

Energy Efficiency and Renewable Energy
Office of Energy Efficiency and Renewable Energy
Overview
Appropriation Summary by Program

(dollars in thousands)

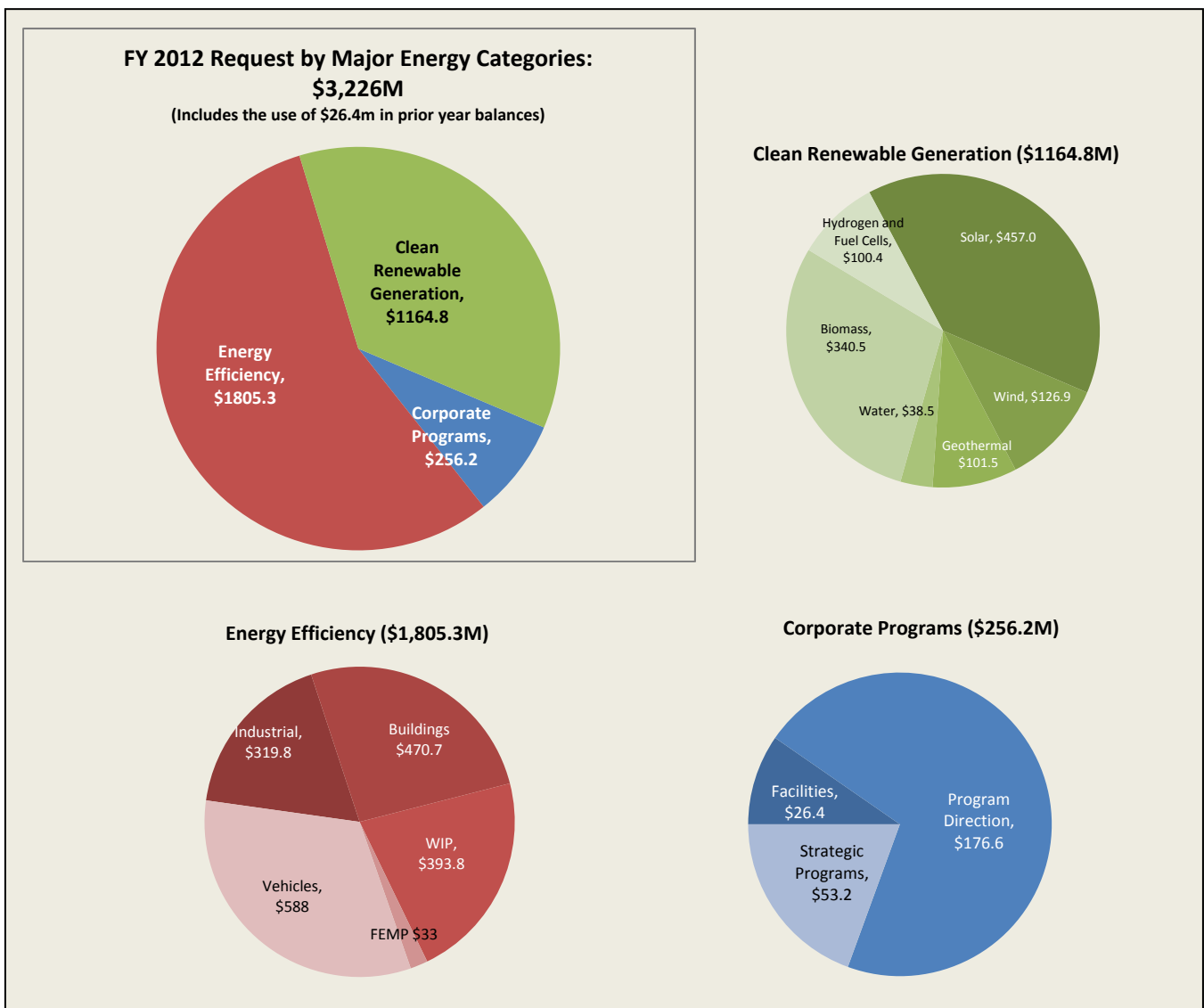
	FY 2010 Current Approp ^a	FY 2011 CR	FY 2012 Request
Energy Efficiency and Renewable Energy (EERE)			
Hydrogen & Fuel Cell Technologies	170,297	0	100,450
Biomass & Biorefinery Systems RD&D	216,225	0	340,500
Solar Energy	243,396	0	457,000
Wind Energy	79,011	0	126,859
Geothermal Technology	43,120	0	101,535
Water Power	48,669	0	38,500
Vehicle Technologies	304,223	0	588,003
Building Technologies	219,046	0	470,700
Industrial Technologies	94,270	0	319,784
Federal Energy Management Program	32,000	0	33,072
Facilities and Infrastructure	19,000	0	26,407
Weatherization and Intergovernmental Activities	270,000	0	393,798
Program Direction	140,000	0	176,605
Strategic Programs	45,000	0	53,204
Congressionally Directed	292,135	0	0
Subtotal, EERE	2,216,392	2,242,500	3,226,417
Use Of Prior Year Balances	0	0	-26,364
Total, EERE	2,216,392	2,242,500	3,200,053

^a SBIR/STTR funding transferred in FY 2010 was \$23,310,200 for the SBIR program and \$2,797,220 for the STTR program.

Preface

The Office of Energy Efficiency and Renewable Energy (EERE) requests \$3.2 billion in FY 2012 including the use of \$26,364 in prior year balances. EERE's research, development, demonstration, and deployment (RDD&D) activities are critical to meeting the Nation's goals of growing our economy and keeping America competitive in the 21st century by developing cutting-edge technologies with real-world applications that dramatically reduce energy consumption, GHG emissions and oil consumption and diversify our electricity generation. EERE programs provide a vital link between advances in basic research and Administration efforts to commercially deploy clean energy technologies. EERE does this by supporting applied research, technology development, and demonstrations of clean energy technologies that have the potential to be cost competitive with conventional alternatives. EERE coordinates with the Office of Science on fundamental research, and with ARPA-E on the development of breakthrough technologies. These activities also help inform national policies that can create markets for widespread deployment of innovative technologies. EERE also works in close partnership with state and local organizations to achieve these objectives.

The FY2012 programs fall into three major categories:



First, EERE will achieve **rapid gains in the efficient use of energy** by supporting the development of cost-effective new building systems that can reduce commercial and residential energy use; enabling a vigorous building energy retrofit industry capable of providing comprehensive energy retrofits for the bulk of America's buildings over the next 15 years; and, supporting innovations in materials and manufacturing processes that will increase the energy productivity of US industry and make US firms more competitive in global markets. It does this both through research, development, and demonstration (RD&D) and working to encourage rapid adoption and use of new technology by encouraging innovative financing, codes and standards, improved consumer information, and other methods.

Second, it will ensure the continued availability of affordable transportation for people and freight that does not depend on petroleum by supporting RD&D on a portfolio that would make the United States the **world leader in new transportation technologies** based on electricity, renewable fuels, and other advanced technologies. It also works to ensure that the infrastructure needed to deliver new energy technologies and fuels will be available.



Third, EERE RD&D will achieve **rapid growth in renewable energy** supplies using biomass, wind, solar, geothermal, water power, fuel cells, and other energy technologies to produce competitive sources of fuels and electricity. EERE works with utilities and other partners to ensure rapid adoption of new renewable technologies providing technical information, technical analysis, and other resources.

Mission

Energy Efficiency and Renewable Energy (EERE) supports research, development, demonstration, and deployment activities on technologies essential for meeting national security goals by reducing dependence on oil, meeting environmental goals by minimizing the emissions associated with energy production and use, and stimulating economic growth and job creation by minimizing the cost of energy services and stimulating investment in US businesses.

Benefits

Benefits are estimated in terms of reduced cost of energy services, reduced greenhouse gas and other emissions resulting from energy production and use, and reduced use of oil. EERE will continue to refine its strategic planning methodology and analytical toolkit this year.

Strategic Plan, Implementation

The FY 2012 EERE budget planning process began with a detailed review of how energy is now used in the US, where the energy is obtained, and how federal research and other programs would support the Department's goals and achieve the greatest benefits.

The Department is in the process of updating its strategic plan, and has been actively engaging stakeholders including Congress. The draft strategic plan is being released for public comment concurrent with this budget submission, with the expectation of official publication this spring. The

RAPID GROWTH IN RENEWABLE ENERGY

One way the Recovery Act helped the U.S. move toward growth in the renewable energy sector by retooling manufacturing plants to make parts for technologies such as wind and solar.

draft plan and FY12 budget are consistent and aligned. Updated measures will be released at a later date and available at the following link <http://www.mbe.doe.gov/budget/12budget/index.htm>.

The achievement of RDD&D goals, objectives and strategies by EERE's programs will yield significant short- and long-term results in areas critical to reducing GHG emissions, deploying clean, secure energy, and enhancing economic prosperity.

High-Priority Performance Goals (HPPGs)

The FY 2012 EERE budget request and activities proposed contribute to several HPPGs to:

- Double renewable energy generation (excluding conventional hydropower and biomass) from 2008 to 2012.
- Assist in the development and deployment of advanced battery manufacturing capacity to support 500,000 plug-in hybrid electric vehicles a year by 2015.
- Work with HUD to enable the cost-effective energy retrofits of a total of 1.1 million housing units. Of this number, DOE programs will contribute to retrofits of an estimated one million housing units.

The performance measures for EERE programs are aligned with these goals as well as the goals previously cited, and tracking their progress toward this end in FY 2012. Additional information on the intermediate performance critical to the achievement of these goals is provided at www.performance.gov.

FY 2012 Budget Highlights

Planning, Evaluation, and Transparency

EERE's budget will ensure robust, transparent, and accountable program management and support functions that will efficiently and effectively execute and inform EERE's critical mission. EERE programs will leverage their planning, analysis and deployment funds by collaborating with Strategic Programs (formerly Program Support) activities to maximize the effectiveness of program and corporate activities for EERE and DOE through integrated planning and resource utilization. Efforts include integrated strategic planning, collaboration and coordination initiatives and first-of-a-kind in-depth studies of the future of energy use in transportation, buildings, industry, and electric utilities. Collaborative efforts make EERE more productive as they reduce unnecessary overlap; coordinate and expand the possible scope of interdependent activities; and that EERE resources are optimized to meet National goals in energy security, environmental quality, and economic growth.

Energy Efficiency

EERE's FY 2012 portfolio will achieve rapid gains in the efficient use of energy through research that can dramatically increase energy efficiency for less than the cost of new energy resources, without sacrificing functionality or safety. EERE's energy efficiency programs have been rebalanced to create an effective portfolio of long-term research and development, market priming to speed the market acceptance of new technologies and practices, and efforts to achieve short term objectives such as appliance standards.

In buildings, the FY 2012 budget focuses the Administration's Better Buildings Initiative – that seeks to achieve a 20 percent improvement in commercial building energy efficiency by 2020. In addition, buildings activities will drive the deployment and integration of advanced building components (next generation lighting, heating and refrigeration devices, sensors and controls, windows, shell materials,

etc.) and methods to accelerate the adoption of new efficiency technologies (appliance standards, the development and adoption of new building codes, building rating programs, innovative financing, support for building retrofits, etc) . In industry, the budget focuses on research on new, inherently low embodied energy materials, radically improved manufacturing processes and specialized topics such as combined heat and power (CHP) and energy for computer centers. EERE teams work directly with industry to help audit their facilities, identify cost-effective upgrades and encourage rapid adoption of efficiency technology.

Buildings Technologies (\$470.7M): FY 2012 funding will focus on large, untapped near term energy savings such as low cost retrofits for the large existing building stock. EERE Building Technology Program (BTP) is joining with industry partners to release a new design specification for 10-ton capacity commercial air conditioners. When built according to the criteria of the new specifications, the high-efficiency rooftop units are expected to reduce energy use by as much as 50 to 60 percent over equipment being replaced. Other component technology research fills identified gaps in technical performance and/or cost reduction needed to accelerate market penetration. Also in FY 2012, BTP will convene researchers and innovative thinkers from across disciplines at the building technology Energy Innovation Hub to reach breakthroughs in building efficiency, as well as continuously improve and replicate the results from the Recovery Act Better Buildings projects and expand the Home Energy Score Pilot into a national program. BTP will complete 8 energy efficiency standards while working on 42 product classes. Lastly, DOE is requesting \$100 million for a new major competitive program to demonstrate innovative approaches to improve the efficiency of the commercial and industrial sector. The request also includes \$60 million in FY12 to launch a major initiative for cost effective energy efficient retrofits in commercial buildings.

Federal Energy Management Program (\$33.1M): FEMP will maintain or improve the level of service to Federal agencies through improved quality of assistance and leveraging other EERE resources. There will be increased emphasis on new technology deployment, support for development of agency GHG reduction initiatives, increased support for building-level assessments of cost-effective measures, oversight of alternative financing mechanisms, and support for sustainable design and building commissioning. FEMP is assisting Federal Agencies in reaching the Executive Order 13514 goal to reduce federal GHG emissions by 28 percent by FY 2020 from a FY 2008 baseline. DOE's new Sustainability Performance Office will facilitate DOE's progress with this Executive Order.

Industrial Technologies (\$319.8M): The Industrial program will support advanced industrial technologies to help re-invigorate existing industries while supporting the growth and development of new industries here in the U.S. The program will provide a balanced portfolio of advanced R&D and complimentary near-term low cost deployment opportunities with the objectives of increasing U.S. competitiveness, enhancing clean energy manufacturing, and improving energy productivity. There will be a focus on next generation manufacturing processes and materials, activities for clean energy manufacturing, upgrade of existing facilities with energy efficient technologies, and refocused efforts for Industrial Technical Assistance to achieve greater results with less funding through more effective leveraging of funding for deployment partnerships. Included is a new critical materials energy innovation hub.

Weatherization & Intergovernmental Programs (\$393.8M): The Weatherization and Intergovernmental Program will focus on lowering consumers energy bills by increasing the efficiency of their buildings. The program will transition from the high levels of Recovery Act funding to sustainable approaches using a combination of formula and competitive grants. For example, high impact competitive grants through Innovations in Weatherization (\$97M) will demonstrate methods that reduce weatherization costs, increase leveraging of Federal investment, and improve savings.

**Energy Efficiency and Renewable Energy/
Overview**

FY 2012 Congressional Budget

Renewable Generation

Renewable Generation programs will position the United States as the global leader in developing and manufacturing cutting-edge clean energy technologies. The programs will drive rapid growth in renewable generation with technologies that produce competitive sources of electricity at full price parity with conventional alternatives by driving innovation and investment in our nation's energy infrastructure, thereby catalyzing economic growth and creating American jobs. The FY 2012 budget generally places increased emphasis on R&D at early and mid-stage Technology Readiness Levels (applied research and development), and less on deployment activities. Resources are focused on early-stage research where industry is unable to fully fund activities on their own. Cost-shared partnerships with industry, academia and other research institutions are established to make technologies more cost-competitive and reliable. Demonstrations will be used on a very selective basis to validate economic and performance data needed for commercial deployment. Priority research includes increasing the efficiency and lowering the manufacturing costs of solar devices to \$1 per Watt installed when deployed at scale; increasing the cost-competitiveness of off-shore wind energy; support for both cost-effective low-temperature geothermal systems and high-risk/high-payoff work in enhanced geothermal systems; programs that can upgrade the efficiency and capacity of conventional hydroelectric systems without damaging the environment; and innovative marine hydrokinetic devices.

EERE also supports complementary programs designed to accelerate the introduction of these technologies including work to address the challenge of integrating intermittent electric resources into utility systems, and work in utility policy and building codes that can remove barriers to rapid introduction of renewables. Energy storage systems will also be an important part of this investment. Together, these shifts in R&D activities provide the necessary foundation to drive clean energy penetration into the market at the speed and scale envisioned by the Administration.

Solar (\$457M): A major objective is to achieve a \$1 per Watt installed price for solar electricity before the end of the decade, called the "SunShot Initiative". This would mean that solar energy would be competitive with conventional electric generation in most parts of the US and the world. The Program is pursuing this goal in collaboration with the Office of Science and the Advanced Research Projects Agency- Energy (ARPA-E). The program will drive transformative research looking at next-generation technologies as well as programs designed to improve the performance and drive down the cost of photovoltaic modules, power electronics, and balance of system costs. The program also encourages Systems Integration by developing radically new approaches to reduce the cost and improve reliability and functionality of power electronics and supporting industry development through test and evaluation standards, and tools for understanding grid integration issues. The Balance of Systems-Software (BOS-Software) subprogram will refocus on quantitatively non-hardware related Balance of Systems (BOS) costs including delays in permitting, streamlined permitting, inspection, and interconnection and perform key analyses of policy options that can accelerate the rapid deployment of solar technologies through the use of innovative Information Technology solutions. The Concentrating Solar Power subprogram invests heavily in thermal storage and supporting systems research and optimization to provide baseload power on demand. The Solar Demonstration Zone will enter its second year of funding with resources focused on achieving SunShot goals.



DOE 1.5MW research wind turbine installed at the National Wind Technology Center (NWTCC) in Colorado

Wind (\$126.9M): The Wind Program supports a broad R&D portfolio of land-based and offshore wind systems at small, medium, and utility-scale to achieve clean energy goals. EERE will continue to increase focus on offshore wind. In conjunction with the Department of the Interior approval of the first offshore wind farm in the U.S., the DOE has launched an initiative to accelerate the rapid and responsible development of America’s vast offshore wind resources. EERE will also continue to develop a strong reliability program for land-based turbines. R&D activities focus on analysis, innovative marine platform designs, testing, and integration of advanced components and systems to reduce the cost of energy from wind power and to contribute to

positioning the United States as a global leader in developing and manufacturing cutting-edge clean energy technologies. The Program also supports activities to enable wind energy interconnection with the transmission grid, assure power quality and accurately characterize the wind resource so as to spur innovation and investment in our nation’s energy infrastructure, catalyzing economic growth and creating American jobs. R&D funding will also improve advanced manufacturing for materials technologies related to wind energy, development of codes and standards for domestic manufacturing and supply chains; and analysis, research, and technical support in collaboration with appropriate agencies to address radar issues, environmental concerns, and regulatory barriers. Funding also supports removing market barriers through efforts to improve the dissemination and use of objective, factual wind energy technology and economic data.



Conventional Hydropower Turbine

Water (\$38.5M): The Water Power Program funds cost-shared R&D of innovative water power technologies in order to further develop renewable power generation from water resources in a cost-effective and environmentally responsible manner. This program also supports a wide range of water power resource assessments, environmental studies, advanced modeling, and cost assessments, and other activities aimed at demonstrating the viability, reducing market barriers and accelerating deployment of these innovative technologies. The program’s

goal is to (1) significantly increase generation from existing

hydropower resources, and (2) demonstrate marine and hydrokinetic technologies as viable option within our nation’s renewable energy portfolio. To maximize the speed and scale of clean energy implementation, funding is increased for low-cost efficiency, capacity upgrades and operational improvements of conventional hydropower. Funding for Marine and Hydrokinetic Technologies will be used to test devices with the aim of establishing baseline cost of energy and performance.

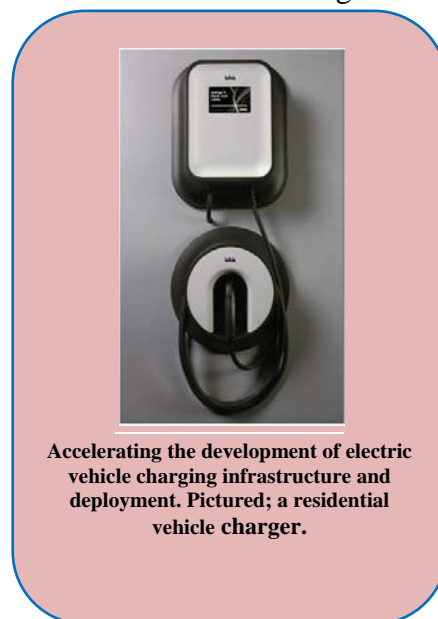
Geothermal (\$101.5M): The Geothermal Technologies Program (GTP) is developing cost-effective ways to exploit the enormous and diverse geothermal energy resources. The program will expand its focus beyond high-risk, high-payoff Enhanced Geothermal Systems technologies to a more balanced portfolio that will include low-



temperature, coproduced, geopressed, and undiscovered hydrothermal resources that have near-term impacts. In FY 2012, in addition to EGS, the Program will pursue four other activities: (1) Low Temperature and Coproduced Resources will expand geothermal energy development to new areas in the United States, (2) Permeable Sedimentary Resources will investigate the opportunity for heat mining in permeable sedimentary reservoirs, (3) Innovative Exploration Technologies will develop new methods and explore undiscovered hydrothermal resources, and (4) Systems Analysis will continue development of analytical tools aimed at reducing geothermal development costs and risks.

Advanced Fuels and Vehicles

Advanced Fuels and Vehicles programs are shifting to a portfolio of new transportation technologies based on electricity, renewable fuels, and advanced technologies that can decouple the U.S. vehicle fleet from fossil fuels. These programs will also enable rapid growth in renewable fuels with technologies that produce cost competitive alternatives to petroleum-based fuels. For FY 2012, vehicle work will focus heavily on new generations of hybrid electric vehicles, plug-in hybrids, electric vehicles, and highly efficient trucks. Investments in infrastructure, and early deployment and field validation of advanced technologies will facilitate rapid introduction of these technologies by gathering critical performance and economic data needed for commercialization. In advanced fuels, priority work includes biomass conversion technologies that can produce bio-based hydrocarbon fuels that face no blend limits in aviation or diesel fuel, and are completely compatible with existing distribution infrastructure. Fuel cell research will continue to focus on cost reductions and durability while new cost competitive forms of renewable hydrogen will be developed. EERE will also support programs designed to accelerate the introduction of these technologies, including the testing of fuels and dispensing equipment so that they can move into the marketplace.



Vehicle Technologies (\$588M): To accelerate the introduction and market acceptance of electric vehicles, the Program is greatly expanding its emphasis on the electrification of the vehicle (i.e., new generations of hybrid electric vehicles, plug-in hybrids, electric vehicles) through research and development of batteries and power electronics, systems R&D on the electric drive to improve performance and cost, development of EV supporting infrastructure (e.g., advanced chargers, streamlined codes and standards), and efforts to reward communities for leadership in reducing regulatory barriers and developing comprehensive electric vehicle-friendly infrastructure. In addition, the Program is focused on developing highly efficient trucks, the testing of non-petroleum fuels so that they can move seamlessly into the marketplace and other work that will facilitate rapid introduction of these technologies, accumulating 112 million miles of plug-in hybrid and electric vehicle testing by 2015.

Biomass & Biorefinery Systems RD&D (\$340.5M): Increased emphasis is placed on basic and applied R&D with an initiative to enable biomanufacturing in collaboration with ARPA-e and the Office of Science. The program is developing thermochemical and biochemical conversion pathways for stable biofuel intermediates that can be used to make hydrocarbon biofuels and environmentally and economically sustainable algae and advanced feedstocks. Continued improvement and innovation will reduce the cost of feedstock logistics. The demonstration and commercial deployment of cutting-edge conversion technologies in integrated biorefineries will also continue, validating these new technologies at scale and reducing investor risk. To provide market surety for new cellulosic biorefineries coming on

line, the Biomass & Biorefinery Systems RD&D Program will rapidly infuse \$150M into the industry through a Cellulosic Biofuels Reverse Auction. A biopower R&D initiative will provide a renewable electricity alternative for regions of the Nation that lack other renewable options, such as wind or solar. In 2012, the Biomass & Biorefinery Systems RD&D Program's major cost performance target for cellulosic ethanol will come due, with the program striving to achieve a modeled cost for mature technology of less than \$3.00 per GGE (less than \$2.00 per gallon of ethanol), based on the technical performance of its improved biofuels conversion technologies.

Hydrogen and Fuel Cell Technologies (\$100.5M): The program will focus on critical R&D to reduce costs and improve the performance of hydrogen and fuel cell technologies primarily through activities in TRLs 2 and 3. The program continues to pursue a balanced portfolio for diverse applications in stationary, portable, and transportation sectors. The program also will include R&D to enable integrating intermittent renewables into the grid, through the use of hydrogen for energy distribution and storage. A key goal in 2012 will be to achieve a catalyst specific power of 6 kW per gram of platinum group metal compared to 2.8 kW per gram in 2008. These activities contribute to the development of a more diverse and efficient energy infrastructure and help to ensure the U.S. stays competitive in emerging clean energy technologies.

Corporate Programs

Program Direction (\$176.6M): Program direction provides for Federal staff salaries and benefits, the DOE Working Capital Fund, office space, travel, training, and contractor support services. This funding allows EERE to strengthen program and project management, as well as improve monitoring and oversight functions.

Strategic Programs (\$53.2M): Formerly Program Support, these activities support EERE corporate priority efforts, including: communications and outreach; legislative affairs; regulatory affairs; strategic priorities and analysis; innovation and deployment; education and training; and international.

Facilities and Infrastructure (\$26.4M): Funding requested supports essential maintenance, repair, and equipment replacement requirements at the National Renewable Energy Laboratory (NREL). In addition, it supports Safeguards and security activities at NREL, which provides a safe work environment for the research and support staff and the protection of property, both physical and intellectual.

High-Priority FY 2012 investments include the following activities:

- **Buildings:** Additional funding is allocated to the Better Buildings Initiative to retrofit commercial buildings (>35 percent of U.S. electricity demand) critical to achieving Administration goals for improving energy efficiency and improving competitiveness. The initiative will:
 - Increase integrated commercial buildings technical research to develop and demonstrate new retrofit practices, technologies, and tools for the many types of commercial buildings across the country, and
 - Initiate a major competitive program to encourage states and municipalities to upgrade building codes, performance standards and regulations to increase commercial building energy efficiency.
- **Accelerated Cost Reduction for Photovoltaics (PV):** The SunShot initiative will reduce the total costs of photovoltaic energy systems by about 75 percent so that they are cost competitive at large scale with other forms of electricity without subsidies. Without an accelerated effort on

PV, the U.S. will lose its technical edge and solar energy manufacturing will not remain competitive with other countries. While the EERE effort primarily focuses on the module and balance of system, it will be closely coordinated with ARPA-E in power electronics and other areas. Collaborations with the Office of Science Energy Frontier Research Centers and other programs will enable basic research discoveries to be applied to fundamental questions related to PV devices.

- **Competitive Offshore Wind:** Efforts to develop cost-competitive offshore wind energy by 2020 continue to expand. Funding will be used to start a new cost-shared, public-private demonstration project to more clearly pinpoint research areas of focus for cost reduction and to provide performance and economic data necessary for initial commercial deployment.
- **Innovation in Manufacturing & Materials:** Funding for the Industrial program is increased to help drive a U.S. manufacturing renaissance based on next generation processes and materials. R&D efforts will advance transformational manufacturing technologies and next generation materials; and help enable major cost reductions in manufacturing energy efficiency devices (**lighting**, windows, and batteries) and renewable energy technologies (wind blades, power conversion, and PV arrays).
- **Innovations in Weatherization:** The expansion of this activity will support high impact competitive grants to demonstrate methods which reduce weatherization costs, increase leveraging of Federal investment, and improve savings. The Innovations in Weatherization network will conduct 50 pilot projects and result in an additional 15,000 energy retrofits for low income families.

Basic and Applied R&D Coordination

Coordination between the Department's basic research and applied technology programs is a high priority for EERE, the Office of Science and other program offices. The Department has a responsibility to coordinate its basic and applied research programs to effectively integrate R&D by the science and technology communities (e.g., National Laboratories, universities, and private companies) that support the DOE mission. Efforts have focused on improving communication and collaboration between Federal program managers and increasing opportunities for collaborative efforts targeted at the interface of scientific research and technology development to accelerate DOE mission and national goals.

Coordination between the basic and applied programs is also enhanced through joint programs, jointly-funded scientific facilities, and the program management activities of the DOE Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. Additionally, co-funding research activities and facilities at the DOE laboratories and funding mechanisms that encourage broad partnerships (e.g., Funding Opportunity Announcements) are means by which the Department facilitates greater communication and research integration within the basic and applied programs. EERE will work closely with DOE's Office of Science and the Advanced Research Projects Agency – Energy (ARPA-E) to ensure that cutting edge technology innovations are accelerated into the commercial marketplace research communities. EERE also utilizes the DOE Hubs to focus on problems that are ripe for the close integration of discovery-oriented science with translational engineering research so that they can quickly seize opportunities for commercialization.

Power Electronics: Our future electric systems will need cost-effective, high-capability power electronic components and devices—that can only be enabled by research in advanced materials and manufacturing processes—to control and link complex HVDC networks, measure and control flow, and reduce energy losses in long-distance transmission. Advanced materials need to be demonstrated in

devices and applications that can handle appropriate power and voltage requirements that are needed to reliably control and connect the varying forms of electric generation and consumption (and intermediate components) into an integrated system. The urgency to advance cost-effective power electronics systems is already growing. A targeted effort by the Department, integrated with efforts from materials and device manufacturers (e.g., semiconductor industry), can lead to US manufacturers capturing the lead in the global market for devices and systems. Goals include significant advancements in the cost, reliability, and performance of power electronic devices and systems. This will be a collaborative initiative with the Office of Science, ARPA-E and the Office of Electricity Delivery and Energy Reliability.

Key FY 2010 Accomplishments

In FY 2010, the **Hydrogen and Fuel Cell Technologies** program reduced the modeled high-volume production cost of fuel cells to \$51/kW, a 16 percent cost reduction from FY 2009 and more than an 80 percent cost reduction compared to the baseline cost of \$275/kW in 2002. Also in fuel cells, the non-platinum group metal catalyst performance improved by more than 100X since 2008, exceeding the 2010 target of 130 A/cm³ at 0.80V. The program reduced the water electrolyzer cost by over 20 percent via a 55 percent reduction in catalyst loading using new processing techniques. The program exceeded the 2010 Recovery Act fuel cell installation target by more than 90 percent with 230 fuel cells installed.

Biomass and Biorefinery Systems RD&D has validated sustained operations at one of its cellulosic ethanol biorefinery projects having 1.4 MGY (million gallons per year) capacity, and has brought another plant with 2.5 MGY biofuel capacity online. Additionally, the NEPA compliance process was completed for over 75 percent of the program's integrated biorefinery projects. In partnership with the Vehicle Technologies Program, the program also completed ethanol blends testing for vehicles 2007 and newer, supporting an EPA waiver decision on E15. Conversion technology efficiency was also improved measurably. For biochemical conversion, the program has demonstrated >85 percent intermediate sugars production from the conversion of oligomers to simple sugars (xylan to xylose). For thermochemical conversion, >90 percent CH₄ conversion to syngas has been achieved. In addition, feedstock logistics costs were also significantly reduced from \$46.15 per dry ton to \$37.80 per dry ton.

Solar Energy, in collaboration with SunPower, developed and is commercially producing 20 percent efficient crystalline silicon PV modules after a multi-year development effort. Abengoa Solar built a 4 MW demonstration CSP plant demonstrating that the heat produced by a solar facility can increase the efficiency and decrease the carbon footprint of a conventional plant.

Geothermal Technologies dramatically expanded its portfolio under the Recovery Act, awarding 151 projects - totaling up to \$368.2 million - including EGS R&D and demonstrations, low temperature, coproduced fluids, ground source heat pumps and innovative exploration technologies. With GTP support, GE Global developed a high temperature circuit chip for down hole sensing up to 300 degrees C, a notable milestone in the field of high temperature electronics.

Wind Power Several significant initiatives were launched to access the 4,150 GW offshore wind resource, including the publication of a draft Strategic Plan for public comment and a Memorandum of Understanding (MOU) between the Department of Energy and the Department of Interior to ensure resources and expertise from both agencies to support commercial-scale projects on the Outer Continental Shelf. The DOE Wind program hosted several major workshops and published nationally significant studies that addressed the highest priorities for wind energy deployment such as new cost of energy analysis, transmission planning studies, radar interference mitigation, turbine reliability, and wind resource forecasting. Major R&D milestones included installation of two utility-scale, research

turbines at the National Wind Technology Center, finalization of Non-Destructive Inspection standards, and testing of highly instrumented innovative rotor designs.

Water Power completed the initial model of a radically redesigned Francis hydropower turbine with improved environmental performance, and competitively awarded Recovery Act funds to increase generation between 7 percent and 30 percent at seven existing hydropower projects. The program also executed a Memorandum of Understanding (MOU) between the Department of Energy, the Department of Interior, and the Army Corps of Engineers. This MOU will focus on increasing energy generation at federally-owned facilities and explore opportunities for new development of low-impact hydropower. The Program also awarded funding to 27 innovative marine and hydrokinetic (MHK) technologies across a range of technology readiness levels, in order to advance the commercial readiness of this innovative suite of new renewable energy technologies, and released the MHK Siting and Regulatory Handbook to assist stakeholders in the state and federal licensing process.

Vehicle Technologies lowered the cost of plug-in hybrid electric vehicles (PHEV) batteries to \$800 per kWh in Energy Storage; demonstrated efficiency improvements for gasoline engines that can potentially double the fuel economy of passenger vehicles on real-world driving cycles; completed a Magnesium front end design with a 45 percent weight reduction compared to a conventional steel design; developed a cost-neutral, advanced high strength steel chassis component with a 28 percent weight reduction compared to a standard component; and Clean Cities coalitions and VTP deployment initiatives contributed to the reduction of over 500 million gallons of petroleum use during 2010 and helped to open over 400 new electric & alternative fuel fueling stations.

Building Technologies (BTP) established new energy conservation standards for five products; completed two test procedure final rules and more than doubled the pace of rulemaking publications in preparation for a ramp-up in future conservation standards; and provided key research for the successful commercialization of the solid state lighting (SSL) lamp, which has an energy savings of 81 percent over traditional lamps. Also in SSL, the Program developed and facilitated the scale adoption of technology and performance specifications for light-emitting diode (LED) refrigerated case lighting, LED parking lot lighting, and high efficiency lighting for parking structures, with projected savings of about 50 percent. In other areas of research, BTP successfully commercialized dynamic insulation, a new Energy Star Hybrid Heat Pump Water Heater with an Energy Factor (EF) of 2.35, and a low-cost solar water heating system.

Industrial Technologies has awarded 47 industrial energy efficiency grand challenge concept grants that support the development of transformational industrial processes, technologies, and materials. The program initiated 14 projects that support the development of new technologies to improve energy efficiency in the information and communication technology sectors, funded by the Recovery Act. The program also launched a new industry partnership program in which companies commit to reduce their energy intensity by 25 percent or more in 10 years; as of December 2010, 104 companies had signed this pledge.

The **Federal Energy Management Program** awarded an unprecedented \$589 million in Energy Savings Performance Contract (ESPC) projects. FEMP also trained over 1,000 people in Utility Energy Service Contracts, Power Purchase Agreements, and ESPCs. FEMP awarded and completed 120 agency energy and efficiency projects funded by the Recovery Act.

Weatherization and Intergovernmental Activities utilized annual appropriations and approximately \$11.5 billion in Recovery Act funds to support over 2,500 innovative State, Tribal, and local energy projects including: clean energy project planning and deployment; energy savings performance contracting; sustainable energy efficiency finance mechanisms; renewable energy certificate trading

programs; energy efficiency-based utility incentives; green workforce training in residential energy retrofit; and the weatherization of additional homes.

Facilities and Infrastructure completed two major EERS projects at the National Renewable Energy Laboratory. The Integrated Biorefinery Project, completed in July, provides the Nation a unique continuous process research and development capability to accelerate the production of ethanol from cellulose. The Research Support Facility, completed in June, consolidates the majority of NREL operations into a building that demonstrates EERE's leadership in energy modeling, efficient design, and renewable technologies. Both projects were completed at cost, in scope, and on time, and serve as examples of how to create ultra-energy efficient projects today. The Research Support Facility (\$80M) and Integrated Biorefinery Facility (\$20M) were both completed at cost, scope, and schedule and commissioned for use.

Indirect Costs and Other Items of Interest

Institutional General Plant Projects (IGPPs)

Institutional General Plant Projects (IGPPs) are miscellaneous construction projects that are less than \$10 million and are of a general nature (cannot be allocated to a specific program). IGPPs support multi-programmatic and/or inter-disciplinary programs and are funded through site overhead.

Current projects include: safety and security improvements; replacement of building systems and components; replacement, and upgrades to building and site utilities; site wide energy efficiency improvements; reconfigurations of existing buildings to accommodate changes or growth in RDD&D programs or research support needs; upgrades to the primary site access point; and other site improvements to maintain the viability of EERE's capital investments at NREL. The following table displays IGPP funding by site.

(dollars in thousands)	
FY 2010 Current Approp	FY 2012 Request

Institutional General Plant Projects (IGPP)

National Renewable Energy Laboratory

Total, IGPP

10,000	11,515
10,000	11,515

Facilities Maintenance and Repair

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

Indirect-Funded Maintenance and Repair

(dollars in thousands)

FY 2010 Current Approp	FY 2012 Request
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National Renewable Energy Laboratory	2,504	4,261
Total, Indirect-Funded Maintenance and Repair	2,504	4,261

Direct-Funded Maintenance and Repair

(dollars in thousands)

FY 2010 Current Approp	FY 2012 Request
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National Renewable Energy Laboratory	0	3,300
Total, Direct-Funded Maintenance and Repair	0	3,300