability to pursue cellulosic ethanol research and for industry to assess biological conversion technologies. The Request for Proposals will be released in March 2008, with a contract award expected in July 2008. The IBRF will be completed in September 2009.

South Table Mountain Site Infrastructure Development (SID). In FY 2008, Congress provided $6.8M to initiate the first phase of a new general infrastructure development project at NREL's South Table Mountain location. This infrastructure (e.g., roads, walkways, parking; natural gas, electricity, water and sewer; and data/telecom connections) is necessary to accommodate newly funded site construction projects. The Request for Proposals is expected to be released in July 2008, with contract award anticipated in November 2009. No additional funding is requested in FY 2009. First phase construction is anticipated to begin in March 2009.

Energy Systems Integration Facility (ESIF). ESIF will provide the component testing, system design and integration, and analytic capabilities necessary to quantify and reduce risk in support of accelerated commercialization of renewable energy and energy efficiency technologies – a key objective of the President's Advanced Energy Initiative. Phase I funding of $54.5 million ($93.0 million total estimated project cost) was appropriated by Congress in FY 2008. EERE's FY 2009 request includes $4.0 million needed to complete initial facility construction (Phase I). The Request for Proposals will be issued in July 2008; project award and construction start is anticipated in January 2009. Phase II, (outfitting of the building with scientific and computing equipment and related

capabilities) requirements will be refined based upon proposal selection. The ESIF is planned for completion in January 2012.

Program Direction

The Program Direction budget request provides 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 facilities, equipment, supplies, and materials required to support management and oversight of programs. Areas funded by this request include: Federal staff, information systems and technology equipment; office space; travel; and support service contractors.

The FY 2009 budget request for Program Direction totals $121.8 million includes a $17.8 million increase over the FY 2008 request. This increase reflects EERE's updated and revalidated staffing needs, which more closely align critical skills to mission requirements and increases staff to fill technical program staffing needs for implementation of the 2007 Energy Bill, *"Twenty in Ten"*, AEI and EPACT 2005 priorities.

FY 2009 Budget Request
Program Direction

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Salaries and Benefits	67,699	75,624	83,000
Travel	3,618	3,314	3,572
Support Services	17,021	13,713	24,115
Other Related Expenses	10,930	11,406	11,159
TOTAL	**99,264**	**104,057**	**121,846**

In Fiscal Year 2009, the Department is requesting $121.8 million for the EERE Program Direction, an increase of $17.8 million from the FY 2008 appropriation.

Program Direction funds 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 (PMC), created in FY 2004, includes the Golden Field Office, and FE employees at the National Energy Technology Laboratory (NETL). The Project Management Center is responsible for the field project management of R&D partnerships, laboratory contract administration, and a variety of professional and technical functions including administering the management and operating contract for the National Renewable Energy Laboratory and providing procurement, legal, business management, and information resource management.

The PMC will continue to work with States and communities to promote EERE programs, identify and engage community and state partners, to help integrate EERE programs with public and private sector activities. The PMC administers nearly $400 million in program funding to States, localities, and regional organizations. It continues to 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 State Energy Program;

- Delivering EERE's principal technical assistance programs, including Clean Cities, Rebuild America, and the Federal Energy Management Program;
- Serving as EERE's liaison to state energy offices, other state agencies, regional organizations, 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.

Program Support

The Program Support budget request provides resources for crosscutting planning, analysis, and performance evaluation, for EERE programs and for technical advancement and outreach activities. The timely, independent, and high quality credible information developed by the Program Support components provides information they need to make decisions related to energy alternatives that will achieve Departmental goals. The FY 2009 budget request for Program Support activities totals $20.0 million, representing a $9.2 million increase from the FY 2008 budget request. The increase reflects the expansion of EERE's market transformation analysis, additional support necessary for new EPACT 2005 reporting requirements, and the Energy Efficiency Public Information Initiative.

The Planning, Analysis, and Evaluation activity funded within Program Support is requesting $11.0 million in FY 2009 to enable collection and analysis of economic, market, and technology data in support of EERE's programs. It also develops cross-cutting analytical tools and models for forecasting future energy and technology markets, estimating the possible impacts of energy policy, supply, and 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.

FY 2009 Budget Request
Program Support

Activity	Funding ($ in thousands) FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request
Planning, Analysis and Evaluation	7,418	7,333	11,000
Technology Advancement and Outreach	3,512	3,468	9,000
TOTAL	**10,930**	**10,801**	**20,000**

The Fiscal Year 2009 request for Program Support Activities is $20.0 million, $9.2 million more than the FY 2008 Appropriation.

The Technology Advancement and Outreach activity within Program Support is requesting $9.0 million in FY 2009 and communicates 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. TAO leads outreach efforts for EERE, including implementation of EPACT directives to undertake national energy efficiency campaigns. The funding requested in this budget area enables key EERE public information activities, including managing the EERE website, supporting a toll-free information center, delivering consumer education materials, and responding to stakeholder inquires and request. Use of EERE's websites has expanded rapidly, and continues to grow at a pace of 5.4 million additional "page views" per year. The Information Center annually fields around 27,000 inquiries and delivers roughly 300,000 publications to consumers, businesses, and schools.

EERE Funding Summary by Program

(dollars in thousands)

	FY 2007 Current Approp.	FY 2008 Current Approp.	FY 2009 Request to Congress	FY 2009 Request vs. FY 2008 Approp.
Energy Efficiency and Renewable Energy				
Programs:				
Biomass and Biorefinery Systems R&D	196,277	198,180	225,000	+26,820
Building Technologies	102,983	108,999	123,765	+14,766
Federal Energy Management Program	19,480	19,818	22,000	+2,182
Geothermal Technology	5,000	19,818	30,000	+10,182
Hydrogen Technology	189,511	211,062	146,213	-64,849
Industrial Technologies	55,763	64,408	62,119	-2,289
Solar Energy	157,028	168,453	156,120	-12,333
Vehicle Technologies	183,580	213,043	221,086	+8,043
Water Power	0	9,909	3,000	-6,909
Wind Energy	48,659	49,545	52,500	+2,955
Subtotal, Programs	**958,281**	**1,063,235**	**1,041,803**	**-21,432**
State and Other Supporting Activities:				
Weatherization and Intergovernmental Activities	281,731	282,217	58,500	-223,717
Facilities and Infrastructure	107,035	76,176	13,982	-62,194
Program Direction	99,264	104,057	121,846	+17,789
Program Support	10,930	10,801	20,000	+9,199
Congressionally Directed Activities	0	186,664	0	-186,664
Adjustments	0	-743	-738	+5
Subtotal, State and Other Supporting Activities:	**498,960**	**659,172**	**213,590**	**-445,582**
Total, Energy Efficiency and Renewable Energy	**1,457,241**	**1,722,407**	**1,255,393**	**-467,014**