Fiscal Year 2010
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 Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) manages America's investment in research, development and deployment (RD&D) in clean energy technologies. Through a diverse applied science portfolio, EERE works to change the national landscape of energy supply and demand by developing new renewable energy and energy efficiency technologies and increasing the rate and scale at which these technologies are commercialized.

The mission of EERE is to strengthen America's energy security, environmental quality, and economic vitality through R&D and public-private partnerships that diversify the Nation's sources of energy, increase efficiency and productivity of the existing energy infrastructure, bring clean, reliable, and affordable energy technologies to the marketplace, and make a difference in the everyday lives of Americans by productively enhancing their energy choices and quality of life.

Accomplishing EERE's mission will directly contribute to the Administration's and the Department's goals to increase access to reliable, clean, and affordable energy, create new jobs in the clean energy economy, break U.S. dependence on oil, promote efficiency in the home and workplace, and make the U.S. a leader in climate change mitigation. EERE's integrated programs will contribute to these goals by:

- Reducing demand-side pressure on our energy markets and mitigating energy costs;
- Reducing oil imports;
- Diversifying the mix of domestic energy production; and
- Resolving the technology and market barriers to widespread commercialization of clean energy technologies.

The FY 2010 request of $2.319 billion is approximately $140 million higher than the FY 2009 appropriation, providing a balanced and diverse portfolio that builds upon and accelerates existing activities in EERE while expanding EERE's work into new, transformative RD&D activities. The FY 2010 budget sustains and promotes the economic objectives of the American Recovery and Reinvestment Act of 2009 and carries out key provisions of both the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007.

EERE's portfolio will address the urgent energy, environmental, and economic challenges facing our country today by investing in three strategic areas:

- **Advanced Transportation**: Investments in this area will focus on reducing U.S. dependence on foreign oil through improving advanced vehicle technologies, such as plug-in hybrid electric vehicles, fuel cells, and advanced biofuels technologies, such as non-food based—or cellulosic—ethanol.
- **Energy Efficiency in the Built Environment**: Energy efficiency is the cheapest, cleanest, fastest energy source to deploy and the most cost-effective way to reduce greenhouse gas emissions and energy bills. The budget increases investments in buildings and industrial efficiency and maintains robust weatherization and Federal energy management programs.

- **Renewable Electricity Generation**: EERE will make strategic investments in the renewable electricity areas of geothermal, wind, solar, and advanced water power that will increase energy security, diversify our energy supply, and help promote energy storage and smart grid solutions.

EERE's balanced portfolio of RD&D and commercialization activities is already catalyzing unprecedented growth rates in renewable energy and efficiency technologies. Renewable energy capacity (excluding large-scale hydropower) has grown by 150 percent during the last eight years, and the U.S. now leads the world in wind energy production. Biofuels production has reached record levels, with the U.S. producing over 9 billion gallons annually. 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 15 percent for the U.S. economy since 2000.

EERE will continue to take aggressive steps to catalyze the rapid development, commercialization, and deployment of this technology portfolio by addressing barriers to adoption of clean energy technology. We will partner with organizations that can significantly accelerate market adoption of EERE technologies and work to enable sustainable energy policies and practices at all levels of government. Another important component of EERE's portfolio is advancing scientific research of clean energy technologies through targeted RD&D programs at National Laboratories, university campuses, and private facilities that span the country. The EERE programs and National Laboratories participate in a wide variety of public-private partnerships to provide a stream of market solutions for our Nation's energy needs and economic growth.

The cumulative impact of EERE's past and future efforts will include a rapid and sustainable long-term reduction in greenhouse gas emissions and position the U.S. as a world leader in climate change technology. Furthermore, increasing the market penetration of renewable energy sources, efficiency technologies, and advanced transportation measures will help to reduce America's reliance upon petroleum from unstable regions of the world, thereby improving national economic stability, balance-of-trade, and energy security. By investing in partnerships and training programs, EERE's activities will help develop a greener workforce and create thousands of specialized green-collar jobs in the clean energy industry across the U.S. Funding in these areas will also broadly benefit all Americans by providing them with more affordable clean energy choices.

The achievement of EERE program goals could save consumers over $800 billion by the year 2030[1] and as much as $6 trillion by 2050, and could also reduce annual costs to the electric power sector by $500 billion and $1.3 trillion in by 2030 and 2050, respectively. Similarly, EERE's portfolio of technologies could avoid 10 gigatons of carbon (GTC) by 2030 and more than 45 GTC by 2050 (cumulatively). Finally, the portfolio is expected to offset 4 billion barrels of imported oil by 2030 and nearly 40 billion barrels by 2050, cumulatively, considerably diversifying the National energy portfolio with substitutions for petroleum.

However, government funding alone will not be sufficient to address all the challenges of changing our Nation's energy portfolio. EERE efforts today and in the future need to develop solutions that stimulate large-scale public and private actions and the investment necessary to meet our national energy requirements. With action plans, performance milestones, and clearly articulated deliverables, EERE's budget execution will strengthen our dynamic partnerships with private industry and academia that will continue to improve our Nation's economic well-being. Our laboratory partnerships will also increasingly result in clean energy technology commercialization at unprecedented levels.

[1] References to future years represent calendar years unless otherwise noted.

Highlights: Investing in Accelerating and Scaling-up Clean Energy Solutions

The EERE portfolio leads the growth in Administration efforts to invest in clean energy research, reduce dependence on oil and other volatile foreign energy sources, and transform how the U.S. powers the economy by focusing on scientific discovery, job creation, energy transformation, and climate change impacts. EERE's 2010 portfolio investment:

- Significantly advances the RD&D of technologies and practices in **energy efficiency** in the built environment, including investments in Building Technologies ($237.7 million requested; increase of $97.7 million), Industrial Technologies ($100.0 million requested; increase of $10.0 million), Weatherization and Intergovernmental Program activities ($301.0 million requested; decrease of $215.0 million; however, significant Recovery Act funding will be used in FY 2010), and the Federal Energy Management Program (FEMP; $32.3 million requested; increase of $10.3 million);

- Fosters the deployment of **clean, renewable electricity technologies**, including Solar Energy ($320.0 million requested; increase of $145.0 million), Wind Energy ($75.0 million requested; increase of $20.0 million), Water Power ($30.0 million requested; decrease of $10.0 million), and Geothermal Technology ($50.0 million requested; increase of $6.0 million);

- Continues to build upon the recent investments, RD&D, and improvements in **advanced transportation technologies**, including Biomass and Biorefinery Systems R&D ($235.0 million requested; increase of $18.0 million), Vehicle Technologies ($333.3 million requested; increase of $60.1 million), and Fuel Cell Technologies ($68.2 million requested; decrease of $100.7 million);

- Increases funding for **Program Direction** ($238.1 million requested; increase of $110.5 million) to scale-up staffing and continue oversight, transparency and reporting activities of all EERE programs. This increase is commensurate with the more than one billion dollar expansion to the EERE portfolio since FY 2007;

- Significantly expands **Program Support** ($120.0 million requested; increase of $101.8 million) to allow more effective analysis of EERE's portfolio regarding energy security, climate change, and economic impacts, fund ongoing commercialization and communication efforts for clean energy technologies, and build strategic partnerships with China, India, and other growing economies;

- Builds upon the recent investments in **Facilities and Infrastructure** ($63.0 million requested; decrease of $13.0 million) to ensure the continued growth and efficacy of DOE's National Laboratories; and

- Initiates the **REgaining our ENERGY Science and Engineering Edge program** (RE-ENERGYSE; $115.0 million requested; increase of $115.0 million) to fund scholarships, research grants, and vocational training programs for advanced energy jobs. This is a DOE-wide initiative.

Program Priorities

Biomass and Biorefinery Systems R&D ─ Enabling cost competitive, advanced biofuels and a reliable domestic supply of environmentally sustainable biomass feedstocks through public-private partnerships including: applied R&D, technology demonstration in integrated biorefineries, and targeted infrastructure activities.

Building Technologies ─ Implementing a systems approach in deploying technologies for "net-zero" energy buildings that produce as much energy as they consume, with less emphasis on individual components and more emphasis on integration and systems optimization. Builder's Challenge, the Commercial Buildings Initiative, and accelerated building codes and appliance standards implement this new approach.

Federal Energy Management Program ─ Help Federal agencies save 50 trillion lifecycle Btus. Project financing activities will secure over $240 million in alternative financing from private sector investment and utility sources, which will result in about 3.7 million metric tons of carbon dioxide equivalent saved over the lifecycle of the projects.

Fuel Cell Technologies ─ Added focus on near-term stationary and early market applications to create economies of scale, accelerate learning-by-doing, and reduce cost of technology for transportation market.

Geothermal Technology ─ Focusing on Enhanced Geothermal Systems (EGS) that could allow geothermal energy to be harnessed nationwide providing up to 10 percent of our Nation's future electricity. Priority efforts include: evaluation and validation of reservoir stimulation techniques; assessing a stimulated reservoir; and expanding EGS component R&D.

Industrial Technologies ─ Expanding partnerships with energy intensive industries through the highly successful *Save Energy Now* initiative, as its energy assessments have already identified ways to achieve energy savings exceeding 131 trillion Btus in natural gas and save industry over $1.2 billion per year.

RE-ENERGYSE ─ This DOE-wide initiative targets education and training efforts, develops a "green energy" workforce with expertise in science, technology, engineering and mathematics (STEM) and associated energy fields and trades to ensure U.S. leadership in advanced energy research for a low carbon economy.

Solar Energy ─ Achieve grid parity with PV and other solar technologies by 2015 through advanced R&D over the entire supply chain. Reinvigorate Concentrated Solar Power program through launch of energy storage research and demonstration.

Vehicle Technologies ─ Focusing on fuel flexible Plug-in Hybrid Electric Vehicles through greatly enhanced battery research activities and new utility partnerships.

Water Power ─ Reducing the barriers to deployment for marine and hydrokinetic technologies through technology development and testing, resource assessments, and environmental impact studies; supporting projects to expand hydropower generation and improve environmental performance.

Wind Energy ─ Focusing on improving cost, performance, and reliability of large and distributed wind turbine technology; facilitate wind energy's rapid market expansion; and addressing potential barriers to integrating wind into the electric transmission system.

Weatherization and Intergovernmental ─ Develop stronger ties with States and utilities by providing technical assistance and by developing "best practices" and model policies for faster and larger scale adoption of efficiency and renewable energy.

Key Accomplishments

In pursuit of the advancement of the EERE mission in FY 2008 and FY 2009, a number of noteworthy accomplishments and intermediate steps took place, including:

Biomass and Biorefinery Systems R&D issued awards for four commercial scale cellulosic ethanol biorefinery projects and seven smaller scale biorefinery demonstrations. Additionally, 36 cellulosic energy crop trials have been conducted and over $30 million was invested in advanced biofuels R&D, resulting in tangible biomass conversion cost reductions.

Building Technologies returned to its schedule for addressing efficiency standards and test procedures, addressing the energy conservation standards for nine products, and establishing ENERGY STAR criteria for important lighting and advanced major appliances.

Federal Energy Management Program helped Federal agencies save nearly 50 trillion lifecycle Btus, more than twice FEMP's annual target, and its Super Energy Service Performance Contract (ESPC) awards will generate project investment approaching $250 million and a corresponding guaranteed cost savings of more than $600 million. Similar Utility Energy Service Contract project investment grew 40 percent, exceeding $120 million.

Fuel Cell Technologies made significant progress with its partners in several critical areas extending durability, reducing modeled production costs by nearly 20 percent; increasing hydrogen desorption rates by orders of magnitude; and accelerating early market acceptance with products using fuel cells that have lower life cycle costs than the current equipment they replace.

Geothermal Technology competitively selected four field sites and more than 17 research projects to demonstrate, design, and investigate advanced component EGS technology that will provide over 400 MW in new grid capacity and breakthrough power generation potential for conventional, undiscovered, and EGS resources.

Industrial Technologies collaboratively developed advanced technologies with industry, ranging from new membrane-based technologies for low-energy chemicals production to wireless sensor systems for equipment monitoring, and major commercial sales activities. R&D activities supported by the program won three *R&D 100* awards in 2008 and its 2000+ Save Energy Now assessments are resulting in nearly $200 million per year in energy cost savings.

Solar Energy and partners set a new solar-to-grid system conversion efficiency world record of 31.2 percent. In addition, the program incorporated key performance and production dish improvements that have effectively improved marketability, resulting in significant growth in power purchase agreements.

Vehicle Technologies accelerated activities focused on developing and demonstrating plug-in hybrid components (electric motors, batteries, and power electronics) and vehicles; demonstrated 43 percent improvement over a comparable gasoline engine with a car diesel engine; and demonstrated $25/kW battery production cost leading to the commercial production, by a partner of an advanced Li-ion HEV battery.

Water Power competitively selected partnerships with leading technology and project developers and research institutions to address key technical and environmental barriers to the development and installation of marine and hydrokinetic technologies. The program also began detailed wave and tidal energy resource assessments, launched two university-led marine renewable energy centers, and established DOE as a leading source of up-to-date information for the ocean energy industry with comprehensive, searchable databases identifying and characterizing relevant projects, technologies and appropriate testing facilities.

Wind Energy and partners are installing two utility scale turbines at the National Wind Technology Center for performance and reliability R&D. Interconnection studies for key regions of the U.S. were completed in support of efforts to increase wind penetration on the electric grid. A small wind independent testing program was launched to improve turbine safety and consumer confidence.

Weatherization and Intergovernmental Activities facilitated standardization of renewable energy certificate trading programs, managed a comprehensive partnership with the Nation's utilities to put energy efficiency on an even footing with energy generation, and initiated a national effort with States to accelerate the use of ESPCs.

Key Program Benefits

Accomplishing the EERE mission will benefit the economy, the environment, and both the supply and demand sides of DOE'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. The expansion and increasing market viability of EERE's RD&D portfolio will create jobs in new industries in the near term and transform America's energy economy for future growth and prosperity in the long term. Three energy paths create those benefits—efficiency, new fuels and power for transportation, and clean domestic renewable energy.

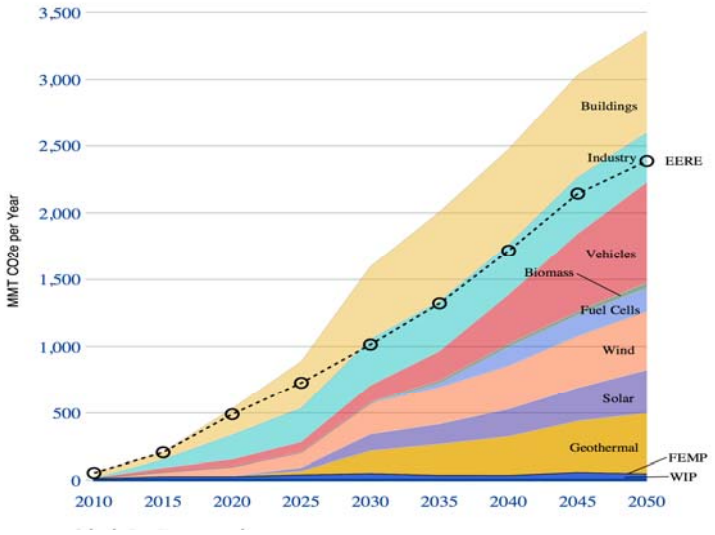
The FY 2010 portfolio analysis includes EERE's program assessment of achievable benefits based on the assumptions that barriers were successfully addressed, technology goals were achieved, and resources were available as necessary. The achievement of EERE program goals will yield the significant short- and long-term results anticipated by EISA 2007, and enable significant additional quantitative climate, energy security, and economic impacts from 2010 budget activities, reflected in the following graphs.

These graphs depict the contributions of the individual programs, and the integrated impacts of EERE programs that result from marketplace competition (represented by the dotted black line labeled EERE). The integrated impacts are lower than the sum of the individual program impacts due to competitive interaction among the technologies. The Buildings and Solar programs received significant additional resources late in the benefits estimation period; their benefits and integrated impacts will be remodeled and updated by July 2009 and made available at: http://www1.eere.energy.gov/ba/pba/program_benefits.html. EERE's strategic benefits include:

Climate Change

Avoid nearly 10 gigatons of carbon dioxide ($GTCO_2$) emissions by 2030 and more than 45 $GTCO_2$ by 2050 (cumulatively). Relative annual contributions of individual programs to annual avoided CO_2 are shown in Figure 1:

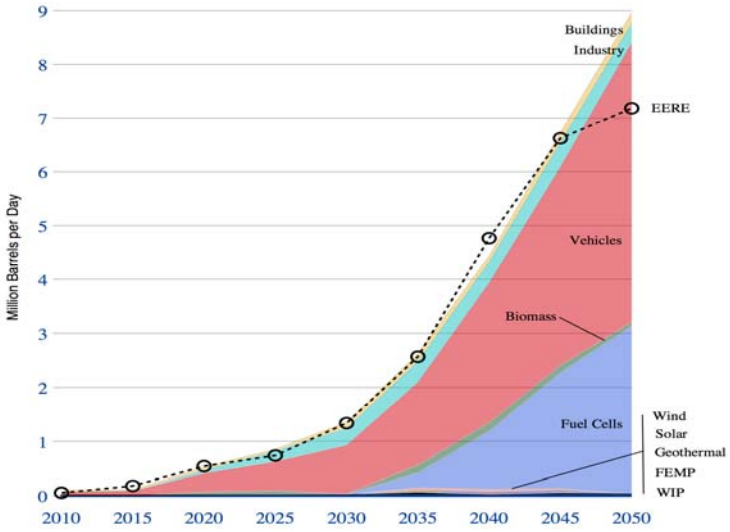
Figure 1: EERE Program Contributions to CO_2 Avoidance



Energy Security

Offset up to 4 billion barrels of imported oil by 2030 and nearly 40 billion barrels by 2050, considerably diversifying the U.S. energy portfolio with substitutions for oil. Relative annual contributions of individual programs to petroleum import savings are shown in Figure 2:

Figure 2: EERE Program Contributions to Petroleum Import Savings



Economic Impact

Save consumers at least $800 billion by the year 2030 and more than $6 trillion by 2050 (cumulatively). Reduce cumulative costs to the electric power sector by $500 billion dollars by 2030 and $1.3 trillion dollars by 2050. Relative annual consumer and utility savings contributions by individual programs are shown in Figures 3 and 4 (please note that the scales on the two graphs are significantly different, and that the utility industry savings are a subset of the consumer savings):

Figure 3: EERE Program Contributions to to Consumer Savings

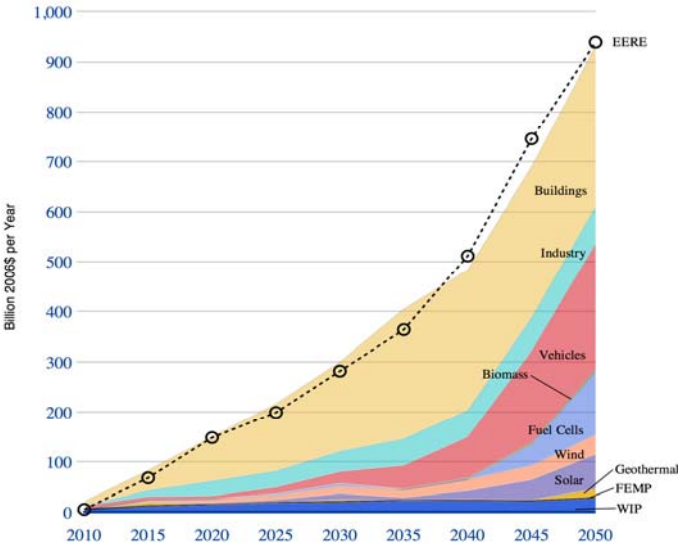
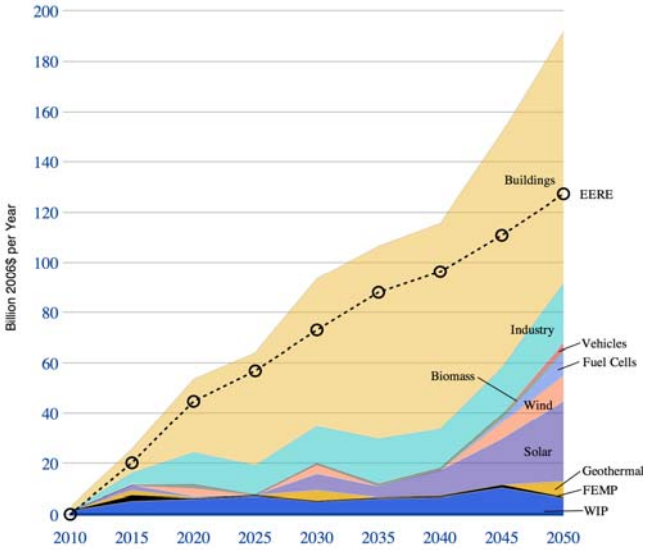


Figure 4: EERE Program Contributions to Electric Power Industry Savings



Much of the increased production of cellulosic ethanol conversion technology and increased light duty vehicle fuel efficiency that, in prior years was attributed to EERE program activities in benefit models, is now assumed to occur as a result of policies such as the EISA 2007 transportation sector-related mandates (RFS and CAFE), as opposed to RD&D activities. This methodological choice has been made to preserve the philosophical integrity of the model; however achieving the aggressive mandated targets with minimum adverse impact on the U.S. economy will depend on successful current and future EERE research, development, demonstration, and deployment (RDD&D) activities in these programs.

More detailed information is included in the EERE Congressional budget and on the EERE website: http://www1.eere.energy.gov/ba/pba/program_benefits.html; updates will be provided by July 2009.

Key Investments

- *Biomass Program*. The Department's FY 2010 request includes an increase of $18 million in continuing Biomass Program support of the Energy Independence and Security Act of 2007 and its Renewable Fuel Standard targets. In FY 2010, the Biomass Program plans to continue the deployment of integrated biorefinery technologies through demonstration projects of varying scales leveraging private sector cost-sharing, while also advancing biomass conversion technologies through targeted R&D work with the National Laboratories, academic institutions, and industry. Additionally, feedstock production trials will be expanded with a greater emphasis on environmental sustainability, while feedstock logistics technologies are developed and improved to significantly reduce feedstock costs. Ethanol blends testing and collaborative efforts with other DOE programs, Federal agencies, and other external stakeholders will also continue in support of the development of biofuels infrastructure and end-use markets.

- *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 2010 request will allocate an additional $97.7 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, 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, and combined heat and power. The Department is also developing and disseminating model building codes that are 30 percent more efficient than current codes in both the residential and commercial sector, and will continue to clear the backlog of rulemakings for appliances and commercial equipment and meet all of the requirements of EPAct 2005 and EISA 2007. An Energy Innovation Hub will be initiated with FY 2010 funding that will go beyond advanced research on building components and develop systems models that optimize and integrate components to provide increased energy savings through synergistic functionality.

- *Federal Energy Management Program.* In 2010 FEMP is responding to the increasing need of the Federal Government to become more energy efficient, less reliant on nonrenewable energy sources, and to decrease its use of water. FEMP provides the assessments, audits, training, rulemaking, coordination, access to alternative private financing, and leadership across the Federal government so it can achieve its legislated and Executive mandates to change. Within the Department, FEMP facilitates planning and implementation of investments to enable the Department to meet or exceed all energy and water goals.

- *Geothermal Technology.* The funds requested, an increase of over $6 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 and complement accelerated activities enabled by ARRA.

- *Industrial Technologies Program.* The program request will support a critical expansion of the "*Save Energy Now"* (SEN) initiative necessary for realizing the program's "25 in 10" goal of reducing industrial energy intensity by 25 percent over 10 years through voluntary collaborative partnerships. This goal derives from EPAct 2005, which prescribed a 2.5 percent per year reduction over 10 years. Through SEN, 2,098 energy use assessments have been completed to date identifying ways to save more than $1.2 billion annually in energy costs and avoid 10.5 million metric tons of carbon dioxide emissions. Additionally, the program will continue to conduct a diverse portfolio of industry-specific and crosscutting RD&D activities, ranging from ultra-high efficiency boiler systems to innovative low-energy chemical membrane systems and the development of cutting-edge nanotechnologies. Another major program focus will be the development of energy-efficient combined heat and power (CHP) systems with the potential to save 5.3 Quads of energy and reduce 848 million metric tons of CO_2 emissions annually by 2030.

- *REgaining our ENERGY Science and Engineering Edge Program (RE-ENERGYSE).* This DOE-wide initiative in the FY 2010 budget request will allow a focus on creating a highly skilled U.S. workforce dedicated to developing and implementing advanced energy technologies and processes that help the U.S. accelerate its transition to a low carbon economy. In addition to providing opportunities for highly qualified students, this program will help American universities develop the capacity to support and educate these scientists, engineers, and other experts needed in the advanced energy field. Through a competitive process, this program will provide fellowships, internships, and other opportunities for undergraduate, graduate, and post-doctoral students focusing on clean energy. The program will also support the development of interdisciplinary masters programs in advanced energy to create an attractive option for students interested in pursuing a professional degree that is highly marketable. RE-ENERGYSE will also dedicate resources to technical training to equip workers with the skills needed to enter green jobs in the near-term as well as K-12 students to ensure a pipeline of individuals available to solve future energy and climate change challenges.

- *Solar Energy*. The Solar Energy Program budget request reflects a 45 percent increase over the FY 2009 appropriation. This includes a 20 percent increase in Photovoltaics for a new PV Manufacturing Initiative; a 3-fold increase in Concentrating Solar Power (CSP) for new thermal storage concepts, a solicitation to develop advanced CSP technologies for baseload applications, and the establishment of a pilot solar energy zone in the U.S. Southwest; a doubling of the budget in Systems Integration to address grid integration issues specific to the high penetration of PV and the impact of energy storage; a doubling of the budget for Market Transformation to focus on solar professional development and a new solicitation for the Solar Policy and Analysis Network (SPAN); and the creation of a $35 million Solar Electricity Energy Innovation Hub which will support cutting-edge research in solar technology areas involving university, laboratory, and industry expertise.

- *Vehicle Technologies*. The Department is requesting an additional $42 million to broaden RD&D and reduce technical risks for advanced batteries and plug-in hybrid vehicle technologies. Plug-in hybrid vehicles will reduce oil use beyond standard hybrid configurations by enabling electricity to become a significant transportation fuel. Accessing 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. Operating in an electric mode produces no tail-pipe emissions and consumes no petroleum. The Department is also seeking an increase of $17 million for improving the efficiency of combustion engines and enhancing their ability to work well with alternative fuels, and an additional $15 million for

increased efforts to develop lightweight materials to further improve the fuel economy of both passenger and commercial vehicles.

- *Water Power.* FY 2010 funds will be used to support and complete activities that accelerate the design and development of water power in the United States, including the development of wave, tidal and ocean thermal energy technologies and projects, assessments of extractable energy from marine and hydrokinetic resources and existing non-powered dams, and environmental impact studies to reduce the barriers to project development and deployment. Funds requested decrease $10 million from FY 2009, but are fully sufficient to continue supporting activities initiated in FY 2008 and FY 2009, and to initiate selected activities in FY 2010. The program will continue to provide technology development, testing, and deployment assistance to water power developers, to support the development of models and tools that will assist in the design of these emerging technologies, and to be a source of critical information to the water power industry. For conventional hydropower, the program will continue to invest in improving the efficiency, dispatchability, and environmental performance of hydroelectric generation, and in quantifying and maximizing hydropower's value to the Nation's electricity grid.
- *Wind Energy.* The larger FY 2010 budget request of $75 million includes wind energy research and development to increase wind turbine reliability and performance and to overcome wind energy deployment barriers by addressing key integration and inter-connection challenges (wind energy intermittency, power quality, and variability). Program outreach efforts will continue to address market barriers to wind energy deployment through education, analysis, and technical assistance activities.
- *Weatherization and Intergovernmental Activities.* Weatherization and Intergovernmental Activities accelerate sustainable energy integration and clean energy deployment, in partnership with State and local, U.S. Territory, and Tribal governments. The State Energy Program supports the expanding State role in utility, renewable energy, and building code policies and other high impact energy projects. Tribal Energy Activities support feasibility assessments and project planning for clean energy projects on Tribal lands. The Weatherization Assistance Grants program, through a state-managed network of local weatherization providers, supports home energy retrofits for low-income families and career development opportunities for workers.

This Budget-in-Brief summarizes the key activities and changes in each of the 14 program areas. A chart summarizing the FY 2010 budget request is on page 62. More detailed program information, including the EERE FY 2010 budget request, can be found at www.eere.energy.gov.

Biomass and Biorefinery Systems R&D

The mission of the Biomass and Biorefinery Systems R&D Program ("Biomass Program") is to facilitate the development and transformation of domestic, renewable, and abundant biomass resources into cost-competitive, high performance biofuels, bioproducts, and biopower through targeted research, development, and deployment (RD&D) leveraging public and private sector partnerships. The Biomass Program's funding directly supports the Renewable Fuel Standard of EISA 2007. Additionally, this work supports the Administration's priorities for energy and the environment by contributing to the near term creation of domestic green jobs and long-term reductions in greenhouse gas emissions and foreign oil dependence.

The Biomass Program addresses technical barriers to producing affordable biofuels across the supply chain. Biomass includes organic materials grown for the purposes of being converted to energy, such as agricultural wastes, forest resources, energy crops, and algae. To grow a domestic biofuels industry capable of sustainably producing large enough quantities of affordable biofuels to support EISA, the Biomass Program has developed an approach centered on the integrated biorefinery concept. A biorefinery is a facility similar in function to a petroleum refinery that uses biomass instead of crude oil to produce fuels and a variety of useful co-products.

In addition to aggressively deploying integrated biorefinery technologies with industry partners, the Biomass Program works with external partners to develop technical feedstock production and logistics solutions to lower feedstock costs and provide environmentally sustainable feedstock sources. Coupled with these feedstock efforts are the program's robust R&D efforts to innovate and improve conversion technologies to equip biorefiners with the best tools possible for producing affordable biofuels. Finally, the Biomass Program conducts ethanol blends testing and collaborates with external stakeholders to help ensure sufficient biofuels infrastructure and end-use markets are being developed. To inform its mission, the Biomass Program actively seeks external feedback through the Biomass R&D Board, a stakeholder-comprised Technical Advisory Committee, and a range of other sources.

FY 2010 Budget Request
Biomass and Biorefinery Systems R&D

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Feedstock Infrastructure	12,144	15,500	27,500
Platforms R&D	65,844	53,400	59,700
Utilization of Platform Outputs R&D....	112,690	148,100	147,800
Cellulosic Ethanol Reverse Auction	4,955	0	0
TOTAL	**195,633**	**217,000**	**235,000**

In Fiscal Year 2010, the Department is requesting $235.0 million for the Biomass Program, an increase of $18.0 million from the FY 2009 appropriation.

The Biomass Program's vision extends beyond the near-term goal of making cellulosic ethanol cost competitive to proving the commercial viability of a new generation of advanced biofuels and ensuring a sustainable domestic feedstock supply.

Feedstock Infrastructure

Feedstock Infrastructure activities address the availability and accessibility of domestic biomass resources to ensure a stable supply of environmentally sustainable and affordable feedstocks critical for a viable domestic biofuels industry. Working with other Federal agencies such as USDA and diverse non-governmental stakeholders across the Nation, the Biomass Program concentrates on the following three feedstock R&D focus areas: production, environmental sustainability, and logistics.

Production efforts address resource assessment, yield improvement, sustainable feedstock production systems development, and biomass quality. Through the Regional Biomass Feedstock Development Partnerships, the program conducted 36 cellulosic agricultural residue and herbaceous energy crop trials in over 20 states in FY 2008. These efforts were expanded in FY 2009 and will continue in FY 2010 to include increased emphasis on environmental sustainability and consider a broader diversity of feedstocks. Expanded environmental sustainability efforts include determining sustainable levels of agricultural residue removal, monitoring key environmental criteria during production (such as fluxes of water and carbon), and integrating this information into a national GIS decision-making tool to inform future biofuels production strategies. Feedstock logistics R&D will leverage industrial partnerships to improve feedstock collection and delivery systems, including the following feedstock unit operations: harvesting, collection, preprocessing, storage, queuing, handling, and transport. To support new integrated biorefinieries, a deployable process demonstration unit is also being developed at Idaho National Laboratory, which will be used by industrial partners on a cost-shared basis to discover ways to increase efficiency in their unit operations. ($27.5 million)

Platforms R&D[1]

- The Thermochemical Platform R&D 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. In particular, efforts to develop and improve processes for converting syngas to advanced liquid biofuels compatible with existing transportation infrastructure will be expanded. This will help launch the next generation of biofuels and support future biorefinery validation projects. ($28.0 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. Key activities include: feedstock interface, pretreatment, and conditioning; hydrolysis and saccharification (sugars production); enzyme improvement; and process integration with the ultimate goal of reducing the cost of sugars for subsequent fermentation into liquid fuels. The development of these technologies will enable the conversion of a wider range of feedstocks, support integrated biorefinery development, and help launch the production of the next generation of cellulosic biofuels. ($31.7 million)

[1] Platform R&D unifies linked projects that support a particular technology or objective

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 valuable co-products through risk-diminishing Federal cost-sharing. The FY 2010 request continues funding for the commercial scale biorefinery demonstrations projects, as authorized by EPAct 2005, Section 932(d). These pioneering commercial scale demonstration facilities are critical for validating technologies and evaluating the efficacy and economic viability of biorefinery pathways for producing biofuels, so that the biofuels industry can successfully garner the private capital necessary for long-term independent growth. Additionally, the FY 2010 request continues funding for several advanced biorefinery projects at approximately 10 percent of commercial scale that will similarly validate technologies and economics of additional biomass conversion technologies and feedstocks. Activities in this budget area also include analyses, systems integration, testing, targeted R&D, and stakeholder outreach efforts to ensure the cost effective transport, storage, distribution, and delivery of growing volumes of biofuels to end users throughout the Nation. Specifically, continued 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. ($133.5 million)
- Products Development work will continue involving fermentation organisms that display an increased productivity, stability, and robustness, at a lower cost. The goal of this effort is to accelerate the development of advanced micro-organisms capable of efficiently fermenting mixed sugars from cellulosic residues to increase biofuels production from future biorefineries, ultimately contributing to their commercial viability. Additionally, new analysis and assessment activities will be performed to further explore the conversion of promising advanced feedstocks such as algae to biofuels. ($14.3 million)

Cellulosic Ethanol Reverse Auction

The program is not requesting funds for a reverse auction in FY 2010. In FY 2008, the program began establishing the framework for an ethanol reverse auction in accordance with Section 942 of EPAct 2005. This work was completed in early FY 2009.

Building Technologies Program

The mission of the Building Technologies Program (BT) is to develop technologies, techniques, and tools for making residential and commercial buildings more energy efficient, productive, and affordable. Energy use by residential and commercial buildings accounts for 40 percent of the Nation's total energy consumption, including 72 percent of the electricity and 55 percent of the natural gas consumed within the United States. This level of energy use costs the U.S. approximately $400 billion annually. BT's activities are instrumental to our Nation's energy independence and economic viability. Increasing the energy efficiency of residential and commercial buildings leads to reductions in the consumption of electricity, natural gas, and to a lesser extent, oil; thus, America is less vulnerable to energy supply disruptions, energy price volatility, and constraints in the Nation's electricity infrastructure. The funding supports a portfolio of activities that includes advanced building technologies, such as solid state lighting, and their effective integration using whole-building-system-design techniques that will enable the design of net Zero Energy Buildings (ZEB). The program also includes the development of building codes and appliance standards that eliminate the most inefficient existing technologies in the market through energy efficiency standards, which will eventually mandate technologies applicable in ZEB. Finally, successful education and market introduction programs, including ENERGY STAR, Solar Decathlon and EnergySmart Schools catalyze the introduction of new technologies and the widespread use of highly efficient technologies already in the market.

The Fiscal Year 2010 request for the Building Technologies Program is $237.7 million, an increase of $97.7 million from the FY 2009 appropriation.

FY 2010 Budget Request
Building Technologies

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Residential Buildings Integration	23,725	21,900	40,000
Commercial Buildings Integration	11,891	33,000	40,000
Emerging Technologies	36,546	43,840	92,698
Technology Validation and Market Introduction	13,239	21,260	30,000
Equipment Standards and Analysis	21,981	20,000	35,000
TOTAL	**107,382**	**140,000**	**237,698**

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 Zero Energy Homes (ZEH) that produce as much energy as they use on an annual basis by 2020.

Increased funding will support Building America, which is an industry-driven research program designed to accelerate the development and adoption of advanced building energy technologies in new and existing homes. In order to achieve the technical capability for ZEH by 2020, BT will develop integrated cost-effective whole-building strategies to reduce the energy consumption of residential buildings by 70 percent (compared to the Building America Benchmark) and integrate cost effective renewable energy for the remaining 30 percent. During FY 2010, research for production-ready new residential buildings that are 40 percent more efficient will continue for two climate zones. BT will also test strategies to achieve a 50 percent reduction in home energy use.

Additionally, Builders Challenge will be accelerated to move research into the market place. Builders Challenge focuses on achieving 30 percent energy savings in thousands of new single family homes and on research strategies to support home performance contracting to achieve 30 percent reductions in energy use in existing homes. ($40.0 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.

The commercial building research will accelerate the goal of 50 to 70 percent reduced energy consumption through Commercial Building National Accounts and Energy Alliances in three commercial building segments: retail, commercial real estate, and hospitals. Two additional Energy Alliances will be launched in FY 2010: colleges and universities, and State and local government. BT will work with these groups to identify new or underused energy efficiency technologies for advancement in the marketplace. Additional National Account teams will be selected to construct or retrofit buildings that achieve savings of 50 percent and 30 percent respectively above ASHRAE/IESNA Standard 90.1-2004. ($40.0 million)

Building Technologies' activities result in direct engagement with the developers of these buildings, which will provide BT the opportunity to better understand the business models and value propositions that are necessary to develop strategies that promote the construction of highly efficient commercial buildings. In addition, BT will benefit from participating in real world whole-building design, construction, operation, and retrofit/rehabilitation experiences.

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. ($92.7 million)

- Solid State Lighting will develop technologies that can reduce commercial building lighting electricity consumption by at least 50 percent. Projects will focus on the development of general illumination technologies that achieve energy efficiencies of up to 113 lumens per Watt, through the creation of a technical foundation to revolutionize the energy efficiency, appearance, visual comfort, and quality of lighting. ($ 20.7 million)

- Space Conditioning and Refrigeration R&D will demonstrate design concepts that have the long-term potential to reduce annual heating, ventilation, and air-conditioning (HVAC) energy

consumption by 50 percent in new residential buildings including 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). ($9.0 million)

- Building Envelope R&D will develop new envelope materials to help meet Zero Energy Building (ZEB) goals. Specifically, this research will include phase change materials 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. BT's research will allow our light-weight, low-cost construction practices to function similarly to heavy mass walls. In addition, BT 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. BT will continue its research on highly insulating windows such as vacuum glazings that can achieve R10 performance, approximately three times that of today's ENERGY STAR windows. ($16.0 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. ($5.5 million)

- Solar Heating and Cooling focuses on the challenges of integrating solar technologies into building systems and products. Activities will include: research on exemplary low-cost solar water heating systems for Zero Energy Homes (ZEH) in cold climates and the development of prototype systems; R&D of combined solar heating, cooling, and water heating systems that utilize seasonal storage to achieve high solar fractions; continued development of dehumidification applications for combined photovoltaic/thermal systems for ZEH; and support of a solar rating and certification system. ($6.5 million)

- Energy Innovation Hub: Energy Efficient Building System Design, a new initiative, will establish a research and development institute that focuses on integrating smart materials, designs, and systems to tune buildings to conserve energy and control the allocation of lighting, heating, air conditioning, and electricity. A solicitation will be made to establish this institute on energy efficient building design. A standard, peer-reviewed process will be held and a Board of Advisors will be established to review the progress of the research institute. ($35.0 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:

- ENERGY STAR, a joint DOE/Environmental Protection Agency (EPA) activity, will continue to update criteria on selected products in accordance with EPAct 2005. For FY 2010, a three-pronged strategy will be used to support a full and growing portfolio of ENERGY STAR labeled clean energy technologies: 1) Developing and updating efficiency criteria for DOE-managed products;

2) Working with EPA, 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 the benefits of select products and technologies. ($10.0 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 EnergySmart Hospitals and EnergySmart Schools. ($5.0 million)

- Building Energy Codes will support the development and upgrade 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 the efficiency levels in the current residential and commercial codes. ($10.0 million)

- Solar Decathlon, a high-profile university competition held biennially in Washington, D.C., promotes public awareness of highly efficient building technologies and zero-energy homes using solar energy. Activities in FY 2010 will start with concluding the 2009 event in October and recruiting new teams for the 2011 Solar Decathlon. ($5.0 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 75 quadrillion Btus (Quads) of energy cumulatively by the year 2045. 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 2007 significantly increases the number of efficiency standards and test procedures DOE must develop, including incorporating standby and off mode power consumption into test procedures for residential products. In 2009, DOE initiated standards rulemaking for four products (Elliptical Reflector/Bulged Reflector/Reflector lamps, walk-in coolers and freezers, metal halide lamp fixtures, and residential clothes washers). These will continue in FY 2010 along with test procedures initiated for nine products in FY 2009. In FY 2010, DOE anticipates initiating energy conservation standard rulemakings on furnace fans, 1-599 hp electric motors, and commercial refrigeration equipment. Additionally, on February 5, 2009, the President issued a Memorandum to the Secretary of Energy requesting that DOE "work to complete prior to the applicable deadline those standards that will result in the greatest energy savings." DOE will initiate and accelerate up to three additional rulemakings not currently on its multi-year schedule and consider the potential energy savings when evaluating which products to accelerate. This could include products such as televisions, commercial automatic ice makers, and/or plumbing products. ($35.0 million)

Federal Energy Management Program

The Federal Energy Management Program (FEMP) facilitates the Federal Government's implementation of sound, cost effective energy management and investment practices to enhance the Nation's energy security and environmental stewardship. These goals are accomplished by means of alternative financing contract support, technical assistance and training, coordination of Federal reporting and evaluation, supporting the introduction of advanced technologies into the Federal vehicle fleet and other leadership activities that support Federal Agencies as they strive to meet Executive Order 13423 and EISA 2007 requirements. 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. FEMP will continue to 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 continue to support planning and implementation activities designed to establish DOE as the Federal agency leader in strengthening environmental, energy, and alternative fuels management. DOE Order 430.2b sets the framework for 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 2010 Budget Request

Federal Energy Management Program

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Project Financing	8,606	8,000	12,072
Technical Guidance and Assistance	8,153	4,000	8,000
Planning, Reporting and Evaluation	3,059	2,000	3,000
Federal Fleet	0	2,000	3,000
DOE Specific Investment	0	6,000	6,200
TOTAL	**19,818**	**22,000**	**32,272**

The Fiscal Year 2010 request is $32.3 million, an increase of $10.3 million from the FY 2009 appropriation.

Project Financing

FEMP facilitates Federal agencies access to private sector financing to fund energy efficiency improvements through its Energy Savings Performance Contracts (ESPCs), public benefit funds, and Utility Energy Service Contracts (UESCs) program support. It provides guidance, documentation, and individual project assistance to Federal agencies that utilize these programs which help develop and finance energy improvements at Federal facilities that can benefit from significant energy system retrofit. Under ESPCs and UESCs, agencies can take advantage of private sector expertise with little or no upfront cost to the Government. The Government pays back the Energy Savings Performance Company (ESCO) or other third party through energy cost savings over the life of the projects. ($12.1 million)

Technical Guidance and Assistance

Technical Guidance and Assistance helps Federal agencies take advantage of innovative technologies, tools, and best practices in the areas of energy efficiency, renewable energy and water conservation. These activities support agency development of new and existing high performance buildings that are moving toward the goal of consuming no more energy than the energy produced at the site (a net zero energy building). FEMP's broad range of assistance includes analytical support to Federal agencies from its laboratories, new technology deployment, development of Federal agency efficiency standards, specification of products for agency procurement, energy assessments and assistance to help other agencies develop their own comprehensive planning and internal processes to reduce their energy use and to achieve their water conservation goals. ($8.0 million)

Planning Reporting and Evaluation

The National Energy Conservation and Policy Act (as amended by EISA 2007) requires the Department to collect, verify and report on progress by the Federal agencies (including the DOE) toward the Federal energy management goals of reducing energy intensity in buildings, reducing petroleum usage, and conserving water. FEMP will collect and publish data for the Annual Report to Congress and respond to inquiries to help ensure accuracy in reporting and analysis of trends. Through its awards program, FEMP recognizes energy efficiency and renewable energy champions at Federal agencies. FEMP activities will include strategic communications and marketing, improved analysis of investments and financing, training for FEMP personnel and critical contractor support staff and support for the GovEnergy conference. ($3.0 million)

Federal Fleet

Federal vehicle fleet activities will include the required tracking and reporting activities for the Federal fleet and 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 will demonstrate opportunities for increased petroleum displacement through increased alternative fuel use. ($3.0 million)

DOE Specific Investments

DOE Specific Investments includes activities designed to implement Federal environmental, energy, and transportation management goals at DOE sites. These activities support DOE Order 430.2b, which will put DOE in the forefront of implementing Federal best practices in the areas of environmental, energy, and transportation management. Because a core mission and responsibility of DOE is to lead the Nation in promoting and utilizing the best available energy management technologies and

practices, executable plans have been developed by DOE program offices that ensure that they will meet, exceed, and lead in the implementation of Executive Order 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. ($6.2 million)

Fuel Cell Technologies

The mission of this program is to carry out "use-inspired, fundamental research" on the technical and commercialization barriers of using fuel cells in support of the national goals set for reducing greenhouse gas emissions increasing our energy security and creating or maintaining jobs. The program's key goals include improving fuel cell reliability and performance, while reducing cost.

The Fiscal Year 2010 budget request for Fuel Cell Technologies is $68.2 million, $100.7 million less than the FY 2009 appropriation, due to a re-focusing of activities on areas with near-term impact—in terms of increased energy efficiency and job-creation—consistent with Presidential objectives. Fuel Cell Systems R&D consolidates previous efforts in Fuel Cell Stack Components R&D, Transportation Fuel Cell Systems, Distributed Energy Fuel Cell Systems, and Fuel Processor R&D.

FY 2010 Budget Request
Fuel Cell Technologies

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Fuel Cell Systems R&D	0	0	63,213
Hydrogen Production and Delivery R&D	38,607	10,000	0
Hydrogen Storage R&D	42,371	59,200	0
Fuel Cell Stack Component R&D	42,344	62,700	0
Technology Validation	29,612	0	0
Transportation Fuel Cell Systems	7,718	6,600	0
Distributed Energy Fuel Cell Systems	7,461	10,000	0
Fuel Processor R&D	2,896	3,000	0
Safety and Codes and Standards	15,442	0	0
Education	3,865	0	0
Systems Analysis	11,099	7,713	5,000
Market Transformation	0	4,747	
Manufacturing R&D	4,826	5,000	0
TOTAL	**206,241**	**168,960**	**68,213**

BENEFITS

Fuel cells have a potentially broad and vital role to play in our energy economy. They provide a highly efficient means for producing electricity from many fuels, including several that are renewable, abundant, and domestically produced. They can use biofuels, by-products from biomass (such as biogas from landfills, agricultural sites, and food processing facilities), and other renewable fuels, as well as fossil fuels, including natural gas, propane, and diesel as the primary source energy. Fuel cells can efficiently power transportation vehicles and heavy machinery (e.g., forklifts and airport baggage tugs), and be used as auxiliary power units, which would save more than 700,000,000 gallons of gasoline alone in the trucking industry.

Fuel cells can be much more efficient than internal combustion engines, and in combined-heat-and-power (CHP) applications, they can operate with roughly 80 percent efficiency, compared to the approximate 34 percent efficiency of grid power generation. They are uniquely suited for many distributed power and CHP applications because they are highly efficient and reliable, have no moving parts, are quiet and vibration-free, emit no criteria pollutants, and have low operation and maintenance (O&M) requirements.

Progress in fuel cell R&D has led to significant advances in a number of commercial applications. Some of these applications have already gained traction in the marketplace, while others are poised to become competitive in the near-term. Fuel cells are less costly in many cases (on a lifecycle basis) than incumbent technologies for critical-load power for data centers, material-handling equipment (e.g., forklifts), and backup power. Other applications for fuel cells that are currently commercially viable or are expected to be competitive in the near-term include: auxiliary power units (APU), primary power systems, combined heat and power (CHP) systems, and portable power.

Continuing technological progress in the areas outlined below will potentially allow fuel cells to be applied in markets that have stringent requirements in terms of cost, durability, and performance. Once fuel cells demonstrate commercial viability in these first "beachhead" applications, the market will be able to decide how to best take advantage of this innovative technology on a national and or global scale.

Program Focus on Fuel Cell Systems and Systems Analysis

The Fuel Cell Technologies (FCT) Program in FY 2010 is aligned with President Obama's priorities for improvements in energy efficiency and domestic job-creation. The Department is restructuring these efforts to achieve benefits 1) sooner; 2) at less cost; and 3) with less technology risk. In FY 2010, the program's funding priorities are realigned to focus resources on key barriers facing fuel cell system applications in two subprograms: Fuel Cell Systems R&D and Systems Analysis.

Efforts in Hydrogen Production and Delivery R&D; Hydrogen Storage R&D; Technology Validation; Safety, Codes and Standards; Education; and Manufacturing R&D are being deferred to allow for emphasis on activities with higher near-term impact. The Department is not requesting FY 2010 funding for Market Transformation, because funding for that activity was increased through the American Recovery and Reinvestment Act.

Fuel Cell Systems R&D

Fuel Cell Systems (FCS) R&D is a new subprogram created in FY 2010 to consolidate the efforts of four previously funded subprograms: Fuel Cell Stack Components R&D, Transportation Fuel Cell Systems, Distributed Energy Fuel Cell Systems, and Fuel Processor R&D. This new key activity will

address the fundamental barriers blocking fuel cell commercialization across multiple applications (APUs and CHP systems, operating heavy machinery and transportation), whereas the previous program was focused on passenger vehicles. This change allows the program to focus on the fundamental barriers to broader market adoption, while allowing industry and the market choose the "winning" application domains.

FCS R&D will also concentrate on the core technological barriers for using multiple fuels in diverse applications including solid-oxide, alkaline, hydrogen and polymer electrolyte membrane fuel cells; fuels include renewable fuels (methanol, biogas, and other renewables), natural gas, and diesel for multiple applications (transportation, CHP and APUs) to reduce fuel consumption and emissions by heavy duty vehicles, direct methanol fuel cells for portable power, and backup power for critical infrastructure.

The goals of Fuel Cell Systems R&D address the key challenges of improving the durability, reducing the cost, and improving the performance (power, start-up time, transient response, etc.) of fuel cell systems. These advances are necessary to enable fuel cells to expand into new markets and compete with other advanced technologies, and they will require improvements in fuel cell stack and balance of plant components. FCS R&D will improve multiple core technologies, including: catalysts, membranes, and balance of plant components for polymer electrolyte membrane (PEM) fuel cells; interconnects, catalysts, and design configurations for solid oxide fuel cells; and catalysts, improved tolerance to contaminants, and design configurations for alkaline fuel cells.

The program will continue to make progress in one of the key areas affecting the cost of fuel cell stacks—the use of platinum (and related rare metals) as a catalyst. Over the past few years, the program has made considerable advances in reducing the amount of these metals needed in polymer electrolyte membrane fuel cells, but further reductions are necessary to meet cost goals. In FY 2010, FCS R&D will support new approaches in research to increase the activity and utilization of platinum and platinum group metal catalysts (PGM), and to improve the performance of non-PGM catalysts.

FCS R&D will address two critical factors that can reduce the durability of fuel cells: "poisoning" of the electrodes by impurities in the fuel or air supply; and freezing of water in the fuel cell stack after the fuel cell is shut down in cold weather. In FY 2010, the subprogram will employ research data and analytical models to better understand how fuel and air impurities degrade cell performance and to help develop methods for mitigating those effects. FCS R&D will improve water management by exploring novel concepts and improved system configurations.

FCS R&D will also develop and improve key fuel cell stack components, including: high-temperature membranes that enable more efficient utilization of catalysts, reduce the effects of impurities, and allow for a smaller cooling system; bipolar plates and seals that are inexpensive and corrosion resistant; and improved gas diffusion layers between the membrane electrode assemblies (MEAs) and bipolar plates. The proposed FY 2010 Budget investments in R&D build upon Recovery Act investments that accelerate fuel cell market transformation and demonstration activities. ($63.2 million)

Systems Analysis

The Systems Analysis subprogram conducts independent analysis to identify the benefits and challenges of various technology pathways for fuel cells and the fuels they use. These efforts include quantifying environmental benefits, assessing cost, identifying key technological gaps, evaluating research results, and assessing potential markets and employment impacts. The results of these efforts

assist in the prioritization of R&D pathways.

In FY 2010, the subprogram will develop analytical models and tools to help quantify benefits and identify technology gaps for various applications. These new models will enable the program to quickly and cost effectively identify resource limitations, options for stationary power generation from fuel cells, options for renewable fuel supply, infrastructure issues, and the environmental benefits and impacts of widespread commercialization. The Macro System Model will be updated to determine the benefits of integrating stationary power fuel cells with the electrical sector.

The Systems Analysis subprogram will also conduct market studies to assess the opportunities for early market applications of fuel cells, the resulting impacts on job growth, and the effects of a Federal fuel cell acquisition program on fuel cell costs. The subprogram will conduct risk-analysis to evaluate progress toward the program's targets and goals and assess the risk and effects of not meeting key targets. In addition, the subprogram's funds will be used to support peer reviews as required. ($5.0 million)

Geothermal Technology

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 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 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 a major 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—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. 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—10 percent of currently installed electric capacity—by 2050. This compares with today's 2900 MW of installed capacity at existing U.S. geothermal power plants using today's technology. Operating as a closed loop (no water exchange outside of the system), 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 2010 Budget Request
Geothermal Technology

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Enhanced Geothermal Systems	19,307	44,000	50,000
TOTAL	**19,307**	**44,000**	**50,000**

The Fiscal Year 2010 request is $50.0 million, an increase of $6.0 million from the FY 2009 appropriation.

In FY 2010, the program will develop critical technologies needed to create EGS reservoirs that mine heat from rock and transport the heat to the surface for electricity generation. Core research projects will be performed through cost-shared awards to private companies and academic institutions via competitive solicitations. National Laboratories with unique expertise in the subject areas will conduct the balance of the competitively-selected research projects. Field demonstrations with private companies and academic institutions via competitive solicitations will validate the commercialization potential of EGS. During FY 2010, the program plans to conduct six EGS demonstrations at field sites selected in previous years. Complementary activities will include a web-based, public geothermal database for resource, power plant, and institutional data; international collaborative activities; and investigation of low temperature geothermal opportunities. Commercial EGS could provide baseload, domestic power and contribute to the security and diversity of U. S. energy supplies. When implemented, EGS will avoid GHG emissions and be a source of clean, secure energy. EGS demonstrations should foster rapid growth in the use of geothermal energy in the outyears. ($50.0 million)

Industrial Technologies Program

The Industrial Technologies Program (ITP) seeks to reduce the intensity of energy use (energy per unit of output) of the U.S. industrial sector through the targeted research, development, and deployment (RD&D) of next generation manufacturing technologies, and the leveraging of collaborative industry partnerships for the adoption of efficient technologies and process improvements. Industrial energy consumption accounts for about one-third of all U.S. energy use, and 94 percent of industrial carbon emissions.

In 2006, the most recent year for which complete data is available, ITP directly contributed to industrial energy savings of almost 500 trillion Btus. ITP estimates that technologies developed and activities undertaken since 1977 have cumulatively saved more than 103 million metric tons of carbon equivalent (MMCTe) and over 5.6 Quads of energy. At the heart of ITP's success is a spirit of collaborative problem-solving, involving vigorous outreach to voluntary industry partners. This spirit is epitomized by ITP's *Save Energy Now* initiative (SEN). Since its inception in 2006, over 2,000 SEN industrial energy assessments have identified ways to save over 131 trillion Btus of natural gas, roughly equivalent to that used by 2 million average U.S. homes. Building upon these successes, ITP will be expanding these efforts. Simultaneously, ITP will continue to forge ahead on the cutting-edge of technological innovation with diverse RD&D partners, and initiate transformational R&D activities to address long-term climate change issues.

The Fiscal Year 2010 budget request of $100.0 million for Industrial Technologies is $10.0 million more than the FY 2009 appropriation. This budget reflects a continuing shift toward crosscutting technology development and increased emphasis on technical assistance. The end result of this shift will be a maximization of ITP's impacts across a broader set of industries.

FY 2010 Budget Request
Industrial Technologies

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Industries of the Future (Specific)	10,969	15,575	12,627
Industries of the Future (Crosscutting)	52,223	74,425	87,373
TOTAL	**63,192**	**90,000**	**100,000**

Industries of the Future (Specific)

To reduce the energy consumption and improve environmental performance, Industries of the Future (Specific) cost-shares RD&D of advanced technologies with partners from four major energy and waste intensive industries: forest and paper products, steel, aluminum, and chemicals.

Key technologies under investigation and development include high efficiency pulping and innovative paper drying; energy efficient iron- and steel-making and recovery of valuable components from steel industry wastes; efficient aluminum melting and forming; and alternative energy efficient chemical processes, oxidation reactions, hybrid distillations, and micro reactors. In FY 2010, ITP will also initiate additional early stage R&D with the most energy intensive industries in the Nation. ($12.6 million)

Industries of the Future (Crosscutting)

The Industries of the Future (Crosscutting) activities involve cost-shared RD&D for advanced technologies with potential applications across many industries and crosscutting outreach efforts that promote the use of energy efficient technologies and practices throughout all industries.

ITP conducts crosscutting RD&D work through three of its key activities to maximize the reach of its benefits to industry. The Energy-Intensive Process R&D key activity is comprised of four areas: industrial reaction and separation, high-temperature processing, waste energy minimization and recovery, and sustainable manufacturing. The Industrial Materials of the Future key activity involves R&D on durable materials for energy systems and separations, advanced materials solutions for waste energy recovery, new high temperature corrosion-resistant materials, and advanced manufacturing processes such as low cost titanium production. The nanomanufacturing key activity involves collaborative efforts to build upon existing science and develop next-generation nanomanufacturing processes to dramatically reduce energy intensity, including technologies and processes for enabling the mass production and application of nano-scale materials, structures, devices, and systems. ($25.0 million)

Crosscutting outreach efforts include the Industrial Distributed Energy key activity, which seeks to accelerate the market adoption of combined heat and power (CHP) in industry. CHP is an optimal energy efficiency solution whose adoption creates green jobs, reduces GHG emissions, and improves the efficiency of U.S. industry. The R&D focus will be advanced prime movers, key components, and integrated systems for clean, efficient, and fuel-flexible CHP systems (<20 MW) focusing on non-traditional CHP applications, including untapped markets in the industrial sector. Market transformation will be accomplished through partnerships including the regional Clean Energy Application Centers. Fuel and Feedstock Flexibility key activity work will support efforts to replace natural gas and oil use by continuing R&D and analysis addressing fuel and feedstock flexibility technology platforms and industrial process integration issues in order to increase market adoption of emerging energy technologies. ($28.9 million)

The crosscutting outreach also includes the Industrial Technical Assistance key activity which will continue to drive the latest energy efficient technologies practices to industry through Industrial Assessment Centers (IACs) and the Best Practices SEN initiative. The IACs will perform 300 days of industrial assessments while providing energy, waste, and productivity training to another 100 engineering students at 26 universities. A strategic expansion of SEN activities will be undertaken through new targeted corporate outreach efforts with the most energy intensive industries, including partnerships with leading industrial companies, plants, and supply chains to reduce their energy intensity by 25% over a 10 year period. Through SEN, ITP will continue conducting plant energy assessments and audits, and delivering other ITP services, technologies, and products to plants nationwide either directly or through state, utility and local partners. Coordination will continue for the development of a voluntary American National Standards Institute (ANSI)-accredited certification process for plant energy management and energy efficiency improvement, and work will continue with the International Organization for Standardization (ISO) to develop a new international energy management standard (ISO 50001). ($32.1 million)

REgaining our ENERGY Science and Engineering Edge

The mission of the REgaining our ENERGY Science and Engineering Edge (RE-ENERGYSE) is to create a highly skilled U.S. workforce dedicated to developing and implementing clean energy technologies and processes that will help the U.S. accelerate its transition to a low carbon economy. To that end, this DOE-wide program will:

- Fund opportunities for highly qualified students to study and conduct research in technical subjects with a focus on low carbon energy;
- Support American universities, community colleges, and training centers to develop the capacity to support and educate the scientists, engineers, technicians, and other experts needed in the energy field; and
- Support K-12 schools, educators, and students to ensure a sufficient pipeline of individuals to solve future energy and climate change challenges.

In FY 2010, activities will focus on setting up the structure for each of the competitive grant opportunities, widely promoting the solicitations to eligible candidates, and making awards for implementation in the 2010/2011 academic calendar year.

FY 2010 Budget Request
RE-ENERGYSE

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Higher Education	0	0	80,000
Technical Training and K-12 Education	0	0	35,000
TOTAL	**0**	**0**	**115,000**

The Fiscal Year 2010 request for Program Support Activities is $115.0 million; this is a new program.

Higher Education

The Higher Education activity will provide competitive fellowships, internships, and post-doctoral opportunities in the fields of study relevant to low-carbon energy, such as catalysis, solar power, advanced materials, combustion efficiency, nuclear, and batteries. In particular, this subprogram will offer up to 180 three-year fellowships for graduate students in engineering; up to 180 post-doctoral one-year research opportunities; and up to 900 undergraduate assistantships to support a summer research project as well as continued study in the clean energy field with participating faculty members. The Higher Education activity will also support the development of between six and eight interdisciplinary masters programs in clean energy.

Technical Training and K-12 Education

The Technical Training and K-12 Education activity will support the development of effective training programs at community colleges and other training centers. Competitively-selected community colleges and other training institutions will develop up-to-date, technically accurate curricula as well as faculty training on relevant energy topics. Training and educational programs will be designed to meet current and near-term local market needs for a green workforce. This activity will seek to engage and empower K-12 students and educators to help meet the Nation's energy and environment challenges.

Solar Energy

The mission of the Solar Energy Program (Solar Program) is to conduct research, development, demonstration, and deployment activities to accelerate widespread commercialization of clean solar energy technologies, which will lower greenhouse gas emissions, provide a clean and secure domestic source of energy, and create green jobs.

The United States is the world's largest consumer of electricity, and at the same time has the largest solar resource of any industrialized country. Developing technologies that can reliably and affordably harvest this resource will greatly enhance national energy security while reducing the threat of global warming and create U.S. jobs. To accomplish this mission, the Solar Program invests in two basic types of solar technologies – photovoltaics (PV) which convert the sun's energy directly into electricity, and concentrating solar power (CSP) technologies which concentrate the sun's rays and produce electricity from the resulting thermal energy. The proposed FY 2010 investments complement funds provided by the American Recovery and Reinvestment Act that enhance development of next generation solar technologies, accelerate development of critical path technologies in support of the program's goal of making electricity generated from solar competitive with conventional grid electricity by 2015, and address market barriers.

FY 2010 Budget Request
(Non-Comparable, or as Appropriated, Structure)
Solar Energy

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Photovoltaic Energy Systems	136,744	145,000	149,470
Concentrating Solar Power	27,617	30,000	78,420
Solar Heating and Cooling Systems	1,959	–	–
Systems Integration	–	–	29,660
Market Transformation	–	–	27,450
Solar Electricity Energy Innovation Hub	–	–	35,000
TOTAL	**166,320**	**175,000**	**320,000**

The Fiscal Year 2010 budget request for Solar Energy is $320.0 million, which is an increase of $145.0 million over the FY 2009 appropriation. The proposed structure change consists of four subprograms - two technologies based, PV & CSP, and two crosscutting, Systems Integration and Market Transformation. It preserves the technology distinction between two fundamentally different ways of producing solar power, while providing two distinct crosscutting areas that increase the effectiveness in addressing needs common to the entire solar technology portfolio.

Targeting improved performance and reliability with reduced cost, the Solar Program partners with industry, universities and National Laboratories to focuses its research, development, demonstration, and deployment activities in five subprograms: Photovoltaics R&D, Concentrating Solar Power, Systems Integration, Market Transformation, and the Solar Electricity Energy Innovation Hub.

Photovoltaic R&D

The Photovoltaic R&D 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 has five components: Exploratory Research, Conversion Devices, Measurements and Characterization, Systems Development, and Technology Evaluation.

- *Exploratory Research* consists of work on next generation materials and devices, including technologies such as plasmonics, organic cells, and multiple exciton generation.
- *Conversion Devices* seeks to reduce cost and improve performance of PV cells by focusing on commercial semiconductor materials, device properties, and fabrication processes.
- The *Measurements and Characterization activity* supports new manufacturing development by providing testing, evaluation, and analysis capability for all PV material technologies, and assisting product development with specialized equipment that simultaneously allows for the creation and analysis of PV devices.
- Under *Systems Development*, industry-led Technology Pathway Partnerships focus on development, testing, demonstration, validation, and interconnection of new PV components, systems, and manufacturing equipment. The PV Incubator project enables start-up companies to scale up laboratory processes into pilot manufacturing processes. Under the University Process and Product Development project, universities leverage their fundamental understanding of materials and device physics to transfer PV technologies into the marketplace. The PV Manufacturing Initiative is a new effort in FY 2010, which will accelerate the commercialization and cost reduction of PV.
- *Technology Evaluation* provides independent testing of industry technologies to assess reliability and to provide the data necessary for stage-gate reviews and down-selects. Regional Experiment Stations will evaluate performance of systems in both hot, humid climates representative of the Southeastern U.S. and hot, dry climates representative of the Southwestern U.S. This activity also includes accelerated lifetime testing. ($149.5 million)

Concentrating Solar Power (CSP)

The primary focus of the CSP subprogram is to achieve cost competiveness of CSP in the intermediate power market by 2015. Current efforts are focused on establishing U.S. manufacturing capability for low cost trough components and the technical feasibility of lower cost thermal storage and innovative new concepts such as linear Fresnel.

The addition of energy storage removes the intermittent nature of the solar resource and enables CSP plants to operate whenever homes and businesses require power regardless of weather or time of day. Prototype development and evaluation of thermal storage systems will begin in FY 2010, as well as projects to develop CSP systems capable of operating competitively in the baseload power market by 2020. This is a stretch goal for CSP because baseload power is fueled primarily by coal, which is the least expensive fossil fuel. Providing baseload power will require CSP plants having between 12 and 17 hours of storage and higher temperature capability to enable higher system efficiency and lower cost. ($78.4 million)

Systems Integration

Systems Integration emphasizes engineering development and integration of solar systems in end-use applications, including the electricity grid. Power electronics, i.e., inverters, controllers, and interfaces to energy management systems, which are required for integration, will be developed and demonstrated. A key application is residential/commercial/industrial buildings, in which the Solar Program is coordinating with the Building Technologies Program to provide the solar thermal and solar electricity needed for a zero-energy building (or home).

In FY 2010, increased emphasis will be placed on development of energy storage systems for integration with PV operations at distribution levels to support high penetration of PV into the national grid. ($29.7 million)

Market Transformation

Market transformation efforts focus on facilitating the commercialization of solar technologies by identifying and breaking down market barriers and promoting deployment through stakeholder outreach at all levels. Market transformation efforts look to ensure that technologies do not wind up "on the shelf" instead of "on the roof" because of issues such as interconnection standards, net metering, utility policies, solar access laws, workforce development, and policymaker understanding of solar technologies. Activities also seek to capture opportunities to promote market-pull through the facilitation of large-scale solar deployment opportunities.

The subprogram will continue to fund activities supporting 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 Solar Program goals. The program will launch the Solar Policy and Analysis Network in FY 2010 to meet the need for accurate and timely local, state, and regional policy research and analysis that supports solar market transformation. ($27.5 million)

Solar Energy Innovation Hub

The Solar Electricity Energy Innovation Hub will incorporate cutting-edge research in solar technologies. A competitive solicitation will be made to establish the institute. A standard, peer-reviewed process will be held and a Board of Advisors will be established to review the progress of ongoing research. ($35.0 million)

Vehicle Technologies

The Vehicle Technologies (VT) program focuses on highway vehicles (passenger and commercial vehicles), which account for 55 percent of total U.S. oil use ─ more than all U.S. domestic oil production. Cost-competitive, more energy-efficient and fuel diverse vehicles will enable individuals and businesses to accomplish their daily tasks while reducing consumption of gasoline and diesel fuels.

The program uses the majority of its funds to support R&D of technologies that have the potential to achieve significant improvements in vehicle fuel efficiency or significant displacement of petroleum-based fuels with clean, cost-competitive alternative fuels that can be produced domestically.

The program's R&D efforts pursue four technology pathways, each of which can improve vehicle efficiency relative to conventional technology, thus lowering vehicle oil use and greenhouse gas emissions: improve hybrid electric vehicle (HEV) component efficiency (up to 50 percent improvement in fuel economy); improve plug-in hybrid electric vehicle (PHEV) components (up to 300 percent improvement in fuel economy); improve combustion engines and fuel characteristics (up to 40 percent improvement in fuel economy and displacement of oil by non-petroleum fuels); and reduce the weight of vehicles (up to 30 percent improvement in fuel economy).

These improvements can be combined to create integrated advanced technology vehicles capable of between 200 and 400 percent increased fuel economy per vehicle for passenger vehicles and 40 to 50 percent improvement for commercial vehicles.

FY 2010 Budget Request
Vehicle Technologies

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Hybrid Electric Systems	92,079	125,709	164,661
Advanced Combustion Engine R&D	43,443	40,800	57,600
Materials Technology	38,616	39,903	54,905
Fuels Technology	17,376	20,122	25,122
Technology Integration	16,845	46,704	31,014
TOTAL	**208,359**	**273,238**	**333,302**

The Fiscal Year 2010 request is $333.3 million for the Vehicle Technologies Program, a $60.1 million increase over the FY 2009 appropriation (a $90.0 million increase on a comparable budget basis). The FY 2010 request fully supports the FreedomCAR and Fuel Partnership goals for hybrid and internal combustion powertrain systems. In addition, VT is requesting a $46.0 million increase for development of plug-in hybrid electric vehicle technologies, where the potential oil reduction benefits are significant.

The Vehicle Technologies budget was modified in FY 2009 by transferring three activities into VT from the Hydrogen Technology Program (now the Fuel Cell Technologies Program): Education; Technology Validation; and Safety and Codes and Standards. In FY 2010 those activities are returned to the Fuel Cell Technologies Program; they have been focused on hydrogen and fuel cells and are not "critical-path" activities for achieving the VT program goals.

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. ($164.7 million)

- The Energy Storage R&D activity addresses the first building block of a hybrid-electric vehicle: electricity storage. Developing batteries that are rugged, long-lasting, affordable, lighter, hold a substantial charge, and work in all climates and seasons is still a major R&D challenge. This activity supports long-term research, applied research, and technology development of advanced batteries, and collaborates with battery R&D in other Federal agencies through the Interagency Advanced Power Group (DOE, NASA, Army, Navy, and the Air Force).
- The activity's long-term research is focused on developing advanced materials for the next generation of energy storage technologies. This research effort is being conducted at universities and National Laboratories. These efforts are being coordinated with the Office of Science. The activity will continue to develop advanced diagnostic techniques to investigate and better understand life- and performance-limiting processes in lithium-based batteries in transportation applications. The program will develop and apply electrochemical models to understand failure and thermal runaway mechanisms in lithium batteries, and to design new functional materials.
- In FY 2010, applied research will focus on the investigation of cell behavior of higher energy Li-ion cells. The primary goal of this activity is to develop and engineer higher-energy electrodes utilizing high capacity cathode and anode materials. Optimal cell chemistries will be developed around the most promising higher energy density materials and evaluated.
- Nearer-term technology development will continue to support cost-shared subcontracts through the United States Advanced Battery Consortium (USABC) with multiple battery suppliers to drive down the cost of Li-ion batteries. The program will continue to develop full-sized Li-ion modules using low-cost, thermally stable, high-performance anode and cathode materials. All USABC subcontracts to develop advanced batteries are awarded under a competitive process and are at least 50 percent cost-shared by developers. ($77.4 million)
- Advanced Power Electronics and Electric Motors R&D addresses the second building block of hybrid-electric vehicles, which includes the electric and electronic devices that deliver the power stored in the battery to the vehicle's drive-train: power control circuits, charging circuits, electric motors, logic to synchronize the power from the battery and motors with the main vehicle engine, and other related components.
- In FY 2010, existing work in these areas will be expanded to address the more stringent performance requirements for PHEVs. Activities focusing on advanced materials will be enhanced to enable the production of prototype devices to accelerate the process of transferring research results to device manufacturers. Also in FY 2010, a new solicitation will be issued to fund industry R&D efforts to develop power electronics and electric motors, with the goals of achieving substantial reductions in cost, weight, and volume. ($30.0 million)
- 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. 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.

The significant increase in funding for FY 2010 will support expanded heavy vehicle systems modeling and development of technologies to reduce commercial vehicles' parasitic losses such as aerodynamics and friction. It will also support significantly increased testing of both commercial vehicles and passenger vehicles. The additional funds will increase the number of PHEVs evaluated in the PHEV Technology Acceleration & Demonstration Activity. VSST will also expand the evaluation of advanced HEVs and PHEVs in medium and heavy duty uses such as school buses, urban delivery vehicles, and transit buses.

VSST will validate, in a systems environment, performance targets for deliverables from the power electronics and energy storage technology R&D activities, and examine overall vehicle impacts associated with integration of other advanced vehicle technologies. ($53.4 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 from 30 percent in 2002 to 45 percent by 2010 and for commercial vehicles from 40 percent in 2002 to 55 percent by 2017 (within vehicle demonstration), while meeting cost, durability, and emissions objectives. ($57.6 million)

- The Combustion and Emission Control R&D: 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. ($47.2 million)
- Solid State Energy Conversion activity develops technologies to convert waste heat from engines to improve overall thermal efficiency and reduce emissions. This activity will continue cost-shared cooperative agreements awarded in FY 2009 to develop and fabricate high efficiency thermoelectric generators and thermoelectric air conditioning for passenger vehicles. These improvements could increase vehicle fuel economy by up to 10 percent. The program will release a competitive solicitation in FY 2010 for research in advanced thermoelectric materials and scale-up for demonstration in vehicle applications. ($8.7 million)

Materials Technology

The Materials Technologies subprogram supports the development of cost-effective materials and manufacturing processes that can contribute to fuel-efficient passenger and commercial vehicles. The subprogram consists of three activities: Propulsion Materials Technology, Lightweight Materials Technology, and the High Temperature Materials Laboratory (HTML). ($54.9 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. In support of the Advanced Combustion Engines team, Propulsion

Materials will use specialized characterization and processing techniques to develop materials for in-cylinder thermal management, friction reduction, improved dynamic response, increased power to weight ratios, and robust catalysts for emissions control. Support for hybrid- and electric-drive systems will be expanded by addressing materials requirements for high efficiency electric motors, high-temperature power electronics, high performance electrical connections, and characterization and evaluation of battery component materials. ($13.7 million)

- The Lightweight Materials Technology activity supports R&D on advanced concepts to reduce the weight of vehicles, accomplished primarily by substitution of lower density or stronger materials for current materials. Research includes lightweight metals such as magnesium, aluminum, advanced high-strength steels, and titanium, and also covers polymer- and metal-matrix composites. FY 2010, increased funding will focus on new development and demonstrations at pilot-scale of technologies for reducing the effective costs of aluminum, magnesium, carbon-fiber and carbon-fiber composites and components made from these materials. ($34.0 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. ($5.7 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. 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. ($25.1 million)

- The Advanced Petroleum-Based Fuels (APBF) activity develops petroleum-based fuels and lubricants that will enable extremely high efficiency engines for passenger and commercial vehicle applications. In FY 2010, APBF will continue to study the effects of physical and chemical property variation in petroleum-based fuels on the performance and emissions of advanced combustion engines, in cooperation with the Advanced Combustion Engine subprogram. Also in FY 2010, APBF will initiate analysis of the flexibility of the U.S. petroleum fuel production, distribution, and retailing infrastructure with respect to changes in physical and chemical properties of gasoline and diesel fuel for transportation use and other petroleum-based products and fuels. ($6.8 million)
- The Non-Petroleum-Based Fuels and Lubricants (NPBFL) activity formulates and evaluates non-petroleum-based fuels and lubricants that can be used as neat (pure) alternative fuels or as blendstocks in transportation fuels. In FY 2010, the activity will continue studies of the effects of physical and chemical property variation in synthetic and renewable fuels on the performance and emissions of advanced combustion engines. NPBFL will also work to minimize the nominal miles per gallon differential between ethanol and gasoline and test intermediate ethanol blends (between 10 and 50 percent) to identify technical and safety issues that must be addressed before these intermediate blends can be introduced for use in vehicles without any special "flex-fuel" adaptations. In FY 2010 NPBFL will expand its studies of next-generation biomass-derived transportation fuels. A comprehensive R&D and testing program will be developed to fully evaluate these fuels in cooperation with industry and other stakeholders. ($17.6 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. 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. ($31.0 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. ($1.0 million)
- The Advanced Vehicle Competitions. FY 2010 will be the second year of the 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. ($2.0 million)
- The Education activity in 2010 is transferred from the VT Program to the Fuel Cell Technologies Program as part of a reprioritization of fuel cell and hydrogen-related work. ($0.0 million)
- The Safety and Codes and Standards activity in 2010 is transferred from the VT Program to the Fuel Cell Technologies Program as part of a reprioritization of fuel cell and hydrogen-related work. ($0.0 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. ($2.0 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. 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. Demonstration and deployment of other alternative-fuel and advanced combustion and emission control technologies developed by DOE will also be supported. ($25.5 million)
- Biennial Peer Reviews - In FY 2010 there will be a biennial review of the 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

The mission of the Water Power Program is to research, test, and develop innovative technologies capable of generating renewable, environmentally responsible, and cost-effective electricity from water. These include marine and hydrokinetic technologies, a new suite of emissions-free renewable technologies that harness the energy from untapped wave, tidal, current, and ocean thermal resources. In addition, the Water Power Program works to develop technologies and processes to improve the efficiency, flexibility, and environmental performance of hydroelectric generation, which currently accounts for approximately 7% of the U.S. electricity supply.

The Water Power Program is positioned to play a key role in the nascent marine and hydrokinetic industry in FY 2010 by providing a significant funding source to drive the development and deployment of these emissions-free technologies. With FY 2010 funding, the program also has the opportunity to support cost-effective measures to increase clean, renewable energy generation at existing hydropower facilities and to maximize hydropower's value to the U.S. electricity grid. Investment in both of these sectors will expand the Nation's renewable energy portfolio by providing additional sources of clean, secure energy, contribute to economic prosperity by spurring demand for new green jobs, and signal strong U.S. commitment to lowering greenhouse gas emissions and addressing climate change.

This budget request of $30.0 million will support a continuation of FY 2009 R&D activities for both marine and hydrokinetic technology and conventional hydropower. A $10.0 million decrease is proposed for FY 2010, as the program synthesizes and evaluates the findings of FY 2009 R&D activities (which will continue into FY 2010).

FY 2010 Budget Request

Water Power

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Water Power	9,654	40,000	30,000

Marine & Hydrokinetic Technologies:

The Water Power Program is in a unique position to help make marine and hydrokinetic energy a commercial reality in an accelerated time frame by funding activities that will reduce costs and technical and project risks across the whole sector. The program's priority is to reduce barriers to the development and deployment of these early-stage technologies and projects. This includes R&D funding for the development of optimized components and devices, higher-resolution resource assessments to quantify and validate estimates of extractable energy quantity by location, environmental effects studies to aid the regulatory process and reduce project development costs, and integrated National Marine Renewable Energy Centers to support R&D, device testing and validation, and information-sharing across the industry. The program also supports the development of models and tools that assist in the design of these emerging technologies, as well as the creation and maintenance of comprehensive, searchable databases that provide industry with key technology and project development data.

Although the industry has seen an increase in the number of technology developers over the last few years, marine and hydrokinetic devices and components are still in the early stages of testing and development, with few in the U.S. having reached full-scale demonstration or deployment. FY 2010

funding supports the Water Power Program's efforts to facilitate device and component testing necessary to optimize these technologies and help industry reduce costs and technical risks. With FY 2010 funding, the program will continue to support and evaluate the technology development projects that were initiated through the program's FY 2009 competitive solicitation to industry.

FY 2010 funding also allows the Program to continue resource assessment activities begun in FY 2008 and FY 2009 that play a pivotal role in quantifying the practicably extractable energy by resource and the potential energy output from these technologies. Results of the resource assessments will provide fundamental data on the size, location, and characteristics of wave, tidal, ocean current, and ocean thermal resources in the U.S. and fill essential information gaps needed to reduce technical and project risk for the investment community.

The program initiated studies in FY 2009 to help the industry assess potential environmental, navigational, and socio-economic impacts that are required to license and permit projects and may hinder the industry's ability to deploy quickly and cost-effectively. The program seeks to reduce project development costs and aid the regulatory process by studying these impacts and engaging industry in developing a framework for developing mitigation and minimization methods and improved device designs.

Conventional Hydropower:

Conventional hydropower is a significant contributor to the U.S. electricity portfolio, representing approximately 7 percent of total U.S. energy generation and approximately 75 percent of current U.S. renewable energy generation (EIA data). There is a significant opportunity to increase the Nation's incremental hydroelectric generation, quantify and maximize the ancillary benefits to the U.S. electric grid, and improve environmental performance of the U.S. hydroelectric infrastructure.

FY 2010 funding supports a continuation of the program's FY 2009 efforts to assess the current state of the U.S. hydroelectric infrastructure and identify opportunities for increased and more valuable generation. This includes activities to increase incremental generation through efficiency and capacity gains at existing power stations, as well as the placement of power stations at existing non-powered dams and in constructed waterways.

Conventional hydropower also has the potential to increase the flexibility and stability of the U.S. electric grid and to support the integration of variable renewable resources. Projects funded in FY 2010 will seek to maximize this potential value by developing and deploying technologies that increase operational flexibility, including pumped storage, as well as the modification of models to better assess the potential capacity expansion of pumped storage and facilitate introduction of other variable renewable resources into the market.

Both the development of new incremental generation and improvements in operational flexibility are constrained by hydropower's association with adverse environmental impacts, particularly with respect to fish passage, water quality in reservoirs and downstream from dams, and altered flow regimes that may degrade physical habitat for fish below dams. To address these problems, the program's FY 2010 funding will continue to fund development of new technologies and methods that improve environmental performance.

Wind Energy Program

To help meet America's increasing energy needs while protecting our Nation's energy security and environment, the Wind Energy Program is working with wind industry partners to develop clean, domestic, and innovative wind energy technologies that can compete with conventional fuel sources.

The program supports the President's goals and Departmental priorities for increasing the viability and deployment of renewable energy; leads the Nation's efforts to improve wind energy technology through public-private partnerships that enhance domestic economic benefit from wind power development; and coordinate with stakeholders on activities that address barriers to the use of wind energy.

Wind energy has demonstrated significant expansion and promise as an affordable energy supply, increasing from about 2.5 GW in 2000 to nearly 25 GW by the end of 2008. The program aims to reduce the risks that undermine the growth potential of wind energy in the United States by focusing on improving cost, performance, and reliability of land-based and offshore wind technology and addressing barriers to wind energy's rapid market expansion, including challenges related to electrical transmission and integration, manufacturing, policy, and market acceptance.

The FY 2010 budget request for Wind Energy is $75.0 million, an increase of $20.0 million from the FY 2009 appropriation.

FY 2010 Budget Request
Wind Energy

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Technology Viability	26,461	32,000	45,440
Technology Application	22,573	23,000	29,560
TOTAL	**49,034**	**55,000**	**75,000**

The "20% Wind Energy Report" (published by DOE with support from the wind industry, utilities, academia, and other stakeholders in 2008) concluded that wind turbine performance, reliability, and the challenge of limited transmission and systems integration are some of the key barriers that need to be overcome in order to provide 20% of the Nation's electricity with wind energy by 2030. To address these and other barriers, the program will increase its efforts in: 1) supporting research and testing to help mitigate reliability concerns with existing turbine fleet and improve performance for new technology applications, including a new effort to improve turbine manufacturing; 2) systems interconnection, transmission, and energy storage applications that support high wind energy penetration onto the national electric grid; and 3) offshore wind technology development and resource assessment.

Technology Viability

Technology Viability activities are aimed at improving wind turbine system reliability, performance, and cost. The activities are performed through targeted research and development projects through competitively selected public/private partnerships and Cooperative Research and Development Agreements (CRADAs). The projects are closely coordinated with Supporting Research and Testing conducted by National Laboratories.

Low Wind Speed Technology (LWST) focuses on activities which improve the cost and performance of utility-scale, land-based and offshore wind turbines to achieve the following goals:

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

Land-based systems projects promote industry adoption of technology developments and emerging innovation. The activities are accomplished in collaboration with National Laboratory expertise concentrating on three technical areas: 1) conceptual design studies; 2) component development and testing; and 3) turbine system prototype development and testing. In FY 2010, the program will continue to lower the cost of energy for wind turbine systems through existing and new partnerships and CRADAs. Efforts on offshore wind technology will be increased to support potential field demonstration and prototype development; areas of research include environmental impact, resource assessment, system design criteria, and offshore construction techniques. ($15.6 million)

Distributed Wind Technology (DWT) supports the full range of wind technology applications on the distribution side of electric power systems—residential, small commercial, farm, community, and tribal wind markets. In order to improve the quality of small wind turbines and increase consumer confidence in their performance, independent field testing of small wind turbines and support for certification will continue. If necessary, regional test centers will be created outside of NREL in FY 2010 to expand testing capabilities. In addition, the program will explore the possibility of supporting an effort to develop mid-sized turbine technology to address the lack of advanced products in this market segment. ($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 LWST projects and 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. Activities are coordinated with industry and other research institutions to facilitate technology transfer and transition of designs and component improvements into full systems. In FY 2010, there will be an increased focus on drivetrain and blade performance and reliability. Two utility-scale wind turbines will begin field testing at the National Wind Technology Center. The program will work in collaboration with industry and National Laboratories in an effort to improve manufacturing processes for wind turbine components, and to facilitate advanced supply chain development in support of high volume manufacturing. ($23.8 million)

Technology Application

This effort addresses opportunities and barriers concerning use of wind energy systems, other than wind turbine technology cost, performance, reliability, and manufacturability. This work helps to prepare and accelerate the market for significantly broader application of wind technologies. To enable wind energy to provide the expected contribution to the President's renewable energy goals, this area of the program requires expansion. ($29.5 million)

Systems Integration (SI) focuses on anticipating and overcoming utility operational and planning issues associated with interconnecting greater amounts of wind energy and other renewables into the electricity system. 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. FY 2010 efforts will be closely coordinated with clean energy grid investments provided under the American Reinvestment and Recovery Act including: 1) renewable plant performance characterization and forecasting at levels of detail required for electric system planning and operations; 2) operations analysis and modeling to understand the dynamic interaction between wind plants and the rest of the utility electric system; 3) renewable interconnection planning support to assist transmission planners with long-term integrated resource planning; and 4) a centralized source of technical information on wind energy interconnection. ($18.4 million)

Technology Acceptance (TA) focuses on resolving institutional issues; providing state, regional, local, and tribal energy sector outreach; workforce development initiatives; and investigating and mitigating social environmental and wildlife issues associated with wind energy development. The Wind Powering America component of TA is aimed at facilitating wind technology deployment in the United States, bringing economic and environmental benefits to the country, and stimulating sustainable tribal and rural-based energy sectors. In FY 2010, TA activities will increase the emphasis on efforts to assess and mitigate effects of wind turbines on federally owned land areas and the environment and on enhancing the regional wind support effort that was started in FY 2007. TA 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. ($11.1 million)

Weatherization and Intergovernmental Activities

The mission of the Weatherization and Intergovernmental Activities program is to accelerate the deployment of energy efficiency, renewable energy, and oil displacement technologies and practices by a wide range of government and business stakeholders.

Program activities complement and contribute to the Secretary's clean energy and economic prosperity priorities through:

- Supporting innovative state and local energy projects, programs, and policies;
- Preparing thousands of workers for "green" careers;
- Stimulating clean energy project planning and construction on tribal lands;
- Obtaining immediate energy savings benefits from weatherizing thousands of low-income homes;
- Encouraging increased utilization of energy savings performance contracting and sustainable energy efficiency financing mechanisms;
- Facilitating expansion of renewable energy certificate trading programs and energy efficiency based utility incentives; and
- Maintaining effective management of both FY 2010 and Recovery Act funded ($11.6B, FY 2009) state and local clean energy projects.

FY 2010 Budget Request
Weatherization and Intergovernmental Activities

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Weatherization Assistance Grants	227,222	450,000	220,000
State Energy Program	44,095	50,000	75,000
International Renewable Energy Program	0	5,000	0
Tribal Energy Activities	5,945	6,000	6,000
Renewable Energy Production Incentive	4,955	5,000	0
TOTAL	**282,217**	**516,000**	**301,000**

The Fiscal Year 2010 request for Weatherization and Intergovernmental Activities is $301.0 million, $215.0 million less than the FY 2009 appropriation. The program received $11.6 billion under ARRA.

Weatherization Assistance Grants

The Weatherization Assistance Grants program and technical assistance concurrently reduces national energy consumption and energy costs for low-income families. The program is implemented by States and other grantees, through a national network of approximately 900 weatherization agencies. These community-based organizations manage client intake and the home retrofit process.

The program contributes directly to the Secretarial priority of creating a green workforce. State grantees develop and implement specialized training programs for thousands of workers in the residential energy audit and retrofit field to make buildings more energy efficient, affordable, and sustainable. DOE also develops and shares effective and technically advanced energy efficiency tools and methods to improve program performance. The decrease at the request level is due to the

availability of FY 2009-2010 funding from the Recovery Act. ($220.0 million)

State Energy Program

The State Energy Program reduces energy use and cost, increases renewable energy capacity and production, and lessens dependence on foreign oil. The program provides technical and financial resources to help States develop and manage a variety of high impact energy programs. Formula grants allow state energy offices the flexibility to develop energy projects focused on the buildings, electric power, industry, and transportation sectors as well as crosscutting policy initiatives. Competitive Special Project grants address specific and important deployment and policy opportunities. Other program activities include: enhanced outreach and technical assistance to grantees and continued development of web-based reporting and monitoring systems. ($75.0 million)

International Renewable Energy Program

The International Renewable Energy Program expands international clean energy technology deployment through environmentally effective and economically sustainable projects. These efforts broaden EERE participation in international climate change initiatives, such as the International Partnership for Energy Efficiency Cooperation, the Western Hemisphere Energy Cooperation Initiative, and a cooperative agreement with Israel. In FY 2010, activities and program funding are transferred to the Program Support International subprogram request. This reflects the consolidation and integration of international activities at the corporate level. ($0.0 million)

Tribal Energy Activities

Tribal Energy Activities build partnerships with tribal governments to address residential, commercial, and industrial energy needs of Native Americans. The program provides competitive grants to evaluate and develop promising clean energy resources. Key areas of technical assistance are: 1) the development of model financial solutions and legal frameworks to advance broader project development; and 2) expanded outreach of EERE technologies to tribes and Alaskan Native corporations. ($6.0 million)

Renewable Energy Production Incentive

The Renewable Energy Production Incentive was created by the Energy Policy Act of 1992 to spur the deployment and operation of renewable energy facilities by not-for-profit utilities. The annual incentive payments are based on kilowatt-hours generated and the amount of the fiscal year appropriation. The expansion in size and number of renewable energy facilities has resulted in increasingly smaller resources available for individual payouts, 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 2010 is $63.0 million, $19.0 million for core operations and maintenance (a $3.0 million decrease), and $44.0 million for the South Table Mountain (STM) Ingress/Egress and Traffic Capacity Upgrades. This budget request represents a decrease of $13.0 million compared to the FY 2009 appropriation.

FY 2010 Budget Request
Facilities and Infrastructure
National Renewable Energy Laboratory

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Operation and Maintenance			
General Plant Projects	3,331	7,000	14,000
General Capital Equipment	3,587	3,000	5,000
Science and Technology Facility (STF)/Solar Energy Research Facility (SERF)	7,927	0	
GPE – Scientific Computing at Sandia National Laboratory	**0**	**12,000**	**0**
Total, Operation and Maintenance	**14,845**	**22,000**	**19,000**
Construction			
South Table Mountain Infrastructure, Zone I	6,831	0	0
South Table Mountain Infrastructure, Zone II	0	13,000	0
STM Ingress/Egress and Traffic Capacity Upgrades	0	0	44,000
Energy Systems Integration Facility	54,500	41,000	0
Total, Construction	**61,331**	**54,000**	**44,000**
TOTAL	**76,176**	**76,000**	**63,000**

In Fiscal Year 2010, the Department is requesting $63.0 million for NREL Facilities and Infrastructure, a decrease of $13.0 million from the FY 2009 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 currently home to 1,300 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.

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 real property reinvestment objectives. 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. This includes scientific equipment with multiple program uses across NREL, information technology, site safety and security equipment, and other multiple purpose equipment.

Technology-specific capital equipment required by EERE programs is budgeted separately and not included in the general maintenance and repair request. ($19.0 million)

Construction

South Table Mountain (STM) Infrastructure, Zone II. In support of growing EERE mission needs, the accelerated development of NREL requires expansion of site utilities to previously undeveloped portions of the STM site. This project provides the Zone II basic site infrastructure improvements necessary to efficiently and effectively reconfigure and upgrade the 30-year old STM utility infrastructure and to add new capacity to enable accelerated implementation of the Ten Year Site Plan. EERE's current and recently approved capital projects at NREL will significantly expand site population, necessitating significant changes to current site operations including electrical service, fiber optic network and telecommunications services, water, sewer, storm water, natural gas, heating and cooling water distribution, roads and walkways, and renewable energy technologies. This project was fully funded in FY 2009. ($0.0 million)

STM Ingress/Egress and Traffic Capacity Upgrades. EERE's recently approved and proposed capital projects at NREL are expected to triple the STM site population by 2011 (adding 1,400 full-time equivalents) necessitating significant changes to current site operations including external access, parking, and traffic flow. This project acquires an additional external site ingress/egress route for normal traffic and emergency access, stacked parking for 1,500 vehicles to preserve valuable land for R&D use, and supporting roadway reconfigurations and improvement of existing drainages necessary to accommodate the new site traffic patterns and future site development. This project is critical to the safe and cost-effective expansion of the fundamental access and traffic capacity on the NREL site. ($44.0 million)

Program Direction

The Program Direction budget request provides the necessary resources for executive leadership, technical direction, and project management and oversight to effectively administer EERE technology development programs. The budget request covers an increase in Federal staff and contract support; enhancements to information technology business systems; expanded office space; and additional travel, equipment, supplies and materials necessary to implement and execute EERE's rapidly growing programs.

The FY 2010 budget request for Program Direction totals $238.1 million, which is an increase of $110.5 million above the FY 2009 appropriation of $127.6 million. This increase is necessary to ramp up EERE staffing to achieve the Administration and Secretarial goals. From FY 2001 through 2006 EERE's Appropriations averaged $1.2 billion with a workforce of 526 FTE per year. From FY 2007 through 2009, Congress increased EERE's Presidential budget requests by more than $1 billion, almost doubling prior year budgets and workload requirements in 3 years. During this period, EERE's workforce declined to 478 FTE due to the lack of Program Direction funding needed to hire at a scale and pace commensurate with workload growth created by budget increases. The FY 2009 Omnibus Appropriations level for EERE is $2.2 billion, with a projected workforce of 489 FTE responsible for planning, processing, executing, and providing unprecedented management and oversight for more than 2,900 active contracts, grants and agreements in excess of $3.5 billion. The number of transactions in the next fiscal year is expected to exceed 6,900. The current workforce is inadequate to process the backlog of work and address increased future workload requirements.

FY 2010 Budget Request
Program Direction

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Salaries and Benefits	65,837	78,726	131,117
Travel	3,919	4,772	7,583
Support Services	21,290	27,803	66,097
Other Related Expenses	13,014	16,319	33,320
TOTAL	**104,057**	**127,620**	**238,117**

In Fiscal Year 2010, the Department is requesting $238.1 million for the EERE Program Direction, an increase of $110.5 million from the FY 2009 appropriation.

Program Direction funds both headquarters' operation and the field Project Management Center (PMC). Headquarters employees are responsible for program planning and management, while the PMC is responsible for implementation, execution, and project management and oversight of EERE's research, development, deployment and demonstration partnerships, laboratory contract administration, and a variety of business and technical functions including administering the management and operating contract for the National Renewable Energy Laboratory.

The PMC will continue to work with States and local communities to accelerate EERE programs and activities, identify and engage community and state partners to help integrate EERE programs with public and private sector activities. The PMC administers the majority of EERE's program funding to

States, localities, and regional organizations and continues to play a key role in administering grants and implementing deployment and outreach programs. Major PMC activities include:

- Administering principal technology deployment grant programs, including the State Energy Program;
- Delivering principal technical assistance programs, including Clean Cities, Rebuild America, and the Federal Energy Management Program;
- Serving as a liaison to state energy offices, other state agencies, regional organizations, and other stakeholders involved in energy and environmental quality issues;
- Providing program managers with customer feedback on how to make EERE programs more efficient and effective; and
- Ensuring EERE's investments are transparent and have total accountability, management, and oversight consistent with the recent Congressional and Administration initiatives.

Program Support

The Program Support budget request advances Presidential and Secretarial objectives in science and discovery, clean and secure energy, economic prosperity and climate change. Program Support provides resources for crosscutting planning, analysis, and performance evaluation for EERE programs and for international and outreach activities. The timely, independent, and high quality credible information developed by the Program Support components provides information needed for consultation, collaboration, and decision making related to energy alternatives that will achieve Departmental goals. The FY 2010 budget request for Program Support activities totals $120.0 million, representing a $101.8 million increase from the FY 2009 budget request. The increase reflects the addition of three new subprograms in FY 2010, to cover international, strategic priorities and impact analysis, and commercialization activities. Modifications were made to establish and consolidate activities formerly funded within program line items to improve integration, functionality, management, and transparency.

FY 2010 Budget Request
Program Support

Activity	Funding ($ in thousands) FY 2008 Approp.	FY 2009 Approp.	FY 2010 Request
Planning, Analysis and Evaluation	7,333	10,078	11,000
Technology Advancement and Outreach	3,468	8,079	11,000
Strategic Priorities and Impact Analysis	–	–	43,000
Commercialization	–	–	45,000
International	–	–	10,000
TOTAL	**10,801**	**18,157**	**120,000**

The Fiscal Year 2010 request for Program Support Activities is $120.0 million, $101.8 million more than the FY 2009 appropriation.

Planning, Analysis, and Evaluation (PAE) is requesting $11.0 million in FY 2010 to enable collection and analysis of economic, market, and technology data in support of EERE's programs. It also develops crosscutting analytical tools and models for assessing and 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 represented in the benefits sections of the budget overview, program budgets, and other budget justification materials. These analyses are essential for program planning, prioritization, management, and defense of robust program pathways that can achieve EERE goals in the most cost-effective manner.

Technology Advancement and Outreach (TAO) is requesting $11.0 million in FY 2010 to communicate the EERE mission, program plans, accomplishments, and technology capabilities to a variety of stakeholder audiences including Congress, the general public, educational institutions, industry, and other government and non-government organizations. TAO leads outreach efforts for EERE, including implementing 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 inquiries and requests. Use of EERE's websites has expanded rapidly, and continues to grow at a pace of 6.4 million additional "page views" per year. The Information Center annually fields about 27,000 inquiries and delivers roughly 300,000 publications to consumers, businesses, and schools.

Strategic Priorities and Impact Analysis (SPIA) is requesting $43 million in FY 2010. SPIA will consolidate and provide strategic analysis of technology and policy innovation focused on by the Congress and Administration. SPIA, in concert with PAE, provides senior EERE management with credible, reliable, and independent analysis that is essential for informing and making decisions across the broad set of technology programs' challenges. Activities focus primarily on climate change, market, policy, and energy-systems and supply chain issues that impact and are impacted by EERE clean energy technologies.

Commercialization is requesting $45 million to further its mission of increasing the speed and scale of the market penetration by the energy efficiency and renewable energy technologies borne out of EERE's investments in its National Laboratories. This funding will support new and consolidate existing priority corporate needs that were previously supported through multi-program collaborations. The consolidation at the corporate level enhances overall efficacy and facilitates economies of scale and scope.

Commercialization entails both accelerating Lab technologies into the marketplace as well as generally growing the American markets for efficiency and renewable technologies. The individual initiatives seek to increase the flow through the product pipeline to the market by enhancing the awareness of market relevance earlier in the Lab development process. Commercialization thus enhances both market "push" on the supply side and market "pull" on the demand side. All efforts carry the added benefits of maximizing energy savings, reducing carbon emissions, and enhancing national security, yet the primary focus remains one of interfacing with the capital markets.

Several initiatives are designed to specially draw out individual technologies from the Labs. These include the Entrepreneur in Residence program (EIR), the Technology Commercialization Showcase (TCS), and the Technology Commercialization Fund (TCF). In the EIR program, individual venture capital firms competitively bid for a one-year slot at one of the National Labs selected by the Secretary. The firms then name an individual to spend one year at the named Lab to identify promising technologies for market readiness and build the business case around it. While EIR brings business interests into the Labs, TCS on the other hand, brings the Lab science into the business community. The Technology Commercialization Showcase, held at DOE Headquarters in Washington, D.C., asks representatives from across EERE Programs and Lab Technology Transfer Offices to present the technologies they believe have market interest to a broad and diverse representation of the financial community. The third effort designed to draw out individual technologies from the Labs is the Technology Commercialization Fund. TCF maturation funds have been distributed to National Labs' Technology Transfer Offices in order to forge cost-sharing relationships to mature individual technologies. Each of these initiatives has run for two years and will continue into 2009 and 2010.

An additional set of Commercialization initiatives is designed to strengthen the interface among DOE, National Labs, and the capital markets. Through a single, web-accessible database, the Lab Technology Portal will provide a consolidated view of publicly available energy-relevant technology information for those who seek to further develop and to fund efficiency and renewable technologies.

EERE's **International** subprogram is requesting $10.0 million in FY 2010 to coordinate a variety of international initiatives, partnerships, and events that promote greater understanding and utilization of renewable energy and energy efficiency worldwide. The International subprogram advances EERE's mission globally by promoting U.S. global climate change, energy security, and economic goals; accelerating clean energy innovation and cost reductions; and transforming renewable energy and energy efficiency markets in key developing countries. The subprogram, which was formerly funded within the Office of Weatherization and Intergovernmental Activities Program, leverages DOE's technical expertise, activities, and relationships to make a significant and sustainable impact in addressing climate change and enhancing U.S. energy security and economic vitality.

EERE Funding Summary by Program

(dollars in thousands)

	FY 2008 Current Approp.	FY 2009 Current Approp.	FY 2010 Request to Congress	FY 2010 Request vs. FY 2009 Approp.
Energy Efficiency and Renewable Energy				
Programs:				
Biomass and Biorefinery Systems R&D	195,633	217,000	235,000	+18,000
Building Technologies	107,382	140,000	237,698	+97,698
Federal Energy Management Program	19,818	22,000	32,272	+10,272
Fuel Cell Technologies	206,241	168,960	68,213	-100,747
Geothermal Technology	19,307	44,000	50,000	+6,000
Industrial Technologies	63,192	90,000	100,000	+10,000
RE-ENERGYSE (DOE-wide Initiative)	–	–	115,000	+115,000
Solar Energy	166,320	175,000	320,000	+145,000
Vehicle Technologies	208,359	273,238	333,302	+60,064
Water Power	9,654	40,000	30,000	-10,000
Wind Energy	49,034	55,000	75,000	+20,000
Subtotal, Programs	**1,044,940**	**1,225,198**	**1,596,485**	**+371,287**
State and Other Supporting Activities:				
Weatherization and Intergovernmental Activities	282,217	516,000	301,000	-215,000
Facilities and Infrastructure	76,176	76,000	63,000	-13,000
Program Direction	104,057	127,620	238,117	+110,497
Program Support	10,801	18,157	120,000	+101,843
Congressionally Directed Activities	186,664	228,803	–	-228,803
Adjustments	-743	-13,238	–	–
Subtotal, State and Other Supporting Activities:	**659,172**	**953,342**	**722,117**	**-231,225**
Total, Energy Efficiency and Renewable Energy	**1,704,112**	**2,178,540**	**2,318,602**	**+140,062**