DOE/CF-0073
Volume 3

Department of Energy

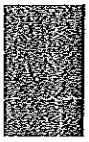
FY 2013 Congressional Budget Request

Energy Efficiency and Renewable Energy
Electricity Delivery and Energy Reliability
Nuclear Energy
Fossil Energy Research and Development
Naval Petroleum and Oil Shale Reserves
Strategic Petroleum Reserve
Northeast Home Heating Oil Reserve
Ultra-Deepwater Unconventional Natural Gas
Elk Hills Lands Fund
Advanced Tech. Vehicle Manufacturing Loan Program
Title 17 Innovative Tech. Loan Guarantee Program
Energy Information Administration

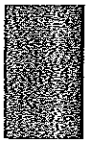
DOE/CF-0073
Volume 3

Department of Energy
FY 2013 Congressional Budget Request

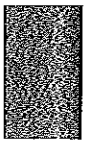
Energy Efficiency and Renewable Energy
Electricity Delivery and Energy Reliability
Nuclear Energy
Fossil Energy Research and Development
Naval Petroleum and Oil Shale Reserves
Strategic Petroleum Reserve
Northeast Home Heating Oil Reserve
Ultra-Deepwater Unconventional Natural Gas
Elk Hills Lands Fund
Advanced Tech. Vehicle Manufacturing Loan Program
Title 17 Innovative Tech. Loan Guarantee Program
Energy Information Administration



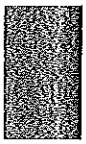
Energy Efficiency and Renewable Energy



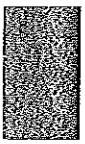
Electricity Delivery and Energy Reliability



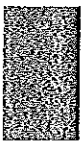
Nuclear Energy



Fossil Energy Research and Development



Naval Petroleum and Oil Shale Reserves

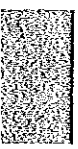


Strategic Petroleum Reserve

Northeast Home Heating Oil Reserve

Ultra-Deepwater Unconventional Natural Gas

Elk Hills Lands Fund



Advanced Tech. Vehicle Manufacturing Loan Porgram

Title 17 Innovative Tech. Loan Guarantee Program

Energy Information Administration

Volume 3

Table of Contents

The Department of Energy's Congressional Budget justification is available on the Office of Chief Financial Officer, Office of Budget homepage at http://www.cfo.doe.gov/crorg/cf30.htm.

DEPARTMENT OF ENERGY
Appropriation Account Summary
(dollars in thousands - OMB Scoring)

	FY 2011 Current	FY 2012 Enacted [1]	FY 2013 Request	FY 2013 vs. FY 2012	
				$	%
Energy And Water Development, And Related Agencies Appropriation Summary					
Energy Programs					
Energy Efficiency and Renewable Energy	1,771,721	1,809,638	2,337,000	+527,362	+29.1%
Electricity Delivery and Energy Reliability	138,170	139,103	143,015	+3,912	+2.8%
Nuclear Energy	717,817	765,391	770,445	+5,054	+0.7%
Fossil Energy Programs					
Clean Coal Technolgy	-16,500	0	0	0	0
Fossil Energy Research and Development	434,052	346,703	420,575	+73,872	+21.3%
Naval Petroleum and Oil Shale Reserves	20,854	14,909	14,909	0	N/A
Elk Hills School Lands Fund	0	0	15,580	+15,580	+100.0%
Strategic Petroleum Reserve	123,141	192,704	195,609	+2,905	+1.5%
Northeast Home Heating Oil Reserve	10,978	10,119	4,119	-6,000	-59.3%
Subtotal, Fossil Energy Programs	***572,525***	***564,435***	***650,792***	**+86,357**	**+15.3%**
Uranium Enrichment D&D Fund	497,084	472,180	442,493	-29,687	-6.3%
Energy Information Administration	95,009	105,000	116,365	+11,365	+10.8%
Non-Defense Environmental Cleanup	225,106	235,306	198,506	-36,800	-15.6%
Science	4,897,283	4,873,634	4,992,052	+118,418	+2.4%
Advanced Research Projects Agency-Energy	179,640	275,000	350,000	+75,000	+27.3%
Nuclear Waste Disposal	-2,800	0	0	0	0
Departmental Administration	48,894	126,000	122,595	-3,405	-2.7%
Inspector General	42,764	42,000	43,468	+1,468	+3.5%
Innovative Technology Loan Guarantee Program	169,660	0	0	0	0
Advanced Technology Vehicles Manufacturing Loan	9,978	6,000	9,000	+3,000	+50.0%
Total, Energy Programs	***9,362,851***	***9,413,687***	***10,175,731***	**+762,044**	**+8.1%**
Atomic Energy Defense Activities					
National Nuclear Security Administration:					
Weapons Activities	6,865,775	7,214,120	7,577,341	363,221	+5.0%
Defense Nuclear Nonproliferation	2,281,371	2,295,880	2,458,631	162,751	+7.1%
Naval Reactors	985,526	1,080,000	1,088,635	8,635	+0.8%
Office of the Administrator	393,293	410,000	411,279	1,279	+0.3%
Total, National Nuclear Security Administration	***10,525,965***	***11,000,000***	***11,535,886***	**+535,886**	**+4.9%**
Environmental and Other Defense Activities					
Defense Environmental Cleanup	4,979,165	5,002,950	5,472,001	+469,051	+9.4%
Other Defense Activities	795,670	823,364	735,702	-87,662	-10.6%
Total, Environmental & Other Defense Activities	***5,774,835***	***5,826,314***	***6,207,703***	**+381,389**	**+6.5%**
Total, Atomic Energy Defense Activities	***16,300,800***	***16,826,314***	***17,743,589***	**+917,275**	**+5.5%**
Power Marketing Administration					
Southwestern Power Administration	13,050	11,892	11,892	0	0
Western Area Power Administration	109,006	95,968	96,130	+162	+0.2%
Falcon & Amistad Operating & Maintenance Fund	220	220	220	0	0
Colorado River Basins	-23,000	-23,000	-23,000	0	0
Total, Power Marketing Administrations	***99,276***	***85,080***	***85,242***	**+162**	**+0.2%**
Subtotal, Energy And Water Development and Related Agencies	***25,762,927***	***26,325,081***	***28,004,562***	**+1,679,481**	**+6.4%**
Uranium Enrichment D&D Fund Discretionary Payments	-33,633	0	-463,000	-463,000	N/A
Excess Fees and Recoveries, FERC	-36,461	-25,534	-25,823	-289	-1.1%
Rescission of Balances	0	0	-360,667	-360,667	N/A
Total, Discretionary Funding by Appropriation	**25,692,833**	**26,299,547**	**27,155,072**	**+855,525**	**+3.2%**

[1] The FY 2012 Enacted reflects a rescission of $73,300 associated with savings from the contractor pay freeze; $600M ($500M Strategic Petroleum Reserve, $100M Northeast Home Heating Oil) was rebased as mandatory after enactment.

Energy Efficiency and Renewable Energy

Energy Efficiency and Renewable Energy

Table of Contents

Energy Efficiency and Renewable Energy

Proposed Appropriation Language

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for energy efficiency and renewable energy activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, $2,337,000,000, to remain available until expended: *Provided*, That $164,700,000 shall be available until September 30, 2014 for program direction: *Provided further*, That, of the amount provided under this heading, the Secretary may transfer up to $100,000,000 to the Defense Production Act Fund for activities of the Department of Energy pursuant to the Defense Production Act of 1950 (50 U.S.C. App. 2061, et seq.).

Energy Efficiency and Renewable Energy

Overview

Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted[b]	FY 2013 Request
Energy Efficiency and Renewable Energy (EERE)			
Biomass & Biorefinery Systems RD&D	179,979	199,276	270,000
Geothermal Technology	36,992	37,862	65,000
Hydrogen & Fuel Cell Technologies	95,847	103,624	80,000
Solar Energy	259,556	288,951	310,000
Water Power	29,201	58,787	20,000
Wind Energy	78,834	93,254	95,000
Advanced Manufacturing	0	0	290,000
Industrial Technologies	105,899	115,580	0
Building Technologies	207,310	219,204	310,000
Federal Energy Management Program	30,402	29,891	32,000
Vehicle Technologies	293,151	328,807	420,000
Weatherization and Intergovernmental Activities	231,300	128,000	195,000
Facilities and Infrastructure	51,000	26,311	26,400
Program Direction	170,000	165,000	164,700
Strategic Programs	0	25,000	58,900
Program Support	32,000	0	0
Subtotal, EERE	1,801,471	1,819,547	2,337,000
Use of Prior Year Balances	-30,000	-9,909	0
Cancellation of Prior Year Balances	0	0	-69,667
Transfer from State Department	250	0	0
Total, EERE	1,771,721	1,809,638	2,267,333

[a] SBIR/STTR funding transferred in FY 2011 $24,170,000.
[b] FY 2012 Enacted reflects a rescission of $5,453,000 associated with savings from the contractor pay freeze.

Program Overview and Accomplishments

The Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) supports clean energy applied Research, Development, Demonstration and Deployment (RDD&D) for efficiency and renewable energy technologies. Through the resulting technologies and practices, EERE will help address our Nation's energy security, environmental, and economic goals by:

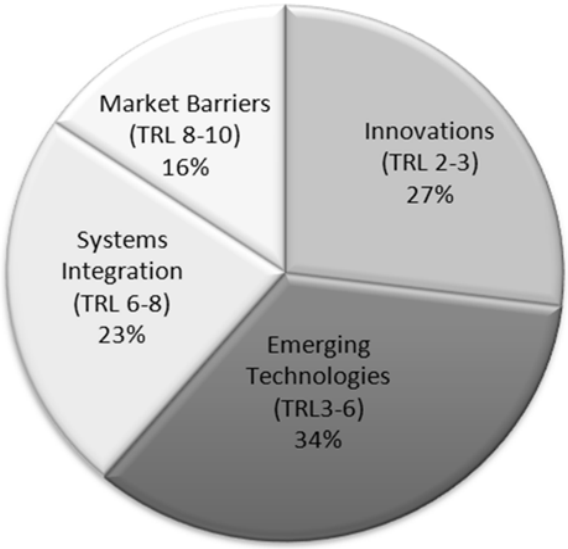
- Providing American businesses and households with low-cost energy services by creating low cost renewable supplies and energy efficient products and systems;
- Insulating the U.S. economy from the price and supply uncertainties associated with petroleum;
- Ensuring diversity and choice in the way energy services are produced; and
- Developing approaches that can accelerate economic growth and job creation while improving the environment by both reducing greenhouse gas emissions and improving air and water quality.

EERE achieves this by developing and accelerating the adoption of a new generation of energy technologies — buildings, factories, and vehicles that are clean, safe, efficient, and productive. These are the technologies of the world's future and there is an intense international race underway that will determine where these systems are invented and produced. EERE supports innovation that will allow U.S. manufacturers and U.S. workers to lead the race and secure the benefits of clean, domestic energy systems as a foundation for a prosperous American future.

Our specific program goals include:

- Invest in developing electric vehicles technologies enabling one million electric drive vehicles on the road by 2015;
- Make non-residential buildings 20 percent more energy efficient by 2020, saving approximately $40 billion annually (President's Better Building Challenge);
- Reduce oil imports by 1/3 by 2025;
- Provide technical assistance to reduce Federal greenhouse gas emissions by 28 percent by 2020, including at DOE;
- Save consumers hundreds of billions of dollars over the next 35 years while providing consistent efficiency requirements across domestic and international product manufacturers through equipment standards;
- Generate 80 percent of the Nation's electricity from a diverse set of clean energy sources by 2035; and
- Cut the Nation's greenhouse gas emissions in the range of 17 percent below 2005 levels by 2020, and 83 percent by 2050.

EERE's Portfolio[a]



EERE's work is conducted across a portfolio of investments that includes:

- Innovations — Challenging the Nation's most innovative companies, universities, and National Laboratories to develop innovative technical concepts in energy technology;
- Emerging Technologies — Work to convert these innovations into practical, prototype technologies and products;
- Systems Integration — Work to integrate these devices into functional, efficient, and validated systems such as comfortable, productive buildings, factories, vehicles, and power facilities; and
- Market Barriers — Work to accelerate the adoption of clean technologies by simplifying and streamlining regulations, developing cost-effective standards, reducing the technical risk for private financing, facilitating the adoption of clean energy technologies by Federal agencies and state and local governments, and other activities.

EEREs investments have paid large dividends to the Nation over the past few years. They have, for example, resulted in:

- Provided the technological foundation for the addition of over 20 TWh in renewable energy

[a] Does not include EERE Corporate Programs or Weatherization and Intergovernmental Activities.

generation (excluding hydropower) in 2010 that contributes to our goal of doubling new source renewable electricity by the end of 2011.
- Increased energy efficiency in 750,000 homes since 2009 through retrofitting an average of over 25,000 homes per month, on track towards our priority goal of one million home retrofits by 2015.
- Saved consumers billions in their energy costs through the issuance of energy conservation standards. These standards build towards the goal of issuing at least nine new energy conservation standards, which will save consumers hundreds of billions of dollars over 35 years.
- Reduced consumer costs by more than an estimated $7 billion through technology for diesel engine efficiency improvements that helped enable vehicle manufacturers to increase fuel economy.
- Advanced the technologies underlying a range of products now on the market including advanced lighting (including LEDs), highly insulating windows, low cost photovoltaic devices, highly efficient fuel cells, renewable biodegradable plastics, biobased chemicals, and cost-effective wind electricity.

Alignment to Strategic Plan and Quadrennial Technology Review

EERE is a major contributor to the Department's Strategic Goal of catalyzing the timely, material, and efficient transformation of the Nation's energy system and securing U.S. leadership in clean energy technologies. EERE pursues three core pathways to that goal**:**

- Deploy the technologies we have;
- Discover the new solutions we need; and
- Lead the national conversation on energy.

EERE is also supporting four of the department's eight Priority Goals:

- Reduce consumer energy use and costs for household appliances. By December 31, 2013, issue at least 9 new energy conservation standards to deliver net consumer savings of hundreds of billions of dollars over 30 years and require efficient products across domestic and international manufacturers.
- Reduce the cost of batteries for electric drive vehicles to help increase the market for Plug-In Hybrids and All Electric Vehicles and thereby reduce petroleum use and greenhouse gas emissions. By October 2013, demonstrate a prototype Plug-In Hybrid battery technology that is capable of achieving a cost of $400/kWhr, (useable energy) during high volume manufacturing (100,000 packs per year) compared to a 2008 baseline of $1000/kWhr.
- Make solar energy as cheap as traditional, non-renewable, sources of electricity. By the end of the decade, drive the cost of solar electricity down to: $1/W at utility scale; $1.25/W at commercial scale; and $1.50/W at residential scale. By December 2013, demonstrate a prototype thin film or film silicon module with an efficiency of greater than 21% and a balance-of-system with a 50 percent reduction in the permitting and installation costs to $1.50/W.
- Save low-income families money and energy through weatherization retrofits. From FY 2010 through FY 2013, in collaboration with HUD, enable the cost-effective energy retrofits of a total of 1.2 million housing units, of which more than 75 percent are low income.

EERE's portfolio planning benefited from the DOE Quadrennial Technology Review (QTR) and a concurrent review of most promising technologies that cut across the DOE programs. The investment portfolio reflects the QTR drivers emphasizing technologies with:

- Maturity — Technologies that have significant technical headroom yet could be demonstrated at commercial scale within a decade;
- Materiality — Technologies that could have a consequential impact on meeting national energy goals within two decades (where "consequential" is defined as roughly 1% per year of U.S. primary energy); and
- Market Potential — Technologies that could be expected to be adopted by the relevant markets understanding that these markets are driven by economics but shaped by the private sector.

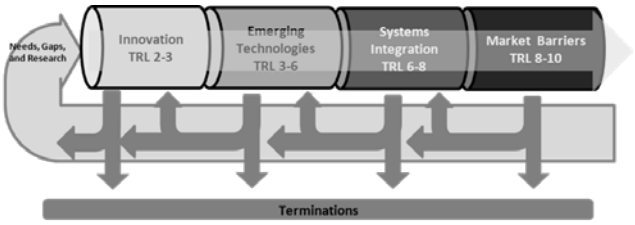
Strategic Approach

EERE directs and manages a portfolio of activities to foster and support technological solutions across the research and development (R&D) continuum, bridge gaps by increasing performance and knowledge, and attract commercial resources necessary for ultimate commercialization. EERE's portfolio includes strategic investments in research areas where risks and other factors mean that private research investment will not occur and areas where programs that are crafted to overcome market barriers can help important new technologies reach a point where private investment will be able to turn them into profitable businesses opportunities.

Following the recommendations of the QTR, EERE conducts a broad review of opportunities in its areas of responsibility to ensure that projects selected meet the tests of Materiality and Market potential — ensuring that the problems being addressed will have a significant impact in meeting national clean energy goals.

Considerations of the maturity of the technology determine where the work belongs in the EERE portfolio and which aspects of it are better suited to the private sector.

The integrated technology readiness level (TRL) approach depicted below shows the flow of our technology development portfolio from directed research and innovation through the stages of product and process development necessary to bring a technology to market. This includes performance reviews and stage gates that result in data which supports the movement of promising technologies to the next series of TRLs and feedback to address newly uncovered technical hurdles through the necessary revisions or added research, development and demonstration (RD&D). It also includes all the reasoned terminations such as completions, closeouts, and proved hypotheses. These results as a whole are utilized for portfolio planning, technology down selects, and overall program execution.



Activities historically characterized as applied research are captured in the Innovation subprogram; former development activities are largely captured in Emerging Technologies; Demonstration activities in Systems Integration; and Deployment activities in the Market Barriers subprograms.

Transparent analysis, planning, and performance assessments are undertaken at every tier of program management to identify, prioritize, and determine the critical path and performance necessary to achieve program goals. Overall, EERE priorities are reviewed by EERE's Advisory Committee, and many other technology-specific panels and workshops that include representatives from a wide range of businesses, universities, and other organizations. These groups help ensure that EERE is focused in the correct technology areas, accelerating progress, and is working to attract commercial investments while avoiding internal overlaps.

Technology roadmaps are under continuous development to include assessment of current markets, determination of where the technologies need to be to meet national goals, and assessment of what technology development can concurrently fulfill the demands of the market in both the near-term and into the future.

At each stage, EERE collaborates closely with other organizations in DOE, other Federal agencies, and state and local governments. These collaborations include:

- Office of Science (Science) — EERE and Science are collaborating to develop synthetic-biology tools to enhance national capability in bio-manufacturing and biofuel production and research efforts involving fuel cells, hydrogen production and storage. Advances in nanotechnology and other new materials developed in Science are transitioned to advanced product concepts in areas ranging from photovoltaic devices to solid state lighting. EERE works to ensure that Science is aware of areas where a fundamental scientific breakthrough would be critical for cutting costs or improving the efficiency of key devices. In addition, EERE will work with the Office of Science on joint solicitations that accelerate the transition of novel scientific discoveries into energy technologies and improve coordination of energy-related research across the Department.
- Advanced Research Projects Agency-Energy (ARPA-E): EERE is working collaboratively with ARPA-E to plan and implement specific research solutions most productively within our respective purviews to provide complementary identification of needs and opportunities without duplication. Specific examples include research needed to achieve power electronics and photovoltaics objectives within the SunShot Initiative. The ARPA-E collaboration also includes efforts related to the Buildings Hub and advanced biofuels development and batteries.
- Office of Electricity (OE) — EERE is collaborating with OE on assessing utility policies and regulations for encouraging energy efficiency and on analysis showing how new transmission, smart grid technologies, energy storage, and other advances can facilitate introduction of renewable energy.
- Other Federal Programs — EERE's Federal Energy Management Program is supporting agency plans across the Federal government, as well as within DOE, so that energy management goals set forth in law and executive order will be achieved. EERE additionally supports the common goals it shares with other Federal organizations and agencies, such as the Environmental Protection Agency (EPA), Department of Housing and Urban Development (HUD), U.S. Department of Agriculture (USDA), Department of Defense (DOD), Federal Energy Regulatory Commission (FERC), Army Corps of Engineers (ACE), National Institute of Standards Technology (NIST), and Council on Environmental Quality.

EERE works closely with other Federal agencies when collaborations can serve common goals. It has partnered with EPA, HUD, USDA, DOD, FERC, and DOC/NIST. In areas where there is a strong overlap between DOD and

DOE missions, the Defense Production Act can be an effective tool for accelerating the construction of novel production facilities that provide industrial resources and critical technology items needed for national defense purposes. Examples include pilot-scale production of biomass fuels, advanced manufacturing concepts, and advanced materials. EERE looks forward to working with the Congress to make effective and efficient use of this Act to advance critical energy technologies.

EERE is committed to participating in the Department's pilot laboratory research internship project for the Science, Technology, Engineering, and Mathematics (STEM) education program authorized by section 101 of the America COMPETES Reauthorization Act of 2010.

These crosscuts and collaborations are characterized more completely in the program narratives.

FY 2013 Portfolio Prioritization

EERE invests in a diversified portfolio of activities in pursuit of clean energy goals. This investment portfolio is established based on the national goals embodied in Administration priorities, Congressional legislation, and the DOE Strategic Plan. EERE begins the process of strategic planning for its portfolio with an assessment of the opportunities available in each renewable and efficiency program sector and an assessment of areas where market failures make it currently unlikely that private investment in the area will be adequate. Our goal is to provide energy services, such as comfortable buildings or safe, reliable transportation, at the lowest cost to the consumer — including externality costs. This means balancing investments that reduce the energy needed to provide these services and investments that supply energy from renewable sources. Our review of the opportunities and gaps in private investment led to the overall division of investment putting 60 percent of funding into efficiency and 40 percent into renewables. Energy efficiency technologies are often inexpensive but face major market failures leading to underinvestment in research and deployment.

Once the broad allocations have been made, we prepare detailed technology roadmaps for each sector. These include assessments of current markets, determination of where the technologies need to be to meet national goals, and assessment of what technology development can fulfill the demands of the market in both the near-term and into the future.

These roadmaps show which technologies are most critical to meeting the cost and performance goals for the sector and which type of Federal investment is most appropriate. For example, when a technology is very immature, that technology is funded in EERE's applied research activities. As technologies mature, the best investment may be an investment in system integration improvements or large-scale demonstrations. Late stage improvements might be driven by reduction or removal of market barriers. Each sector and technology is unique and that is why we routinely consult with experts and update our analyses to reflect technology progress and market conditions.

Each program section will discuss its strategy based on their technology roadmap and goals that have been established as a result of analysis and modeling. In each case, the program's goal is to produce energy services at costs equivalent to or below the cost of these services from conventional resources under the currently enacted legislation. Our work reflects all legislation currently enacted.

Technology roadmaps and modeling results establish a basis for making the trade-offs to be made for individual program investments and the mix for the overall EERE portfolio.

Within the energy efficiency portfolio, we are emphasizing spending on vehicle technologies to invest in battery and other technologies to support electric vehicle and to make electric and conventional liquid-fuel vehicles more efficient through a wide array of technologies. Because residential and commercial buildings drive our electricity consumption, we continue to emphasize building technologies and efforts to validate and deploy existing energy efficient products and techniques in new construction and retrofits of existing buildings. In addition, we look to the Advanced Manufacturing Program to focus on new techniques with broad applications for energy-intensive manufacturing methods. These new approaches will reduce energy consumption and manufacturing costs, making American industries more competitive. Additionally, the Advanced Manufacturing Program which will foster the development of next generation materials for energy efficiency and manufacturing improvements, including through the Critical Materials Hub.

The renewable energy portfolio is comprised of investments in a broad range of renewable technologies that all target price parity with conventional sources of electricity, without subsidies, as a common goal. We are continuing our SunShot effort, aiming for $1/Watt installed costs by the end of the decade. This work includes continued efforts to drive down the cost for module manufacturing and investments in reducing balance-of-system costs – both hardware components and "soft costs" such as permitting.

Biomass builds on success in converting cellulosic material to ethanol by increasing our focus on converting non-food cellulosic feedstocks to hydrocarbons that can be directly substituted for gasoline, diesel, and jet fuel at competitive prices. In addition, we will pursue algae

based fuel research to complement our cellulosic material research.

EERE's efforts in hydrogen and fuel cells continue to build on substantial progress made in reducing the cost and improving the durability of fuel cells and reducing the cost and improving the performance of technologies for producing, delivering, and storing hydrogen. Continued progress seeks to enable fuel cells to achieve cost-parity with internal combustion engines for vehicles by 2017 and to enable renewable hydrogen to be competitive with conventional fuels by 2020, based on modeled costs projected from component technologies to systems in high-volume production.

Wind energy has become a commercial success and EERE's efforts will concentrate on the next generation of challenges and opportunities, including a new focus on capturing America's enormous offshore wind resources at a competitive price. In addition, EERE will continue to address key deployment barriers limiting larger scale deployment.

Geothermal work will concentrate on unlocking the significant domestic geothermal potential for base load electricity generation through improved resource exploration technologies and development of new technologies for enhanced geothermal systems (EGS).

Consistent with the recommendations of the QTR, EERE is de-emphasizing onshore wind, distributed fuel cells, conventional hydro (and concentrating on marine and hydro-kinetic research), and have shifted mature, market-ready geothermal heat pump technologies to the purview of the Buildings Program.

Management

Efficient management is essential and EERE continues to find ways to optimize operations. Among other things it has:

- Increased the fraction of work selected through open solicitations and peer review;
- Strengthened and streamlined the peer review process;
- Streamlined procurement and personnel processes; and
- Built a strong Strategic Programs Office to manage crosscutting activities efficiently, avoid duplication, and ensure consistency in analytical approaches. Crosscutting work includes strategic analysis, international programs, curricula and tools for training and education, research management, innovation and deployment activities, and communications and outreach.

Benefits

EERE activities in each program can provide economic, security, and environmental benefits. Their integrated impacts can have a transformative effect on the use of energy in the U.S. economy.

Reducing the cost of renewable energy to $.05-.06/kWh without subsidies would enable significant market penetration, directly impacting job creation, energy security, and global competitiveness.

Investing to achieve the efficiency opportunities that are readily available in the existing domestic systems, infrastructure, and environment can produce energy savings that are far greater than the costs of the efficiency investments. An additional benefit of saving in the near term is the creation of cost and energy use buffers that will buy us time to enable emerging technologies to develop sufficiently to be able to economically meet our future goals. Longer range, successes and breakthroughs in our portfolio of planned research and development are expected to make entirely novel opportunities available to meet demand for energy services and stimulate economic growth.

Developing and rolling out advanced transportation options such as efficient vehicles using electric drivetrains and sustainable fuels from biomass is the key strategy component for oil use reduction. In the longer term, hydrogen fuel cells can provide material impact to address oil dependency and greenhouse gas emissions.

EERE estimates the potential market and economic development of technologies to assess the impacts of R&D success. EERE's models and analysis[a] indicate:

- Cost and performance improvements in EERE technologies could lead to deployment of efficiency measures and clean energy in all sectors of the economy with an aggregate 2050 savings, relative to the base case, of:
  - 20 quadrillion BTUs of oil (nearly 50 percent);
  - 2.5 billion metric tons of CO2 (nearly 40 percent); and
  - Significant nearer-term benefits characterized in the performance section below and in the individual program chapters.

[a] EERE impacts are estimated through integrated impacts analysis based on budgeted technology and deployment goals described in the program chapters. Historic and expert expected improvement in technologies and systems facilitate estimates of cost compression or performance increases. EERE applies industry and DOE vetted sector-specific and domestic economic analysis tools to modeled cost and performance of the resulting systems to estimate likely sales and stock penetration. EERE corporate analysis iteratively estimates aggregate impacts of program and sector analysis and reports these results relative to the EIA AEO baseline. Complete exposition will be available on the EERE Strategic Analysis website.

- Cost and performance improvements in EERE technologies could lead to deployment of efficiency measures and clean energy in all sectors of the economy with large, long-term savings in oil use and reductions in CO2 emissions, and with significant nearer-term benefits characterized in the performance section below and in the individual program chapters.
- Achieving program goals in renewable generation would result in cost parity with baseload electricity rates across the U.S. in a timeframe varying from 2017 to 2030;
- Advanced vehicles under development can reach lifecycle cost parity with conventional vehicles for the average driver within a decade; and
- Deployment of available efficiency technologies in buildings and industry can save nearly 20 quadrillion BTUs of energy by 2050 saving consumers over $100 billion in energy cost per year.

Key Accomplishments

Biomass and Biorefinery Systems RD&D — Achieved a modeled cost for mature technology for ethanol of $2.62/gge ($1.76/gallon of ethanol) in 2012.

Geothermal Technology — Demonstrated a 10 fold increase in injectivity at an EGS project site which is the first DOE-funded EGS stimulation project. It is now within 30 percent of the flow-rate needed for a commercially viable well. This is a significant milestone in demonstrating the technical feasibility of EGS.

Hydrogen and Fuel Cell Technologies — Reduced cost of fuel cells for advanced vehicles by more than 30 percent since 2008, and more than 80 percent since 2002, to $49/kW (assuming high-volume manufacturing of 500,000 units/year) — on track to meet the 2017 target of $30/kW, which will enable cost-parity with internal combustion engines

Solar Energy — Leveraged more than $1.3 billion in private capital with a $60 million EERE investment in 34 cutting-edge U.S. solar start-up companies. These companies already now provide more than 1,200 high-tech jobs in the U.S.

Water Power — Developed a 10 MW prototype design for an innovative, fish friendly, conventional hydropower turbine; and invested in 177,000 MWh/year of increased generation capacity at existing hydropower facilities through the 2009 American Recovery and Reinvestment Act.

Wind Energy — Has helped catalyze 36 GW of wind generation capacity deployed since 2002 through RD&D. In addition, 25 percent of 695 patents assigned to leading wind energy organizations cite one or more of the 112 DOE-funded patents or papers.

Advanced Manufacturing — Assisted with the commercialization of more than 200 technologies, recognized with more than 50 R&D 100 Awards, and provided assistance through energy assessments, system assessment tools and associated trainings, and energy management system implementation to more than 30,000 industrial facilities.

Building Technologies — Spurred the introduction of many new technologies into the market, including a home water heater that uses 60 percent less energy than the average standard model, a commercial cooling unit that uses 50 percent less energy and a LED replacement for the common light bulb that uses 80 percent less energy (Congressional L-Prize Challenge winner). The Buildings' program has also achieved 30 percent improvement in energy efficiency standards in just two code cycles over the 2004 ASHRAE 90.1 and IECC 2006 baseline.

Federal Energy Management Program — Since 2006, FEMP's Indefinite Delivery, Indefinite Quantity Energy Savings Performance Contracting program has implemented projects at Federal facilities throughout the Federal Government which will result in over $5 billion in energy cost savings over the life of those performance contracts. In 2011 alone, FEMP trained more than 11,000 Federal employees and others on energy saving practices in its seminars. FEMP has also helped DOE reduce Scope 1 & 2 greenhouse gas emissions by 13 percent between FY 2008 and FY 2010.

Vehicles Technologies — Saved the Nation more than an estimated $7 billion by reducing diesel fuel demand by 2.4 billion gallons from 2002 to 2008 through R&D that helped improve heavy-duty diesel engine efficiency by approximately 5 percent; the value of these savings is close to three times the Vehicle Program's budget for the past decade and these savings continue to accrue as the R&D is employed in new engines.

Weatherization & Intergovernmental Activities — By the end of FY 2011, 2,400 recipients of Recovery Act formula grants completed 500,000 residential energy retrofits 3 months ahead of schedule. The eventual goal is to complete 1 million residential energy retrofits by 2013. These grantee recipients also processed $1 billion in energy-related loans and grants and conducted 50,000 lighting retrofits to date.

Strategic Programs — Launched a National Education and Training Resource (NTER) online training platform — a "Wikipedia" of online energy and non-energy training. Adopted nationally by government, industry and education institutions it is transforming the way online training is delivered — consolidating open source training in a one stop, state-of-the-art, and user friendly platform.

Explanation of Changes

EERE has aligned its budget structure to be consistent with the technology development pipeline approach used to manage its investment portfolio. Detailed explanations of change are contained in the program specific narrative.

Goal Subprogram Budget Percentage Distribution Summary

	Innovations	Emerging Technologies	Systems Integration	Market Barriers	Total
Renewable Energy					
Biomass and Biorefinery Systems	29%	32%	23%	16%	100%
Geothermal Technology	43%	42%	9%	6%	100%
Hydrogen and Fuel Cell Technologies	68%	21%	8%	3%	100%
Solar Energy	23%	38%	30%	9%	100%
Water Power	16%	35%	36%	13%	100%
Wind Energy	38%	24%	26%	12%	100%
Energy Efficiency					
Advanced Manufacturing	16%	38%	35%	11%	100%
Building Technologies	6%	26%	36%	32%	100%
Federal Energy Management Program	0%	0%	0%	100%	100%
Vehicles Technologies	45%	41%	3%	11%	100%
Weatherization and Intergovernmental	0%	0%	0%	0%	0%

Strategic Performance Management by Program

Program Name: Biomass and Biorefinery Systems		
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Achieve a modeled total cost for mature technology of less than $3/gallon (GGE) for drop-in fuels such as renewable gasoline, renewable diesel, and renewable jet by 2017 (all costs in 2007$).		
Annual Measure 1: Reduce the modeled conversion cost for woody biomass conversion via fast pyrolysis to a gasoline and diesel blend stock, in support of the 2017 programmatic total cost goal of less than $3.00/gal gasoline.		
	Target	Actual/ Met or Not Met
FY 2013	$2.71/GGE (Gasoline Gallon Equivalent)	N/A
FY 2012	$3.38/GGE	N/A
FY 2011	$3.83/GGE	$3.83/GGE / Met
Analysis	Design case for fast pyrolysis of biomass to blend stock for production of diesel and/or jet fuel. Additional design cases will be examined and developed for alternative thermochemical pathways to drop-in hydrocarbons as part of a major shift towards hydrocarbon fuels.	
Annual Measure 2: Develop a design case for a biochemical conversion route to hydrocarbon fuels that will set yearly technical targets and cost goals for the next five years, in support of the 2017 programmatic goal of $3/gal for drop-in fuels such as renewable gasoline, diesel, and jet fuel.		
	Target	Actual/ Met or Not Met
FY 2013	1 Design Case	
FY 2012	N/A	N/A
FY 2011	N/A	N/A
Analysis	Design cases for biochemical conversion of biomass to gasoline, diesel, and/or jet fuel will be developed with FY 2013 funds, setting out year targets for FY 14-17. Design reports are based on Aspen model simulations for a representative process to convert biomass into advanced biofuels. The data and assumptions that support the Aspen model are generated through integrated piloting at the national labs. This provides the validation of the design cases.	
Annual Measure 3: Reduce non-pulp wood feedstock supply system logistics cost in dollars per dry matter ton ($/dry matter (DM) ton, in $2007, for delivery to plant gate or conversion reactor inlet).		
	Target	Actual/ Met or Not Met
FY 2013	$55.00 (Does not reflect "grower payment")	N/A
FY 2012	$56.77	N/A
FY 2011	N/A	$66.80
Analysis	Datasets and scenarios for non-pulp woody biomass logistics costs that will be complete in 3QFY12. Endpoint cost targets for non-pulp wood feedstock logistics that meet specifications required for pyrolysis (moisture <10% and ash <1%) are currently being developed in accordance with thermochemical conversion technologies. The FY13 FOA supported by this request is expected to move this effort toward accelerated cost reduction past 2013.	
Annual Measure 4: Achieve a validated total yearly production capacity for advanced biofuels of 80 million gallons (MG) by 2014 (or 100 MG including biorefineries projects supported with Recovery Act funds)		
	Target	Actual/ Met or Not Met
FY 2013	75 MG	N/A
FY 2012	15 MG	N/A
FY 2011	5 MG	5.07 MG/Met
Analysis	Independent engineers assigned to each project produce reports validating the project's design capacity pre-construction and also conduct performance validation tests after construction to confirm production capacity.	

Program Name: Geothermal Technology		
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Enable geothermal energy to provide 24-hour base load power across the nation at the same cost as traditional, non-renewable electricity sources by reducing the cost of "blind" hydrothermal resources to $0.06/kWh by 2020 and reducing the cost of Enhanced Geothermal Systems (EGS) to $0.06/kWh by 2030.		
Annual Measure 1: Reduce the LCOE of development of undiscovered hydrothermal systems: assuming non-uniform discount rate.		
	Target	Actual/ Met or Not Met
FY 2013	13.2cents/kWh	N/A
FY 2012	13.6 cents/kWh	N/A
FY 2011	14.6 cents/kWh	Baseline
Analysis	Reduce cost of hydrothermal energy to $0.06/kWh by 2020. • Decrease the processing time for advanced joint processing of geophysical surveys results by a factor of four • Increase temperature rating of well logging tools to 300 C for 1000 hours • Decrease logging tools size by a factor of two (from current diameters of roughly 5 to 6") • Identify at least one new geochemical signal in systems previously considered "blind" • GTP will develop a methodology to estimate discount rates and technical risk annually. • GTP will use results from federally funded projects to validate our theoretical LCOE values in the Geothermal Electricity Technology Evaluation Model (GETEM).	
Annual Measure 2: Reduce the LCOE for development of Enhanced Geothermal Systems: assuming non-uniform discount rate.		
	Target	Actual/ Met or Not Met
FY 2013	22.5 cents/kWh	N/A
FY 2012	23.1 cents/kWh	Re-baseline based on European EGS Project (only operational project in the world)
FY 2011	19 cents/kWh	Baseline (Based on Desert Peak near-field EGS case, pre-project)
Analysis	Demonstrate technical feasibility of a 5 MW EGS system by 2020; Reduce cost of energy to $0.06/kWh by 2030. By 2030 we will: • Increase heat exchange surface area per unit volume of reservoir: watts/m² • Reduce cost of well stimulation: from $8.4M to $7.4M • Increase production well flow rate: 20 kg/sec to 60 kg/sec • Increase drilling Rate of Penetration: from 10 ft. /hr. to 30 ft. /hr. • increase flow rates by developing multiple fracture zones per production well • develop high temp zonal isolation tools and improve understanding of rock stress & fracture orientations • leverage drilling investment from Hydrothermal & Resource Confirmation	

Program Name: Hydrogen and Fuel Cell Technologies		
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Reduce modeled cost to $30/kW and improve durability to 5,000 hours for automotive fuel cell systems by 2017, to enable [life-cycle] cost-competitiveness with traditional internal combustion engines. Achieve a modeled cost of as-dispensed hydrogen of $2–$4/gge hydrogen, the cost-competitiveness threshold, by 2020.		
Annual Measure 1: Improve the catalyst specific power of fuel cells, as measured in kW per gram of platinum group metal, from 2.8 kW/g to 8.0 kW/g in 2017.		
	Target	Actual/ Met or Not Met
FY 2013	5.9 kW/g	N/A
FY 2012	5.8 kW/g	N/A
FY 2011	5.5 kW/g	Met (result = 5.6 kW/g)
FY 2010	3.0 kW/g	Met (result = 5.0 kW/g)
Analysis	Baseline: 2.8 kW/g in 2008 Impact: approach $30/kW fuel cell system cost target	
Annual Measure 2: Relative to the 2011 baseline reduces the cost of delivering hydrogen from the point of production to the point of use by 60%. By 2020, enable the modeled cost of as-dispensed hydrogen to achieve a $2–$4/gge hydrogen threshold cost.		
	Target	Actual/ Met or Not Met
FY 2013	10% reduction from 2011 baseline	N/A
FY 2012	8% reduction from 2011 baseline	N/A
FY 2011	n/a	Baseline
Analysis	Baseline: $8/gge in 2011 Impact: approach $2–$4/gge hydrogen threshold cost The baseline cost is the total dispensed cost of hydrogen excluding taxes, and it includes both hydrogen production and hydrogen delivery. The Program's analysis has shown that the progress that has been made in capital cost reduction (e.g., 80% electrolyzer stack capital cost reduction since 2001), and in other phases of hydrogen production, leaves the delivery portion of the dispensed hydrogen cost as the "critical path" for achieving cost-effective use of renewable hydrogen as a fuel. The projected cost will be modeled using the H2A hydrogen cost model, including the HDSAM (hydrogen delivery scenario analysis model), and validated using a review by external experts.	

Program Name: Solar Energy		
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Make solar energy as cheap as traditional, non-renewable, sources of electricity		
PRIORITY GOAL: Make solar energy as cheap as traditional sources of electricity. By the end of the decade, drive the cost of solar electricity down to: $1/W at utility scale; $1.25/W at commercial scale; and $1.50/W at residential scale. By Dec. 2013, demonstrate a prototype thin film or film silicon module with an efficiency of greater than 21% and a balance-of-system with a 50% reduction of the permitting and installation costs to $1.50/W.		
Annual Measure 1: Reduce market barriers and support domestic market growth to enable increasing annual solar installations in the U.S. (gigawatts (GW) installed capacity per year)		
	Target	Actual/ Met or Not Met
FY 2013	7 GW	N/A
FY 2012	5 GW	N/A
FY 2011	3 GW	1.3 GW annual installation / Not Met
Analysis	Enable up to 50GW of total installed solar electricity generating capacity by 2020, and 300 GW by 2030.	
Annual Measure 2: Reduce the unsubsidized levelized cost of solar electricity (LCOE) from PV at large scale for utility, commercial, and residential applications (cents kilowatt hour) (convert to $/WDC targets using $.05/kwh per $/WDC)		

	Target	Actual/ Met or Not Met
FY 2013	13 - 17 cents/kWh**	N/A
FY 2012	14 - 18 cents/kWh**	N/A
FY 2011	15 - 20 cents/kWh**	Met / 18-24 cents/kWh utility without ITC**
FY 2010	14 - 24 cents/kWh	Met / 15 - 20 cents/kWh utility with ITC
FY 2009	17 - 19 cents/kWh	Met / 17-19 cents/kWh utility with ITC
Analysis	The range in the targets corresponds to different U.S. geographic regions Module cost goal of $0.50 per watt Power electronics cost goal of $0.10 per watt Balance of system cost goal of $0.40 per watt By 2020, demonstrate the commercial viability of PV technologies at multiple scales: - Utility (100 MW) - $1.00/W - Commercial (200 kW) - $1.25/W - Residential (5 kW) - $1.50/W NREL runs this LCOE analysis annually based on best known industry data **Prior to the launch of the SunShot Initiative, the program goals included existing federal tax credits (30% ITC). FY12 and FY13 targets are rebaselined to not include subsidies since the goal of the SunShot Initiative is to achieve unsubsidized grid parity (~ 5-6 cents/kWh) at utility scale by 2020.	

Annual Measure 3: Reduce the unsubsidized levelized cost of solar electricity (LCOE) from Concentrating Solar Power (CSP) for utility applications. (cents per kilowatt hour)		
	Target	Actual/ Met or Not Met
FY 2013	12 - 15 cents/kWh	N/A
FY 2012	15 - 17 cents/kWh	N/A
FY 2011	17 - 21 cents/kWh	Met / results = 17 - 21 cents/kWh
FY 2010	14 - 17 cents/kWh	Not Met / results = 20 - 25 cents/kWh
Analysis	Includes the value storing energy into the evening hours as CSP thermal storage technologies improve LCOE goal of 5-6 c/kWh (CSP&PV) CSP goal: $3.50/W including 16 hours storage (equivalent to $0.06/kWh) – thermal storage allows a much higher capacity factor, enabling $0.06/kWh to be met with $3.50/W installed capacity. NREL runs this LCOE analysis annually based on best known industry data.	

Program Name: Water Power		
STRATEGIC GOAL: Catalyze the timely, material, and economic transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies.		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Develop and test marine and hydrokinetic and hydropower technologies to supply cost-competitive electricity from the Nation's rivers, waves, tides, and ocean currents.		
Annual Measure 1: Test marine and hydrokinetic devices and components to determine baseline cost, performance, and reliability. (all targets cumulative)		
	Target	Actual/ Met or Not Met
FY 2013	10	N/A
FY 2012	5	N/A
FY 2011	2	Met (2)
Analysis	This pathway enables the program to meet its Congressional mandate to report on the potential and economic viability of MHK technologies and resources. Testing 10 emerging MHK devices by 2013 to determine reference costs and performance, and ultimately target program R&D towards promising LCOE reduction pathways. The magnitude of these tests varies from the flume validation of scale model performance to in-water, grid-connected deployment to assess real world performance (production, survivability, environmental impacts) of advanced device designs. Targeting R&D towards identified pathways will reduce the cost of the MHK technologies to 6 cents per kWh by 2030—competitive with least-cost utility scale energy technologies.	

Annual Measure 2: Complete feasibility assessments at conventional hydropower facilities to identify opportunities for efficiency and capacity upgrades to increase hydropower generation, and improve plant flexibility to integrate variable renewables. (Cumulative)		
	Target	Actual/ Met or Not Met
FY 2013	40	N/A
FY 2012	10	N/A
FY 2011	3	Not Met / 2
Analysis	Assessments examine and validate the impacts of upgrades and improvements at the nation's existing 77GW of conventional hydropower generating facilities. The FY 2013 target has been reduced to 40 to capture the impact of project delays. Performing 40 assessments of the existing fleet to determine the untapped potential at existing hydropower sites. These assessments will demonstrate the potential to realize the addition of an estimated 8-16 GW of near-term incremental hydropower to meet the goal of adding 100 GW inclusive of PSH by 2030.	

Program Name: Wind Energy		
STRATEGIC GOAL: Transforming our energy systems by reducing energy-related greenhouse gas emissions by 17 percent by 2020 and 83 percent by 2050.		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Reduce the wind program LCOE to 6.0 c/kWh for Utility-Scale Wind and 9.3 c/kWh for Offshore Wind by 2020, each without subsidization, enabling significant market penetration directly impacting jobs creation, energy security, and global competitiveness.		
Annual Measure 1: Unsubsidized land-based wind cost of energy (DOE influence-adjusted), in cents per kWh, in Class 4 wind speed areas (7.25 m/s mean wind speed at 50m above ground) from a 2010 baseline of 8.2 cents/kWh.		
	Target	Actual/ Met or Not Met
FY 2013	7.7 cents/kWh	N/A
FY 2012	7.9 cents/kWh	N/A
FY 2011	8.1 cents/kWh	7.7 cents/kWh - Met
Analysis	Reduce unsubsidized wind land utility cost of energy to 6.0 cents/kWh in 2020; by 2030 achieve 250 GW of deployment In combination, the following are projected to result in targeted COE reductions by 2020: • Increase rotor diameter: from 77m up to 118m • Increase tower hub height: from 80m up to 110m • Reduce plant losses: from 10 percent down to 8 percent LCOE validated via annual, independent NREL analysis of actual installed US wind plants, normalized for Class IV wind speed, 30 year useful life, standard Federal and State taxes, and with other updated EERE standardization assumptions (updated from prior years.)	
Annual Measure 2: Unsubsidized cost of offshore wind energy, in cents per kWh, in Class 6 wind speed areas (9.25 m/s mean wind speed at 50m above ground) from a 2010 baseline of 25.3 cents/kWh.		
	Target	Actual/ Met or Not Met
FY 2013	21.7 cents/kWh	N/A
FY 2012	23.5 cents/kWh	N/A
FY 2011	25.1 cents/kWh	25.1 cents/kWh / Met
Analysis	Reduce unsubsidized offshore wind (shallow-water) cost of energy to 9.3 cents/kWh in 2020; by 2030 achieve 54 GW of deployment • Increase rotor diameter: from 107m to 156m • Improved controls for lighter tower • Reduce plant losses: from 12 percent to 10 percent • Improve component life: from 10 to 20 years Improve access to sites with greater wind speed via taller towers and larger rated systems	
Annual Measure 3: Number of certified small wind turbine products from a 2010 baseline of 0 turbines to 40 turbines by 2020.		
	Target	Actual/ Met or Not Met

FY 2013	12	N/A
FY 2012	5	N/A
FY 2011	0	Baseline
Analysis	Establish US standards and US small wind (<100kW) turbine certification process, which provides a written seal of compliance to U.S. National Small Wind Standards	

Program Name: Building Technologies		
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Increase residential and commercial energy efficiency, reducing energy use and costs while maintaining the same level of services, through the development of innovative new products and through energy conservation standards. Reduce building-related energy costs by reducing energy use by 50 percent by 2030.		
PRIORITY GOAL: Reduce consumer energy use and costs for household appliances. By December 31, 2013, issue at least 9 new energy conservation standards to deliver net consumer savings of hundreds of billions of dollars over 30 years and require efficient products across domestic and international manufacturers.		
Annual Measure 1: Annual number of products for which Notices of Proposed Rulemaking (NOPRs) for test procedures and standards will be issued / Annual number of products for which final rules for test procedures and standards will be issued / Annual number of ENERGY STAR test procedure proposals completed.		
	Target	Actual/ Met or Not Met
FY 2013	13/18/12	N/A
FY 2012	34/34/12 *	N/A
FY 2011	14/16/8	Met 17/18/10
Analysis	Many of the test procedure and standards rulemakings are legislatively mandated by the Energy Policy and Conservation Act. The number of proposals and final rules are determined by the typical rulemaking cycle, whose completion dates are specified by legislation. For ENERGY STAR, DOE estimated the number of proposals based on the Environmental Protection Agency's work plan for specification development. Program activities assist in achieving this goal by improving the efficiency of new appliances and equipment, establishing test procedures to measure product efficiency, and verifying compliance with these test procedures and specified efficiency levels. The program brings new, efficient technologies developed by R&D into widespread use when the technologies become economically feasible. * The increase in the FY 2012 target from last year for issuance of test procedures and standards represents a new focus to accelerate energy conservation standards rulemakings and test procedures, as well as add new products to the portfolio.	
Annual Measure 2: Complete annual report which outlines the most cost effective retrofit and new home energy efficiency improvements (called measure packages) required to achieve 30 percent and 50 percent savings over the baseline for residential buildings. The report will focus on the improvements needed in 30 metropolitan areas representing five major climate regions across the United States.		
	Target	Actual/ Met or Not Met
FY 2013	1	N/A
FY 2012	1	N/A
FY 2011	1	Met
Analysis	Achievement of the FY 2012 goal will focus on packages with 30 percent savings over baseline. For new homes, the 2009 International Energy Efficiency Code is the baseline. For existing homes, the energy consumption for average existing homes is the baseline, as determined by modeling analysis. At first, these improvements will pertain only to particular homes. As more homes are improved, there is a strong likelihood that different categories of home types will require differently defined measure packages within different climate zones, resulting in defined measured packages that are applicable to defined housing types within climate zones. Initial findings of the FY 2012 report shall evolve as the information from test homes and pilot communities becomes available. The FY 2013 report will use this information to begin reporting on 50	

	percent efficiency measures for both new and existing homes. Ultimately, the Program strives to develop recommended builder and retrofit measures that maximize the cost-effective energy efficiency of buildings in all climate regions. Initially this effort will focus on 30 percent and then 50 percent efficiency improvements for both new homes and existing homes, as demonstrated through test homes and pilot communities across all major climate zones. The 50 percent efficiency target level for both new and existing homes contributes to the overall goal of 50 percent energy reduction. Cost-effectiveness is defined as the NPV of the lifetime of energy savings resulting from the measured packages compared to the NPV of the cost of those improvements. The report will detail the potential national savings that could result if all homes were retrofitted or constructed according to these measured packages. The Program will monitor the market penetration of these measures through the Builder Challenge Program, Home Performance with ENERGY STAR, the Better Buildings Neighborhood Program, and codes.

Annual Measure 3: Complete Retrofit and New Commercial Buildings Case Studies and handbooks outlining 20 percent energy savings over previous building usage, with five year or less payback. (annual number of case studies completed)		
	Target	Actual/ Met or Not Met
FY 2013	10 retrofit / 10 new construction	N/A
FY 2012	10 retrofit / 10 new construction	N/A
FY 2011	5 retrofit / 5 new construction	Met
Analysis	The Buildings Program's case studies and handbooks will document means, methods, and technology solutions for commercial building owners to achieve savings in 6 building types: retail, office, higher education, hospitality, warehouse, and healthcare. FY 2013 funds will document solutions with building owners which include overcoming the market barriers, (such as split incentive, high hurdle rates, uncertain risks, and information gaps), quantifying the opportunity/savings/impacts, and documenting the technology solutions for 6 building types in all climate zones. Develop 30 energy savings packages in total (covering new and existing buildings in each of the major building types and climates). Annual progress report will include identification of the most cost effective efficiency packages as a function of climate and energy costs, a resource tool to provide access to design details for the packages, and a summary of results from the commercial building sector, alliances and Better Buildings Challenge Program.	

Annual Measure 4: Increase lighting efficacy measured in lumens per watt of "white light" solid-state lighting in a lab device. (lm/w)		
	Target	Actual/ Met or Not Met
FY 2013	148 lm/W	N/A
FY 2012	145 lm/W	N/A
FY 2011	123 lm/W	Met / 149 lm/W
Analysis	Endpoint goal is 157 lm/W in 2016 in a lab device	

Program Name: Federal Energy Management Program		
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies.		
OBJECTIVE: Deploy the Technologies We Have and Lead the National Conversation on Energy		
PROGRAM GOAL: FEMP provides the services, tools, and expertise to Federal agencies to help them achieve their Federal energy management goals. These are delivered through project funding mechanisms, technical assistance, and communications and training.		
Annual Measure 1: Lifecycle savings enabled in Federal facility energy use through directly appropriated funds or a performance contracting and technical assistance. (Trillion British Thermal Units (TBtus))		
	Annual Life-Cycle Savings Target (TBtu)	Actual/ Met or Not Met
FY 2013	47	N/A
FY 2012	52	N/A
FY 2011	50	41.6 TBtus – Not Met
Analysis	During FY 11, FEMP enabled the development of projects that result in life-cycle savings of 41.6 Trillion	

	Btus (Tbtus) in Federal facility energy use through alternative finance (Energy Savings Performance Contracts, Utility Energy Services Contacts, Power Purchase Agreements, and public benefit funds) and technical assistance (design assistance, efficiency assessments, renewable energy assessments, commissioning and other activities). FEMP's contribution in FY13 to the Federal Government's annual energy use reduction target of 59 TBtu by 2015 (30% energy intensity reduction) would be approximately 3 TBtu (47 TBtu life-cycle savings divided by an average 15 year project life). From FY11 to FY13, FEMP's contribution to reducing Government annual energy use would be approximately 9 TBtu.

Program Name: Vehicles Technologies		
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Develop integrated advanced technology vehicles capable of between 200 and 400 percent increased fuel economy per vehicle for passenger vehicles and 40 to 50 percent for commercial vehicles, compared to an average 2010 vehicle.		
PRIORITY GOAL: Reduce the cost of batteries for electric drive vehicles to help increase the market for Plug-In Hybrids and All Electric Vehicles and thereby reduce petroleum use and greenhouse gas emissions. By October 2013, demonstrate a prototype Plug-In Hybrid battery technology that is capable of achieving a cost of $400/kW hr. (useable energy) during high volume manufacturing (100,000 packs per year) compared to a 2008 baseline of $1000/kW hr.		
Annual Measure 1: Reduce the modeled cost of energy storage for Plug-In Hybrid Electric Vehicles (PHEVs). ($/kilowatt-hour)		
	Target	Actual/ Met or Not Met
FY 2013	$400/kW-hr	N/A
FY 2012	$500/kW-hr	N/A
FY 2011	$700/kW-hr	Met $650/kilowatt-hour
Analysis	Reduce the production cost of a high energy battery from $1,000/kWh in 2008 to $300/kWh by 2014, enabling cost competitive market entry of PHEVs. The cost projections are based on high volume manufacturing of battery prototypes that meet or exceed performance requirements using a peer reviewed cost model. Endpoint goal is $300/ kWh in 2014, reducing the cost of electrical vehicle batteries by approximately 50 percent (roughly $5,000) from FY 11 and reducing the vehicle payback period by more than 40 percent	
Annual Measure 2: Reduce the modeled cost of electric-drive technologies ($/kilowatt peak power)		
	Target	Actual/ Met or Not Met
FY 2013	$16/kW peak	N/A
FY 2012	$17/kW peak	N/A
FY 2011	$18/kW peak	Met target of $18/kilowatt peak power
FY 2010	$19/KW peak	Met target of $19/kilowatt peak power.
Analysis	Reduce the cost of an electric traction drive system that can deliver 55kW of peak power from $19/kW in 2010 to $12/kW in 2015, enabling cost competitive technologies for market entry and vehicle electrification.	
Annual Measure 3: Increase cumulative miles of PHEV/EV testing (miles tested).		
	Target	Actual/ Met or Not Met
FY 2013	102M	N/A
FY 2012	62M	N/A
FY 2011	15M	Met target of accumulating 15 million miles of PHEV/EV testing.
Analysis	Laboratory and field evaluations of advanced vehicles and refueling infrastructure will characterize the performance, life-cycle cost, and efficiency benefits of the latest technologies to be deployed.	
Annual Measure 4: Reduce the use of petroleum through the adoption of alternative fuel vehicles and infrastructure (gallons per year)		
	Target	Actual/ Met or Not Met

FY 2013	800M	N/A
FY 2012	700M	N/A
FY 2011	570M	Met 645 million gallons per year of petroleum reduction
Analysis	Annual Petroleum reduction/savings for alternative fuel end use is measured through actual fleet and fuel provider reporting; reductions estimated from idle reduction and other activities are tracked & documented by project partners. By 2015, 1B gal/yr. (gge) of petroleum reduction with alternative fuel vehicles and infrastructure. By 2020, 2.5B gal/yr. (gge) of petroleum reduction with alternative fuel vehicles and infrastructure.	
Annual Measure 5: Improve modeled fuel economy for passenger and commercial vehicles solely from improvements in powertrain efficiency (fuel economy gain percentage, passenger percent/commercial percent, compared to 2009 baseline vehicles).		
	Target	Actual/ Met or Not Met
FY 2013	20% / 15%	N/A
FY 2012	15% / 10%	N/A
FY 2011	10% / 5%	Met fuel economy gain of 10% for passenger vehicles and 5% for commercial vehicles.
Analysis	Increase the efficiency of internal combustion engines demonstrating a fuel economy improvement for passenger vehicles of 25 percent by 2015, and for commercial vehicles of 20 percent by 2015 and 30 percent in 2018 when compared to a 2009 baseline vehicle. Baseline vehicles are those selected as representative by industry partners.	
Annual Measure 6: Demonstrate through modeling and laboratory data an increase in the energy conversion efficiency of a prototype thermoelectric device for converting engine waste heat to electricity. (energy conversion efficiency percentage)		
	Target	Actual/ Met or Not Met
FY 2013	12%	N/A
FY 2012	10%	N/A
FY 2011	8%	Met target of achieving an 8% increase in energy conversion efficiency of prototype TE device.
Analysis	The program seeks to increase the efficiency of thermoelectric generators to convert waste heat to electricity from eight percent in 2011 to greater than 15 percent in 2015. The resulting improvement in fuel economy will depend on the design of the thermoelectric generator and the test vehicle. Three cost-shared cooperative agreements were awarded in late FY11 to demonstrate a 5 percent fuel economy improvement by 2015.	
Annual Measure 7: Demonstrate and validate (to within 10 percent uncertainty) the modeled cost-effective reduction of the weight of passenger vehicle body and chassis systems with safety, performance, and recyclability comparable to 2002 vehicles (weight reduction percentage, relative to 2009 baseline).		
	Target	Actual/ Met or Not Met
FY 2013	- 40%	N/A
FY 2012	- 25%	N/A
FY 2011	Model	Met - Developed design for the assemblies that make up the lighter weight vehicle.
Analysis	The weight reduction analysis is a cost model that looks at lifecycle costs and approaches weight reduction by light weight material substitution of the largest structural systems first such as the body-in-white and the chassis.	

Program Name: Weatherization and Intergovernmental Activities
STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies.
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need
PROGRAM GOAL: Supports clean energy deployment in partnership with State, local, U.S. territory, and tribal governments. Includes financial support for energy-efficient home retrofits which lower energy use and costs for low income families.
PRIORITY GOAL: Save low income families money and energy through weatherization retrofits. From FY 2010 through FY2013, in collaboration with HUD, enable the cost-effective energy retrofits of a total of 1.2 million housing units, of which more than 75% are low income.

Annual Measure 1: Weatherize homes of low-income families using non-ARRA weatherization assistance grant funds.		
	Target	Actual/ Met or Not Met
FY 2013	21,286	N/A
FY 2012	10,000	N/A
FY 2011	33,484	Met / 45,042
Analysis	DOE sub-goal of 1 million cumulative residential retrofits (HUD sub-goal of 200,000) by the end of 2013. Estimated FY10-FY13 retrofits of 217,000; 22 percent of DOE part of goal.	
Annual Measure 2: Weatherize homes of low-income families using ARRA weatherization assistance grant funds.		
	Target	Actual/ Met or Not Met
FY 2013	50,500	N/A
FY 2012	159,513	N/A
FY 2011	273,263	Met / 328,215
Analysis	1 million cumulative retrofits by the end of 2013. Estimated FY09-FY13 retrofits of 613,000; 61% of DOE sub-goal. (The Building Technologies Program is targeting achievement of the remaining 17% of retrofits.)	
Annual Measure 3: Achieve an average annual (non-leveraged) energy savings from DOE funded State Energy Program projects. (TBtus)		
	Target	Actual/ Met or Not Met
FY 2013	3.5	N/A
FY 2012	3.5	N/A
FY 2011	3.5	Met/3.67
Analysis	Annual energy savings are 1st year savings from implementations achieved in the target year. Anticipate updated methodology for estimating programmatic impacts, including, energy and cost savings, leveraged contributions, and other metrics by end of FY 2013.	

Program Name: Advanced Manufacturing		
STRATEGIC GOAL: Strongly support new energy-efficient manufacturing processes and materials technologies to reduce the energy intensity and life-cycle energy consumption in manufactured products and promote a corporate culture of continuous improvement in energy efficiency among existing facilities and manufacturers.		
OBJECTIVE: Deploy the Technologies We Have and Discover the New Solutions We Need		
PROGRAM GOAL: Reduced energy consumption in industrial processes and increased competitiveness of domestic manufacturers, and continuous innovation based on the insight and synergies that emerge from manufacturing activities.		
Annual Measure 1: Demonstrate new individual energy-efficient automated manufacturing process technologies with the potential to reduce energy consumption by 50% compared to baseline technologies in industrial facilities.		
	Target	Actual/ Met or Not Met
FY 2013	1	N/A
FY 2012	N/A	N/A
FY 2011	N/A	N/A
Analysis	Due to the wide variety of technologies funded through the AMO portfolio, processes will be demonstrated and verified on a case-by-case basis using metrics unique to each case, including energy saved compared to a suitable base case. For a retrospective analysis of impacts, the program (through the Pacific Northwest National Laboratory) has employed a rigorous approach to evaluate energy and emissions impacts, using data gathered following the successful commercialization of supported technologies by tracking unit sales and estimated performance characteristics.	
Annual Measure 2: Develop next-generation materials with the potential to reduce total product life-cycle energy consumption by 25%.		
	Target	Actual/ Met or Not Met
FY 2013	2	N/A
FY 2012	N/A	N/A
FY 2011	N/A	N/A
Analysis	Potential refers to an estimated savings compared to existing technologies and is assessed on a case-by-case basis to account for the wide variety of industry domains targeted by AMOs activities. AMO and EERE Strategic Programs have initiated work to develop a comprehensive set of tools to model material	

	flows (from "mine-to-materials") based on life-cycle energy and emissions data and thereby assess the energy and emissions impact.

Annual Measure 3: Demonstrate new or improved manufacturing processes that save a minimum of 25% energy compared with conventional manufacturing processes. (number of manufacturing processes)		
	Target	Actual/ Met or Not Met
FY 2013	3	N/A
FY 2012	N/A	N/A
FY 2011	N/A	N/A
Analysis	Technologies will be demonstrated and verified at a relevant scale on a case-by-case basis, based on individual milestones that have been established for each project.	

Annual Measure 4: Increase number of manufacturing facilities certified in Superior Energy Performance by ANSI-accredited bodies (cumulative number certified since the beginning of FY 2011)		
	Target	Actual/ Met or Not Met
FY 2013	25	N/A
FY 2012	10 *	N/A
FY 2011	5	5 / Met
Analysis	Typical plants involved in the Superior Energy Performance demonstrations have annual energy bills over $1 million. Total cumulative energy savings of these 25 plants of 3 TBtus over the three year certification period. * Reduction from last year's FY 2012 target reflects current estimates based on expected timelines for certifications. Some plants have been delayed in their readiness for SEP due to current economic conditions.	

Annual Measure 5: Provide specialized training to new energy efficiency engineers and managers at 24 Industrial Assessment Centers, of whom at least 90% find employment within 6 months of completing training. (number of engineers and managers trained each year)		
	Target	Actual/ Met or Not Met
FY 2013	250	N/A
FY 2012	200	N/A
FY 2011	N/A	N/A
Analysis		

Facilities Maintenance and Repair

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

Indirect-Funded Maintenance and Repair

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
National Renewable Energy Laboratory	2,247	4,000	4,000
Total, Indirect-Funded Maintenance and Repair	2,247	4,000	4,000

Direct-Funded Maintenance and Repair

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
National Renewable Energy Laboratory	3,000	3,300	3,300
Total, Direct-Funded Maintenance and Repair	3,000	3,300	3,300

Small Business Innovation Research/ Small Business Technology Transfer (SBIR/STTR)

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Energy Efficiency and renewable Energy (EERE)			
Biomass & Biorefinery Systems RD&D	2,716	5,900	4,757
Geothermal Technology	1,011	999	1,861
Hydrogen & Fuel Cell Technologies	2,153	2,537	2,150
Solar Energy	3,944	4,258	3,911
Water Power	799	1,741	610
Wind Energy	1,166	2,026	2,133
Advanced Manufacturing	2,342	2,887	7,900
Building Technologies	3,190	4,513	6,455
Vehicle Technologies	6,849	7,842	10,873
Total, EERE	24,170	32,703	40,650

[a] 24,170 transferred to the Office of Science.

Office of Energy Efficiency and Renewable Energy

Funding by Site by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Ames Laboratory			
Advanced Manufacturing	350	0	0
Vehicle Technologies	2,400	2,250	2,400
Total, Ames Laboratory	2,750	2,250	2,400
Argonne National Laboratory (East)			
Biomass and Biorefinery Systems R&D	3,350	3,550	5,150
Geothermal Technology	1,300	1,100	1,500
Hydrogen and Fuel Cell Technologies	9,939	10,920	8,430
Solar Energy	850	900	900
Water Power	517	2,637	670
Wind Energy	170	540	540
Advanced Manufacturing	3,613	1,750	1,750
Building Technologies	2,697	425	3,643
Vehicle Technologies	42,408	31,371	40,000
Strategic Programs	325	253	305
Total, Argonne National Laboratory	65,169	53,446	62,888
Brookhaven National Laboratory			
Geothermal Technology	0	600	0
Hydrogen and Fuel Cell Technologies	1,033	1,220	950
Solar Energy	943	720	720
Vehicle Technologies	1,800	1,550	1,800
Strategic Programs	574	400	675
Total, Brookhaven National Laboratory	4,350	4,490	4,145
Chicago Operations Office			
Hydrogen and Fuel Cell Technologies	20	20	20
Wind Energy	50	50	50
Building Technologies	50	0	68
Vehicle Technologies	22	0	0
Strategic Programs	150	0	0
Total, Chicago Operations Office	292	70	138

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Golden Field Office/Project Management Center			
Biomass and Biorefinery Systems R&D	3,100	2,500	111,340
Geothermal Technology	19,672	9,262	24,000
Hydrogen and Fuel Cells Technologies	34,594	38,650	29,840
Solar Energy	144,840	173,392	210,441
Water Power	14,850	34,313	8,723
Wind Energy	26,718	35,054	33,154
Advanced Manufacturing	24,348	0	0
Building Technologies	170	0	230
Federal Energy Management Program	1,586	1,006	1,180
Weatherization and Intergovernmental Activities	11,050	121,765	188,800
Program Direction	43,563	32,200	32,200
Strategic Programs	2,163	2,077	30,160
Total, Golden Field Office	326,654	450,219	670,068
Idaho National Laboratory			
Biomass and Biorefinery Systems R&D	9,464	9,600	10,380
Geothermal Technology	1,000	1,600	1,500
Wind Energy	520	400	400
Advanced Manufacturing	946	0	0
Federal Energy Management Program	350	277	325
Vehicle Technologies	11,073	8,863	11,000
Strategic Programs	50	35	60
Total, Idaho National Laboratory	23,403	20,775	23,665
Lawrence Berkeley National Laboratory			
Biomass and Biorefinery Systems R&D	0	3,000	3,000
Geothermal Technology	2,500	5,000	5,000
Hydrogen and Fuel Cell Technologies	2,503	2,930	2,260
Solar Energy	737	650	650
Wind Energy	550	500	500
Advanced Manufacturing	2,363	2,242	1,250
Federal Energy Management Program	4,613	3,015	3,537
Building Technologies	29,773	14,812	40,212

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Vehicle Technologies	16,912	16,605	17,000
Weatherization and Intergovernmental Activities	560	200	600
Strategic Programs	1,035	1,120	1,540
Total, Lawrence Berkeley National Laboratory	61,547	50,074	75,549
Lawrence Livermore National Laboratory			
Geothermal Technology	1,300	1,700	1,500
Hydrogen and Fuel Cell Technologies	2,105	2,320	1,790
Wind Energy	376	350	350
Advanced Manufacturing	88	0	0
Vehicle Technologies	3,775	2,853	3,000
Total, Lawrence Livermore National Laboratory	7,644	7,223	6,640
Los Alamos National Laboratory			
Biomass and Biorefinery Systems R&D	0	0	1,100
Geothermal Technology	100	800	500
Hydrogen and Fuel Cell Technologies	7,324	8,220	6,350
Wind Energy	11	400	400
Advanced Manufacturing	675	0	0
Vehicle Technologies	960	640	800
Total, Los Alamos National Laboratory	9,070	10,060	9,150
National Energy Technology Laboratory			
Geothermal Technology	0	1,200	500
Advanced Manufacturing	20,225	0	0
Building Technologies	41,448	23,836	55,981
Federal Energy Management Program	360	322	378
Vehicle Technologies	96,509	33,070	35,000
Weatherization and Intergovernmental Activities	212,313	0	0
Program Direction	19,184	13,900	13,900
Total, National Energy Technology Laboratory	390,039	72,328	105,759
National Renewable Energy Laboratory			
Biomass and Biorefinery Systems R&D	39,060	42,330	26,090
Geothermal Technology	3,000	2,500	3,000
Hydrogen and Fuel Cell Technologies	17,815	19,460	15,020

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Solar Energy	59,529	64,469	64,469
Water Power	2,259	3,208	1,893
Wind Energy	31,461	32,002	35,902
Advanced Manufacturing	0	450	0
Building Technologies	37,948	28,895	51,254
Federal Energy Management Program	6,669	5,096	5,978
Vehicle Technologies	26,523	19,640	25,000
Weatherization and Intergovernmental Activities	1,220	1,290	1,200
Facilities and Infrastructure	51,000	26,311	26,400
Strategic Programs	10,758	8,445	10,010
Total, National Renewable Energy Laboratory	287,242	254,096	266,216
NNSA Sandia Site Office			
Wind Energy	230	130	0
Total, NNSA Sandia Site Office	230	130	0
Oak Ridge Operations Office			
Geothermal Technology	20	0	0
Hydrogen and Fuel Cell Technologies	172	230	180
Solar Energy	3,000	0	0
Wind Energy	1,000	0	0
Advanced Manufacturing	10	0	0
Building Technologies	266	0	359
Vehicle Technologies	1,625	0	0
Strategic Programs	2,275	1,464	300
Total, Oak Ridge Operations Office	8,368	1,694	839
Oak Ridge National Laboratory			
Biomass and Biorefinery Systems R&D	3,985	6,239	4,590
Geothermal Technology	1,300	800	500
Hydrogen and Fuel Cell Technologies	4,012	4,670	3,600
Solar Energy	818	0	0
Water Power	3,430	2,780	853
Wind Energy	307	250	250
Advanced Manufacturing	13,401	15,444	11,313

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Building Technologies	28,327	17,383	38,259
Federal Energy Management Program	3,163	1,604	1,882
Vehicle Technologies	52,408	35,928	48,000
Weatherization and Intergovernmental Activities	2,039	0	2,000
Strategic Programs	995	900	1,490
Total, Oak Ridge National Laboratory	114,185	85,998	112,737
Pacific Northwest National Laboratory			
Biomass and Biorefinery Systems R&D	11,120	20,825	14,480
Geothermal Technology	100	300	0
Water Power	1,857	3,627	1,184
Wind Energy	1,702	1,299	999
Hydrogen and Fuel Cell Technologies	3,824	4,130	3,190
Advanced Manufacturing	1,904	350	0
Building Technologies	35,912	25,688	48,504
Federal Energy Management Program	2,356	2,358	2,766
Vehicle Technologies	10,302	7,022	9,000
Strategic Programs	2,452	1,700	3,295
Total, Pacific Northwest National Laboratory	71,529	67,299	83,418
Sandia National Laboratories			
Biomass and Biorefinery Systems R&D	250	1,980	1,350
Geothermal Technology	3,200	5,000	5,000
Hydrogen and Fuel Cell Technologies	5,956	5,830	4,500
Solar Energy	35,354	20,515	20,515
Water Power	4,880	6,265	3,512
Wind Energy	9,030	9,540	9,540
Building Technologies	1,004	320	1,356
Federal Energy Management Program	490	124	146
Vehicle Technologies	11,395	11,230	11,000
Weatherization and Intergovernmental Activities	400	400	400
Strategic Programs	0	0	200
Total, Sandia National Laboratories	71,959	61,204	57,519
Savannah River National Laboratory			

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Hydrogen and Fuel Cell Technologies	2,360	2,770	2,140
Wind Energy	0	191	191
Federal Energy Management Program	0	13	16
Vehicle Technologies	150	0	0
Total, Savannah River National Laboratories	2,510	2,974	2,347
Washington Headquarters			
Biomass and Biorefinery Systems R&D	109,650	109,252	92,520
Geothermal Technology	3,500	8,000	22,000
Hydrogen and Fuel Cell Technologies	4,190	2,254	1,730
Solar Energy	13,485	28,305	12,305
Water Power	1,408	5,957	3,165
Wind Energy	6,709	12,548	12,724
Advanced Manufacturing	37,976	95,344	275,687
Building Technologies	29,715	107,845	70,134
Federal Energy Management Program	10,815	16,076	15,792
Vehicle Technologies	14,889	157,785	216,000
Weatherization and Intergovernmental Activities	3,718	4,345	2,000
Program Direction	107,253	118,900	118,600
Strategic Programs	11,223	8,606	10,865
Total, Washington Headquarters	354,531	675,216	853,522
Subtotal, Energy Efficiency and Renewable Energy	1,801,471	1,819,547	2,337,000
Transfer from State Department	250	0	0
Use of Prior Year Balances	-30,000	-9,909	0
Cancellation of Prior Year Balances	0	0	-69,667
Total, Energy Efficiency and Renewable Energy	1,771,721	1,809,638	2,267,333

Biomass and Biorefinery Systems Program

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Biomass and Biorefinery Systems			
Feedstocks	25,335	34,808	45,872
Conversion Technologies	77,949	102,489	112,767
Integrated Biorefineries	66,695	41,576	94,000
Analysis and Sustainability	10,000	9,669	9,695
Biopower	0	4,834	2,909
SBIR/STTR	0	5,900	4,757
Total, Biomass and Biorefinery Systems	179,979	199,276	270,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Biomass and Biorefinery Systems			
Innovations	79,298	89,453	75,344
Emerging Technologies	29,186	57,709	84,629
Systems Integration	3,335	2,079	62,987
Market Barriers	68,160	44,135	42,283
SBIR/STTR	0	5,900	4,757
Total, Biomass and Biorefinery Systems	179,979	199,276	270,000

Public Law Authorizations

P.L. 95 91, "Department of Energy Organization Act" (1977)
P.L. 106-224, "Biomass Research and Development Act" (2000)
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"
P.L. 110-234, "The Food, Conservation, and Energy Act of 2008"

Overview

The mission of the Biomass and Biorefinery Systems Program is to leverage technical innovation in the physical and biological sciences to develop and promote a commercially viable, sustainable, domestic bioenergy industry that produces clean, secure, renewable biofuels, bioproducts, and biopower that will reduce dependence on oil, reduce greenhouse gases (GHG) emissions, and create jobs through targeted research, development, demonstration, and deployment (RDD&D) supported through public and private partnerships. The potential advantages to the Nation are many. First, the new industry being developed can potentially create a great deal of economic activity and new jobs, especially in the farms and forests of rural America. Farming and forestry are both vital industries today, and biomass-based industries can produce new crops and provide more job opportunities for agriculture and forestry. Another economic advantage provided by the program is that the products that will be developed as a result of the program's investments will replace fossil fuels, especially crude oil. A recent study[b] estimates that the U.S. has the agricultural and forest resources to potentially displace 30 percent or more of the country's present petroleum consumption while supporting economic development in the U.S., mostly in rural areas.

Second, in addition to the expected economic benefits, increased use of biofuels, bio-products, and biopower can decrease life-cycle emissions of GHG and other pollutants substantially, depending on feedstock type, crop management practices, and processing. For liquid transportation fuels, biofuels are one important option for achieving such reductions, especially for diesel trucks and jet aircraft. Liquid transportation fuels are advantageous because they are largely compatible with existing infrastructure to deliver, blend, and dispense

[a] SBIR/STTR funding transferred in FY 2011 was $2,716,000.
[b] http://www1.eere.energy.gov/biomass/pdfs/billion_ton_update.pdf.

fuels. The program's supported biomass conversion technologies are projected to enable displacement of over 20 billion gallons of petroleum-based liquid transportation fuel annually by 2022 in support of meeting the Renewable Fuel Standard.

Finally, displacement of imported crude oil by domestically-produced, renewable biomass-derived products also increases our energy security. This is partly reflected in the Armed Services' aggressive targets for renewable energy as 50 percent of total consumption by 2020 — a target that can only be achieved by including bio-based diesel and jet fuels.

There are two underlying challenges that will not change. First, the scale of the liquid fuel and petrochemical industries are vast, and the facilities for producing those products are extremely capital-intensive. Biofuels and bio-products will be no different — in the U.S., almost $1 trillion in annual economic activity is involved, related to the liquid fuel and petrochemical industries, and hundreds of billions of dollars will ultimately have to be invested by the private sector to make a significant impact with biomass. Second, crude oil costs far less to produce than we typically pay to buy it, due to oil market supply and demand dynamics.[a] As a result, biofuels and bio-products may soon be price-competitive, but because they will not soon be cost-competitive, there is substantial risk to the nascent biofuels industry from periodic downward swings in oil prices. Crude oil producers can survive these downward swings because they are balanced by profit margins during other periods; producers of advanced biofuels will have much thinner margins at the outset. Biomass-derived products can be profitable businesses if crude oil prices are where we predict them to be in the coming years, but it will be decades before they can survive vs. oil prices that are close to the actual cost of production (currently around $20/barrel worldwide average).[b]

To help overcome these fundamental barriers, we must:

- Develop and demonstrate the advanced technologies needed to make bio-derived products price-competitive with their fossil competition — this is the primary focus of the program's efforts. Unless this is done to reduce the perceived risk and facilitate a greater sense of confidence and stability, private capital will be slow to flow to the emerging industry.

[a] http://www3.weforum.org/docs/WEF_RepoweringTransport_ProjectWhitePaper_2011.pdf; http://www.eia.gov/todayinenergy/detail.cfm?id=4550

[b] http://www.iea.org/textbase/nppdf/free/2008/ weo2008.pdf; http://www3.weforum.org/docs/WEF_RepoweringTransport_ProjectWhitePaper_2011.pdf;

Strategy

The program develops technologies across the entire value chain — from strain development and cultivation of algal feedstocks and collection of standing biomass at farm or forest, through conversion of biomass into finished products. These technologies enable the competitively viable operation of industrial-scale integrated biorefineries. Other innovative solutions are also envisioned that can harness the sun or chemical energy directly, without biomass feedstocks, converting CO2 directly into hydrocarbon fuels.

There are significant barriers to overcome in this work. To produce meaningful volumes of biomass is not difficult — significant quantities exist today as agricultural and forestry residues and urban wastes. To economically collect and haul these materials to a central processing facility is not so easy. Bales and bundles and chips are not as economical to transport as crude oil, coal, or corn grain because of their intrinsically higher bulk and lower energy densities. Conversion of biomass to fuels is another very large challenge. Some feedstocks, such as cane sugar, cornstarch, and vegetable oil are relatively easy to convert to liquid fuel products — nature provides these materials in a form that is relatively easy to digest by microorganisms and convert to fuels — but these feedstocks have competing uses as food. Other biomass feedstocks are a different story. The inherent structure of most biomass materials presents technological challenges to making useful fuels and chemical products from biomass. The program specifically focuses on the non-food based feedstocks and the unique conversion issues associated with their recalcitrance.

Solving these challenges drives the major goals of the program. To address the first problem, the logistics of biomass collection, pre-processing transportation, and storage, we are following two strategic pathways. Along one pathway, we are developing efficient ways to convert raw biomass to pellets (or other suitable densified solid formats) that will be stable in storage, have suitable flowability characteristics, be efficient to transport (much as we do with corn or wheat grain today), and have uniform handling and transport characteristics in any season and from any biomass source, and yet be readily convertible to biofuels and other products. The other pathway we are developing uses pyrolysis or other liquefaction technologies to produce "green crude" that can easily be transported for conversion at large scale, either in an existing refinery or a new, purpose-built facility.

To address the second major obstacle, the conversion of biomass to fuels, we are working on both biochemical and thermochemical approaches to production of so-called "drop-in" fuels and other chemical products.

Ethanol has been a successful motor fuel, and indeed it has demonstrated the economic benefits that a biofuels industry can bring to rural America. However, as ethanol blend levels increase, there is a need to address potential vehicle engine and fuel infrastructure compatibility. Additionally, ethanol replaces gasoline, and that is only about 40 percent of what is currently made from a barrel of crude oil. In order to replace the diesel, jet fuel and petrochemical products that are made today from crude oil, we need to develop technologies that can make these products from biomass.

Fortunately, leveraging technologies developed for cellulosic ethanol and additional advances being made by Department of Energy (DOE) Office of Science-funded projects, tools are available to do exactly that. It is now becoming practical to convert certain feedstocks to not only ethanol, but diesel fuel, jet fuel, and a host of other useful chemical products. The program formed the National Advanced Biofuels Consortium in order to accelerate these new developments in the production of drop-in fuels by both biochemical and thermochemical methods. In addition, we continue to support earlier-stage research and development (R&D) in drop-in fuels, in close cooperation with the Office of Science's Bio-Energy Research Centers. The program also works with Advanced Research Projects Agency-Energy (ARPA-E) on development of biomass-related topics, including breakthrough concepts in biomass crop variety development and novel conversion technologies. Finally, there is the issue of increasing the available feedstock supply in an economic and sustainable manner. For terrestrial crops, the focal point of such development is the U.S. Department of Agriculture (USDA), but the program continues to contribute in some areas and plays a lead role in feedstock logistics. In addition to terrestrial crops and waste materials, the program has a major feedstock effort related to algae. While algal technology development faces challenges, compared with typical terrestrial feedstocks, algae are compelling since : 1) cultivating algae requires no arable land, hence mitigates land-use competition with food production; 2) algae growth does not require fresh water that could otherwise be used for human and animal consumption or crop irrigation; 3) some algal species can theoretically be more efficient at converting sunlight to fuels; and 4) algal biomass productivities per acre and unit time can be much higher than most temperate and tropical terrestrial crops.

Through collaboration with ARPA-E, other innovative solutions are also envisioned that can harness the sun or chemical energy directly, without biomass feedstocks, converting CO2 directly into hydrocarbon fuels. These technologies have the ability to overcome the inherently low efficiencies of photosynthetic routes, as well as eliminate any concerns over food versus fuels issues associated with biomass feedstocks.

Benefits

Through RDD&D, the program will contribute significantly to making cellulosic biofuels competitive with petroleum-based fuels, achieving a modeled[a], mature technology wholesale finished-fuel cost of renewable gasoline, diesel, and jet fuel to less than $3.00 per gallon by 2017. This will also support the Renewable Fuels Standard volumetric requirements by deploying first of a kind integrated biorefineries that can produce advanced biofuels by the end of 2014. These goals will provide three major benefits:

- It will develop commercially-viable technology to potentially replace 30 percent or more of the country's present petroleum consumption while supporting economic development in the U.S., mostly in rural areas;
- In displacing a large amount of oil consumption, it will enhance our energy security; and
- It will decrease the emissions of GHG from the transportation sector. For light-duty and local/fleet vehicles, and especially for heavy/long-haul vehicles (trucks, trains, ships, and planes), it will provide one important option for accomplishing this goal. In fact biomass-derived jet fuel is currently the only alternative envisioned for aviation.

During the summer of 2011, the Secretaries of Energy, Navy and Agriculture entered into a Memorandum of Agreement to assist the development and support of a sustainable commercial biofuels industry for defense purposes, particularly for diesel and jet fuel. In FY 2012, the Department will continue to support this agreement with technical expertise moving to pilot-scale demonstration projects in FY 2013 of up to $40 million that will support our on-going technology maturation program and, eventually lead to, larger-scale production to support the Navy. Those pilot-scale demonstrations could be chosen from potential joint solicitations for defense biofuels production, if mutual advantages to the Defense and Energy missions can be achieved in awards to projects proposed. Planning for that potential outcome, the Department has requested legislative language to allow the flexibility for EERE appropriations pursuant to such pilot demonstrations to be transferred to the Defense Production Act Fund.

[a] An ASPEN Process simulation is utilized to derive the cost of production (design case). Heat and mass balance of the process is simulated by utilizing chemical and physical property data and assumptions about process conditions. Based on these results the software calculates the process capital and operating costs.

Key Accomplishments

In FY 2012, the program will have demonstrated and validated multiple integrated systems for the conversion of biomass to ethanol and other industrial alcohols. This will conclude the program's efforts in R&D of cellulosic ethanol technologies. The data from the program's effort directed at alcohol fuels will be available to industry and others looking to commercialize any of these technology pathway. During FY 2013 and beyond, the program will shift R&D efforts from alcohol fuels to producing drop-in fuels and bio-products to displace the entire barrel of imported oil.

Specific accomplishments in FY 2012 include:

- Achievement of a modeled cost for mature technology of $2.62/ gallon gasoline equivalent (gge) ($1.76/gallon of ethanol) for ethanol in 2012.
- Reduction in feedstock logistics costs for dry herbaceous biomass (i.e., field-dried corn stover) from harvest to biochemical conversion plant gate to $.44 per gallon of ethanol (equivalent to approximately $35/DT in 2007 dollars).

During the summer of 2011, the Secretaries of Energy, Navy and Agriculture entered into a Memorandum of Agreement to pursue production of biofuels for defense purposes, particularly diesel and jet fuel. In FY 2012, the Department will continue to support this agreement with technical expertise moving to pilot-scale demonstration projects in FY 2013 of up to $40 million that will support our on-going technology maturation program and, eventually lead to, larger-scale commercial production to support the Navy. Those pilot-scale demonstrations could be chosen from potential joint solicitations for defense biofuels production, if mutual advantages to the Defense and Energy missions can be achieved in awards to projects proposed. Planning for that potential outcome, the Department has requested legislative language to allow the flexibility for EERE appropriations pursuant to such pilot demonstrations to be transferred to the Defense Production Act Fund.

Strategic Plan and Program Performance Measures

As described above, there are three medium-term and one longer-term focus area; all are measured against economic performance criteria as part of an overarching goal for biofuels costs:

- Develop solid and/or liquid biomass-intermediate feedstocks that can be transported efficiently over long distances, allowing for efficient, large-scale conversion, use of existing infrastructure insofar as possible, and proximity to end-user markets.
- Develop conversion technologies to produce drop-in, infrastructure-compatible fuels and chemicals to utilize the entire barrel of crude oil to replace petroleum-derived fuels, chemicals and materials.
- Demonstrate, up to and including the first commercial-scale plant, the readiness of these technologies for market competition, in order to help attract the private capital required to fully develop the new industry.
- Pursue longer-range algae and other novel technologies as potential game-changers in terms of the volume, product palette, and sustainability of domestically-produced biomass.

The program conducts comprehensive and periodic reviews and annually updates its long-range plans. The program holds workshops to seek outside stakeholder input on new program directions, strategies, and technologies (such as advanced biofuels pathways). The program's long-range planning also integrates reviews and evaluations of technology progress through multiple other channels including: annual state of technology assessments, bi-annual independent peer reviews, and annual comprehensive project reviews for large deployment projects (i.e. Integrated Biorefineries). Information from external sources and internal reviews are incorporated annually into ten-year, integrated resource loaded plans, which are included in the annual update of the program's Multi-Year Program Plan (MYPP).

An important feature of program management is the feedback loop between RDD&D results and technoeconomic and sustainability analysis. By developing rigorous models of technical performance, micro- and macro-economic impacts, and environmental/societal sustainability, we are able to:

- Fund the most innovative and ground-breaking technologies from the portfolio of emerging technologies being developed in more fundamental programs, including the Office of Science, ARPA-E, and others.
- Identify the best opportunities for performance improvement and cost reductions along any pathway under development.

Analysis activities are essential to measure key metrics of program success such as the cost of production of biofuels. Our design reports show project cost for pyrolysis pathways will decline and become competitive by 2017 as technical goals are met. Design reports are based on Aspen model simulations for a representative process to convert biomass into advanced biofuels. The data and assumptions that support the Aspen model are generated through integrated piloting at the national labs. This provides the validation of the design cases. Also, the program has invested in over two dozen integrated biorefineries at the pilot, demonstration, and commercial scales that are generating a considerable amount of operational data to validate the design case

findings. The overarching lessons from integrated biorefinery operations are being used by the program to inform the design cases, as appropriate. This type of analysis provides clear guidance on areas important for technical R&D. The program supports a rigorous effort in understanding the cost of production of biofuels. Cost data from these studies have to withstand significant scrutiny due to the numerous uncertainties and assumptions that can influence the results. The program and its partners go to great lengths to obtain input and feedback from industry which is used to create data sets and models that can be utilized to provide results that are consistent and reliable.

The program's efforts in cost-shared RDD&D are the primary factors affecting the achievement of its "mature-technology, wholesale, finished-fuel cost" goals. In addition, ongoing innovation in the biofuels industry contributes more incrementally toward meeting cost goals. The cost models utilize data from a variety of sources including both program-supported projects and industry. DOE and an independent engineering organization participate in comprehensive project reviews of large scale projects. The data from these reviews can be used to validate cost and performance metrics against modeled numbers.

Additionally, in collaboration with USDA, resource assessment is conducted to determine the amount and price of biomass feedstocks that are expected to be available as a function of time. Life cycle analysis is conducted to determine the GHG emissions of various biofuels and compare them to fossil-based transportation fuels. The combination of this and other types of analysis provide the program with an overall picture that helps determine the viability of various biofuels production pathways.

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Biomass and Biorefinery Systems			
Innovations — The overall decrease in the program's early stage efforts is a direct result in transitioning innovations developed through previous years funding to validation at the bench, particularly in thermochemical conversion pathways. The conversion pathways however, will expand efforts in TRLs 1-3 as the program's primary focus further shifts to drop-in hydrocarbons.	89,453	75,344	-14,109
Emerging Technologies — Efforts expand in production of stable liquefied biomass intermediates, including bio-oil and in downstream process technologies to final products. Efforts increase in dewatering of algal biomass using novel technologies and the program will initiate a cook stove development effort.	57,709	84,629	+26,920
Systems Integration — Increased funding is the result of advances toward the completion of construction and operating for pilot and demonstration scale biorefineries selected through prior year Funding Opportunity Announcements (FOAs) including the EPACT 932 authorization. The funding differential reflects the new budget organization. Additionally, funds for an innovative pilot program will support new technologies as they transition from emerging technology development as well as advances in external programs, such as ARPA-E, and will support the DOE, Department of Defense (DOD), USDA initiative to commercialize biofuels for military applications. The program will also support deployment of the mobile feedstock process demonstration unit to address feedstock logistics scale-up issues as well as a new demonstration effort for cook stoves.	2,079	62,987	+60,908
Market Barriers — The slight decrease is reflective of completion of funding for mortgages on existing first-of-a-kind commercial biorefinery projects, which have broken ground and are being built.	44,135	42,283	-1,852
SBIR/STTR are calculated based on research and development funding allocations.	5,900	4,757	-1,143
Total, Biomass and Biorefinery Systems	199,276	270,000	+70,724

Explanation of Changes

The program is moderately decreasing funds in innovation activities to shift these funds to enable a more significant increase in emerging technologies as a result of transitioning R&D to the next TRL. Efforts are also expanding in emerging technologies to incorporate an increased focus on bio-oil and in downstream process technologies to final products. There is also a significant increase in systems integration because of the full-fledged construction of pilot and demonstration scale integrated biorefinery projects that were competitively awarded in 2007 and 2008 and that will be operational in 2014 to help support the EISA RFS goals. A portion of the increase in systems integration will support the joint DOE-DOD-USDA FY 2013 initiative to commercialize biofuels for military use.

Funding Opportunity Announcement Background

The program posts current and past funding opportunities for all program areas, at the program's webpage (http://www1.eere.energy.gov/biomass/financial_opportunities.html). Links to related opportunities from DOE National Laboratories and other Federal agencies are also available.

This open, competitive solicitation process is designed to meet the top technology needs identified by industry's roadmaps and the program's analyses. Funding opportunities encourage collaborative partnerships among industries, universities, National Laboratories, Federal, state, and local governments and non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance.

Anticipated FOAs

(Dollars in Thousands)

Fiscal Year	Technology Focus Area:	Program Area of Focus	Projected Funding
FY 2012	Conversion Research	Innovations and Emerging Technologies	30,000
New FOAs planned to overcome barriers identified in roadmap re-written in FY 2012 will likely include work on improving efficiencies of catalysts and new biocatalysts, integration of processing steps to evaluate engineering scale up and validate cost reductions, as well as applying synthetic biological approaches and tools to improve organisms for conversion of intermediates to hydrocarbon fuels			
FY 2012	Algae	Innovation and Emerging Technologies	14,300
New FOAs are planned to look at nutrient needs and improved algae sustainability, and to develop algae testbeds that will provide facilities and larger volumes of algae for technology research and development.			
FY 2012 and FY 2013	Innovative Pilots	Systems Integration	20,000
Funding will allow for development of advanced and innovative technologies, including algae-based technologies, with a focus on military fuels (diesel and jet) at the pilot scale to validate costs and accelerate commercialization (Total Federal investment planned $40 million).			
FY 2013	Conversion Research	Innovations and Emerging Technologies	67,500
New FOAs planned to overcome barriers identified in roadmap re-written in FY 2012 will likely include work on improving efficiencies of catalysts and new biocatalysts, integration of processing steps to evaluate engineering scale up and validate cost reductions, as well as organism development for conversion of intermediates to hydrocarbon fuels.			
FY 2013	Focus Area: Algae	Innovation and Emerging Technologies	22,100
New FOAs are planned to improve algal strain robustness and productivity, as well as to improve algal harvesting/dewatering efficiency. These R&D objectives were identified as barriers in the National Algal Biofuels Technology Roadmap, and the need for continued innovations in these particular areas are confirmed by research reports, as well as initial resource, technoeconomic, and lifecycle findings.			
FY 2013	Biomass Preconversion and Formulation	Emerging Technologies and Systems Integration	11,000
Funding allows for R&D to support feedstock preprocessing and handling and the deployable process demonstration unit to be utilized with industrial partners via partnerships with the Integrated Biorefinery Platform.			

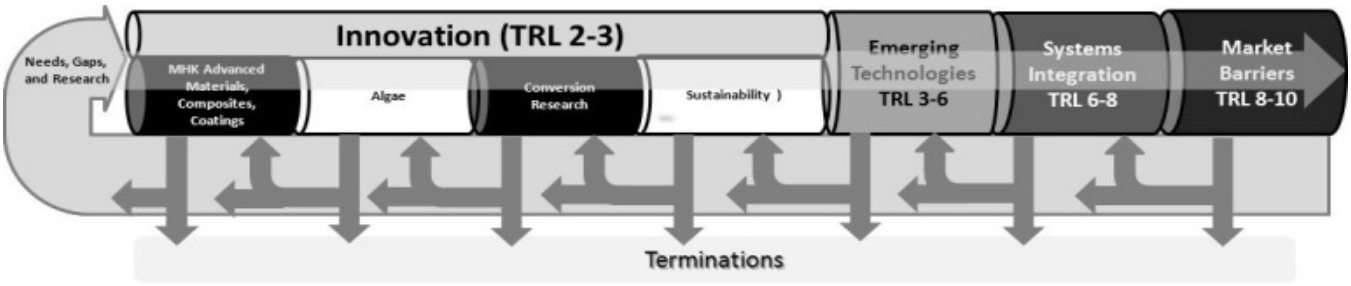
Innovations

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	79,298	89,453	75,344
SBIR/STTR	0	2,726	1,991
Total, Innovations	79,298	92,179	77,335

Sequence



Description

Innovation activities in the program to date address mostly TRLs 2-3. These activities utilize technologies enabled by prior years' support as well as TRL 1 activities developed through the Office of Science, National Science Foundation, and others. The activities funded support laboratory scale projects to move beyond basic principles and enable initial proof of concept. Work in this section will highlight innovations needed for the whole value chain, including analysis, feedstock and logistics, and conversion.

Key Technology and Focus Areas

Biomass Preconversion and Feedstock Formulation — In FY 2013, the program will continue to support work aimed at developing engineering solutions based on fundamental biomass characteristics that support the creation of biomass feedstocks that meets conversion performance specifications. This is envision to be a uniform format feedstock supply system whose design relies on regionally distributed preprocessing facilities that will service one or more biorefineries each. These projects will strive to preserve both biomass composition and mass through management of moisture content and package integrity. The purpose of the Innovations subprogram in feedstock supply is to identify and develop basic data, mathematical relationships, and computer models that support the design and creation or modification of hardware that can be tested at scale within the engineering tasks of the existing product demonstration unit (PDU).

Algae — In FY 2013, work initiated in FY 2010 will identify at least 3 innovative algae production strains will be identified with excellent biofuels traits, such as high lipid productivities that consistently exceed 30 percent of cell volume or strains that show high biomass productivities that exceed 25 $g/m^2/d$. However, current data show that few known algal strains exhibit both of these qualities and can also perform well in large production systems. Support in FY 2013 will enable these traits to be combined to systematically improve biomass and biofuel yields. Additionally, it is anticipated that cultivation system improvements will allow the performance of these selected strains to be investigated in innovative and low cost cultivation systems that can improve upon baseline estimated capital costs of open pond cultivation. In addition, a FOA will be issued to initiate innovative research projects that can support achieving a biomass productivity target of 35 grams per meters squared per day (annual average) under a variety of "real-world" or scalable, outdoor cultivation conditions within 4 years of project commencement. Achieving an algal biomass productivity target of 35 grams per meters squared per day (annual average) will reduce the modeled capital expense (CAPEX) component of algal biofuels within the integrated algae process design case, and progress from these projects will inform the formulation of outyear technical goals that relate to modeled cost of hydrocarbon fuels from algae.

Conversion Research — Conversion activities will focus on reducing the conversion cost of producing hydrocarbon fuels and chemicals from lignocellulosic biomass, by targeting key technology barriers. These

barriers would be associated with unit operations such as: pretreatment, enzyme production, hydrolysis, and fermentation and/or catalysis to hydrocarbon fuels and chemicals through biochemical conversion pathways. Understanding how to optimize biomass deconstruction via thermochemical processing, improving intermediate bio-oils and other liquid intermediates production, stabilization and upgrading, and identifying new and improved catalysts for fuel production remain key barrier areas to be addressed within thermochemical conversion pathways. Fundamental tools such as computational modeling, catalysis, synthetic biology, genomics, and cell wall characterization will be employed to drive the applied research to overcome the barriers. Additional topics identified during a FY 2012 roadmapping exercise (to identify technical barriers and innovative solutions in the path to commercialization of hydrocarbon based fuels and chemicals) will inform new R&D performed in FY 2013.

Specifically, FY 2013 activities will include the development of new design case(s) – that is, future projections based on modeled production costs for the most promising technologies within conversion pathways to hydrocarbon fuels and intermediates. The biochemical design case(s) will help identify future metrics for the biochemically related focus areas for FY 2013 and beyond. Research, in FY 2013, will also focus on barriers associated with carbohydrate intermediates and hydrocarbon fuel production. This will leverage the accomplishments of FY 2012 (such as, 90 percent conversion of xylan to xylose), to accelerate development of hydrocarbon fuels pathways. All of these activities are in support of the 2017 programmatic goal of less than $3.00/gallon renewable gasoline, diesel and jet fuels.

FY 2013 thermochemical pathway efforts will include the demonstration of the use of uniform-format densified solid feedstocks and its seamless interface with conversion technology; demonstration of equivalent oxygen reduction while reducing coke formation by 30 percent using novel vapor phase upgrading catalysts, and completion of a new liquefaction design case using results of the program core platform research and non-proprietary information from National Advanced Biofuels Consortium. Ultimately, R&D in FY 2013 will result in experimental validation of a modeled FY 2013 conversion price projected target of approximately $2.70/gge for a combined gasoline and diesel fuel, which enables a finished fuels price of <$3/gge in 2017 (EIA 2009 projected price of gasoline).

Sustainability — Activities include analysis to evaluate the potential impacts of large scale bioenergy production on water quality, water availability, and biodiversity. In addition, the program is supporting research to assess the potential impacts of climate change on biomass yield and water demand. These analyses are done in partnership with the program's technology research activities in order to consider the latest advances in research and technoeconomic analyses on feedstock production, supply chain logistics, and conversion technologies.

Cook stoves Initiative —The goal of the Biomass Program's Cookstoves Initiative, in coordination with several USG agencies and the Global Alliance for Clean Cookstoves, is to accelerate the dissemination of low-emission, high-efficiency cookstoves technologies that use solid biomass fuels. By replacing open fires and inefficient stoves, these technologies can increase access to clean energy and enhance indoor air quality, personal health, livelihoods, and the environment. Small businesses developing cookstove technologies can drive innovation in the U.S. for international markets as well as domestic markets where the technologies are applicable. To this end, the program will identify, develop, and test lower cost materials with high levels of performance and durability, the development of affordable and reliable fan drives, controls, and sensors to improve combustion and heat transfer, and improve the understanding of the mechanisms and combustion conditions that minimize the formation of particulate emissions and heat transfer to optimize efficiency and reduce emissions. These applied research efforts will be unified in a design tool to accelerate cook stove development by unifying the large existing research knowledgebase in an accessible framework to enable stove designers from many organizations to quickly assess the impacts of design modifications on stove performance under a range of conditions.

Benefits

Technology Benefits:

- Develop tools that enable process step improvements for reducing the cost of producing fuels from biomass.
- Provide data to the research community to enable sustainable development of new innovations.

Engineering Benefits:

- Identify opportunities for value engineering and cost improvement.
- Generate process performance parameters for engineering design and scale-up.
- Enable refinement of capital cost estimation.
- Facilitate the expansion of energy feedstocks and creation of feedstock supply infrastructure.
- Understand the impact of physical and chemical feedstock quality characteristics (i.e., particle size, particle density, moisture content, ash content, lignin content, carbohydrate content, and nitrogen content) on conversion performance parameters.

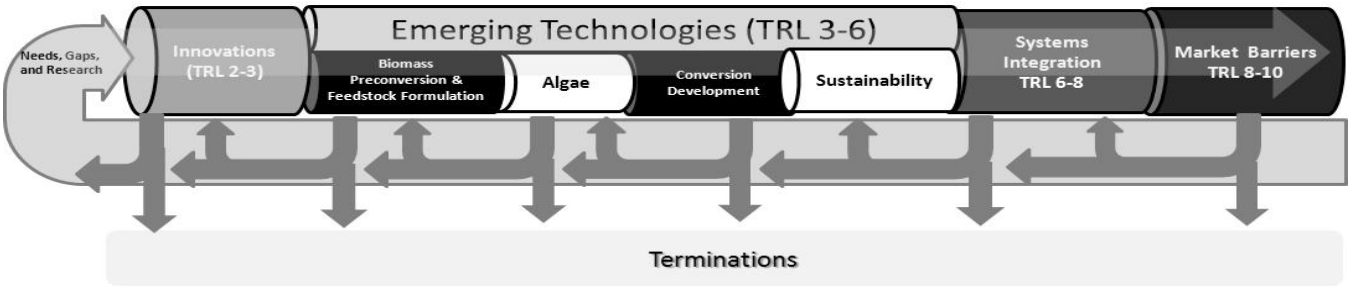
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	29,186	57,709	84,629
SBIR/STTR	0	1,760	2,536
Total, Emerging Technologies	29,186	59,469	87,165

Sequence



Description

The program addresses emerging technologies for future deployment through development activities in TRLs 4-6. These activities support the validation of technologies in the field environment and the development of prototypes for further validation. These activities utilize innovative technologies developed through efforts in TRLs 1-3 including those enabled by prior years' support.

Prior to FY 2013, the program will demonstrate and validate multiple integrated systems for the conversion of biomass to ethanol and other industrial alcohols. The data from these development activities will be available to industries and others looking to move into TRLs 7-9. Beginning in FY 2013, the R&D program will make a shift to developing and validating technology for producing hydrocarbon ("drop-in") fuels from biomass. In FY 2013, the program will support technology development toward achieving a 2017 modeled conversion cost of $1.50/gallon for gasoline and diesel (assuming 2007 dollars and n^{th} plant costs), plus a delivered feedstock cost of $80/dry ton). Combined with feedstock improvements this will meet the 2017 program goals of less than $3.00/ gallon renewable gasoline and diesel, and renewable jet fuel.

Key Technology and Focus Areas

Funding from prior year appropriations have been used to:

- Establish university and industry-led demonstration projects that will provide data on system validation. Yield data from regional partnership field trials have informed a nationwide resource assessment. Watershed-scale field trials focused on feedstock sustainability have led to the development of approaches to support best management practices.
- Adapted electrocoagulation technologies that have traditionally been used in the wastewater industry to successfully concentrate algae 100-fold from 0.1 percent to 10 percent solids.
- In 2012, achieved a modeled n^{th} plant ethanol cost of $2.15/gal for biochemically derived ethanol from corn stover, by demonstrating technology capable of economically converting biomass feedstocks (conversion cost being $1.41).
- In 2012, achieved a modeled n^{th} plant ethanol conversion cost of $1.31/gal ($2007) in support of a modeled ethanol production cost of $2.05/gallon for thermochemical gasification of biomass followed by mixed alcohol synthesis and alcohol separation.

Biomass Harvest, Collection, Transport, and Storage Logistics Systems — These activities focus on the development of engineering solutions to address in-field moisture management, harvesting techniques for new energy crops, single-pass harvesting, feedstock milling and densification, feedstock formulation, and controlling feedstock quality factors within the logistics chain to facilitate conversion performance. These preprocessing systems stabilize and densify the material for long-term storage and utilization, while also contributing to increased conversion process performance characteristics.

Sustainability — Development activities include field studies to evaluate the productivity and sustainability of best management practices for feedstock production and work to establish relevant metrics and baselines for

sustainability of feedstock production and conversion. These activities are conducted at DOE National Laboratories as part of interagency efforts in coordination with USDA scientists.

Algae — In FY 2013, work initiated in FY 2010 will continue in developing low energy intensity technologies for dewatering algal biomass, which will provide a better understanding of how these and similar technologies will be able to scale in terms of flow-rate, and how broadly applicable these technologies will be to match the needs of the algae producers and the downstream processes. In addition, increased throughput rates will be emphasized. Emerging technologies investments initiated in 2012 will make improvements towards the goal of > 90 percent continuous recycling of key nutrients (N and P) during algal cultivation. Improvements in nutrient recycling technologies can reduce the modeled operating expense (OPEX) component of algal biofuels within the integrated algae process design case. In addition, a FOA will be issued to initiate projects with the potential to support achieving reductions in both harvesting CAPEX and OPEX by 40 percent from the baseline algae process design case within 4 years of project commencement.

Conversion Development — The program will advance the efficiency and yield of bio-oil production systems and subsequent hydrotreating subsystems to produce renewable gasoline, diesel, and jet fuel. Specific activities will integrate multiple unit operations in the bio-oil production process (e.g. feedstock supply, liquefaction, upgrading steps), including:

- At laboratory scale, integrate and optimize bio-oil production and upgrading processes, as well as catalytic systems that produce hydrocarbons in the gasoline, diesel, and jet fuel range.
- At laboratory scale, integrate and couple thermochemical biomass conversion processes so that resulting products are amenable to processes used in petroleum refineries; enabling efficient leveraging of current infrastructure.
- Model and develop integrated systems to produce refinery-ready bio-oils.
- Model and validate the technically and economically optimal refinery insertion points for thermochemically derived intermediates.
- Develop the methodologies to validate integrated thermochemical systems for processing biomass to hydrocarbon ("drop-in") fuels.
- Develop feed systems handling to overcome current barriers identified by biorefinery activities in TRLs 7-9.
- In FY 2013, key biochemical conversion development activities will continue to focus on process integration with special attention paid to pretreatment, clean sugar production and fermentation and/or catalysis to hydrocarbon fuel intermediates and bio-based chemicals. Additional topics identified during FY 2012 roadmapping exercises (to identify technical barriers to commercialization of hydrocarbon fuels and chemicals) will also be the focus of new FOAs to perform development work in FY 2013.

Cook stoves Initiative — Prototypes will continue to be developed for a range of regions, cuisines, and fuels. Laboratory testing will be used to optimize stove designs to improve efficiency and reduce emissions.

Benefits

Benefits of the investment will include:

Technology Benefits:

- Define and develop uniform format feedstock materials;
- Create feedstock materials that meet cost and feedstock format targets for conversion processes; and
- Provide the industry with multiple validated designs that are able to be cost competitive with petroleum fuels when commercialized.

Engineering Benefits:

- Identify opportunities for value engineering and cost improvement;
- Generate process performance parameters for engineering design and scale-up; and
- Enable refinement of capital cost estimation.

Financial Benefits:

Reduce financial risk associated with pioneer commercial plants.

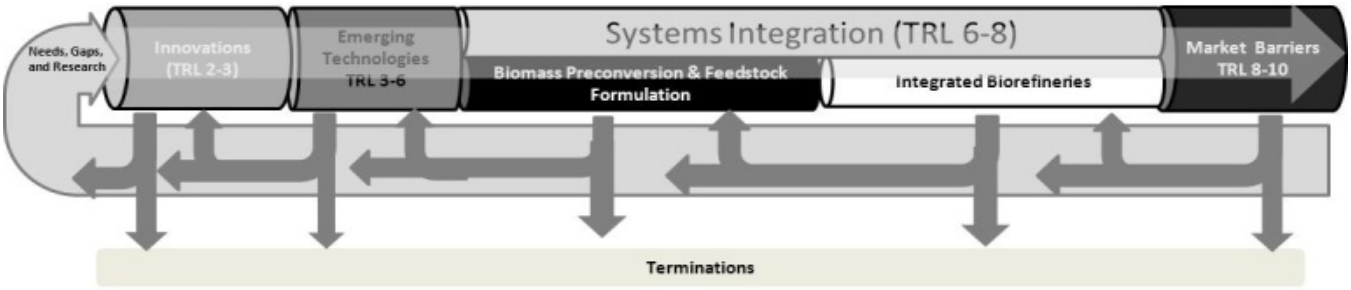
Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	3,335	2,079	62,987
SBIR/STTR	0	63	93
Total, Systems Integration	3,335	2,142	63,080

Sequence



Description

The program is focused on supporting the growth of the emerging domestic biomass utilization industry in the U.S. The widespread commercialization of biomass conversion technologies for fuels, products and power would reduce the Nation's dependence on oil, stimulate rural economic development and job creation, and improve the sustainability of the Nation's economic activities. The program will help achieve these benefits by investing in the demonstration of integrated biofuels production facilities known as "integrated biorefineries" at the pilot and demonstration scales.

Systems Integration activities in the program address TRLs 7-8. These activities support the integrated operation of pilot (typically 100,000-500,000 gallons per year) and demonstration scale (typically 1-10 million gallons per year) biomass feedstock logistics and conversion facilities and equipment that utilize technologies enabled by prior years' support of emerging technologies in TRLs 4-6. By comparison, viable commercial-scale biorefineries typically produce greater than 20 million gallons per year. The support of integrated pilot and demonstration scale biorefineries is intended to reduce the technological and financial risks associated with the commercial deployment of new process technologies by validating integrated process operation at increased scale, determining real world manufacturing costs for these facilities and generating the engineering data required for the design, scale-up and operation of commercial scale biofuels production facilities.

Key Technology and Focus Areas

Funding from prior years' appropriations has been used to establish 29 integrated biorefinery awards, leading to the construction and operation of 12 pilot scale biorefineries and 4 demonstration scale biorefineries. Three of the recipients have leveraged the investment from DOE to enable successful initial public offerings resulting in $422 million of public and private sector investment. Three other projects have leveraged their DOE awards to help attract over $200 million in private equity investment.

Integrated Biorefineries — In FY 2013, the program will continue to fund ongoing pilot and demonstration scale integrated biorefinery projects that are validating a diverse set of feedstocks and fuels, including cellulosic ethanol and renewable diesel, and that have entered the construction and operation phases. The FY 2013 funding level supports the innovative pilot projects selected in the solicitation held in FY 2012. These innovative pilots will leverage prior year investments in high risk/high reward R&D technologies made through ARPA-E, Office of Science and others. The program's innovative pilot scale investments will enable entrepreneurs with promising technologies that can overcome some of the barriers to utilizing lignocellulosic or algae feedstocks for the production of drop-in hydrocarbon fuels. These piloting activities will generate necessary operational

data to validate technoeconomic models and move R&D from laboratory to commercial ready projects. Additionally, these innovative pilot projects will align with the Memorandum of Understand signed by the DOE, DOD, and USDA (June 2011) with the objective of producing advanced biofuels meeting military specification at a price competitive with petroleum.

Biomass Preconversion and Feedstock Formulation — In FY 2013, the program will continue to support the maintenance, deployment and operation of a mobile feedstock preprocessing demonstration unit (called the dPDU—deployable Process Demonstration Unit) that was developed by the Idaho National Laboratory with prior year funding from DOE. This mobile demonstration unit is designed to preprocess low bulk density biomass feedstocks such as corn stover, forest residuals and switch grass into more energy dense, stable, high quality uniform formats (e.g., pellets, liquids, torrefied, pyrolyzed material). These efforts include both the development and the demonstration of new pre-processing pathways. They will also enable testing of materials in support of biorefinery efforts at DOE and with other entities. This will enable the transformation of raw biomass to meet feedstock conversion specifications of real conversion processes, while also reducing the transportation, storage and handling costs associated with biomass feedstocks, reducing feedstock losses during storage and handling, and maintaining feedstock quality during storage, as well. This will allow the emerging biomass industry to utilize the existing national network of agriculture and forestry industry infrastructure. The deployable PDU will be utilized only in collaboration with industrial partners in projects awarded under a planned FOA in FY 2013.

Cook stoves Initiative — To ensure performance, usability, durability, and safety, cook stoves will be piloted in relevant regions. To complement laboratory testing during the development phases, field testing and monitoring will be used to validate stove performance and usage under realistic conditions. Other agencies in the cook stove initiative, including the U.S. Agency for International Development and Peace Corps will have primary responsibility for deployment.

Benefits

Benefits of the investment in pilot and demonstration scale integrated biorefineries will include:

Technology Benefits:

- Validate integrated process performance and quantify sustainability metrics;
- Identify operability and material compatibility issues; and
- Generate initial product volumes required to obtain fuel certifications.

Engineering Benefits:

- Identify opportunities for value engineering and cost improvement;
- Generate process performance parameters for engineering design and scale-up; and
- Enable refinement of capital cost estimation.

Financial Benefits:

- Assist entrepreneurial enterprises in crossing the project development “Valley of Death”; and
- Reduce financial risk associated with pioneer and subsequent commercial plants.

National Benefits:

- Contribute to the goal of producing 21 billion gallons per year of annual advance biofuels production capacity by 2022, including the associated economic development and creation of jobs;
- Reduce dependence on oil and fossil fuels;
- Development of sustainable energy technologies; and
- Facilitate the establishment of economically viable and sustainable energy feedstock crops, and the creation of viable feedstock supply chain infrastructure.

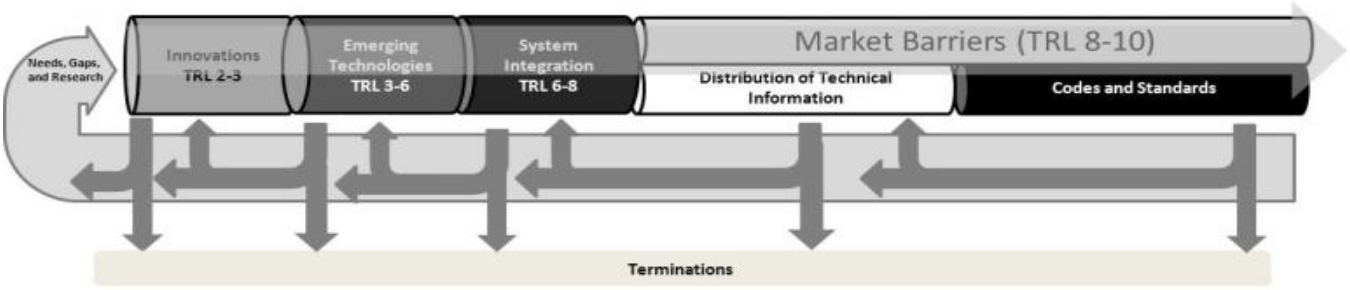
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	68,160	44,135	42,283
SBIR/STTR	0	1,351	137
Total, Market Barriers	68,160	45,486	42,420

Sequence



Description

The program is focused on supporting the growth of the emerging domestic biomass utilization industry in the U.S. The widespread commercialization of biomass conversion technologies for fuels, products and power will reduce the Nation's dependence on oil, stimulate rural economic development and job creation, and improve the sustainability of the Nation's economic activities. The program will help achieve these benefits by investing in the deployment of first-of-a-kind integrated biofuels production facilities known as "pioneer plants".

Deployment activities in the program address TRL 9. These activities support the integrated operation of first-of-a-kind commercial scale biomass conversion facilities known as "pioneer plants". The design and construction of pioneer biorefineries will be enabled by prior years' support of demonstrated technologies in TRLs 7-8. The support of pioneer commercial scale biorefineries is intended to reduce the engineering and financial risks associated with nationwide commercial deployment of biomass conversion technologies at commercial scale. This will be accomplished by implementing production technologies in their final form and operating under the full range of operating conditions, including year-round, steady state, 24/7 operation while meeting cost, yield, and output targets.

Key Technology and Focus Areas

Funding from prior years' appropriations (including Recovery Act funding) has been used to establish four commercial scale pioneer biorefineries.

Integrated Biorefineries — The program's four commercial scale projects cover a wide range of technologies that use lignocellulosic biomass to produce commercial scale quantities of advanced biofuels. These projects are critical to the validation of the technical and economic performance necessary for subsequent build out of the cellulosic biofuels industry with private investment. Success in this will catalyze the build out of the industry that will eventually meet the aggressive advanced biofuels goals set forth by the EISA RFS2 (2007)

In FY 2013, the program will continue to support the President's commitment to help entrepreneurs break ground for four next-generation biorefineries – each with a capacity of more than 20 million gallons per year. The program has four commercial scale integrated biorefineries that have already broken ground on pioneer plants operating at least 20 million gallons per year advanced biofuels capacity (Abengoa, POET, Bluefire, and Mascoma). In FY 2013, the program will continue to support the existing outyear mortgage commitments associated with these prior year awards as they move through construction and enter the operations phase of the projects. These commercial scale projects have secured hundreds of millions in debt and equity investments from the private sector and created hundreds of renewable energy jobs, with the potential for significant multiplier effects assuming commercial

scale replications. DOE's continuing support is essential to complete these projects, to maintain DOE's credibility with the biofuels industry and the momentum associated with this emerging renewable energy industry sector. There are no new commercial scale biorefineries planned.

Analysis — In FY 2013, the program will continue to support technoeconomic, sustainability, and engineering analyses relating to the cost of production and total project cost of pioneer (first of a kind) and "n^{th}-plant" commercial scale biorefineries.

Benefits

Benefits of the investment in pioneer commercial scale integrated biorefineries will relate to risk reduction and the creation of domestic biofuels production capacity, including:

Technology Risk:

- Demonstrate sustained, continuous conversion process performance at the appropriate scale, while meeting cost, yield, and output capacity targets.

Engineering Risk:

- Allow for the provision of performance guarantees; and
- Enable reduction in engineering and construction costs.

Financial Risk:

- Demonstrate cash flow and economic viability at the commercial/demonstration/pilot scale, as appropriate;
- Demonstrate the logistics and economics of feedstock supply agreements; and
- Demonstrate the logistics and economics of product off-take agreements.

National Benefits:

- Contribute at least 80 million gallons per year in FY 2014 to the goal of 21 billion gallons per year of annual advance biofuels production capacity by 2022 including the associated economic development and creation of jobs;
- Reduce dependence on oil and fossil fuels;
- Development of sustainable energy technologies; and
- Facilitate the establishment of energy feedstocks and creation of national feedstock supply infrastructure.

Geothermal Technologies Program

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Geothermal Technologies Program			
Enhanced Geothermal Systems	15,513	15,528	43,627
Low Temperature and Co-produced Resources	3,877	4,852	2,000
Innovative Exploration Technologies	12,602	12,483	13,512
Systems Analysis	5,000	4,000	4,000
SBIR/STTR	0	999	1,861
Total, Geothermal Technologies Program	36,992	37,862	65,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Geothermal Technologies Program			
Innovations	17,000	18,925	27,146
Emerging Technologies	8,815	10,056	26,661
Systems Integration	6,177	3,882	5,332
Market Barriers	5,000	4,000	4,000
SBIR/STTR	0	999	1,861
Total, Geothermal Technologies Program	36,992	37,862	65,000

Public Law Authorizations

P.L. 93-410, "Geothermal Energy Research, Development, and Demonstration Act" (1974)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-618, "Energy Tax Act" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989"
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990"
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"
P.L. 111-5, "American Recovery and Reinvestment Act of 2009"

Overview

The Geothermal Technologies Program's mission is to accelerate deployment of geothermal energy nationwide through research, development, demonstration and analysis efforts focused on improving performance and decreasing costs. Decreasing the levelized cost of electricity (LCOE) of geothermal systems to $.06/kWh (without subsidies) by 2020 and developing improved methods for tapping into geological heat reservoirs throughout the Nation will allow geothermal energy to compete directly with conventional electricity sources and will enable widespread utilization in the U.S.

Geothermal energy represents an enormous, under-utilized heat and power supply that has a number of advantages over other energy technologies. Geothermal energy is clean (emits little or no greenhouse gas), reliable (high system availability), widespread, and is one of the few renewable energy technologies that can provide baseload power. Geothermal technology has the potential to help transform the Nation's energy system by reducing its dependence on fossil fuels and improving national energy security. Furthermore, investment in the advancement of geothermal energy will contribute to strengthening the Nation's science and engineering sector while re-enforcing American technological leadership — a cornerstone of our economic competiveness and growth.

[a] SBIR/STTR funding transferred in FY 2011 was $1,011,000

There is currently over 3,000 MW of geothermal installed capacity in the U.S. yet there remain important technical barriers that must be addressed before geothermal technologies can play a significant role in our country's energy mix. Because of declining exploration activities in recent years, installed geothermal capacity represents only a small portion of the estimated U.S. geothermal resource.

To bring more clean energy online in the near-term, the program is investing in developing the Nation's undiscovered hydrothermal resources. These resources are defined by the presence of three key elements — heat, fluid, and permeability (the ability for fluid to flow through rock), which are associated with geologically active areas that are located primarily in the western U.S. The capacity developed to date has exploited hydrothermal resources that can easily be identified from the surface, via manifestations of key indicators, such as geysers and fumeroles. The remaining hydrothermal resource in the U.S. is over 30,000 MW in the western U.S. alone[a], but shows little to no surface expression, i.e. they are "blind" resources. Therefore, advancement of exploration technologies that provide a means to interpret the characteristics of the subsurface is critical to identify viable, economic resources that can increase geothermal energy generating capacity by tenfold.

Today, the risks and costs associated with geothermal development in uncharacterized areas are high; the inability to consistently drill economically viable wells is a major barrier to near-term capacity expansion. The program is focused on developing the technologies necessary to effectively find and access these "blind" resources at lower cost, after which they can be developed and brought online by the private sector. The program is also targeting research to reduce the costs of operation and maintenance (O&M), as O&M costs account for about 10 percent of blind hydrothermal systems' LCOE.

Another significant opportunity lies in Enhanced Geothermal Systems (EGS), a technology that has yet to bring power to the grid in the U.S., but has been successfully developed in Europe at small scale. EGS paves the way to access a ubiquitous resource provisionally estimated to be over 500 GW_e[a]. The EGS concept involves creating a man-made geothermal reservoir wherever there is accessible heat in the subsurface. This is accomplished by adding one or two of the key elements found in natural geothermal systems: fluid and/or permeability.

High drilling costs, created or "stimulated" reservoir volume limitations, lack of durable high temperature and pressure tools, and insufficient fluid flow and fracture characterization abilities must be addressed before EGS can make a significant contribution to our energy mix. To this end, the program develops, improves, and demonstrates EGS reservoir access, creation, and sustainability technologies through research, development and demonstration (RD&D). Although technology development and demonstration are essential in each of these categories, the program focus is reservoir creation as it is the key to demonstrating technical feasibility of EGS by 2020.

Market barriers for geothermal (both hydrothermal and EGS) include the high cost of geothermal drilling and development, insufficient geothermal resource data, public concern over geothermal development risks, transmission access or availability challenges, regulatory delays for all phases of geothermal development and RD&D, and a lack of trained geothermal professionals in both the public and private sectors. To address these issues, the program invests in robust technical and economic modeling, data gathering and dissemination efforts, permitting and transmission analysis, and education efforts.

Strategy

To accomplish the goal of establishing geothermal as a major baseload contributor to the U.S. energy mix, the program supports a balanced portfolio of investments in innovation, emerging technologies, systems integration, and activities that address market barriers. The program´s strategy focuses on two main technology pathways, both of which can result in the lowering of geothermal costs and accelerated adoption of geothermal energy.

- Hydrothermal and Resource Confirmation will accelerate geothermal development in the near-term by addressing the critical barriers to hydrothermal development, namely exploration risks and costs. The program will focus on developing or improving exploration technologies and continue efforts to lower the operational and maintenance cost of geothermal systems, including low temperature systems, with an emphasis on emerging technologies and systems integration.
- EGS will enable utilization of an enormous, wide spread energy resource in the long-term. The program will be directed at core investments in innovations and emerging technology solutions needed to determine the technical feasibility of creating and sustaining economically viable EGS.

[a] "Assessment of Moderate- and High-Temperature Geothermal Resources of the U.S.," Williams, Colin F. et al., U.S. Geological Survey, 2008, http://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf.

This will be accomplished through specific RD&D and the initiation of a field test site effort where fundamental questions pertinent to EGS development can be addressed.

The program will, in alignment with program goals, support a wide spectrum of geothermal technologies in accordance with the Energy Independence and Security Act of 2007 (Public Law 110-140). These technology pathways will enable development of advanced geothermal technologies capable of lowering the LCOE from "blind" hydrothermal resources to $.06/kWh by 2020, while accelerating the discovery and utilization of the estimated 30,000 MWe of undiscovered hydrothermal resources in the Western U.S, and enabling development of 500 GW_e of EGS resources nationwide.

Because the critical barriers to widespread geothermal resource development are technological as well as economic, the program supports cutting edge RD&D efforts to improve performance, reduce costs, validate technologies, and ultimately permit access, characterization and sustainable development of all geothermal resource types.

To set priorities, the program, in conjunction with stakeholders, evaluated progress, results and research gaps of the current RD&D portfolio from results of the Annual Peer Review and roadmapping. The program identified technology focus areas that require immediate attention to reach subprogram goals, including: reservoir stimulation technologies, tools and techniques by which EGS reservoir evolution can be monitored and volume changes estimated, advanced geophysical techniques for identifying blind hydrothermal resources, and geochemical techniques for characterizing hydrothermal and EGS resources. In addition, previously funded research areas that warrant additional attention were defined, including: high temperature tool development advanced drilling, and well completion technologies.

Also, as a result of this evaluation, five focus areas were identified for further analysis to determine whether research progress or impact could be improved by leveraging complementary work or whether research funding should be directed elsewhere. These research areas are: 1) tracer Interpretation; 2) CO_2 interactions; 3) reservoir and fracture prediction modeling; 4) advanced seismic surveying for hydrothermal exploration; and 5) advanced working fluids in power cycles.

For example, in the area of prediction modeling, the program has formed an EGS reservoir modeling working group to assess capabilities and reservoir representation issues. To identify and resolve the strengths and weaknesses of each model, the working group participants will take part in a code comparison study where a common data set is run. Another R&D area undergoing further analysis involves an exploration technology widely used in the oil and gas industry to locate underground resources. The program invested American Recovery and Reinvestment Act of 2009 (ARRA) funds to validate the use of advanced seismic surveys with shear wave processing in hydrothermal fields, but initial results show that the technology is not directly transferable to geothermal environments and that more R&D needs to be done before it can improve the accuracy of geothermal exploration well targeting.

FY 2013 activities will focus on EGS reservoir creation and monitoring technologies along with improved resource characterization through initiation of one or more EGS field test sites, regional data gathering to identify new prospects, and continued funding of RD&D projects.

These first-of-its-kind EGS test sites are envisioned as multi-user pre-competitive R&D environments for EGS testing and validation. Such facilities are critical to the advancement of EGS technology as they will help establish the technical and operational settings and parameters under which EGS can be commercially successful. At up to three separate and geologically unique test sites, best practices and technologies for accessing, creating and sustaining EGS reservoirs will be developed. Furthermore, as government-managed collaborative facilities, the sites will provide a common setting for high temperature tool evaluation and testing against a common baseline, and accurate assessment of indirect and geophysical tools against a known and characterized subsurface and thermal regime. These opportunities to test tools and stimulation techniques at a government run site will considerably lower the risk of EGS technology development, thereby enhancing the ability of innovative private companies to obtain critical early-stage financing.

Sites will be chosen in consultation with industry, academia and National Laboratories experts to maximize collection of technology-critical data and information. The site and technology scoping process will include consultation with other Federal agencies including the Department of Defense and the Department of the Interior.

The site selection process includes fundamental criteria to ensure that the sites selected include sufficient technical and geologic diversity, including depth, rock properties and pressure, to maximize the probability of success. This includes exploring a variety of operation and management models, provided that government control of operations and technical direction is maintained. It is anticipated that the model will include a "user-facility" component whereby technology developers can test new tools and techniques in a government managed, low cost environment. R&D

activities will be competitively selected and prioritized based upon a merit review of comparative impacts on EGS success, in particular impacts on lowering EGS LCOE.

Benefits

The U.S. geothermal industry is comparatively small and the payback period on investment in geothermal development is longer than that in the oil and gas industry, yet the development costs are similarly high. Consequently, geothermal companies have limited financial resources to invest in the R&D work required to make geothermal energy a major player in the U.S. energy mix. Further-more, venture capital firms will not invest significantly in a geothermal project until the resource is proven (hydrothermal) or EGS technology is established as economic and sustainable. It is therefore imperative that the Government work to reduce both financial and technical risks so that geothermal energy can become established as a significant, reliable and baseload energy source.

The program has been instrumental in developing the technologies necessary to improve the economic feasibility of geothermal resources for power production. Prior to the emergence of the Geothermal Program, commercial power production from geothermal resources in the U.S. was limited to a single dry-steam field[a]. Since its inception, the program has enabled the technology for production from wet-steam and liquid-dominated resources, greatly expanding the potential for domestic geothermal energy production and helping to increase power produced from geothermal to over 3,000 MW.

Key Accomplishments

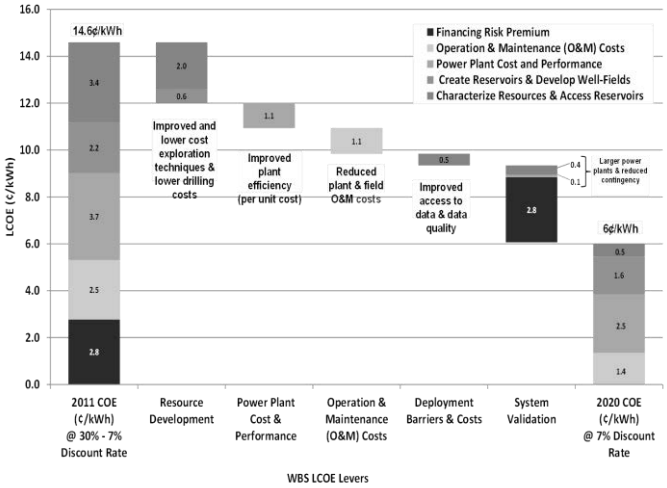
Some examples of recent accomplishments that contribute to meeting the program goals include:

- In FY 2011, one of the program's seven EGS field demonstration projects proved that an under-productive geothermal well can be successfully stimulated to increase its economic viability. This represents a significant step towards establishing the technical feasibility of EGS, one of the program's primary goals.
- The program has advanced drilling technology in geothermal environments and shown increased rates of penetration in hard, crystalline rocks[b] on the order of 15 ft/hr. and approaching the 30 ft/hr. goal. Drilling improvements of this magnitude will play an integral role in decreasing high development costs associated with geothermal energy and eventually facilitating widespread deployment.
- A low temperature demonstration project in Nevada showed in FY 2011 that production from low temperature resources is feasible and can be a viable contributor to the geothermal and renewable energy mix.
- The program is demonstrating the use of an innovative variable phase turbine that enables the production of 30 percent more power from low temperature geothermal resources.
- The program is making large quantities of geothermal-based geoscience data available to the public, investors and geothermal explorers through the National Geothermal Data System to reduce exploration risk and costs. At risk, legacy geothermal-relevant data from all 50 states is being digitizing and existing digital data is being published.

Strategic Plan and Performance Measures

The program's analysis of how to reduce the LCOE of "blind" hydrothermal resources to $.06/kWh can be seen in Figure 1. The cost data was developed using a geothermal techno-economic model that has been developed and validated by the National Laboratories with performance and cost data from industry and input from multiple experts. It shows that program activities need to target resource development costs, including resource characterization and exploration and reservoir access. Progress in these areas will significantly lower the LCOE. The program can also effect change by reducing O&M costs. By investing in projects that reduce the cost of both plant and well field maintenance the LCOE can be reduced by almost 10 percent. Finally, some impact can be made by reducing power plant (turbine, generator, and condenser) and the balance of plant costs. Although these latter technical areas are not a main focus of the program, continuing projects in emerging technologies and systems integration are yielding results in this area.

Figure 1:
Levelized Cost of Energy for Blind Hydrothermal Resources - Path to $.06/kwh.



[a] The Geysers, located in Northern California.

[b] Typical of all geothermal reservoirs but atypical in terms of traditional oil and gas reservoir types.

Performance Measure Analysis

As part of the effort to transform the Nation's energy supply and secure U.S. leadership in development of clean energy technologies, the program seeks to develop geothermal technologies that will lessen dependence on fossil fuels for domestic electricity production. To make this a reality, the program will need to reduce the cost of developing geothermal resources by improving identification tools, developing advanced drilling techniques, and progressing the state-of-the-art for reservoir creation and characterization. The specific performance measures used demonstrate efforts to improve efficiencies and reduce costs so that geothermal energy can be competitive with conventional electricity sources.

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Geothermal Technologies Program			
Innovations — The increase in funding in the Innovation subprogram represents the influx of new projects initiated through the EGS test site(s) and improved resource characterization efforts in addition to the continuation of ongoing R&D in critical focus areas.	18,925	27,146	+8,221
Emerging Technologies — An FY 2011 Funding Opportunity Announcement (FOA) was issued to address critical technology focus areas, including research focused on: safely accessing geothermal reservoirs faster and at lower costs, identifying and characterizing blind hydrothermal resources, and innovative means by which EGS reservoirs can be created and monitored throughout their lifetime. Increased focus on emerging technologies reflects the progression of these R&D projects and initiation of the new EGS test site(s) and associated projects.	10,056	26,661	+16,605
Systems Integration — Geothermal Systems Integration efforts will increase slightly to reflect projects progress towards commercial viability; advances made in exploration technologies, power conversion and reservoir creation and characterization will be validated.	3,882	5,332	+1,450
Market Barriers — The program will continue its efforts in Systems Analysis.	4,000	4,000	0
SBIR/STTR are calculated based on research and development funding allocations.	999	1,861	+862
Total, Geothermal Technologies Program	37,862	65,000	+27,138

Explanation of Changes

The increase in program funding represents new projects initiated through the EGS test site(s), improved resource characterization efforts, and drilling and reservoir creation activities.

In carrying out its vision and mission, the program conducts a broad portfolio of specific, goal-directed activities to accelerate the development and use of geothermal energy by reducing the cost of identifying, extracting and converting geothermal resources.

Funding Opportunity Announcement Background

The Geothermal Technologies Program posts current and past funding opportunities for all program areas, including R&D for innovation, emerging technologies, systems integration, and market barriers projects at the program's webpage www1.eere.energy.gov/geothermal/financial.html.

This open, competitive solicitation process is designed to meet the top technology needs identified by industry's roadmaps and program analyses. Funding opportunities encourage collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local governments, non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance.

Anticipated FOAs

			(Dollars in Thousands)
Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2013	Hydrothermal and resource characterization: Regional Reconnaissance and National Inventory of New Geothermal Sites	Innovations	6,000
This activity will focus on the identification of resource data gaps; projects will collect key resource information on regions where no hydrothermal development exists and where research has been limited in order to build a robust set of prospect areas and promote industry development.			
FY 2013	EGS: Research, Development & Demonstration	Innovations and Emerging Technologies	23,000
This FOA will initiate activities related to up to three separate and geologically unique test sites each of which will help pursue R&D on the viability of EGS, create pathways to new technologies and new investment partners into the sector, and shape an operating and technology template for EGS, which industry can use at the site in a predictable and risk-controlled fashion. FOA funding for establishing the test site(s) – that is, the balance between funding infrastructure development versus specific projects at those sites – is fully conditional on actual site selections and the selected operating model. For example, a "greenfield" test site will incorporate greater start-up and infrastructure costs, as compared to selection of an existing "site of opportunity" which could have full infrastructure in place.			
FY 2013	Systems Analysis	Market Barriers	1,500
Activities associated with this FOA include improving the fidelity of R&D impacts on LCOE, identifying critical technology gaps, assembling industry's Best Practices for subsurface data correction and calibration methodologies and developing techniques for the calibration/normalization of oil and gas temperature data.			

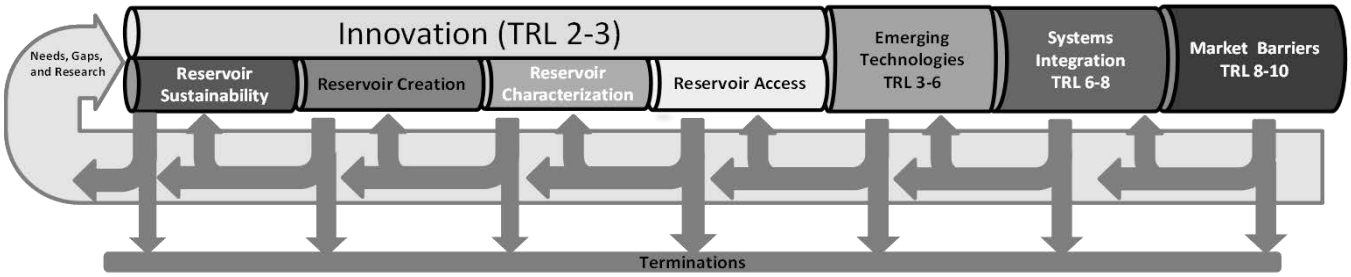
Innovations

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	17,000	18,925	27,146
SBIR/STTR	0	575	854
Total, Innovations	17,000	19,500	28,000

Sequence



Description

Investment in innovation is critical to achieve necessary cost reductions and to overcome the technical challenges that geothermal companies face during development. The program proposes $28 million in research at TRL 2-3 in FY 2013. The funding will be divided among four areas: 1) a new EGS field test site effort that will improve the quality and efficiency of tools, as well as drilling, monitoring and stimulation technologies, 2) regional reconnaissance to improve geothermal resource characterization, 3) phase II funding for successful R&D projects focused on drilling, well completion, zonal isolation, geophysical and geochemical exploration technologies, observation and monitoring tools; and 4) National Laboratory projects designed to meet program goals and objectives. Expected outcomes from these projects include faster, more efficient, lower cost drilling; lower cost well completion technologies; increased exploration success rates; and advanced zonal isolation techniques through which more productive EGS reservoirs can be developed. The EGS field site(s) will create an opportunity to validate EGS tools and techniques in pre-commercial environments thereby lowering the risk of EGS technology development and accelerating the adoption of innovative techniques.

In FY 2011 and FY 2012, the program supported a variety of influential technologies focused on reservoir access and reservoir creation/characterization which show promise for improving our understanding of geothermal reservoirs and eventually lowering associated development costs.

Key Technology and Focus Areas

Reservoir Access — Due to the high temperatures, hard rock and corrosiveness of typical geothermal environments, drilling equipment often sustains significant damage, requiring frequent, time-consuming and expensive "trips" out of the wellbore to replace the component parts. Research indicates that doubling the life of drill bits and components can decrease drilling time significantly, thereby, reducing drilling costs by approximately 15 percent.

Reservoir access investments focus on tools that allow researchers and developers to gain entry to deep, hot reservoir rocks (includes drilling and well completion technologies) in a more cost effective manner. These tools can be tested at the EGS field site(s). The program will also continue to fund innovative drilling technologies including percussive drilling or deviated/horizontal drilling; these will lower development costs and improve efficiencies. This drilling technology R&D will be limited to only those system components not being addressed by the private sector, and which can directly benefit drilling for EGS targets.

Reservoir Creation and Resource Characterization — Reservoir characterization is necessary to locate and identify naturally occurring geothermal systems (hydrothermal) and to develop heat exchangers in the hot rocks deep in the subsurface (EGS). Reservoir creation is accomplished by opening new fractures or reopening existing fractures. To effectively create these fractures, an in-depth understanding of the rock's composition and structure is necessary. Advanced characterization methods make this possible.

When fractures in EGS reservoir rocks shift slightly during stimulation, a small seismic signal is produced. This signal can be measured and used to estimate and monitor fracture creation and reservoir evolution. This is one of few methods by which researchers can "image" reservoir creation. Therefore, the accuracy of seismic measurements is essential to understanding the size and shape of a stimulated volume. The program has made several investments in observation and monitoring tools that utilize these signals to analyze the subsurface. By FY 2013, the program will have completed the initial design and testing of a first-of-its-kind, high temperature and pressure fiber optic geophone array for continual monitoring in geothermal wells. This will provide highly advanced and high-resolution seismic data acquisition that will facilitate fracture imaging and improved EGS reservoir management. Similar technologies and tools related to reservoir creation and characterization will be tested and optimized at the EGS test site(s), based on a competitive selection process.

Successful, cost-effective exploration for hydrothermal resources also requires better means to detect, process, and analyze faint signatures from deep, blind systems. The program work in advanced characterization methods makes this possible. Projects include advanced high temperature tools, advanced seismic processing, improved geochemical analysis, remote sensing, and improved fracture identification technologies.

The program is also continuing to partner with the U.S. Geological Survey to develop updated National Geothermal Resource Assessments. In FY 2011, the Low-Temperature Geothermal Resource Assessment of the U.S. was updated. In FY 2012, the Sedimentary Geothermal Resource Assessment is planned. In FY 2013 the program will complete the update of the EGS Resource Assessment by extending it nationwide.

Reservoir Sustainability — To extract heat from the rocks at depth sustainably over long periods of time, optimization of the reservoir is paramount. Therefore, the program is investing in reservoir modeling and geochemical analysis to better understand reservoir evolution with time.

Benefits

Because the geothermal community is small and financing is not readily available, the program's involvement in applied research is essential to the continued development of geothermal tools. The program's investments in this area provide the geothermal community with the resources needed to conduct research into cutting edge technologies that are necessary to reduce the LCOE and development risk, and expand the potential for domestic geothermal energy production.

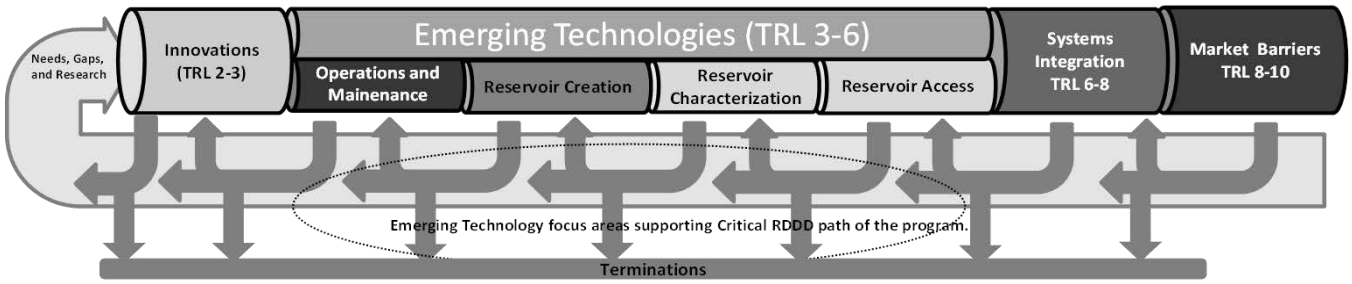
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	8,815	10,056	26,661
SBIR/STTR	0	306	839
Total, Emerging Technologies	8,815	10,362	27,500

Sequence



Description

The Geothermal Technologies Program advances game changing exploration and production technologies consisting of component, subsystem validation, and prototype demonstrations at TRL levels 3-6. In FY 2011 and FY 2012, the program supported a variety of influential technologies focused on resource characterization and exploration, reservoir access and creation, and reservoir sustainability/O&M and maintenance technologies that have progressed from the innovation stage to TRL 4-6 and show promise for reducing costs.

The program proposes $27.5 million in emerging technologies in FY 2013. Funding is split between development of one or more new EGS field test sites, phase II funding for successful R&D awards (focused on advanced heat recovery, drilling, well completion, zonal isolation, geophysical and geochemical exploration and characterization technologies, observation and monitoring tools), and National Laboratory projects designed to meet program goals and objectives.

Key Technology and Focus Areas

Reservoir Creation and Resource Characterization — Subsurface characterization and imaging are critical for the efficient utilization of all types of geothermal resources. These tools will reduce high upfront exploration risks and project costs, encouraging the discovery of up to 30,000 MWe of conventional hydrothermal resources. Improved sensitivity of advanced seismic surveys, and more effective methods for geochemical analysis will also facilitate resource discovery and contribute to significant reductions in the LCOE. In FY 2013, development of these exploration tools (e.g., remote sensing, seismic processing, and structural, geochemical and thermal signature tools) for resource confirmation in blind geothermal fields will continue. Many projects awarded in this area in FY 2011 will have progressed from TRL 2-3 to TRL 4.

With a goal of establishing the technical feasibility of EGS, in FY 2013 the program will develop new technologies in collaboration with industry, academia, and other government agencies that focus on EGS reservoir creation and associated technologies. These include novel stimulation methods and improved understanding of reservoir rock mechanics and fracture characterization technologies including advanced seismic monitoring and advanced zonal isolation techniques through which more productive EGS reservoirs can be developed. The EGS test site(s) will provide an R&D platform to develop and test new stimulation methods and other technologies and tools for creating and characterizing EGS reservoirs. The test site(s) will be integral to the program's investment in emerging technologies in FY13, with analysis in support of candidate sites selection as the first step in establishing this effort.

An example of the program's investments in reservoir creation is the development of a novel high-energy technique using liquid propellants to stimulate, or re-open fractures in an EGS reservoir. Liquid propellants have specific desirable properties that accelerate stimulation of a rock body. Field tests of the liquid

propellant pump fed gas generator configuration yielded promising results. Planned accomplishments for FY 2012 are in-situ testing of the hardware in shallow test wells, and, depending on these results, an actual EGS well stimulation could be conducted in the future. This benign stimulation technique eliminates the need for pumping equipment and large quantities of water required with conventional stimulation methods; it has the potential to revolutionize the means by which EGS are created.

Reservoir Access — The program will continue to build on investments made in FY 2011 and FY 2012 on emerging advanced drilling and well completion technologies for geothermal environments. The testing of novel drilling technologies will reduce the costs of development by decreasing the time necessary to drill a well, allowing for more efficient well completion, and reducing "trouble costs" that can constitute a significant portion of well drilling costs. The EGS test site(s) will be a well-controlled validation environment to test advanced geothermal drilling techniques designed to perform in high temperature and pressure conditions.

The program is in the process of building a field-ready prototype of a revolutionary drilling method using hydrothermal spallation. This technology has the potential to overcome the cost and performance barriers of current conventional drilling methods in deep, hard rock applications by establishing rates of penetration many times higher than possible with existing technology and eliminating bit wear and drill string fatigue. Hydrothermal spallation drilling can significantly reduce well construction costs and enable widespread deployment of geothermal systems.

Work performed and funded by the program has also shown recent success in emerging technologies related to reservoir access. Manufacture and testing of remaining mechanical parts for a prototype of a high temperature and pressure geothermal ultrasonic fracture imaging tool, which can identify natural and induced fractures down-hole was completed in FY 2011. This prototype is expected to lead to lower cost, high temperature fracture imaging services for the geothermal community, which is essential to optimum well placement and effective stimulation design.

Reservoir Sustainability — Critical to the economic success of EGS is the ability to stimulate multiple fracture networks in a wellbore and to maintain economic fluid flow rates throughout the lifetime of the reservoir. The program will continue to make progress in this area through FY 2011 awards made to zonal isolation projects and National Laboratory modeling work; some success has already been achieved in this area. The program funded the characterization and development of a suite of self-degradable geopolymers that are capable of temporarily sealing fractures during reservoir creation or management. This is essential to developing large volume EGS reservoirs by which one set of fractures can be sealed while new fractures are re-opened via stimulation, enabling flow through a multi-zoned fracture network (a reservoir with large surface area) rather than through one or two large fractures that may rapidly cool down a reservoir. Operation and Maintenance — O&M costs represent a significant portion of hydrothermal LCOE. The program will continue some work in this area through targeted emerging technologies projects. In FY 2011, the program successfully improved lithium extraction technologies which transform the materials present in geothermal brine into saleable strategic minerals (Li compounds, silica, iron silicate, lithium/manganese battery materials). Furthermore, the program is working with partners to develop technology to cost-effectively extract additional materials (manganese, zinc, boron, potassium, cesium, and rubidium) from geothermal brines of varying salinity. This project has progressed from lab evaluations to field pilot tests.

Benefits

In the last decade the geothermal industry has had limited success discovering new resources as a result of limited funds for innovative technology development that aid in identification and characterization of resources. The program's investments in emerging technologies related to resource characterization and reservoir access and monitoring (sustainability) will facilitate lower cost and more efficient geothermal development, triggering increased resource discovery and EGS success in the near-term; industry will then have the ability and opportunity to expand development in new resource areas and to take advantage of new cutting-edge technologies ultimately bringing additional clean, domestic energy online.

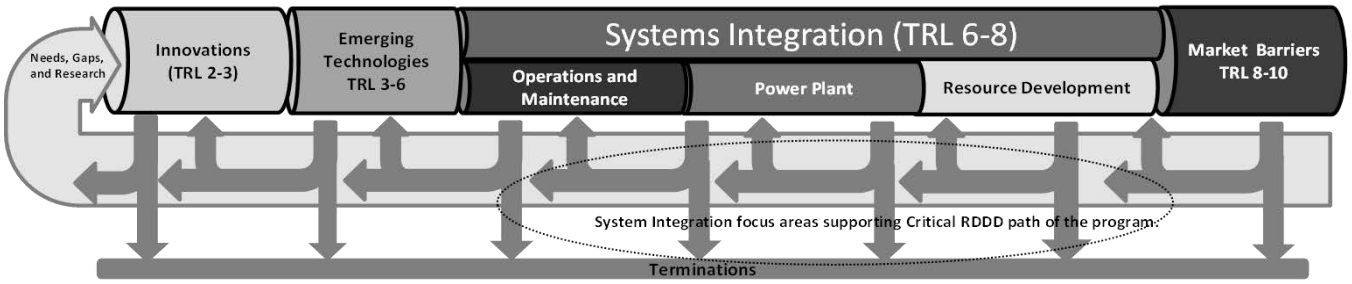
Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	6,177	3,882	5,332
SBIR/STTR	0	118	168
Total, Systems Integration	6,177	4,000	5,500

Sequence



Description

The program actively pursues system integration projects in the areas of system O&M, power plant, and resource development to improve performance, reduce cost, and to validate technologies for subsequent deployment. The main thrust of the systems integration subprogram in FY 2013 will be a continuation of ongoing demonstration activities at TRL 6-8 from prior year efforts including co-production from oil and gas sites.

Currently the program also funds seven full-scale EGS demonstration projects to develop and prove the feasibility of EGS and 24 field exploration projects to identify new tools and techniques for identifying blind hydrothermal resources.

Relevant field tested technologies that have shown recent success include both down-hole and non-invasive exploration and characterization technologies; advanced power cycles; fluid inclusion gas chemistry for the identification of hydrothermal resources and EGS reservoir creation/characterization; reservoir sustainability technologies with a focus on high temperature tool and sensor development; and zonal isolation.

In addition, an EGS reservoir was successfully stimulated and created in FY 2011. The project achieved well injection rates that were within the bounds of commercial hydrothermal injection well rates (~70 percent). In this instance, the injection rate served as a proxy for permeability created during stimulation, as a non-fractured system would be physically unable to accept flow rates of this magnitude; thus demonstrating that a permeable reservoir was created. This indicates that the previously sealed fractures were effectively re-opened via the stimulation process. Three additional EGS demonstrations are scheduled to perform reservoir stimulations in early FY 2012, with similar success anticipated. Note, however, that these projects are mostly located in near-hydrothermal and infield sites, which limits the breadth of the results' applicability to the broader challenges of accelerating nationwide EGS development. Consequently, the EGS field test site(s) are designed to facilitate government-managed R&D to comprehensively test EGS technologies in varied geologic environments.

The program is investing $5.5 million in systems integration in FY 2013. The funding will be divided among the mortgages of existing demonstration projects, projects directed at leveraging the capabilities of the oil and gas sector, and National Laboratory projects at the appropriate TRL level. Projects and activities will be focused on lowering blind hydrothermal LCOE to $.06/kWh and establishing technical feasibility of EGS by 2020.

Key Technology and Focus Areas

Reservoir Creation — In FY 2013, the program will continue to demonstrate reservoir creation and validate flow rate improvements at seven EGS field sites. These sites, which will be within or beyond reservoir stimulation phases, will demonstrate reservoir enhancements (through hydraulic, chemical, thermal, or other stimulation methods) and sustained energy production.

As previously noted, the program has had some recent successes in this area. In FY 2011, an EGS demonstration hydraulically and chemically stimulated a well in an existing hydrothermal field over a period of five months and subsequently achieved significant gains in the amount and rate at which fluid can be circulated through the subsurface.

Reservoir Characterization — Accurate characterization of the subsurface is difficult in geothermal environments due to the high temperatures and pressures found at depth and the inability of existing electronics to withstand such conditions. The program will continue to develop and improve subsurface characterization and imaging tools (down hole tools, sensors, geochemical analysis methods, tracers, and fracture characterization techniques) and reservoir creation methodologies (novel stimulation methods, zonal isolation, reservoir and predictive modeling), which are critical for the development and efficient utilization of all geothermal resources. These tools will reduce high upfront exploration and development risks and costs for hydrothermal and EGS resources.

In FY 2011, the program supported research that demonstrated novel circuit board technology and a down-hole pressure and temperature tool capable of operating at 300°C. This accomplishment has broad implications; it enables improved characterization of reservoirs and lower costs associated with well field development and reservoir stimulation (as a result of better well siting etc.).

Reservoir Access — Reducing drilling costs remains a major focus area of the program as they can comprise almost half of geothermal development costs. By FY 2013, multiple drilling system emerging technologies projects will have progressed to the systems integration stage.

Reservoir Sustainability (Power Plant and O&M) — Improvements in the efficiency of a geothermal power plant can lower geothermal levelized cost of energy significantly by increasing power production and reducing the need for additional wells. For instance, the program is in the process of demonstrating a variable phase cycle for low temperature geothermal power production, which will lower the capital cost relative to other low temperature systems by using a liquid heat exchanger instead of a boiler and separator and by directly driving the generator, eliminating the gearbox. An improvement in power production of 30 percent for lower temperature resources has been achieved. This project validated the technology with a pilot test, and will be engaging in a full-scale field demonstration in the coming months. Existing Low Temperature/Co-produced field demonstrations will also progress, facilitating power production from widespread low temperature resources and increased efficiency power cycles in various climates.

Benefits

The high upfront development costs and limited resources of the geothermal industry make the program's role in demonstrating the technical and economic feasibility of EGS technology, low temperature/co-produced resources, and new hydrothermal exploration and development tools of paramount importance for the establishment of geothermal energy as a cost-effective, widespread alternative to conventional electricity sources. The program's investments in systems integration bridge the gap between initial development of promising technologies and their eventual successful deployment in the geothermal marketplace. Without the program's assistance, many of these new tools and techniques would perish in the "technology valley of death," significantly reducing the impact of the initial R&D investment made by the Department and other stakeholders. By enabling integration and demonstration efforts, benefits in the areas of EGS stimulation demonstrations and innovative power cycles become possible; contributing to technology validation, performance improvement and cost reductions. The program's targeted role in funding projects at TRL 7-8 is essential.

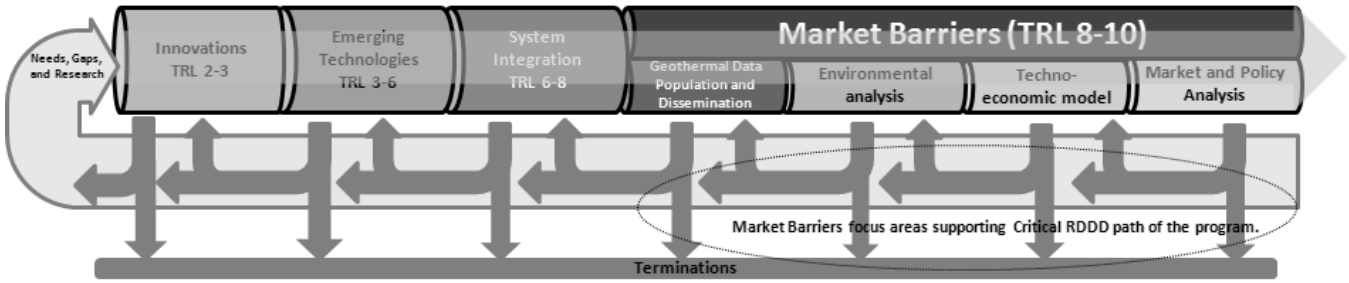
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	5,000	4,000	4,000
Total, Market Barriers	5,000	4,000	4,000

Sequence



Description

The Geothermal Technologies Program supports activities that provide direction, focus and support to address key questions pertaining to geothermal technology development and to overcome market barriers including:

- High risk and cost of geothermal development;
- Limited access to transmission capabilities;
- Lack of streamlined permitting procedures for ensuring regulatory compliance;
- Insufficient geothermal resource data;
- Public perception of geothermal development risks;
- Incomplete information on geothermal water and lifecycle impacts; and
- Lack of trained geothermal professionals.

A focus on understanding and mitigating these market barriers will help accelerate establishment of geothermal energy as a major contributor to base-load power generation in the U.S. These hindrances will be addressed by funding activities in the following key technology and focus areas:

- Techno-economic and Financial Analysis;
- Environmental impact;
- Siting and permitting;
- Geothermal Data provision;
- Intergovernmental coordination; and
- Workforce development.

Key Technology and Focus Areas

Techno-economic and Financial Analysis — This critical analysis is required to understand how geothermal system costs can be reduced and availability of private financing increased. Techno-economic analysis evaluates the capital cost and operational and maintenance cost of the geothermal development cycle using the Geothermal Electricity Technology Evaluation Model (GETEM). The program will analyze geothermal LCOE levers to estimate the cost reductions necessary for geothermal energy to be competitive with conventional electricity generation sources. The LCOE for geothermal energy varies greatly depending on site variables including depth, temperature, geology, and other factors. In FY 2011, resource deployment estimates were made for co-produced fluids with near-term market potential.

Financial Analysis — Initiatives in FY 2013 will address current technical, market, and financial barriers to lowering LCOE. Detailed cost evaluation of new DOE funded RD&D projects coming online will inform the technology roadmapping and identify financial barriers that need to be addressed. This data will help validate GETEM.

Environmental Impact, Siting and Permitting — These activities are vital to addressing public questions about geothermal development risks, understanding where and how geothermal energy can access transmission, and to moving RD&D forward. Specific FY 2013 activities include completing EGS Life-Cycle Analysis and estimating water-use in geothermal power plants and systems. In FY 2011, life-cycle analysis has been instrumental in putting geothermal development on an equal analytical footing with other energy sources. Reducing uncertainties and unexpected delays encountered in geothermal permitting by promulgating environmental impact data

and more streamlined and well defined processes that will reduce the cost of geothermal RD&D. In FY 2011, geothermal development permitting checklists for eight states were made publically available through *Open-EI* – an interactive web application.

Geothermal Data Provision — These activities are critical in reducing a geothermal developers risk and expanding the pool of potential geothermal prospects. National Geothermal Data System projects funded under ARRA have provided new data in areas lacking critical information. Planned FY 2013 accomplishments include a full deployment of data and visualization tools such as *Geothermal Prospector* developed in FY 2011 and FY 2012. This important geospatial tool assists in identifying new geothermal prospects and for mapping areas where geothermal development is permitted.

Workforce Development — Activities are implemented through the program's RD&D financial award activities to the extent possible. These efforts will focus on the development and retention of geothermal-specific competencies and on the development of teaming opportunities with universities and industry for education programs. In FY 2011, the program funded postdocs programs at key National Laboratories and supported a National Geothermal Student Competition that sparked the interest of students from eleven universities, introducing them to a real world geothermal development challenge. The National Geothermal Academy[a] was also launched in FY 2011. There, students from across the country had the opportunity to participate in an eight week summer program taught by the leading experts in the field. Program investment in the Academy included formulation and development of curricula focused on all aspects of geothermal development. In FY 2013, the program will continue activities to leverage resources in support of geothermal workforce growth.

Intergovernmental Coordination — This work leverages resources through continued facilitation of an *Interagency Geothermal Working Group*. The Working Group vets geothermal issues across the Federal Government. To reduce resource development costs and increase U.S. adoption, the program is also leveraging lessons learned from international RD&D projects and market barrier reductions with participation in International Energy Agency (IEA) activities and the International Partnership for Geothermal Technologies. An example of FY 2011 work done in this area is the development of a drilling handbook that will be published through IEA.

Benefits

Market Barrier activities facilitate geothermal development by contributing to a reduced LCOE. For instance, financial analysis will help identify barriers and opportunities for geothermal investment, including analysis of policies and incentives which are aimed at reducing risk and costs. Also, data provision[b] and resource assessment projects will reduce the high upfront costs of geothermal development and will increase the industry's ability to locate high-quality geothermal prospects.

Overall, the program's effort in the area of market barriers works to reduce or eliminate: regional data gaps; limited access to quality resource information; lack of permitting procedures; and incomplete information on geothermal water and lifecycle impacts. Without the program's efforts, these impediments will further hinder developers, public officials, and the community from developing and supporting geothermal power.

[a] Consortium of universities with shared curricula.

[b] Includes gathering, organizing, storing, retrieving, and classifying geothermal data for public use.

Hydrogen and Fuel Cell Technologies Program

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Hydrogen and Fuel Cell Technologies Program			
Fuel Cell R&D	41,916	43,556	36,899
Hydrogen Fuel R&D	32,122	33,785	26,177
Manufacturing R&D	2,920	1,941	1,939
Systems Analysis	3,000	2,925	2,922
Technology Validation	8,988	8,987	4,992
Safety Codes and Standards	6,901	6,893	4,921
Market Transformation	0	3,000	0
SBIR/STTR	0	2,537	2,150
Total, Hydrogen and Fuel Cell Technologies Program	95,847	103,624	80,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Hydrogen and Fuel Cell Technologies Program			
Innovations	54,519	64,021	52,441
Emerging Technologies	29,027	19,465	15,909
Systems Integration	8,869	11,421	6,980
Market Barriers	3,432	6,180	2,520
SBIR/STTR	0	2,537	2,150
Total, Hydrogen and Fuel Cell Technologies Program	95,847	103,624	80,000

Public Law Authorizations

P.L. 93-275, "Federal Energy Administration Act" (1974)
P.L. 93-577, "Federal Non-Nuclear Energy Research and Development Act" (1974)
P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-413, "Electric and Hybrid Vehicle Research, Development and Demonstration Act" (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-238, Title III – "Automotive Propulsion Research and Development Act" (1978)
P.L. 96-512, "Methane Transportation Research, Development and Demonstration Act" (1980)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-494, "Alternative Motor Fuels Act" (1988)
P.L. 101-566, "Spark M. Matsunaga Hydrogen Research, Development, and Demonstration Act of 1990"
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 104-271, "Hydrogen Future Act of 1996"
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The Hydrogen and Fuel Cell Technologies Program mission is to enable the widespread commercialization of hydrogen and fuel cell technologies, which would reduce petroleum use, greenhouse gas (GHG) emissions, and criteria air pollutants and contribute to a more diverse energy supply and more efficient energy use. The program pursues this mission through research, development, demonstration, and deployment (RDD&D) activities, with the goals of advancing these technologies to be competitive in terms of cost, reliability and performance, and reducing the institutional and market barriers to their widespread commercialization. Key objectives include reducing cost to $30/kW (equivalent to the cost of a gasoline internal combustion engine) and improving durability to 5,000 hours (equivalent to 150,000 miles of driving) for automotive fuel cell systems by 2017. While the focus is transportation technologies, cross-cutting activities will be pursued to also achieve $1,500/kW and 60,000-hour durability for micro-CHP

[a] SBIR/STTR funding transferred in FY 2011 was $2,153,000.

systems operating on natural gas or liquefied petroleum gas (LPG) by 2020.

The program employs a comprehensive approach that addresses both technical and non-technical barriers to commercialization and aims to catalyze domestic growth in this emerging industry. This approach includes supporting pre-competitive R&D, demonstrating hydrogen and fuel cell systems under real-world conditions, and conducting activities to address key market barriers. The program is investing in R&D to increase fuel cell durability; reduce fuel cell costs; reduce the costs of producing, delivering, and storing hydrogen; and improve the capacity of hydrogen storage systems.

As shown in Figure 1, the program's R&D efforts in fuel cell stacks and hydrogen fuel seek to reduce the overall cost of fuel cell electric vehicles (FCEVs) by more than 30 percent (by $.16/mile, over the lifecyle of the car). An additional $.09/mile reduction is projected to be achieved through improvements in manufacturing technologies and economies of scale (assuming high volume manufacturing — e.g., 500,000 vehicles per year). To reduce manufacturing costs, the program is developing improved high-speed fabrication processes and inline quality assurance methods. The lifecycle cost per mile includes the per-mile cost of fuel (a function of the fuel economy and fuel price) and annualized capital cost (manufactured vehicle cost) over the life of the vehicle (assumed at 15 years, at 10,000 miles per year).[a] The figures show costs that were estimated using models whose input of future performance values (e.g., fuel economy of vehicle, electric efficiency of stationary fuel cell, etc.) are extrapolations of current technology's performance. Figure 2 shows comparable cost-reductions for stationary fuel cells. Improvements in manufacturing processes and technologies, along with economies of scale, are projected to provide more than 30 percent reduction in cost for stationary fuel cells. The program is also addressing market barriers across the entire spectrum of applications, including working with stakeholder communities on safety, codes and standards, safe operations, permitting, and siting.

Figure 1

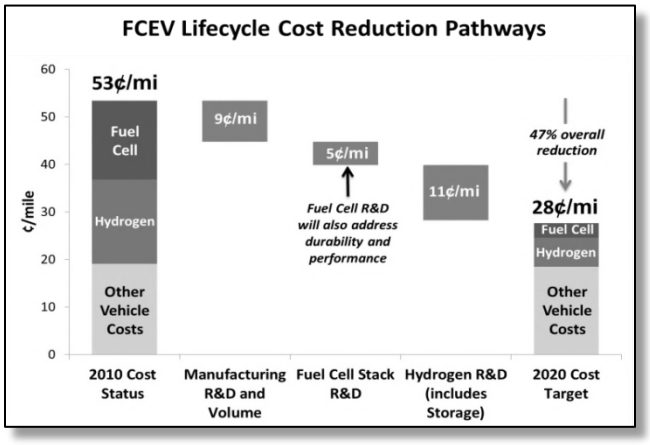
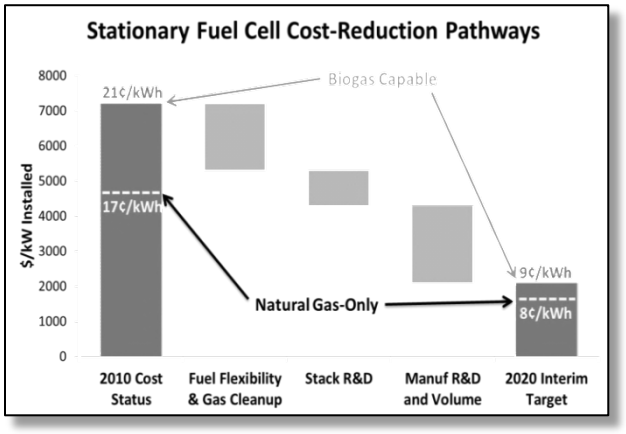


Figure 2



This highly integrated and leveraged approach will result in substantial cost reductions in hydrogen and fuel cell systems, which will enable key targets to be met, including an interim target of <$.09/kWh in stationary power (with a long-term goal of $.05 to $.06/kWh), the hydrogen fuel threshold cost of $2–4/gallon gasoline equivalent (gge), and a vehicle lifecycle cost of <$.30/mile.

While emerging foreign fuel cell industries (in such countries as Germany, Japan, and South Korea) experience rapid market growth, sustained support of the program and continued progress toward its goals help enable the U.S. to maintain leadership in fuel cell manufacturing and hydrogen production technology. Success of the program will also support domestic employment and economic growth as well as increase our options for clean power.

[a] For this estimate, markups on the vehicle beyond the manufacturing plant's gate were not considered, e.g., distribution, dealer's markups, taxes, etc. Also not included were insurance and maintenance costs incurred by the vehicle owner.

Strategy

The program conducts activities to address the full range of obstacles facing the widespread commercialization of hydrogen and fuel cell technologies. These efforts balance the need to overcome critical technical challenges with the need to reduce non-technical barriers. They are also balanced to address a variety of technical approaches to fuel cells (such as polymer electrolyte membrane, solid oxide, and phosphoric acid technologies) and to provide critical advances for a wide range of applications (including stationary, portable, and transportation applications) while maintaining a longer-term focus on transportation.

To guide R&D priorities, set program goals, and clarify where hydrogen and fuel cells can be most beneficial, the program conducts a comprehensive systems analysis effort and engages in several key partnerships that provide valuable stakeholder input. These partnerships help to ensure that the research, development and demonstration (RD&D) efforts of government, academia, and industry are well coordinated; their diverse capabilities are well integrated; and their resources are effectively utilized. The program coordinates with the Vehicle Technologies Program to participate in a key strategic partnership — involving automobile manufacturers, energy companies, and utilities — known as U.S. DRIVE (Driving Research and Innovation for Vehicle Efficiency and Energy Sustainability). The program also engages continually with stakeholders through involvement with organizations including the Fuel Cell and Hydrogen Energy Association, the California Fuel Cell Partnership, the Hydrogen Utilities Group, and the California Stationary Fuel Cell Collaborative. The program also participates in working groups that coordinate activities in specific technology areas. In addition to input received through these groups, the program regularly solicits input and feedback from stakeholders in the planning of its activities, through various channels, including requests for information and workshops to establish high-level program direction and update technology-specific RD&D plans.

The program addresses technical barriers through pre-competitive applied research, technology development, and technology validation and demonstration. The program's R&D strategy maintains an inclusive, technology-neutral approach while conducting focused efforts in specific technical areas and applications. Emphasis on different applications is balanced to enable success in early markets and support the growth of a strong domestic industry, while maintaining progress in longer-term, higher-impact areas. Growth and learning in early markets can help to reduce costs industry-wide, maintain a minimal supply chain, strengthen consumer acceptance, expand the infrastructure, and overcome a variety of logistical challenges. These activities are critical while the vehicle application, which will have a large material impact, is still in the development phase. Therefore, the program pursues advances for a wide variety of applications, with varying time-frames for commercial success. Through this approach, the program provides near-term advances that can accelerate the growth of existing early markets (such as backup power and material handling equipment), while maintaining progress along near-, mid- and longer-term developmental roadmaps, such as those for CHP fuel cell systems, fuel cell electric vehicles, and technologies for the large-scale production and delivery of renewable hydrogen.

Key areas of RD&D include — Fuel Cell R&D, which seeks to improve the durability, reduce the cost, and improve the performance of fuel cell systems, through advances in fuel cell stack and balance of plant components; Hydrogen Fuel R&D, which focuses on enabling the production of low-cost hydrogen fuel from diverse renewable pathways and addressing key challenges to hydrogen delivery and storage; Manufacturing R&D, which works to develop and demonstrate advanced manufacturing technologies and processes that will reduce the cost of fuel cell systems and hydrogen technologies; and Technology Validation, which demonstrates and validates pre-commercial technologies before the deployment phase. These RD&D efforts have already made substantial progress in a range of key areas, including:

- Reducing the cost of automotive fuel cells (projected at high volumes) to $49/kW in 2011, a >30 percent reduction since 2008 and >80 percent reduction in cost since 2002;
- More than doubling the durability of automotive fuel cell systems operating under real-world conditions, with >2,500-hour durability (about 75,000 miles) that can be demonstrated on the road with <10 percent degradation; and
- Reducing the projected high-volume cost of hydrogen produced from natural gas in distributed facilities from $5 to $3/gge [including all costs except taxes — e.g., feedstock, capital equipment (natural gas reformer, compressor, storage tanks, dispensers, etc.), labor, etc.].

To help ensure that advances in the laboratory can be realized in the marketplace, the program conducts targeted activities to address economic and institutional barriers. The program seeks to act as a catalyst in the transition from R&D to demonstration and early deployment by integrating real-world technology demonstrations, independent studies, data assessments, and early market deployments into a well-planned timeline. These activities are also closely coordinated

with other Federal agencies and state and regional efforts.

Market Transformation activities provide financial and technical assistance for the use of hydrogen and fuel cell systems in early market applications, with the goals of achieving sales volumes that will enable cost reductions through economies of scale, supporting the development of a domestic industry, and providing feedback to testing programs, manufacturers, and potential technology users. In FY 2013, the program will rebalance its portfolio away from these activities in order to focus on R&D to overcome critical technical challenges. The program also conducts efforts in Safety, Codes & Standards to develop information resources and best practices to address safety issues, and to provide critical information needed for technically sound codes and standards. These efforts in codes and standards significantly smooth the commercial deployment process, and they will be ongoing as new technologies emerge and mature.

The program maintains close collaboration with hydrogen and fuel cell activities in the Office of Basic Energy Sciences, the Office of Science's Energy Frontier Research Center's, and the Advanced Research Projects Agency- Energy to advance work on hydrogen and fuel cell technologies.

The program also funds efforts such as EPAct 2005 and EISA 2007 requirements; peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Benefits

The program offers a broad range of anticipated benefits for the environment, for our Nation's energy security, and for our domestic economy, including: reduced GHG emissions; reduced oil consumption; expanded use of renewable power (through use of hydrogen for energy storage and transmission); highly efficient energy conversion; fuel flexibility (use of diverse, domestic fuels, including clean and renewable fuels); reduced air pollution; and highly reliable grid-support through distributed power generation. Fuel cells also have numerous potential advantages that make them appealing for end-users, including: quiet operation, low maintenance needs, and high reliability. In addition to using hydrogen, fuel cells can provide power from a variety of other fuels, including natural gas and renewable fuels such as methanol or biogas.

Analysis by Brookhaven National Laboratory, using the MARKAL model indicates that by 2050, reductions of 350 – 400 million metric tons/year of GHG emissions and 2 – 3 million barrels/day of oil are possible as the program achieves its cost targets. These results are inline with NRC estimates. In addition, a study conducted by DOE has found that hydrogen and fuel cells could provide a significant economic opportunity for the U.S., with projections of significant net job creation by 2050, as well as import offsets.[a] Growing interest and investment in hydrogen and fuel cell technologies among leading world economies such as Germany, Japan, and South Korea, underscore the global market potential for these technologies and the need for continued investment for domestic industry to remain competitive, with the ultimate size and scale of the global market dependent on how much progress is made on cost.

Hydrogen and fuel cells can provide these benefits and address critical challenges in all energy sectors — commercial, residential, industrial, and transportation — through their use in diverse applications, including: distributed energy and CHP systems; backup power systems; systems for storing and transmitting renewable energy; portable power; auxiliary power for trucks, aircraft, rail, and ships; specialty commercial vehicles, and passenger and freight vehicles, including cars, light trucks, buses, and short-haul trucks.

While fuel cells are becoming competitive in several specialized markets, the range of these markets can be greatly expanded with improvements in durability and performance and reductions in manufacturing cost, as well as advances in technologies for producing, delivering, and storing hydrogen. Federal funding is appropriate and may be essential for addressing the long-term, high-risk/high-reward research associated with the critical early stages of hydrogen and fuel cell technologies and, equally important, to maintaining U.S. leadership in these fields. More than 80 percent of the program's requested FY 2013 funds are planned for the Innovations and Emerging Technologies subprograms.

Key Accomplishments

Recent key accomplishments include:

- Reducing the cost of automotive fuel cells to $49/kW, assuming high-volume manufacturing (500,000 units/year) — a more than 30 percent reduction since 2008 These cost reductions were accomplished through a combination of R&D projects such as the development of nanostructured thin film electrodes;
- Improving the catalyst specific power of fuel cells to 5.6 kW/g of platinum group metal —a 100 percent increase from the 2008 baseline of 2.8 kW/g — through developments such as nanostructured thin film catalysts, and core-shell catalysts in which

[a] "Effects of a Transition to a Hydrogen Economy on Employment in the United States—Report to Congress," U.S. Department of Energy, January 2008, www.hydrogen.energy.gov/pdfs/epact1820_employment_study.pdf.

platinum coats the outside of a non-platinum-containing core;

- Reducing the capital cost of electrolyzer stacks by 80 percent since 2001;
- Reducing the capital cost of hydrogen production systems by 10 percent since 2010 in part by improving the catalyst dispersion, and therefore, reducing the quantity required in water electrolysis systems but also through other factors such as reduced part count, increased efficiency, and lower cost membrane supports;
- Reducing the projected high-volume cost of producing hydrogen using renewable resources through several pathways, including distributed electrolysis ($4.90 – $5.70/gge, dispensed), and centralized electrolysis from wind ($2.70 – $3.50/gge, at the plant gate);
- Reducing the projected cost of hydrogen delivery — including 30 percent reduction in tube-trailer costs, 20 percent reduction in pipeline costs, and 15 percent reduction in liquid hydrogen delivery costs since 2005;
- Deploying 183 fuel cell electric vehicles and 25 hydrogen fueling stations in learning demonstrations and collected data from 3.5 million miles of driving, demonstrating up to 59 percent fuel cell system energy conversion efficiency, more than double the efficiency of gasoline engines;
- Validating vehicles with more than 250-mile driving range, and one vehicle capable of more than 430 miles on a single fill of hydrogen with less than 5 minute refueling time; and
- Demonstrating combined efficiency of 54 percent for co-producing hydrogen and power from a stationary fuel cell.
- Achieving substantial impact on the initial marketplace by facilitating the deployment of approximately 700 fuel cell lift trucks through market transformation activities (including under the Recovery Act). These deployments have led to planned orders by industry for 3,000 more fuel cell lift trucks — with no additional federal funding.

Strategic Plan and Performance Measures

The program strategy maintains an inclusive, technology-neutral approach while conducting focused efforts in specific technical areas and applications, which are geared toward reducing GHG emissions and petroleum use. In addition, a balance is maintained between supporting success in early markets and maintaining progress in longer-term, higher-impact areas. Together, these improvements will enable enhanced manufacturing capability, improved economies of scale, and lower cost for both vehicle and stationary fuel cell systems and hydrogen fuel technologies to achieve their lifecycle cost targets.

Key technology pathways and areas of performance focus include:

- Fuel cells — Stack and balance-of-plant costs and system durability at lower catalyst loadings.
- Hydrogen production and delivery — Capital cost reduction with a focus on the delivery component of the total hydrogen cost.

Performance Measure Analysis

Workshops and groups such as the Hydrogen and Fuel Cell Technical Advisory Committee and the National Research Council have provided input to the program's development of the goal to provide cost competitive hydrogen and fuel cell technologies. Market penetration of these technologies will require that the fuel cell be competitive with incumbent technology such as a gasoline internal combustion engine for transportation applications or microturbines for distributed power generation. As a result, a transportation fuel cell system will need to cost $30/kW with 5,000-hour durability. Due to their different duty cycles, performance requirements, and market conditions, separate targets are needed for stationary fuel cell systems, which will need to cost $1,000 – $1,500/kW with about 60,000- to 80,000-hour durability, depending on size and application. Likewise, for these technologies to become commonplace, the hydrogen fuel will need to be competitive with the existing fuel. An analysis has shown that the hydrogen threshold cost will need to be $2 to $4/gge for significant penetration of fuel cell electric vehicles. Achieving these goals will enable the lifecycle costs for vehicles and stationary fuel cell systems to be achieved

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Hydrogen and Fuel Cell Technologies Program			
Innovations — The reduction in funding reflects substantial progress made in research innovations in the areas of fuel cells and hydrogen fuel production, delivery, and storage.	64,021	52,441	-11,580
Emerging Technologies — This subprogram is reduced due to successful completion of R&D projects, including technologies for stationary fuel cells that will be demonstrated and validated in the Systems Integration subprogram in FY 2013.	19,465	15,909	-3,556
Systems Integration — Major demonstration work was completed in FY 2011, including the learning demonstration for FCEVs. New demonstration projects will begin in FY 2012 such as data collection, fueling technologies, and stationary fuel cell systems that can provide heat, hydrogen and power. These projects will require much reduced funding compared to the learning demonstration.	11,421	6,980	-4,441
Market Barriers — More than $6 million was provided for market barriers in FY 2012, which is focusing on high-penetration fuel cell deployments, such as ground-support equipment and other early market fuel cells, with industry and government partners. FY 2012 funds will cover a large portion of the initial deployments of these systems, so less funding will be required in FY 2013. These projects will sustain limited manufacturing and supply chain capacity while higher-impact applications, such as vehicles, are still under development.	6,180	2,520	-3,660
SBIR/STTR are calculated based on R&D funding allocations.	2,537	2,150	-387
Total, Hydrogen and Fuel Cell Technologies Program	103,624	80,000	-23,624

Explanation of Changes

Reduced funding reflects substantial progress made in research innovations in the areas of fuel cells and hydrogen fuel production, delivery and storage. A robust R&D program remains in fuel cells and renewable hydrogen production. In addition, FY 2013 activities will focus on some high impact fuel cell deployments, such as ground-support equipment and other early market fuel cells, with industry and government partners. Reduced funding in the Innovations subprogram reflects progress made in that area.

Funding Opportunity Announcement Background

In carrying out its vision and mission, the program conducts a broad portfolio of activities to develop cost competitive hydrogen and fuel cell technologies. Most of these activities are conducted through an open, competitive solicitation process designed to support the program's cost reduction and performance improvement goals and objectives. FOAs allow for collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local governments and non-government agencies groups. Solicitations include both financial and technical assistance. Below is a summary of anticipated FY 2012 and FY 2013 hydrogen fuel cell technologies FOA awards. A limited number of new awards in FY 2013 would allow continued investment in new concepts for hydrogen and fuel cell technologies that address the four categories of innovations, emerging technologies, systems integration, and market barriers. More detail is provided in each subprogram area.

The program posts current and past funding opportunities for all program areas, including R&D, systems integration, and market barrier projects at http://www1.eere.energy.gov/hydrogenandfuelcells/financial.html. Links to related opportunities from DOE National Laboratories and other Federal agencies are also available.

Anticipated FOAs

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2012 (FY 2013)	Technology Validation	Systems Integration	7,000 (3,000)
This activity will evaluate the status and technical progress of light-duty fuel cell electric vehicles and refueling stations through data collection and analysis. High-pressure hydrogen tanks for hydrogen delivery, innovative refueling components and combined hydrogen and power systems will be validated through operation of multiple systems in a real-world environment. All Technology Validation activities provide feedback to R&D efforts and determine whether technical targets have been met under real-world conditions.			
Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2013	Hydrogen Fuel R&D	Innovations and Emerging Technologies	1,000 –2,000
This activity is to continue the investment in Hydrogen Fuel R&D, with a focus on hydrogen generation, distribution, storage, and dispensing. The projects will enable low cost hydrogen fuel that is produced from renewable resources, such as solar, wind, and bio-derived materials. These projects will allow the realization of the full potential for fuel cells to reduce greenhouse gas emissions.			

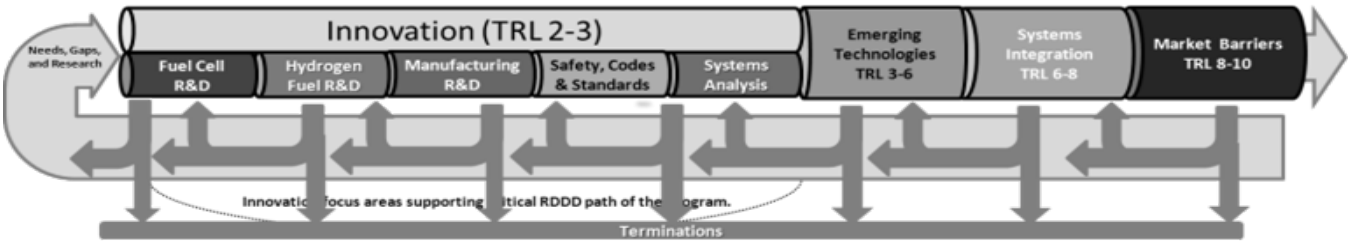
Innovations

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	54,519	64,021	52,441
SBIR/STTR	0	1,945	1,649
Total, Innovations	54,519	65,966	54,090

Sequence



Description

Innovations within the program provide the strong foundation for moving technologies through the product development pipeline. This allows for collaboration among researchers to build onto the findings of others to yield technology advances.

The program plans to invest over $54 million in hydrogen and fuel cell technology innovations in FY 2013. These funds will be used to build on prior year accomplishments such as improving fuel cell catalyst utilization from 2.8 kW/g of platinum group metal to 5.6 kW/g in FY 2011.

The FY 2013 funds will be distributed primarily between Fuel Cell R&D and Hydrogen Fuel R&D innovation projects with a focus on areas such as new catalysts, e.g. low or non-platinum group metal catalysts, system and component modeling and new reactor and materials innovations.

Key Technology and Focus Areas

Fuel Cell R&D — Efforts will enable key improvements in materials and components for fuel cell systems, resulting in increased durability and reduced cost. For example, research advances will improve the utilization of fuel cell catalysts to meet the 2017 target of 8 kW/g, leading to substantial cost reductions. Advances made by Fuel Cell R&D will be beneficial for a wide range of fuel cell technologies (including low-, medium-, and high-temperature fuel cells) and diverse applications (including stationary, portable, and transportation fuel cells). Efforts will be guided by system cost analyses and technical evaluations and will be focused on science and engineering at the cell and stack level. Primary research areas will include: high-performance, lower-cost, ultra-low platinum-group-metal (PGM) and PGM-free catalysts and electrodes; electrolytes; gas-diffusion media; bipolar plates; interconnects; and novel membrane-electrode-assembly/cell architectures. Research activities will also address materials for balance of plant components, fuel cell transport phenomena, degradation phenomena, and the effects of impurities.

Hydrogen Fuel R&D — Activities will improve materials and enable advances in technologies for producing, delivering, and storing hydrogen, resulting in a lower cost of hydrogen produced from renewable resources and lower-cost and higher-capacity hydrogen storage systems. Hydrogen production research will include innovations to increase solar-to-hydrogen efficiencies for photoelectrochemical, solar thermochemical, and biological hydrogen production — for example, increasing solar-to-hydrogen efficiency from 4 percent (in 2008) to >10 percent for photoelectrochemical systems by 2020. Hydrogen delivery research activities will build on mechanisms identified in advanced steels for low-cycle fatigue and hydrogen embrittlement to devise novel mitigation strategies for the design of durable, low-cost distribution pipelines, with the objective of reducing installed pipeline cost from $3 million/mile to less than $1 million/mile (approximately the cost of natural gas pipelines). Hydrogen storage research will include the

discovery of innovative materials with potential to meet the 2017 onboard vehicle system-level capacity targets of 40 g/L volumetric and 5.5 percent by weight gravimetric hydrogen storage; the innovation needed for low-cost production of high-strength carbon fiber for high-pressure tanks to meet a cost of $6/kWh of hydrogen energy stored; and the exploration of advanced synthesis solutions for the balance-of-system in materials-based storage systems.

Manufacturing — Research will enable improvements in manufacturing processes that lead to lower costs for fuel cell systems and hydrogen production and storage technologies. These advances will play a key role in meeting the overall target of $30/kW for transportation fuel cell systems. Efforts will focus on innovative fabrication methods for high and low temperature fuel cell components and fuel stack assembly processes. Research also will be conducted on methods to lower manufacturing costs for centralized hydrogen production and hydrogen pressure vessels.

Safety, Codes & Standards — Research activities will provide critical data that will enable the development of technically sound codes and standards for hydrogen and fuel cell technologies. These activities include conducting research to generate hydrogen material compatibility data for structural materials — such as characterization of the hydrogen compatibility of welded material — and optimizing test methods for structural materials and components in hydrogen gas. A comprehensive effort will also address hydrogen fuel impurities, including investigation of the effects of impurities on fuel cell systems and components, techniques for detecting and measuring impurities, and the effects on fuel quality of various production, purification, and delivery options.

Systems Analysis — Analytical activities will provide the economic and technical basis for prioritizing the program's research efforts and determining technology gaps. Existing analytical models and tools will be utilized to quantify the life-cycle benefits (in terms of reducing GHG emissions, criteria pollutants, and petroleum use) for various applications and multiple fuel and energy pathways. Analysis efforts will also support other subprograms, providing data and analysis to be used in critical aspects of program direction, such as go/no-go decisions.

Benefits

Advances in the high risk, early stage hydrogen and fuel cell technologies are helping to reduce the cost of these technologies significantly. For example, the projected, high volume cost of transportation fuel cell systems has been reduced from $275/kW in 2002 to $49/kW in 2011. This cost reduction is the direct result of innovations in fuel cell technology from the development of nano-structured thin film membranes to new catalyst structures and formulations that have lowered the PGM content in fuel cell systems.

Achieving the overall fuel cell target cost of $30/kW will require continued advances in fuel cell technology such as catalysts, electrodes, and membrane technology. Likewise, the effort expended to lower the cost of hydrogen fuel technologies, such as to the threshold cost of $2 to $4/gge for hydrogen dispensed into a vehicle, will help enable the expansion of the fuel cell market and lower the potential GHG emissions, particularly when the hydrogen is produced from renewable resources. These advances will allow the program to achieve the fuel cell electric vehicle lifecycle cost reduction pathway target of approximately $.28/mile and the interim 2020 target of $.09/kWh for stationary fuel cell systems as well as the ultimate target of $.06/kWh.

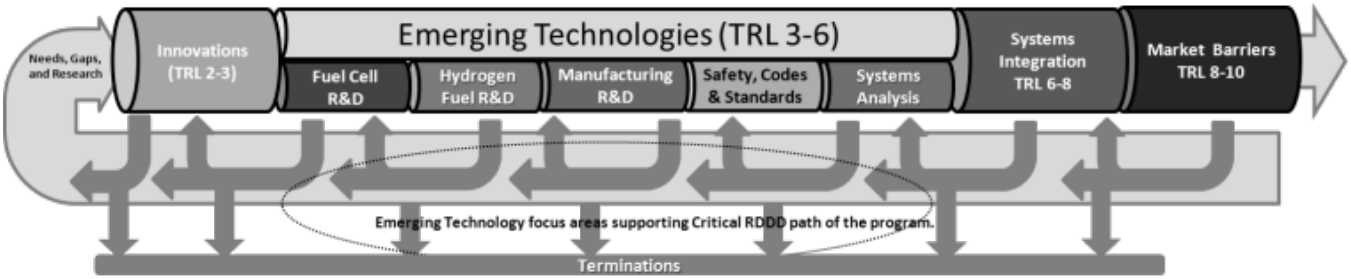
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current.	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	29,027	19,465	15,909
SBIR/STTR	0	592	501
Total, Emerging Technologies	29,027	20,057	16,410

Sequence



Description

Emerging technologies provide the aggregation of base technology developments in materials and components for hydrogen and fuel cell technologies. Combining relevant technologies into subsystems and systems allows for testing and evaluation of technologies prior to larger investment at the demonstration stage.

The program plans to invest over $16 million in hydrogen and fuel cell emerging technologies in FY 2013. These funds will be used to build on prior year accomplishments such as a 50 percent reduction in the manufacturing cost of gas diffusion layers (from $36/kW to $14/kW) and a fourfold increase in manufacturing capacity since 2008.

The FY 2013 funds will be distributed primarily among Fuel Cell R&D, Hydrogen Fuel R&D, and Manufacturing R&D projects with a focus on areas such as membranes for fuel cells, electrolyzer efficiency, hydrogen compressor technology, and advanced hydrogen storage concepts.

Key Technology and Focus Areas

Fuel Cell R&D — Efforts will be directed towards developing components and systems with reduced cost, greater durability, and improved performance — achieving $30/kW and 5,000-hour durability for transportation fuel cells by 2017 and 45 percent electrical efficiency and 60,000-hour durability for stationary micro-CHP (1-10 kW) systems by 2020. At the cell and stack level, technology development activities will include component and materials optimization and cell component integration — such as the integration of electrodes (including catalysts) with electrolyte materials and gas-diffusion layers into membrane electrode assemblies for polymer electrolyte membrane fuel cells and equivalent components for solid oxide fuel cells. At the system level, emphasis will be placed on integration and component interactions, as well as the development of balance of plant components, targeting lower cost and lower parasitic losses. The development of complete systems for a variety of applications will be pursued to allow products to be developed that will be competitive with incumbent technologies. Cost analyses and technical evaluations will guide component development, and modeling will be used to benchmark complete systems before they are built, to enable exploration of alternate components and system configurations.

Hydrogen Fuel R&D — Efforts will focus on the development of renewable hydrogen production systems, advanced delivery components, and onboard storage systems. Hydrogen production activities will include reducing electrolyzer capital cost from current values of $400/kW down to the 2017 target of $125/kW and increasing electrolyzer system efficiency from

current values of 67 percent to meet the 2017 target of 74 percent. Hydrogen delivery activities will include development of: 1) high-pressure vessels for hydrogen transportation and off-board storage at the fueling station; 2) high-efficiency magnetic hydrogen liquefaction systems; and 3) novel high-pressure liquid hydrogen transfer systems. Hydrogen storage efforts will include analyses to predict the performance of novel materials and concepts when incorporated into complete systems; evaluation of later-stage advanced storage system concepts; development of complete on-board storage systems using advanced high-capacity materials; and reduction of the costs of high-pressure storage systems.

Manufacturing — Technology development efforts address the need to move innovations from the laboratory to the factory floor to enable online quality control and faster and more efficient system assembly. Examples include developing novel pressing and sealing technologies for fuel cell membrane electrode assemblies and infrared imaging to identify discontinuities in catalyst dispersion.

Safety, Codes & Standards — Efforts will include development of technologies such as hydrogen sensors, including advanced design and fabrication to ensure safety, performance, and reliability of an integrated sensor. Safety, Codes & Standards efforts will also be coordinated with other technology development activities to develop requirements (for design, performance, and qualification) and test methods for various components and systems.

Systems Analysis — Will provide the analytical and technical basis for prioritizing the program's technology development efforts and determining technology gaps. Analysis efforts will also support other subprograms, providing data and analysis to be used in critical aspects of program direction, such as go/no-go decisions.

Benefits

A significant barrier toward widespread market penetration of hydrogen and fuel cell technologies is the current high cost of the technologies. As a result, this subprogram seeks to reduce cost by combining innovations into laboratory systems for testing and evaluation. A major FY 2011 accomplishment was reducing the electrolyzer stack cost to $400/kW, which represents a >80 percent reduction from the 2001 cost of $2,500/kW.

Prototype development, testing, and evaluation enhance industry and consumer confidence in new technologies, which encourages market adoption. These efforts also enable the continued cost reduction required in fuel cell systems and hydrogen fuel technologies along with the increases in manufacturing capacity and economies of scale that are required to achieve the lifecycle cost targets. In addition, the funding will enable the development of prototypes for larger scale testing and decisions by industry on whether the technologies warrant additional validation as industry begins to take the lead and increase their cost share of the projects.

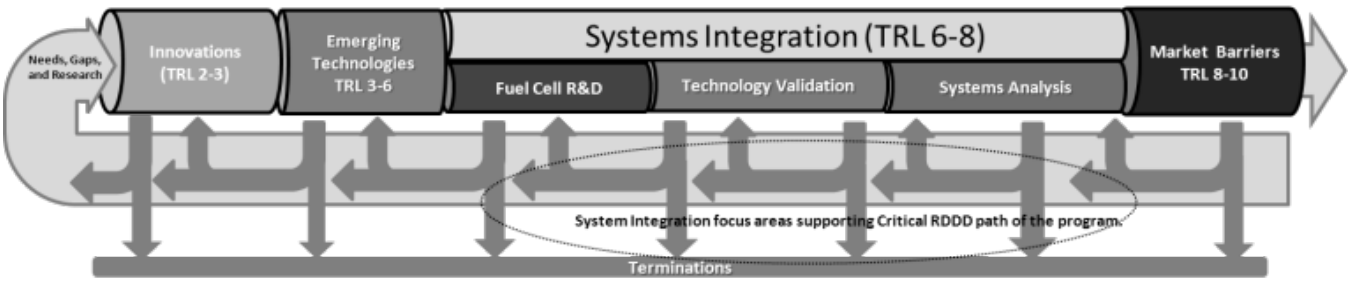
Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	8,869	11,421	6,980
Total, Systems Integration	8,869	11,421	6,980

Sequence



Description

Systems Integration and demonstration activities in the R&D continuum provide the transition from the laboratory R&D advances to real-world operating conditions and to full-scale market transformation activities. The demonstration projects in this subprogram provide valuable feedback to the lower TRL levels as technology gaps are identified. In addition, these validation projects allow for performance targets to be reached under real-world operating conditions and enable an effective transition from demonstration to deployment.

In FY 2011, the FCEV learning demonstration project was completed, having demonstrated more than 170 FCEVs and 25 hydrogen fueling stations. The FCEVs traveled over 3.4 million miles, demonstrating more than twice the energy conversion efficiency of today's gasoline vehicles. Refueling times of approximately 5 minutes for 4 kg of hydrogen were demonstrated, and there were more than 30,000 refuelings in total. The vehicles also demonstrated driving ranges of more than 250 miles on a single fill (in addition, the program has validated a driving range of >430 miles for an FCEV outside of the learning demonstration).

The program plans to invest approximately $7 million in hydrogen and fuel cell technology system integration activities in FY 2013. These funds will be used to validate hydrogen and fuel cell technologies, including work leading to the development of fuel cell systems for CHP and remote power applications. Prior efforts demonstrated increased durability, enabling more than 12,000 hours of operation in the field, an advance representing a significant step toward development of a solid-oxide fuel cell system for widespread commercialization.

The FY 2013 funds will be focused primarily on technology validation projects. With completion of the multi-year learning demonstration project in FY 2011, additional and new validation projects from FY 2012 and FY 2013 will begin in areas such as hydrogen refueling and fuel cell systems that can provide not only power but also heat and hydrogen (combined heat, hydrogen, and power, or "tri-generation"). These projects will help to validate the program's goals of cost competitive hydrogen fuel for early market applications such as fuel cell fork trucks and fuel cell system durability exceeding 40,000 hours.

Key Technology and Focus Areas

Fuel Cell R&D — Efforts will demonstrate components and subsystems for a variety of applications, including: distributed power and CHP; transportation; and emerging market applications, such as portable power. These activities will provide valuable data, which will directly support the Fuel Cell R&D subprogram's cost analysis and technical evaluation efforts.

Technology Validation — Will demonstrate and evaluate the real-world operation of full-scale stationary fuel cells and hydrogen refueling integrated systems. These

demonstrations will include hydrogen refueling for a variety of fuel cell applications, including: material handling equipment, backup power (e.g., for cell towers), transportation, and stationary power. These efforts will also demonstrate innovative approaches and technologies for refueling systems, such as: integrating hydrogen production with stationary fuel cells using natural gas or biogas; electrochemical hydrogen compression; and electrolyzers or reversible fuel cells for refueling backup power systems. Operational data will be collected and analyzed to assess the current technology and provide feedback to the program's R&D activities.

In addition to its own demonstrations, Technology Validation will also collect and analyze data from the Department of Defense, other Federal agencies, and state activities that are demonstrating fuel cells and related systems. For example, the subprogram will coordinate with the Department of Transportation (DOT) to collect and analyze data from the DOT's transit bus demonstrations and will also coordinate with other fuel cell bus demonstrations worldwide.

Systems Analysis — Data collected from demonstrations will help validate the analytical models and tools that are used to quantify program benefits, technology progress, and overall market readiness. For example, data from fuel cell bus, material-handling, and stationary applications will be assessed for their ability to meet market requirements under real-world operating conditions.

Benefits

The demonstration and validation of fuel cell systems in real-world operation provides critical feedback to the Innovations and Emerging Technologies Subprograms and help to guide the next steps in those areas. In 2011, the fuel cell electric vehicle learning demonstrations concluded with 25 fueling stations and over 180 vehicles traveling over 3.5 million miles. In addition, the durability of the fuel cells was over 2,500 hours (with less than 10 percent degradation), which is approximately 75,000 miles. The vehicles also demonstrated efficiencies up to 59 percent, which is more than double the efficiency of a conventional gasoline engine. These vehicles were able to travel over 250 miles on a single hydrogen fueling (the program has also separately validated a fuel cell electric vehicle capable of >430 miles on a single fill of hydrogen).

While this learning demonstration focused on fuel cell electric vehicles, activities in 2013 will also include stationary fuel cell systems to identify technology gaps that inhibit the program from achieving the 2020 interim target of 9 cents/kWh. In addition, validation of tri-generation fuel cell systems producing heat, hydrogen, and power is planned along with the hydrogen fueling infrastructure that the tri-generation systems could support for the early market applications. Projects such as these enable sound decisions on where the technologies reside in the product development pipeline and will help the domestic fuel cell manufacturers to better understand how their specific technologies address the requirements of the market.

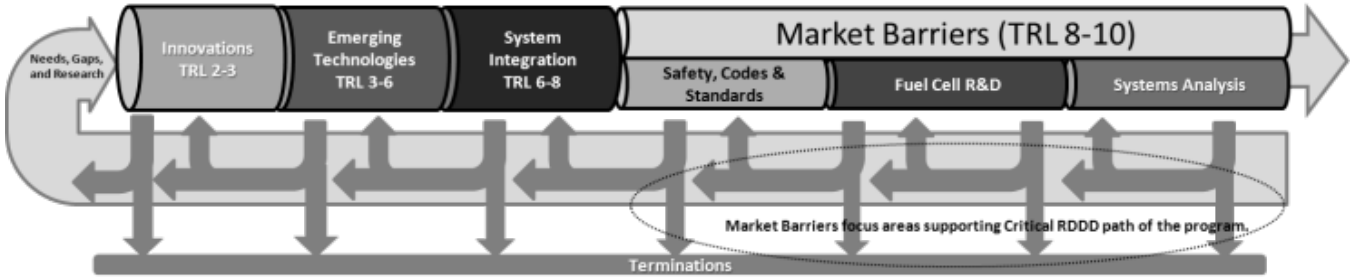
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	3,432	6,180	2,520
Total, Market Barriers	3,432	6,180	2,520

Sequence



Description

Market barriers and deployment activities represent the final stage of the research to deployment continuum. These projects address barriers to market penetration such as developing uniform codes and standards and non-hardware cost reductions such as permitting, siting, and energy efficiency performance standards. Working with industry and other Federal and state agencies, the deployment projects yield full-scale data on multiple fuel cell systems that would not be obtainable at lower TRL levels. These data help the program identify gaps and future RD&D needs.

In FY 2011, this subprogram focused specifically on safety, codes and standards activities. Additionally, performance and cost data from $42 million in deployments made through the Recovery Act are now being collected and evaluated, and standards and best practices are being developed to assist in full market penetration. This full-scale data on multiple fuel cell systems are also helping the program identify gaps and future RD&D needs. The FY 2012 appropriation included funding for additional deployments. The funds were used to strengthen existing partnerships with other Federal agencies, such as the Department of Defense, to deploy and collect performance data for various hydrogen and fuel cell applications, which will build upon past early adoption successes. Analysis by Oak Ridge National Laboratory has estimated that the program's Recovery Act efforts in early market deployments have led to a 10 percent lower average capital equipment cost for fuel cell systems for material handling than would otherwise have been achieved, contributing to an industry-wide 50 percent average cost reduction in the past 5 years and further enabling market penetration.[a] While market growth in terms of megawatts of fuel cell power shipped was 50 percent between 2008 and 2010, approximately three times as many fuel cell systems were shipped by foreign companies than by U.S. companies in 2010.[b]

In FY 2013, the program plans to defer additional investment in Market Transformation to enable ongoing collection and analysis of these data to identify critical R&D needs and emerging markets to address in the future. Funds in this subprogram will focus on development of codes and standards and system analysis activities.

Key Technology and Focus Areas

Safety, Codes & Standards — Will coordinate extensively with national and international organizations to ensure that codes and standards for hydrogen and fuel cell technologies are harmonized. For example, the subprogram will collaborate with Department of Transportation, Environmental Protection Agency, National Institute of Standards and Technology and other

[a] ORNL/TM-2011/101 Status and Outlook for the U.S. Non-Automotive Fuel Cell Industry: Impacts of Government Policies and Assessment of Future Opportunities, May 2011, www-cta.ornl.gov/cta/Publications/Reports/ORNL_TM2011_101_FINAL.pdf.

[b] *2010 Fuel Cell Technologies Market Report*, DOE, June 2011, https://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/2010_market_report.pdf

government agencies to ensure that the development of fuel, fuel storage, and dispensing standards proceeds in agreement with existing regulatory authorities. Building on prior year efforts, the subprogram will also expand the development and dissemination of hydrogen safety information and training resources for code officials, first responders, and other key stakeholders. In addition, the subprogram will assess best-practices and develop information resources that will help reduce the time and cost involved in the permitting, inspection, and siting processes associated with installing hydrogen and fuel cell systems.

Market Transformation — No funding is planned for FY 2013.

Systems Analysis — These analytical activities will include assessment of the opportunities for market penetration for near-term markets, such as material handling, back-up power, and residential CHP applications. In addition, the effects of Federal fuel cell acquisitions and incentives will be assessed to estimate impact on fuel cell cost reduction and market growth.

Benefits

Addressing the market barriers associated with hydrogen and fuel cell technologies allows for quantitative decisions to be made by industry on whether technologies will experience successful market entry as the program has demonstrated with the expansion in the fuel cell lift truck market resulting from the program's funding. As industry achieves increased market penetration, economies of scale will be enabled, resulting in reductions in all total life cycle costs not just the hardware components. Deployment activities increase domestic fuel cell market penetration by removing financial market barriers and reducing non-hardware system costs. Independent analysis shows global markets could mature over the next 10-20 years, producing an industry with significant revenues and creating new jobs in the U.S.

Solar Energy Technologies Program

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Solar Energy Technologies Program			
Concentrating Solar Power	47,328	44,922	45,085
Photovoltaic R&D	132,844	75,554	66,041
Systems Integration (Balance of System and Power Electronics)	54,384	47,916	43,165
Market Transformation (Standards/Operability/Training)	25,000	31,897	42,088
Innovations in Manufacturing/ Validation for SunShot	0	84,404	109,710
SBIR/STTR	0	4,258	3,911
Total, Solar Energy Technologies Program	259,556	288,951	310,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Solar Energy Technologies Program			
Innovations	88,779	79,606	70,045
Emerging Technologies	134,247	126,446	117,055
Systems Integration	9,577	68,090	93,400
Market Barriers	26,953	10,551	25,589
SBIR/STTR	0	4,258	3,911
Total, Solar Energy Technologies Program	259,556	288,951	310,000

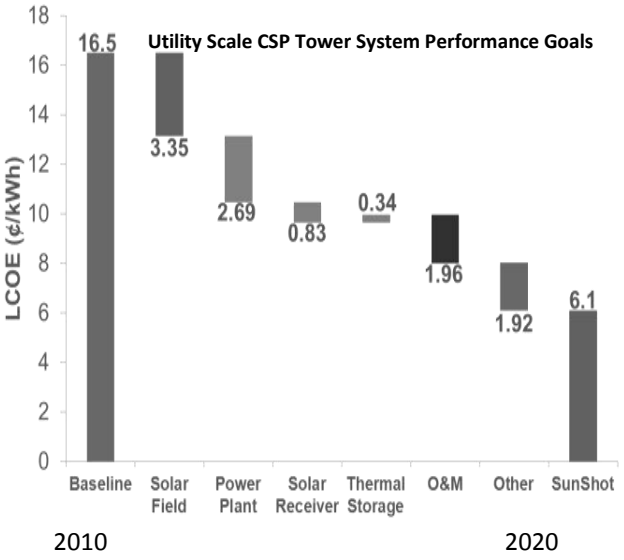
Public Law Authorizations

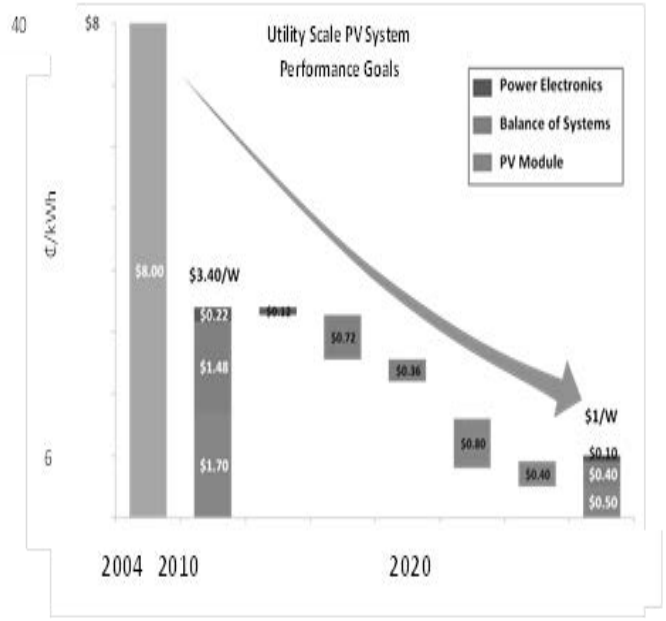
P.L. 95-91, "U.S. Department of Energy Organization Act" (1977)
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The Solar Energy Technologies Program supports the SunShot Initiative's mission to develop solar energy technologies through a collaborative national push to make solar photovoltaic (PV) and concentrated solar power (CSP) energy technologies cost-competitive with fossil fuel based energy by reducing the cost of solar energy systems by 50 to 75 percent before 2020. Reducing the total installed cost for utility-scale solar electricity to roughly $.06/kWh without subsidies will enable rapid, large-scale adoption of solar electricity across the U.S. This investment will help re-establish American technological and market leadership in solar energy, improve the Nation's energy security, reduce environmental impacts of electricity generation, and strengthen U.S. economic competitiveness and catalyze domestic economic growth in the global clean energy race. The program closely coordinates its activities with those at the Office of Science and Advanced Research Projects Agency-Energy (ARPA-E) to prevent duplication of efforts while maximizing agency-wide impact on solar energy. The program focuses on removing the critical barriers for the system as a whole, including technical and non-technical barriers to installing and integrating solar energy into the electricity grid. In addition to investing in improvements in solar technologies and manufacturing, the program focuses on integrating solar generated energy systems into the electricity grid and reducing installation and permitting costs. At the fundamental level, the program embraces two complementary approaches, namely converting solar photons to electricity through direct conversion in a semiconductor (PV) and through intermediate conversion to thermal energy (CSP).

[a] SBIR/STTR funding transferred in FY 2011 was $3,944,000.





At a total installed system cost of utility solar equivalent to the wholesale cost of electricity from fossil fuels — the levelized cost of electricity (LCOE) is approximately $.05-.$06/kWh — PV would be broadly competitive across the U.S. without any subsidies. Such a LCOE of $.05-$.06/kWh translates to an installed cost of approximately $1/Watt of capacity. Achieving this goal will require significant technological innovations and reductions in cost in all PV system components. These components are broadly defined as modules, power electronics, and balance of systems (BOS), which includes all other components and costs required for a fully installed system including permitting and inspection costs. For the PV utility scale system, a rough breakdown of the $1/Watt installed cost would include $.50/Watt for the module, $.10/Watt for the power electronics, and $.40/Watt for the BOS elements. The program's strategy also includes performance targets for cost-competitive commercial ($1.25/Watt) and residential ($1.50/Watt) systems. As of September 2011, reported component prices for utility scale projects in the U.S. were:[a]

- Average utility-scale installed system price: $3.45/$W_{dc}$
- Average module price: $1.32/$W_{dc}$
- Average utility-scale inverter price: $0.23/$W_{ac}$
- BOS price for utility scale systems: $1.95/Watt.

The success of the program will assist the U.S. in regaining leadership in worldwide PV manufacturing. To achieve the goal of grid-parity, the PV technology pathway invests in transformative research, development, and demonstration (RD&D) activities focusing on achieving radical improvements through manufacturing cost and efficiency improvements as well as new discoveries. We fund such activities in a synergistic fashion across industry, National Laboratories and universities. Our funding activities span the entire Technology Readiness Level (TRL) scale, from Basic Science (TRL-1, through work in the Office of Basic Energy Sciences) to reducing Market Barriers (TRL-9).

The program will continue to focus on innovative technology and manufacturing process concepts as applied to PV and will help stimulate and spur the domestic PV manufacturing base. The program also supports Systems Integration by developing radically new approaches to reduce the cost and improve the reliability and functionality of power electronics; by supporting industry development through test and evaluation standards; and by developing tools for understanding grid integration issues. Emphasis will continue to be placed on Market Transformation areas to quantitatively address non-hardware related BOS costs including streamlined permitting, inspection, and interconnection as well as performing key analyses of policy options and their impact on the rapid deployment of solar technologies.

The program will continue to develop CSP technologies with thermal storage to reach the goal of base-load grid parity by 2020. The CSP pathway invests in thermal storage and supporting systems research and optimization to provide baseload power on demand, even at night. Widespread deployment of CSP with significant amounts of thermal storage is critical to achieving reduction in CSP system cost, load balancing to enable high levels of renewable generation integration, and the ability for CSP systems to manage short-term and diurnal disruptions in solar output. Going forward, the CSP component of the program will balance its RD&D activities through a strong push towards a LCOE of $.06/kWh cost structure and the

[a] GTM Research/ SEIA, U.S. Solar Market Insight Report Q3 2011, http://www.greentechmedia.com/research/solarinsight

innovations in the sub-system level required to achieve this.

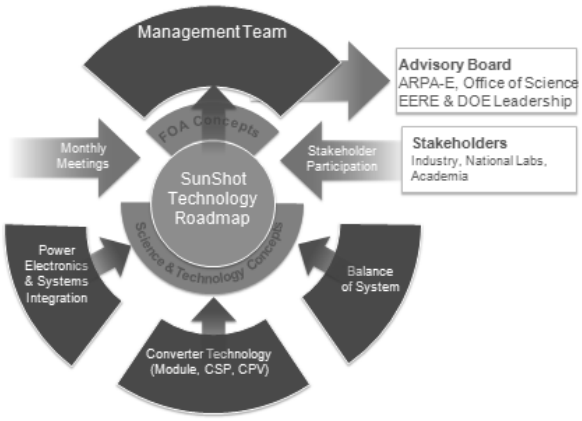
Strategy

The program is based on a balanced RD&D portfolio. Our investment priorities are set primarily by detailed roadmaps to meet cost reduction goals, all the way down to a dollar-a-Watt. We closely coordinate our activities across Basic Energy Sciences, Advanced Research Projects Agency-Energy (ARPA-E) and Energy Efficiency and Renewable Energy (EERE) through the active participation of program managers from all three areas of the Department of Energy (DOE) on a SunShot Management Team.

Achieving the dollar-a-Watt goal will require significant reductions in cost and technological innovations in all PV system components. These are broadly defined as modules, power electronics, and BOS which includes all other components and costs required for a fully installed system. To achieve the dollar-a-Watt goals, PV module prices must continue to be reduced. From the 2010 baseline a 75 percent reduction in price is required. In 2011 module prices have been reduced by about 40 percent. Distributed systems for residential and commercial applications will require a significantly greater reduction in cost. In addition to technological innovations, this reduction can be assisted by economies of scale that can be achieved if installation occurs at much greater scale than today.

SunShot is being implemented through an integrated program conducted through the National Laboratories, industry, and universities, and in close collaboration with the Office of Science on fundamental research, and the ARPA-E to advance work on power electronics. Our program development process is driven by an interdisciplinary team consisting of the four team leads within the Solar Energy Technologies Program housed within EERE, two program managers from ARPA-E and two from the Office of Science's Basic Energy Sciences program. Potential funding opportunity ideas are solicited from the entire solar community, through an on-going series of stake-holder workshops as well as internal "brain-storming" sessions within SunShot. Based on this input, Funding Opportunity Announcement (FOA) White papers are then developed and presented by the FOA manager to the management team. After considerable debate of the pros and cons as well as the value proposition of the FOA proposal, the team votes on it. If and when a FOA concept obtains a positive vote, it emerges as a formal FOA. The FOA manager then begins to put together the FOA solicitation and the approval process required to formally announce it.

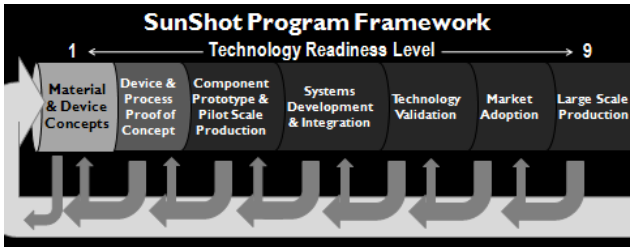
SunShot Management Structure



Benefits

Reducing the solar LCOE to $.05-.06/kWh without subsidies is projected to enable significant market penetration directly impacting jobs creation, energy security, and global competitiveness. The U.S. has been progressively losing market share in PV modules; global investments have increased, and U.S. investment is needed to maintain U.S. competitive advantage. Investment in innovative technologies, in parallel with reduction of market barriers and the BOS costs coupled with technology validation to increase private sector project financing ("bankability"), will further help to stimulate the U.S. manufacturing base.

Analysis from the National Renewable Energy Laboratory (NREL) indicates that achieving $1/W$_{DC}$ could result in approximately 375 GW of PV capacity supplying approximately 13 percent of U.S. electricity by 2030. By 2050, approximately 600 GW of solar PV capacity could be installed, providing 18 percent of U.S. generation. Implementation of the CSP component of SunShot could lead to 3 percent of the total electricity by 2030 and 9 percent by 2050. [a] .



The program is structured as a technology pipeline starting from the earliest stages of Innovations, to Emerging Technologies, to Systems Integration, and finally Market Barriers. Each segment of the technology pipeline is designed to address the cost reduction and

[a] R. Margolis et. al. "SunShot Vision Study," DOE report to be published February 2012.

performance improvement necessary to reach the overall program objective of deployed systems at $1/W_{DC}$ by 2020. The Innovations subprogram supports transformational research primarily performed at universities and National Laboratories. The Emerging Technologies subprogram supports the transition of new ideas, often times ideas that advanced through the Innovations subprogram, into pre-commercial development, primarily at small, medium, and large sized business. Systems Integration takes solar technology development one step further through reducing technical barriers to higher grid-scale integration of solar into the electric grid. This research is primarily performed at National Laboratories and in industry. Finally, Market Barriers funds activities, primarily with state and local governments, aimed at reducing regulatory barriers that can limit the adoption rate of solar technology. The benefits to be obtained for industry and the public sector include:

- Development of new solar technologies that have the potential to change the industry;
- Development and training of university graduates who can directly join the workforce in industry and academia;
- Increased efficiency (and lower costs) for PV and CSP systems through fundamental scientific advances in materials technologies;
- Creation of new start-up companies or new businesses within larger companies;
- Catalyzing industry wide collaborations by linking academia, National Laboratories, and businesses to address common technology problems;
- Reduction in costs for components used in solar energy systems including PV modules and CSP systems;
- Reduction in costs of power electronics and BOS hardware;
- Reduction in risk associated with the use of new technologies (i.e., improved bankability);
- Establishment of streamlined processes for integrating high-penetrations of solar technologies into the grid in a safe, reliable, and cost-effective manner while providing value to the system owner and the utility grid;
- Reduction of permitting, interconnection, and inspection costs;
- Reduction of the time required for permitting, interconnection, and inspection of solar systems; and
- Increased professional installation workforce trained for jobs in the solar industry.

Key Accomplishments

Research at the National Laboratories — Innovative research at NREL has demonstrated Copper Indium Gallium di-Selenide (CIGS) solar cells with higher performance at lower indium content than previously. This could lower the costs this emerging solar cell material while reducing our need for non-earth abundant materials.

SunShot Incubator- Several SunShot Incubator startup companies including Alta Devices and Solar Junction have significantly exceeded previous world record cell efficiencies. In FY 2011, Alta demonstrated 29 percent efficient single junction devices and Solar Junction demonstrated 43.5 percent efficient triple junction devices. At the end of FY 2011, the SunShot Incubator program was expanded to include opportunities to address the soft BOS costs.

Rooftop Solar Challenge – The Rooftop Solar Challenge was launched in FY 2011 to address some of the soft BOS costs in the deployment of residential and commercial solar. Included in this program is extensive data tracking that will provide the DOE with greater resolution and insight into the many factors that have limited the acceleration of solar deployment.

The program's recent accomplishments can be found online in our news archive: http://www1.eere.energy.gov/solar/sunshot/news.html

Strategic Plan and Performance Measures

The program planning is built around three broad technology and market areas, namely: 1) Conversion Technologies, including Photovoltaics and Concentrated Solar Power; 2) Systems and Grid Integration; and 3) Reduction in Market Barriers and BOS costs. In each of these areas, our goal is to spur technological innovations through the confluence of innovative hardware and software technology solutions.

Performance Measure Analysis

The program performance measures outline how the program influences the reduction in the cost of solar electricity, measured in two ways, namely: 1) the cost per Watt, and 2) the LCOE. We use detailed roadmaps to track the evolution of these costs to the SunShot goal of $1/Watt or an LCOE of $.05-$.06/kWh by the end of this decade. These roadmaps are summarized in the cost reduction charts shown above.

In addition, impacts of the program's R&D activities are assessed through retroactive evaluation of the residential, commercial and utility markets. For example, the LBNL Tracking the Sun Report examines residential solar cost data from the California Solar Initiative. Information for commercial scale cost is aggregated from multiple analyses based on data from EIA and relevant financial institutions and industry trade organizations. Similarly, the program uses data collected from industry partners and the Department of Treasury to track costs at the utility scale.

The program will also develop a program performance measure that outlines the program's success in translating the innovations and discoveries (that have historically been the strength of the program) into a measurable value proposition for the tax-payer such as, economic growth in the U.S. solar electricity manufacturing and generation sectors or other such returns on investment. Key technology pathways and areas of performance focus on areas that contribute to the overall cost goals:

- PV Module — Efficiency, manufacturing costs, reliability, form (rigid module vs. flexible module vs. building integrated photovoltaic (BIPV));
- CSP Systems — Higher temperature operation, low cost collection;
- Power Electronics & Systems — high voltage, high frequency, low cost, reliability; weight; grid integration;
- BOS — Lower component costs, streamlining permitting, inspection costs; implement IT solutions; as an example, in the Rooftop Challenge FOA, participants will provide at the start of their award baseline data on the time and cost to permit. At the end of the first year, awardees will provide the updated set of data showing improvements and will demonstrate what protocols (online permitting, form consolidations, pre-approved permitting, etc.) were used to effect these changes. In the second year of this program, the best practices from each region will be brought together to create a unified national model framework.
- Advanced Manufacturing Processes — Create and retain IP and stimulate manufacturing; U.S. industry growth and jobs; global competitiveness.

In FY 2010, the program and ARPA-E jointly held a workshop to identify innovative pathways to achieve $\$1/W_{DC}$ PV systems as an approach to determining and overcoming barriers to LCOE cost-competitiveness. At $\$1/W_{DC}$ installed, PV would be broadly competitive across the U.S. without any subsidies. A rough breakdown of the $1/Watt installed cost would breakdown into $\$0.50/W_{DC}$ for the module, $\$0.10/ W_{DC}$ for the power electronics, and $\$0.40/ W_{DC}$ for the BOS. Our performance is being continuously measured against these aggressive targets. Ultimately, our performance will be gauged by the following questions:

- Did the program enable the attainment of the $.05-$.06/kWh cost target by the end of the decade?
- Did we enable a vibrant U.S. manufacturing base as a consequence of the various RD&D activities that we funded?
- Did these activities enable job creation within the country?
- Did we enable widespread deployment of solar energy conversion, thus spurring the development of an economy that is less reliant on fossil fuels?
- How competitive is the U.S. solar industry and supply chain on a global scale?

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Solar Energy Technologies Program			
Innovations — FY 2011 program activities classified as R&D were reclassified into the Innovations and Emerging Technologies subprogram areas based on the stage of scientific and technical development. The funding change from FY 2012 to FY 2013 reflects a re-distribution of funding to the System Integration subprogram to support an increase in integrated manufacturing-scale process development and validation.	79,606	70,045	-9,561
Emerging Technologies — FY 2011 program activities classified as R&D were reclassified into the Innovations and Emerging Technologies subprogram areas based on the stage of scientific and technical development. The funding change from FY 2012 to FY 2013 reflects a re-distribution of funding to the System Integration subprogram to support an integrated manufacturing-scale process development and validation.	126,446	117,055	-9,391
Systems Integration — FY 2011 program activities classified as testing, validation, and advanced development and demonstrations were reclassified into the System Integration subprogram area. The funding increase in FY 2013 enables the System Integration subprogram to support a critical push toward innovative manufacturing development and demonstrations. This new phase of the Photovoltaic Manufacturing Initiative (PVMI) manifests itself as a novel demonstration manufacturing activity called SUNPATH.	68,090	93,400	+25,310
Market Barriers — The program's Market Transformation subprogram activities from FY 2011 have been refocused significantly to utilize research and development (R&D) solutions to market barrier challenges. These new activities will focus on using standard scientific techniques of data collection, analysis and the development of algorithms to reduce the permitting costs/time for solar installation. This renewed focus is reflected in the increased funding for this topic area.	10,551	25,589	+15,038
SBIR/STTR are calculated based on research and development funding allocations.	4,258	3,911	-347
Total, Solar Energy Technologies Program	288,951	310,000	+21,049

Explanation of Changes

Funding allocation in FY 2012 was based on four technology sub-programs (PV, SI, MT and CSP). In FY 2013, funding allocations have shifted to a Technology Readiness Level (TRL) based program structure. It is critical to note that direct comparisons of funds allocated in FY 2012 and FY 2013 are approximate. Overall the change reflects a realignment of program resources to address critical manufacturing cost drivers. This program strategy is critical to the SunShot Initiative because PV modules make up 50 percent of the cost structure for the $1/Watt goal and cost reductions and performance improvements in manufacturing processes are crucial to achieving this goal.

Funding Opportunity Announcement Background

In carrying out its vision and mission, the program conducts a broad portfolio of activities to make electricity from solar more cost competitive with conventional forms of electricity. Many of these activities are conducted through an open, competitive solicitation process designed to support the program cost reduction goals and objectives. FOA's allow for collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local

governments and non-government agencies and advocacy groups.

The program posts current and past funding opportunities for all program areas here: http://www1.eere.energy.gov/solar/financial_opportunities.html.

Anticipated FOAs

(Dollars in Thousands)

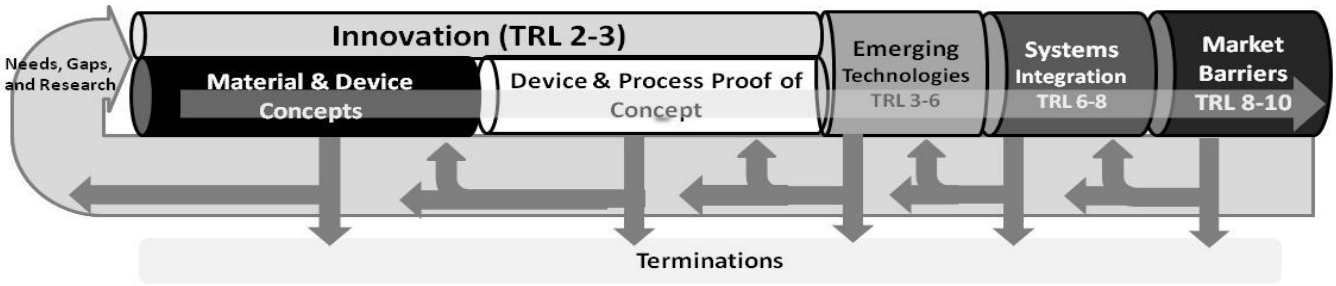
Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2013	Focus Area: Plug and Play Solar Panels	Innovative Research	10,000
This FOA will explore innovative systems level approaches to create a new generation of "Plug and Play" solar technologies. Permitting, mechanical and electrical inspection represents a growing percentage of the systems costs for residential and commercial PV systems as PV panel prices have fallen drastically in recent years. "Plug and Play" solar technology developed under this FOA can simplify and perhaps even eliminate many of these costly steps required by adding self-test and smart grid interoperability.			
FY 2013	Focus Area: Advanced IT solutions for streamlining permitting processes	Emerging Technology Development	5,000
Permitting new solar installations is an expensive process for local jurisdictions to administer and a complicated process for permit applicants. This will explore the use of novel IT and web based processes that can simplify and streamline the conventional permitting and inspection processes for both consumers and jurisdictions.			
FY 2013	Focus Area: Solar Automated Installation: A new pathway to low cost automated utility scale solar	Novel Demonstration for Manufacturing and Systems Concepts	10,000
Installation costs contribute significantly to the cost of utility scale solar. This FOA will explore the implementation of automated solar installation. As mechanization has revolutionized industries from agriculture to road paving, the technology to develop automated large scale machinery to rapidly install utility scale solar plants can lower the costs and rate of utility scale solar deployment. Special purpose machinery is envisioned that may "combine" multiple installation steps into a single machine. Installation technologies such as these are to be developed under this FOA.			
FY 2013	Focus Area: SunShot Technology Validation	Novel Demonstration for Manufacturing and Systems Concepts	10,000
This FOA anticipates bringing several of the sub-systems activities together into a systems level validation concept, for both PV and CSP. This FOA reduces risk of emerging technologies by testing and validating at scale the performance and reliability of solar systems in various geographic and climatic conditions.			
FY 2013	Rooftop Solar Challenge	Market Barriers	25,000
In FY 2013 the program will expand the Rooftop Challenge launched in FY 2011 and implemented in FY 2012 to cover additional segments of the population and also directly engage utilities. FY 2012 activities included support for 22 teams to streamline permitting within their jurisdictions covering a total population of 51 million. Work in FY 2013 will focus on applying best practices from these 22 teams more broadly throughout the country, and expanding geographical coverage. Additionally, these funds will support work with electricity providers to develop new business models that encourage greater penetration of solar on the grid. Similar to the Rooftop Solar Challenge model, DOE will encourage electricity providers to develop these new business models that make sense based on their unique specifications.			

Innovations

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	88,779	79,606	70,045
SBIR/STTR	0	2,348	2,066
Total, Innovations	88,779	81,954	72,111



Description

Our funding portfolio is tracked in two complementary ways: (i) through a TRL evolution chart; (ii) in three technology areas (as described earlier), namely Conversion Technologies, Systems and Grid Integration and Market Barrier Reduction and BOS costs. The TRL pipeline, shown schematically above, tracks the evolution from Innovation (mainly applied research and early stages of development), to Emerging Technologies and then to Systems Integration and finally to Market Barriers. The Innovations subprogram focuses on how science and technology will be brought to bear to create innovative pathways to address the SunShot technology and cost goals. Innovations are primarily funded through two instruments, namely FOA's and the laboratory-directed research funded through Annual Operating Plans. In both cases, funding activities are actively monitored, managed, and are implemented through a detailed analysis of the science and technology barriers that are current limitations.

Key Technology and Focus Areas

Transformational Science and Technology — A core activity is the Next Generation PV R&D work, whose goal is to develop revolutionary and highly disruptive next-generation PV technologies, leading to prototype PV cells and/or processes, thus directly impacting the $1/Watt paradigm. Development work on emerging PV technologies is essential to ensuring innovation and supporting the development and expansion of advanced PV options that will enable PV systems that are even cheaper than $1/Watt.

SunShot Postdoctoral Awards — The SunShot Fellows post-doctoral program funds the next generation of research leaders in the field to pursue breakthrough solar energy technologies. These 2-year awards provide Ph.D. recipients the opportunity to conduct applied research at universities, National Laboratories, and other research facilities.

National Laboratory Core Conversion Technology Research — Over the years, DOE has built up a comprehensive spectrum of expertise and resource base within the National Laboratories, such as NREL. The Core Conversion Technology part of our investment within the Innovations allocation is directly aimed at fully leveraging this prior investment to accelerate the RD&D of solar technologies.

CSP Advanced Research — In order to meet the 2020 Sunshot goals, CSP systems will need to operate at higher temperatures and solar field costs will have to be reduced by 50 to 75 percent. Higher temperature operation results in higher system efficiency and enables thermal storage systems to be less costly. The R&D goals in this area are: Lower costs and improve performance and reliability of solar mirrors; characterize and test materials developed in cooperation with industry; and broaden and unify test methods to standardize qualification requirements of CSP materials, components, and systems.

Thermal Storage R&D — This critical activity area enables power from CSP plants to be dispatched into the utility grid when it is most needed and most valuable. The key goals for this activity are to:

- Develop and deploy advanced heat-transfer fluids (HTF) and thermal storage systems;
- Characterize and improve advanced HTF and thermal storage systems to reduce storage costs; and
- Integrate thermal storage cost and performance models into CSP system models.

Software Innovations — The development and utilization of databases, online training platforms, and IT widgets will facilitate reductions in non-hardware BOS costs by streamlining processes and reducing the time constants associated with system design, permitting, and installation. The transfer of paper- and person-based processes to digital platforms will enable a conversion in the business-as-usual approach in the residential and small commercial market segments.

Solar Resource Assessment — In FY 2013, the subprogram will continue to improve resource maps for both PV and CSP focus areas with an emphasis on providing data to assist industry in site selection and better assurance to utilities and financial institutions on system performance. Main activities will include: development, validation, and dissemination of reliable, accurate, and sufficiently detailed solar resource information; improvements of the quality and completeness of the National Solar Radiation Database; benchmarking U.S. solar databases against international data sets following internationally established protocols; and provision of solar products and tools to stakeholders through accessible web-based mechanisms and outreach activities. The outcomes of this activity will be fed into the Systems Modeling & Analysis activity.

Measurements and Characterization — This activity provides characterization support, collaborative research expertise, and the development of new measurement techniques for the advancement of the PV. The result of these efforts is increased understanding that drives improvements in the performance, reliability, price, and manufacturability of PV systems. Research areas include: Analytical Microscopy; Device Performance Measurement, Electro-Optical Characterization, and Surface Analysis.

Benefits

At $\$1/W_{DC}$ installed, PV would be broadly competitive across the U.S. without any subsidies. A rough breakdown of the $1/Watt installed cost would be $\$0.50/W_{DC}$ for the module, $\$0.10/ W_{DC}$ for the power electronics, and $\$0.40/ W_{DC}$ for the BOS. The Innovations subprogram supports research that will directly impact the module cost and performance. In 2011, the PV module fell to less than $\$1.50/W_{DC}$, less than half of what modules cost just 3 years prior. The Innovations subprogram drives the hardware innovation that forms the foundation for continued and accelerating cost reductions and performance improvements into the future. Examples of these new, early-stage innovations include new PV conversion technologies (e.g., thin film and kerfless Si); dramatic improvements in the efficiency metrics of existing solar materials and technologies (e.g., a new NREL program that is focused on a 23 percent efficient CdTe cell that will significantly change the PV conversion technology landscape that is currently dominated by Si); and low cost heliostats for the CSP program. The Innovations subprogram also supports information technology solutions that will directly impact the BOS costs through streamlined permitting.

The Innovations subprogram also supports transformational research in CSP technologies by supporting advanced thermal storage. Widespread deployment of CSP with significant amounts of thermal storage is critical to achieving reductions in CSP system cost, load balancing to enable high levels of renewable generation integration, and the ability for CSP systems to manage short-term and diurnal disruptions in solar output.

The benefits to be obtained for industry and the public sector include:

- Development of new solar technologies that have the potential to change the industry;
- Development and training of university graduates who can directly join the workforce in industry and academia; and
- Increased efficiency (and lower costs) for PV and CSP systems through fundamental scientific advances in materials technologies.

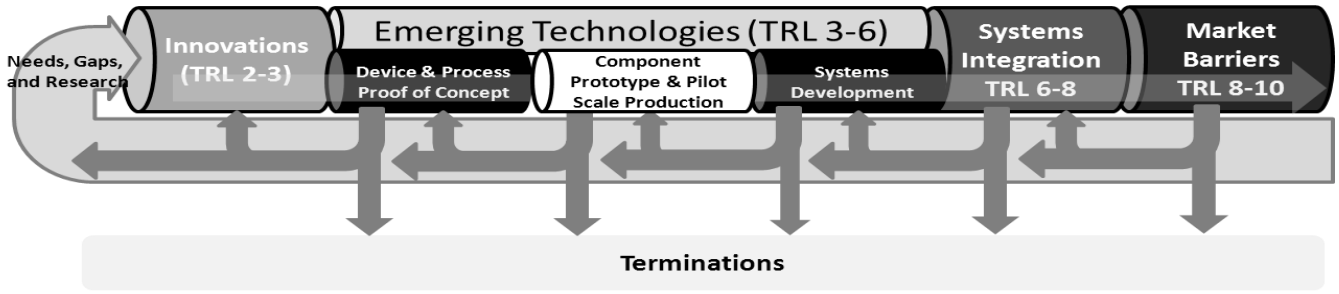
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	134,247	126,446	117,055
SBIR/STTR	0	1,910	1,845
Total, Emerging Technologies	134,247	128,356	118,900

Sequence



Description

Our funding activities in the Emerging Technologies subprogram are primarily focused on creating the core of the next generation of solar technologies, primarily at the TRL level of 3-5, i.e., these funding opportunities are more development oriented. A significant portion of our investment in this subprogram is thus aimed at overcoming the "first Valley of Death" in the technology cycle. The first Valley of Death is the barrier between a pure scientific discovery (which is generally at the TRL 1-2 level) and development of an innovative concept into the first stage of productization, typically requiring an initial investment of $5-10 million, as would happen for example through the formation of a start-up company.

Key Technology and Focus Areas

Foundational Program to Advance Cell Efficiency (F-PACE) is a focused PV effort that is aimed at accelerating the process development and optimization protocols that will lead to enhancing the cell level efficiency. F-PACE will feature a strong collaboration with NSF to directly address scientific advances that can impact the $1/WDC goal. Several new PV materials and processes that were originally funded by DOE-EERE have begun to be commercialized in the past several years, including Copper Indium Gallium Selenide and Cadmium Telluride. Improving the module-level performance of these materials and processes, relative to their laboratory and theoretical maximum performances, is one of the goals of this effort.

SunShot Incubator & Prototype Development — In FY 2010, the PV subprogram merged two successful projects together to streamline the administration of the complementary Pre-Incubator and Incubator activities. The SunShot Incubator targets small businesses in the concept verification stage and bridges their development to a proof-of-concept prototype. It is intended to help innovative new companies reach the stage of development between laboratory concept and pilot scale prototype.

Process Development & Integration Laboratory (PDIL) — The PDIL, housed in the Science and Technology Facility at NREL, will be focused on manufacturing development to give stakeholders an extra level of insight into product development of all PV material technologies with specialized equipment that simultaneously allows the creation and analysis of PV devices. This national resource provides researchers from academia, industry, and other National Laboratories access to a leading edge PV process and testing facility that enables rapid development of new and cost effective PV technologies. We expect the PDIL to be fully built out and functional by 2013. Our plan is to use and leverage this infrastructure to strengthen and build laboratory ties to the outside world, namely industry, start-ups, and university researchers who would like to use the facility (also known as the BES user facility model). The funds will thus be primarily used to support PDIL research staff who will facilitate and lead such collaborations, thereby accelerating the transition of knowledge and innovation from the lab to the private sector.

PV Manufacturing Initiative — FY 2013 will represent the third full year of funding dedicated to innovative manufacturing technology under the PV Manufacturing Initiative. This initiative accelerates the commercialization and cost reduction of PV technologies by coordinating

solutions across industry that will facilitate PV manufacturing in the U.S. The anticipated result of this initiative is the creation of a more robust U.S. PV manufacturing base and the development of a workforce with the critical skills required to meet these goals. The initiative involves consortia of industry and university partners and multi-user manufacturing development facilities to speed the implementation of new cutting edge technologies in industry manufacturing processes.

PV Supply Chain and Cross-Cutting Technologies — This project identifies and accelerates the development of unique PV products or processes that will impact the solar industry. The project supports the $1/$W_{DC}$ goal outlined by the SunShot Initiative. Non-solar companies have many technologies and practices that are beneficial to the PV industry. These capabilities can be used in PV-specific manufacturing methods and products. Examples of such high-impact technologies include equipment or processing steps to improve throughput, yield, or diagnostics; material solutions to improve reliability or enhance optical, thermal, or electrical performance; or system components that streamline installation.

Extreme BOS Hardware Cost Reductions — The objective of this FOA is to significantly reduce the BOS hardware cost component of PV systems. The Emerging Technologies subprogram is funding RD&D of new components and system designs and the development of new building code language to overcome scientific, technological, and engineering barriers to achieve safe, very low cost, and high reliability BOS hardware. These technology innovations may result in lower soft costs (for example, permitting and site preparation) as well.

The BOS-Hardware Activity — This focus area tackles the technology barriers to lower BOS costs through transformational R&D in technologies that enable faster and more efficient system installation, as well as BIPV which can allow the PV material to replace a functional outer surface of commercial and residential buildings. Examples of BIPV are roofing membranes and roofing tiles with integrated PV devices. Besides potential cost savings through replacement of existing building materials, BIPV enables PV to blend into building aesthetics. BIPV activities will be coordinated with the Building Technologies Program.

High Penetration Solar Deployment —Our High Penetration Solar Deployment activities began with initial funding under the Recovery Act. As a consequence of the significant impact these activities had on understanding the impact of large scale grid integration, the subprogram will continue funding of this focus area in FY 2013 to improve modeling tools based on the field verification of high penetration levels of PV into the distribution grid. In addition, the subprogram will continue work with utilities and industry partners to collect data from multi-megawatt systems to characterize the variable output for other utility partners.

Grid Integration — Grid integration activities will establish a timely process for integrating high-penetrations of solar technologies into the grid in a safe, reliable, and cost-effective manner while providing value to the system owner and the utility grid. The approaches include developing advanced grid-friendly PV interconnection technologies, validating inverter and system models, proactively engaging with external stakeholders, and updating standards and codes. This includes addressing technical areas such as variability, voltage regulation, power quality, protection, and unintentional islanding.

This focus area also supports the Solar Energy Grid Integration System – Advanced Concepts activity. This activity develops technologies in power electronics systems that reduce overall PV system costs, allow high penetrations of solar technologies onto the grid (e.g., through reactive power, energy storage, advanced functionalities), and enhance the performance, reliability, and safety of the PV system. In addition, projects funded under this FOA will demonstrate the feasibility of these technologies in the field and will directly support the objectives of the SunShot Initiative.

We note that all of our activities in the power systems area are closely coordinated with on-going efforts in ARPA-E. For example, the materials and devices activity in ARPA-E under the SOLAR-ADEPT FOA is a key part of SunShot; the systems work funded here complements the work in SOLAR-ADEPT and focuses on the systems level of this technology in the development process.

System Modeling & Analysis — Activities will continue in benchmarking, modeling, and analysis for solar technology systems and their integration into distribution and transmission systems (such as High Penetration Solar Deployment). Validation of models for annual energy production will continue to include data collected from PV installations at select locations representative of the range of solar irradiation environment and weather conditions in the U.S. The inclusion of these representative datasets will further validate the modeling of performance of PV systems operating in all U.S. regions.

CSP Component & Systems Development — A solicitation will be released in FY 2012 as a follow on to the FY 2007 CSP solicitation and awards. This new solicitation will be focused on developing novel collection systems through use of new materials, new system configurations, and/or new rapid field installation methods; new solar receivers capable of operation in excess of 650°C with new solar selective coatings that have an absorptivity >0.9 and emissivity <0.4 at this temperature; adapting or continuing the R&D of turbines capable of thermal to

electric conversion efficiencies of >50 percent at a temperature of 650°C or below; and supporting hardware for these systems, such as heat exchangers and pumps, capable of operating at >650°C and with the heat transfer fluids that are capable of reaching that temperature. Additionally, the National Laboratories will continue work on optical tool development and performance and economic modeling software as a complement to the hardware development performed as a part of the previously mentioned solicitation.

Permitting, Interconnection and Inspection — In FY 2013, the subprogram will engage with Federal agencies including the Department of Interior and Department of Defense to accelerate solar permitting on Federal lands, partner with state and local agencies to pilot streamlined processes, support development of innovative technology solutions to permitting challenges, and disseminate best practices to thousands of local jurisdictions, state public utility commissions, and utilities.

Installation — In FY 2013, the funding will support the National Administrator of the Solar Instructor Training Network, which was created through Recovery Act and FY 2010 investments to provide a nationwide train-the-trainer foundation for scaling up downstream solar training programs at community colleges and other local educational institutions across the country; and to promote dissemination of quality curriculum and training best practices. FY 2013 funds will also focus on developing innovative technology solutions installation challenges.

Siting — In FY 2013, this subprogram will continue inter-governmental coordination on analysis and tools development that support smart siting of utility-scale solar projects (both PV and CSP) including finalization of the Solar Programmatic Environmental Impact Statement being conducted jointly with the Department of Interior's Bureau of Land Management; staffing a Council on Environmental Quality-DOE-Department of Interior led interagency siting task force; development of a comprehensive geographic information system siting tool; and development of long-term monitoring strategies for utility-scale solar projects.

Benefits

The Emerging Technologies subprogram supports the transition of new ideas, often times ideas that advanced through the Innovations subprogram, into pre-commercial development, primarily at small, medium, and large sized business. A key component of this subprogram is to foster innovation and growth of companies with products that can transform the solar industry. One such program, the SunShot Incubator, has been extremely successful at supporting small business growth. Since 2007, this program has supported 24 companies with an aggregate of $59 million. Those 24 companies in aggregate have been able to raise over $1.3 billion in private capital for a better than 20:1 leverage of taxpayer dollars. Not all of those 24 companies have succeeded, but the ones that have survived, have thrived and employ over 1,300 workers in the U.S. in aggregate.

Other programs within the Emerging Technologies subprogram also support technology development at larger businesses by investing in the manufacturing supply chain. These efforts help catalyze industry collaboration by linking industry with the National Laboratories and universities to speed up technology development and commercialization, reduce manufacturing costs, and improve process performance.

The benefits to be obtained for industry and the public sector include:

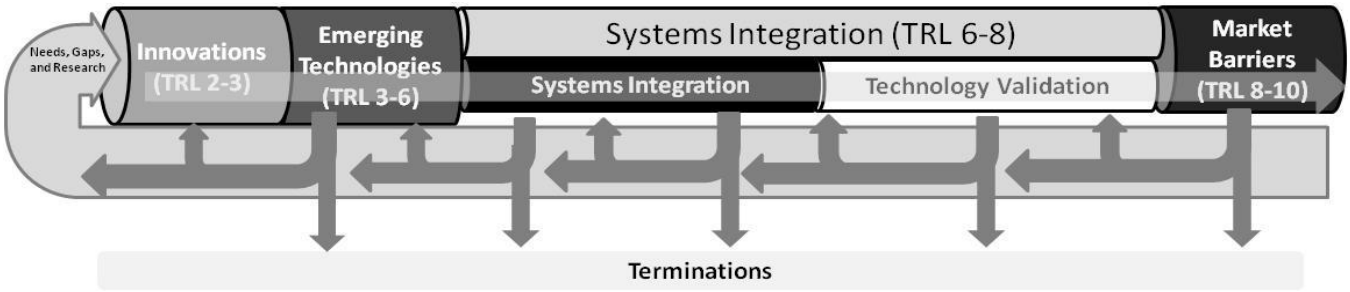
- Creation of new start-up companies or new business units within larger companies;
- Catalyzing industry wide collaborations by linking academia, National Laboratories, and businesses to address common technology problems; and
- Reduced costs for components used in solar energy systems including PV modules, BOS hardware, and CSP components.

Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current.	FY 2012 Enacted	FY 2013 Request
Systems Integration	9,577	68,090	93,400
Total, Systems Integration	9,577	68,090	93,400



Description

Our Systems Integration subprogram activities are focused on addressing two critical issues that currently limit the pervasive, grid level integration of solar electricity and innovative manufacturing. A significant topic that is being addressed is the issue of variability of the solar insolation as a consequence of climatic and weather conditions. We also fund systems level activities in innovative, pilot-scale manufacturing, hardware and software, testing and evaluation, codes and standards.

Key Technology and Focus Areas

PVMI II SUNPATH — The goal of this innovative manufacturing activity is to create research and demonstration grants to accelerate U.S. PV manufacturing, by cost effectively producing the solar panels, electronics and other components needed to achieve the $1/Watt performance goal. This will help enable America to produce and export affordable and high-efficiency solar PV systems. In September 2011, PV module and power electronic components for utility scale systems accounted for over 40 percent of the total system costs.[a] Strengthening U.S. manufacturing and enhancing supply chains is critical to the domestic renewable energy sector and domestic deployment of solar energy technologies. The SUNPATH activity is focused on increasing domestic manufacturing through investments that have sustainable, competitive cost and performance advantages. SUNPATH will help companies with pilot-scale commercial production scale up their manufacturing capabilities, enabling them to overcome a funding gap that often curtails domestic business at a critical stage. By bridging this gap, SUNPATH will help ensure that innovative, low-cost solar technologies are manufactured in the U.S.

Reliability — In FY 2013, the subprogram will continue to conduct both outdoor testing as well as accelerated life-cycle testing in the laboratory, to identify failure modes and mechanisms in modules, inverters, and BOS components. Using this reliability data, the subprogram will reduce the uncertainty and risk to the financial community in using these technologies.

Test & Evaluation —In FY 2013, the subprogram will continue to conduct performance studies on fielded systems as well as on components at the National Laboratories. Using this performance data, the program will continue to develop, improve, and validate system performance models, testing and evaluation technology, and test procedures. This will reduce the risk to the financial community investing in both the installation and manufacture of these technologies.

Regional Test and Evaluation Partnerships (RTEP's) — Evaluation of components, as well as whole systems will continue to be conducted in the field via university and private test lab partnerships. These field studies will continue to provide region-specific data from various climates throughout the country. Findings at the RTEPs (both field and lab) will continue to be used to both validate and complement National Laboratory and industry findings.

Codes & Standards — The subprogram will continue to fund National Laboratory support and leadership on numerous code and standard making panels and committees including the National Electrical Code, Underwriters Laboratories standards review committees,

[a] GTM Research/ SEIA, U.S. Solar Market Insight Report Q3 2011, http://www.greentechmedia.com/research/solarinsight

International Electrotechnical Commission committees, and the Institute of Electrical and Electronic Engineers PV and PV systems related committees.

Benefits

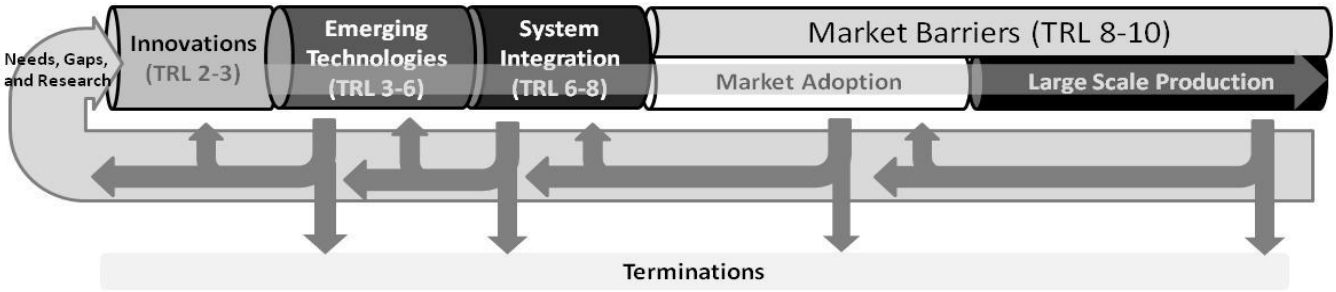
Technology validation focuses on reducing the risk of new and existing solar technologies by developing protocols for testing, evaluating, and improving the performance, reliability, and manufacturability of components and systems. Technology validation also addresses the development of new codes and standards so new technologies, especially those developed under the $1/Watt program, will be able to more easily enter the marketplace. The benefits to be obtained for industry and the public sector include:

- Reducing the costs of power electronics and BOS hardware;
- Reducing the risk associated with the use of new technologies (bankability); and
- Establishing a timely process for integrating high-penetrations of solar technologies into the grid in a safe, reliable, and cost-effective manner while providing value to the system owner and the utility grid.

Market Barriers
Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current.	FY 2012 Enacted	FY 2013 Request
Market Barriers	26,953	10,551	25,589
Total, Market Barriers	26,953	10,551	25,589



Description

Market Barriers to solar electricity can emerge as a consequence of several factors, including the full installed cost of solar, the perceptions about safety and reliability as well as the embedded costs of permitting, inspection, financing and customer acquisition. This subprogram addresses all of these aspects through a coordinated effort within DOE as well as with other agencies.

Key Technology and Focus Areas

Policy, Regulatory, Codes and Standards — FY 2013 funds will support the second year of a funding opportunity to engage in state utility commission proceedings on net metering, interconnection, third-party PPAs, financing, and other market and regulatory barriers to PV deployment. Additionally, best practices in the areas of local codes and standards that impact PV project installation will be developed and disseminated to key stakeholders as they work through these complex problem sets.

Utility Operations and Programs — In FY 2013, the subprogram will leverage the expertise of the National Laboratories in the areas of grid integration and program analysis, engage in regional planning efforts, and work directly with utilities to address complex problems associated with rates and business models. Utilities play a dual role as both customers and suppliers of solar energy. Funding in FY 2013 will enable the program to expand the Rooftop Challenge launched in FY 2011 and implemented in FY 2012 to directly engage utilities. These funds will support work with electricity providers to develop new business models that encourage greater penetration of solar on the grid. Similar to the Rooftop Solar Challenge model, DOE will encourage electricity providers to develop these new business models that make sense based on their unique specifications.

Benefits

Deployment activities increase domestic solar market penetration by reducing regulatory and financial market barriers and reducing non-hardware system costs. A 2010 study by Lawrence Berkeley National Laboratory shows that while module and equipment costs for PV systems are decreasing, non-hardware costs are potentially flat or increasing[a]. These non-hardware costs are significant and part of the installed price of a PV system. Under the SunShot Initiative, our market transformation activities are being directed towards directly and quantitatively addressing these non-hardware BOS.

The benefits to be obtained for industry and the public sector include:

- Reduction of permitting, interconnection, and inspection costs;
- Reduction of the time required for permitting, interconnection, and inspection of solar systems; and

Increased professional installation workforce trained for jobs in the solar industry.

[a] Galen Barbose, Naïm Darghouth, and Ryan Wiser, Tracking the Sun III: The Installed Cost of Photovoltaics in the U.S. from 1998-2009 (LBNL December 2010). http://eetd.lbl.gov/EA/EMP/reports/lbnl-4121e.pdf.

Water Power Program

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Water Power Program	29,201	57,046	19,390
SBIR/STTR	0	1,741	610
Total, Water Power Program	29,201	58,787	20,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Water Power Program			
Innovations	6,082	5,170	3,080
Emerging Technologies	8,994	23,000	6,783
Systems Integration	7,508	24,330	7,068
Market Barriers	6,617	4,546	2,459
SBIR/STTR	0	1,741	610
Total, Water Power Program	29,201	58,787	20,000

Public Law Authorizations

P.L. 109-58, "Energy Policy Act of 2005"

P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The mission of the Water Power Program is to research, develop, test, demonstrate and facilitate the deployment of innovative technologies capable of generating renewable, environmentally responsible, and cost-effective electricity from U.S. water resources at an accelerated pace. These include a) marine and hydrokinetic (MHK) technologies, which includes a suite of renewable technologies that harness the energy from untapped wave, tidal, and current resources, and b) conventional hydropower (CH) technologies which includes technologies to improve the efficiency, flexibility, and environmental performance of conventional hydropower generation from dams and diversion structures. Effective and efficient investments of Department of Energy (DOE) resources in support of advanced water power technologies aim to enable the development of: 1) a robust and competitive MHK industry in the U.S. that significantly contributes to our Nation's energy portfolio, and 2) new, environmentally sound technologies for the domestic conventional hydroelectric industry that would help it generate more clean, renewable electricity than it does today as well as to allow it to continue to serve a vital role in stabilizing the Nation's electric grid. Grid stabilization is achieved by enabling high proportions of variable renewable resources via water management and pumped storage processes.

The Water Program has research, development, demonstration, and deployment (RDD&D) activities tailored to the specific needs of both the MHK and CH technology areas. The program conducts RDD&D and provides high risk, transformational technological innovations that are precompetitive and enable the advancement of the capabilities of the Nation's water power systems. The program also addresses inter- and intra- agency issues associated with water power and leverages solutions that span across the interagency environment. For MHK systems, the program has a unique role in the RD&D of water power systems that cannot be undertaken by a relatively small and still developing industry, due to real or perceived cost, risk, or industry's need to focus on near-term investment returns. For CH, the program's investments support research into the standardization of methods and development of cutting-edge optimization techniques to increase energy generation at existing sites. Additionally, the program supports technology development to reduce the cost of new hydropower, increase energy generation capacity, and provide environmental mitigation options.

The Water Power Program's overarching MHK goal is to support the development of cost-competitive MHK technologies, with a target of reducing the LCOE for

[a] SBIR/STTR funding transferred in FY 2011 was $799,000.

these technologies to $.06/kWh by FY 2030, which would enable competition with projected unsubsidized fossil fuel generation costs. Important near-term milestones include the testing of representative MHK devices in order to generate sufficient performance data that will allow the program to establish baseline cost of energy and performance parameters by FY 2013. By developing baseline LCOE, the program will identify and invest in a cost reduction strategy to achieve the FY 2030 goal. The program is ultimately focused on accelerating the development and deployment of these technologies to provide a domestic source of clean, affordable energy that is both economical and ecologically responsible.

The program's CH activities are focused on developing new technologies, optimization methods, and siting techniques that improve combined energy and environmental performance. These technologies will be demonstrated and finalized for future use by industry. Additionally, technology development and demonstration for low head, low power resources will accelerate generation from new sustainable hydropower. Finally, program activities are addressing the technology and market barriers to advanced pumped storage development.

Strategy

Marine & Hydrokinetic Technologies — MHK energy represents a substantial opportunity for the U.S. to engage directly in an emerging area of energy science while developing an entirely new suite of renewable technologies to help reduce emissions, stimulate a new industry, and meet energy and climate objectives and requirements. MHK technologies encompass an exceptionally broad range of technology platforms, each with its own set of design options, performance characteristics, and cost drivers. The program is dedicated to evaluating and supporting the development of these technology platforms in order to first identify those with the greatest potential to produce reliable and cost-effective electricity, and then to develop the necessary technology that accelerates the development and deployment of such systems. Program activities fall within the following framework:

- Demonstrate functionality and establish baseline cost and performance data;
- Initiate targeted research and development (R&D) to advance components and systems to demonstration phase;
- Support comprehensive testing at progressive technology stages to quantify cost and performance drivers;
- Develop tools, models, and analyses to ensure system survivability;
- Identify and minimize key environmental impacts to allow for demonstration projects;
- Integrate nation-wide resource assessments, technology cost and performance data into advanced cost/performance models to identify critical drivers to reduce overall COE across MHK technologies;
- Refine R&D priorities and set resource-specific COE milestones; and
- As results from baseline cost models and resource assessments are updated, evaluate and adjust RD&D portfolio as necessary to reflect critical components, energy capture designs, and siting needs for the most promising MHK systems.

The MHK strategy is focused on assisting an emerging industry with the design, manufacture, testing, and evaluation of a wide variety of leading concepts and designs to establish existing costs of energy by resource type and technology platform. In doing so, the program is identifying the key opportunities and drivers to reduce costs and improve performance. The program also addresses MHK market barriers and uncertainties, including fully quantifying the amount of energy that can be realistically harnessed from each of the resource types, developing tools and undertaking research to identify, mitigate, and prioritize environmental risks, and ensuring that MHK technologies are properly represented in DOE's electricity planning and benefit models.

In FY 2013, the program will continue to support projects that research, design, demonstrate, test, and evaluate MHK components and systems in order to achieve the program's near-term goal of establishing baseline cost of energy by resource type and technology platform. This baselining effort will be completed in FY 2013 and will serve as a foundation of the program's report to Congress on the technoeconomic viability of MHK technologies at the end of FY 2013. Much of the program's investment is competitively awarded to industry, university projects, and National Laboratories for computational model and design tool research; innovative, early-stage MHK system and component design and testing; and full scale MHK device field demonstration. The objective of these projects is to prove device functionality, evaluate technical and economic viability, and generate cost, performance and reliability data that can be utilized to catalyze a new industry. As devices are tested and data are generated, DOE will continue to compile, analyze, and disseminate information to accurately characterize and evaluate the performance of MHK technologies. The program will integrate this information into numerical models to establish baseline cost of energy to assess key cost drivers and identify cost reduction pathways. In addition, the program is working with international public funding sources to share, aggregate, and analyze

data on MHK deployments abroad, which has the potential to greatly accelerate the ability of the program to establish baseline COE.

Conventional Hydropower — CH generates approximately two-thirds of the Nation's renewable energy supply today. Improvement of existing hydroelectric systems represents one of the fastest and most cost-effective options for increasing new clean and renewable energy generation. The program focuses on targeted, pre-competitive RD&D in areas that support this goal. New innovations in small hydropower technologies (less than 30 MW) and pumped storage offer the possibility to tap new hydropower resources for clean, baseload power and the expansion of grid services to help integrate increasing amounts of variable renewable generation and provide reliability and stability to the grid. Federal R&D for CH helps ensure that this large renewable energy resource is an effective and environmentally responsible instrument for reducing greenhouse gas emissions and increasing the ability of the U.S. electricity system to integrate renewable energy technologies.

A significant amount of additional hydropower could be generated at a very competitive cost of energy, although a wide variety of barriers, including financial, regulatory, and operational constraints, as well as market realities, have slowed new hydropower development by the industry. This cost-effective generation would mostly come from operational improvements and/or hardware additions at existing large and small hydropower facilities. Installation of powerhouses at certain existing non-powered dams could also generate electricity at costs comparable to new fossil fuel generation. Other classes of hydropower are more costly, similar to other renewable technologies, and will require technological advancements to generate large amounts of electricity at competitive prices. This includes new small hydropower installations and the deployment of systems in conduits and other man-made waterways.

Pumped storage hydropower (PSH) is an energy storage technology and a means to further facilitate the integration of variable renewables, rather than being a generation technology. However, PSH faces many of the same barriers as CH generation technologies. The key impediments to the deployment of PSH in the United States are-

- High initial capital costs;
- Long permitting and construction times (7-12 years); and
- Little recognition of the value of ancillary services provided by PSH.

The program's CH strategy is dedicated to adding new generation capacity by aggressively pursuing technological improvements or radical innovations to reduce costs and improve performance of hydropower systems and components. The program's basic approach to CH is to identify resources and address technology needs to maximize cost-effective CH opportunities by:

- Integrating resource assessments and cost curves for small hydro technology to identify critical COE drivers;
- Generating data to accurately correlate generation and water use with environmental impacts;
- Developing and demonstrating an assessment methodology to identify hydropower opportunities and technology needs;
- Developing operational tools to maximize generation at existing and new facilities;
- Developing models that balance competing constraints on multiple hydropower plants in a river system that optimize hydropower generation without sacrificing environmental considerations; and
- Conducting market analyses to accurately quantify hydropower ancillary services.

CH technology development and market barrier activities focus on supporting investment in innovative technology, processes, and environmental mitigation. To identify opportunities for technology and process R&D, the program quantified and characterized the energy resources available from non-powered dams, small hydropower sites, and constructed waterways and is ensuring that these new resources are properly incorporated into electricity sector analytical tools. In FY 2013, the program will support the first-ever demonstrations of advanced physical-science based forecasting and multi-objective optimization algorithms to simultaneously maximize both energy generation and environmental benefits. This will complete an RD&D process begun through a collaboration of National Laboratory scientists with the support of the program. The program will also support and evaluate environmental mitigation approaches and technologies that improve environmental performance and reduce operational constraints of hydropower generation, through partnerships with National Laboratories and industry.

Benefits

The program benefits the industry by conducting high-risk research to develop analysis tools, theories, models, and technologies that are beyond industry's current capability and that benefit the entire industry by accelerating the innovation process toward lower cost technologies, improved performance, and increased deployment speed and scale. The program also fulfills a unique role of Federal government as an unbiased

provider of critical information to policy and regulatory officials, including through interagency processes that seek to address regulatory and permitting issues.

For MHK, the industry is composed of small, entrepreneurial companies with limited access to capital and human resources, doing high-risk technology development. The benefit of DOE's investment in the MHK industry is focusing national-level resources on high-risk, innovative technology development, which would not otherwise occur without DOE investment. The expertise of the National Laboratories is critical to these entrepreneurial companies in researching and developing design tools, helping validate and test system and component designs, and providing expert feedback on technology choices. Models, design codes, and performance data resulting from these industry partnerships are made available to all of the industry, so that all benefit from the developmental lessons learned. DOE's investment in MHK will improve technology costs and allow the technology to compete in the marketplace.

For CH, DOE investment can develop the technologies and provide the tools and information to spur a risk-averse and highly regulated industry to increase deployment of environmentally sustainable CH capacity. Cost-shared industry partnerships reduce the risk associated with the development and testing of new small hydropower and environmentally improved hydropower technology designs. By engaging the expertise of DOE's National Laboratories, innovative technology solutions can be considered and evaluated. New analytical, development, and siting processes for evaluating and improving plant-level and river-basin combined energy and environmental performance will be developed, proven, and made available to industry for commercialization. The program also provides energy policy makers with critical data on CH and pumped storage hydropower resource potential as well as the operational value of integrating other renewables.

For both MHK and CH, DOE plays a significant interagency role in helping to more effectively engage Federal stakeholders including the Federal Energy Regulatory Commission (FERC), DOI (Bureau of Reclamation and Fish & Wildlife Service), U.S. Army Corps of Engineers, and other agencies. DOE's energy perspective is an important ingredient when considering important siting and permitting processes and policy.

Key Accomplishments

The program will complete a number of key projects in FY 2012.

Marine and Hydrokinetics

- MHK Reference Models — Complete wave oscillating water column, wave surge device, and ocean current turbine reference models identifying major cost and performance technology improvement opportunities for guiding R&D investments and next generation design improvements.
- Assess MHK Resource Potential — complete in-stream current and ocean current resource assessments to support the determination of the potential of these sources to contribute to the U.S. energy supply.
- National Marine Renewable Energy Centers (NMRECs) — Following critical Go-No Go decisions made in FY 2012, the program will strategically evaluate investment into select NMRECs to further bolster R&D and test capabilities.
- TRL 7/8 Device Deployment — Grid-connected, in-water testing of the first commercial scale tidal current and wave point absorber technologies in U.S. waters.
- Leverage International MHK Environmental Experience — the content in the "Tethys" online environmental impacts catalogue will be expanded to draw upon international experience in the deployment of MHK devices and arrays.
- MHK Test Protocol Development — Develop standards for the testing of open-ocean MHK devices, including standardized testing protocol and modular instrumentation package for MHK devices.

Conventional Hydropower

- Hydropower Advancement Project (HAP) – As part of HAP, develop and complete the Best Practices Catalogue and Assessment Manual and undertake standardized assessments to demonstrate best practices at 8 existing hydropower facilities to identify efficiency improvement opportunities.
- Water Use Optimization Toolset Demonstration and Validation — Integrate and test water-use optimization toolset for increased generation, value and environmental performance at a demonstration site.
- Assess New Hydro Resource — Complete the new sustainable hydropower resource assessment to determine the potential for small low-head development in the U.S.
- Basin Scale Planning — Complete first opportunity assessment aimed at increasing both hydropower generation and environmental benefits, using an integrated stakeholder-driven basin-scale approach for long-term planning in the Deschutes basin.

Strategic Plan and Performance Measures

The program works to enable greater use of the Nation's abundant water power resources for electric power generation to help meet the Administration's ambitious goals of providing the U.S. with a clean, affordable, reliable, and domestic energy supply to strengthen national security, economic vitality and environmental

quality. The program's strategic goals follow directly from the goals of the Administration, DOE's Secretary, and EERE senior leadership.

The key objectives for MHK are

- Facilitate in-water device testing for higher maturity technologies to support development and identify baseline cost of energy, by device and resource type;
- Support rigorous and standardized device testing protocols for developing emerging technologies across technology readiness levels;
- Support R&D to identify opportunities for technology improvement, design optimization and cost reduction;
- Collect and disseminate validated cost and performance data for technologies and projects, and integrate these data into deployment and benefit models;
- Gather and support the generation of site-specific environmental data in MHK deployment regions;
- Develop tools and technologies to reduce the time and costs of deploying MHK devices by improving the prediction, monitoring, and evaluation of environmental impacts; and
- Develop and disseminate information that directly affects the MHK industry.

Key technology pathways and areas of performance for MHK technology include

- Power conversion system — advanced power take-offs and power electronics for lowered costs and increased efficiencies;
- Device structures — weight reduction and advanced materials for increased energy capture and cost reductions;
- Installation and balance of plant — innovative installation techniques/vessels; advanced mooring designs; and
- Operations, maintenance, and survivability — advanced materials for marine survivability, device and array configurations for streamlined maintenance, in-water testing of structural loadings for extended survivability.

Key objectives for CH include:

- Demonstrating site assessments at hydropower facilities to identify the process and technology development needs for adding incremental generation and capacity;
- Supporting the development and testing of new advanced technologies and components, including advanced pumped storage;
- Characterizing and modeling the technical capabilities of advanced PSH technologies, including for ancillary grid services and for improved grid integration of variable renewable energy;
- Developing technologies/methods to reduce environmental impacts and help meet regulatory requirements;
- Developing data to identify technical opportunities to reduce costs and increase generation from small hydropower resources including non-powered dams and conduits;
- Spurring innovation and stimulating industry hydropower R&D capacity outside government; and
- Developing and disseminating information that directly affects the development of CH.

Key technology pathways and areas of performance for CH include

- Powerhouse and generation equipment — increased turbine-generator efficiencies, modular design for mass production, advanced materials for reduced unit weight and increased performance;
- Civil structures — innovative modular designs, advanced materials for reduced conveyance losses, and advanced construction methods including lower cost/risk underground excavations; and
- Optimization tools — Development and demonstration of methodologies and models that identify hydropower opportunities and technology development needs.
- Market barriers — environmental flow and impact studies, advanced mitigation technology and sustainable turbine development, reduced regulatory risk from improved environmental performance.

Performance Measure Analysis

Owing to the recent creation of the program, performance measures were developed to gauge program progress towards establishing metrics representative of a broader strategic plan.

The MHK metric, technologies with baseline cost of energy, tracks the program's progress towards meeting its original congressional charter. MHK is an emerging industry just beginning to deploy full-scale devices in U.S. waters. The choice of a target of a cumulative 10 devices tested and providing baseline COE data in 2013 is designed to provide the cost and performance estimates necessary to assess the economic viability of MHK resources and technology types in a technoeconomic report to Congress at the close of FY 2013. These tests establish the competitiveness of innovative, first-of-a-kind device prototypes, ushered through the risky design, manufacturing, and testing processes with DOE support in order to arrive at well-validated data for innovative new technologies.

With initial cost of energy adequately determined in 2013, the program will have the data necessary to select technology and COE benchmarks against which to track

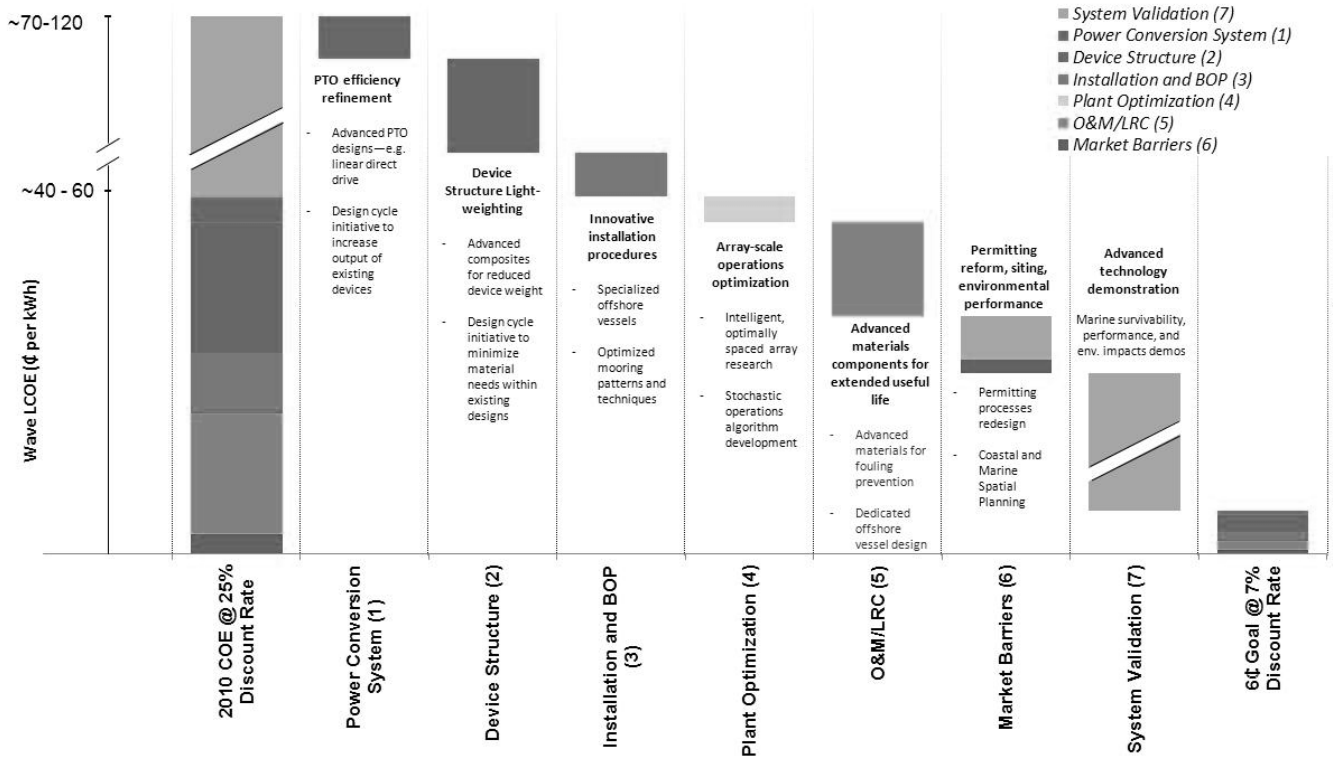
program performance using COE metrics beginning in FY 2014.

For CH, at the close of FY 2011, assessments have been performed at existing hydropower facilities to identify the additional generation potential and R&D needs for increased generation. These assessments were performed as part of the Hydropower Advancement Project (HAP). The HAP was initiated in 2010 to identify the resource potential and barriers to increasing generation at existing hydropower facilities throughout the U.S. After a broad solicitation by ORNL brought forth limited and unresponsive proposals in 2010, the project was re-scoped to better meet the needs of industry in 2011. As a result of the new HAP strategy, the bulk of assessments of existing hydropower facilities will be completed in FY 2013. This improved strategy allows the program to successfully meet the 2013 performance target while more effectively assessing the resource potential and technology needs to increase generation at existing hydroelectric facilities.

With MHK cost baselining and CH resource assessments being completed in FY 2012 and 2013, the program will develop new sustainable hydropower technology development COE metrics to be initiated in 2014.

The waterfall chart below demonstrates the apportionment of wave devices' COE as an example of the program's MHK investment strategy. The cascading center boxes indicate the cost reductions attributable to advancements and reductions in different cost drivers. As the large uncertainty range demonstrates, significant cost and performance data are needed to properly identify a cost of energy baseline and key cost drivers; the intent of MHK technology testing and the COE baseline goal is to develop this capability. Even as the program better defines the LCOE of MHK devices, R&D investment is targeted at those areas that currently appear to have significant impacts. The program's innovation and emerging technologies investments support the fundamental environmental, materials, structural design, and power conversion R&D needed to bring MHK technologies toward cost competitiveness. In addition to providing essential data to refine the LCOE baseline, systems integration investments are testing the commercial viability of these emerging technologies and reducing the risks inherent in new technology investment to attract private investors.

Figure 1



Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Water Power Program			
Innovations — In FY 2013, MHK research will focus specifically on costs, performance, and environmental impacts of innovative, early-stage MHK systems and components.	5,170	3,080	-2,090
Emerging Technologies — Research projects in the Advanced Hydropower Technology FOA and major MHK projects from the Technology Readiness Advancement FOA are completed. Funding for National Marine Renewable Energy Centers (NMRECs) is reduced, but the program continues its planned funding commitment to the NMREC projects that were competitively selected in FY 2008 for development of advanced open-water test infrastructure for MHK devices. Research into the costs and performance of innovative, early-stage MHK systems and components is maintained at a reduced level focused on the technologies with the highest potential for producing reliable and cost-effective electricity.	23,000	6,783	-16,217
Systems Integration — In FY 2013, the program completes the demonstration of Ocean Power Technologies PB 150 wave buoy and terminates deployment support for full scale field testing on remaining competitively selected MHK technology demonstration projects. Additionally, major competitively-selected hydropower demonstration projects from the 2011 FOA are completed with some funding delayed for a handful of demonstration projects. Funding is maintained for the CH Water Use Optimization toolset.	24,330	7,068	-17,262
Market Barriers — An analysis of pumped-storage hydropower contribution to grid stability selected in the Advanced Hydropower Technology FOA is completed and support for CH market barrier reduction projects, including Basin Scale Opportunity Assessments, continues. The program maintains support for the development of international standards for MHK devices and components and analysis of CH environmental and market barriers.	4,546	2,459	-2,087
SBIR/STTR are calculated based on R&D funding allocations.	1,741	610	-1,131
Total, Water Power Program	58,787	20,000	-38,787

Explanation of Changes

The decrease in funding from FY 2012 to FY 2013 is due in large part to the completion of multiyear projects and the reduction in scope of several program activities, consistent with the current technological stages of MHK development and of conventional and small hydropower. The Advanced Hydropower Technology Development FOA mortgages were largely funded in FY 2012 with the exception of two demonstration projects which had funding delayed into FY 2013. Technology Readiness Advancement FOA projects are largely completed in FY 2012. One project will be delayed into FY 2013. Remaining program funds in FY 2013 are used to address MHK and CH technology development and market barriers through ongoing activities and projects, such as the assessment of MHK device impacts on fish and the correlation between hydropower releases and water quality.

Funding Opportunity Announcement Background

The program posts current and past funding opportunities for all program areas, including R&D, systems integration, and market barriers projects at www.water.energy.gov. Links to related opportunities from DOE National Laboratories and other Federal agencies are available.

In carrying out its vision and mission, the program conducts a broad portfolio of specific goal-directed activities to promote the development and deployment of technologies capable of generating environmentally sustainable and cost-effective electricity from the Nation's water resources.

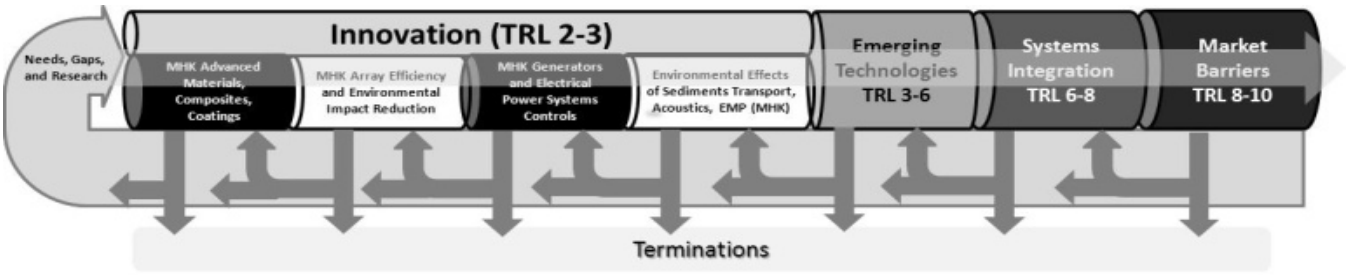
This open, competitive solicitation process is designed to meet the top technology needs identified by industry's roadmaps and program analyses. Funding opportunities encourage collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local governments and non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance.

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	6,082	5,170	3,080
SBIR/STTR	0	158	98
Total, Innovations	6,082	5,328	3,178

Sequence



Description

The program has formed a comprehensive project portfolio aimed at conducting research to advance innovative early stage MHK technologies. In order to support the development and demonstration of MHK technologies, research activities are aligned to provide the technical capabilities and information necessary for the MHK industry to hone in on the most promising energy conversion concepts.

In prior years, the program completed cost-shared partnerships with industry in advanced materials research with higher resistance to corrosion and biofouling in harsh environments. In FY 2013, the program will focus on early stage research for targeted control system and power conversion concepts as well as research in standardized instrumentation systems and testing protocols. A portion of research spending is allocated to characterizing the relationships between marine life and hydrokinetic technologies. This includes identifying new strategies to minimize or mitigate potential environmental effects. In FY 2013, the program will continue activities with National Laboratories, universities, and industry to improve and refine the physical science informing design and performance models; and continue environmental/siting research aimed at measuring and linking key biological responses to MHK systems, and extrapolating information from these studies to assess cumulative impacts of stressors.

Key Technology and Focus Areas

MHK Technology Research — Because the MHK industry is in a nascent phase, the program supports research that can improve performance and reduce costs across a wide range of technology types and device designs. Core activities are focused on conducting higher-risk research that will allow for the development of new components and technologies to reduce costs across the industry. Such research also allows the program to document key cost drivers associated with MHK systems and identify the greatest opportunities for further cost reduction. Key focus areas include

- Research into advanced materials, composites and coatings for the marine environment;
- Development of computational models to optimize array efficiency and reduce impacts;
- Investigating advanced concepts for generators and electrical power systems controls; and
- Applied research on potential environmental effects related to sediment transport, acoustics and electromagnetic fields.

Benefits

Advanced design codes and performance models will assist engineers in refining innovative design concepts. Materials research will promote better system operation in the extreme marine environment. Analysis of MHK device arrays will provide a better understanding of device interactions which increases the likelihood that early stage designs will succeed in progressing along the technology readiness pathway. Environmental research will inform Federal and state regulators and permitting agencies as to the environmental risks associated with the deployment of MHK devices. The program's research in standardized test instrumentation system design and protocol development is essential to the success of the industry. The effort provides broad benefit to the industry by ensuring that device developers have the

means to follow meaningful test programs, working towards meeting international standards. This is a necessary element in enabling companies to attract private investment and applies to all stages of technology development.

Through the program's activities, the MHK industry in the U.S. will be able to identify major cost reduction opportunities and reduce costs through a targeted research program leveraging industry, university, and National Laboratory partnerships. DOE is uniquely positioned to fund this high risk, early stage research because of the broad benefits that can be realized across the entire emerging MHK industry.

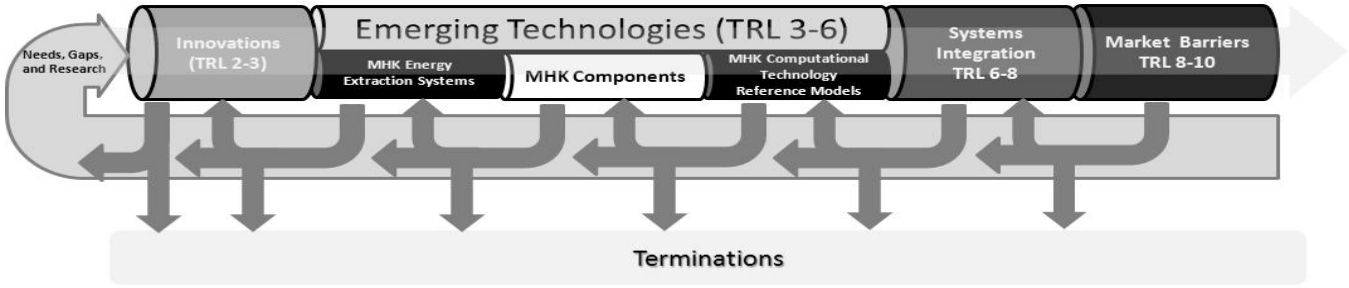
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	8,994	23,000	6,783
SBIR/STTR	0	702	213
Total, Emerging Technologies	7,436	23,702	6,996

Sequence



Description

To support MHK emerging technologies, the program's emerging technologies activities are aligned to design and assess component scale device functionality; improve device availability and component reliability; assess designs to reduce deployment, operations and maintenance costs; and develop advanced test infrastructure to further innovative device designs. In FY 2013, the program will continue prior year efforts to engineer, develop, and test scale systems and components to establish a baseline cost of energy and performance across a diverse set of resource sets, including wave, tidal, ocean and river currents. Each of these requires a unique set of engineering solutions. Competitively selected technology development partnerships will advance the technical and operational readiness of innovative, early-stage MHK systems and components. These projects evaluate system and component functionality, as well as generate cost, performance, and reliability data. As devices are tested and data are generated, DOE compiles, analyzes, and disseminates information to accurately characterize and evaluate the performance and cost of MHK technologies across the entire industry.

DOE will also continue to support the development and maintenance of the open water test infrastructure, including grid-connected test berths and scale testing facilities, necessary for industry to develop advanced, cost-cutting device designs.

Key Technology and Focus Areas

MHK Technology Development — FY 2013 will represent the third year of funding for MHK technology development through a series of industry partnerships to develop tidal, ocean current, river current, and ocean wave energy extraction systems and components.

Projects in this area include

- Optimizing the dynamic responses of an advanced wave buoy;
- Conducting initial engineering and design of an advanced concept for an underwater ocean current turbine;
- Improving the efficiency of a vortex-induced current device;
- Development of a 500 kW wave buoy prototype design for demonstration in an operational environment;
- Verifying ocean wavelength performance for a scaled multimode floating point absorber; and
- Continued development of computational technology reference models for each MHK resource type.

Additionally, the program will continue funding the open-water test infrastructure advanced in FY 2012 to allow developers to refine the performance and structural requirements of advanced design concepts.

Benefits

The program will use inputs from these projects to further develop and refine the technology reference models for each resource type. Future technology development investment decisions will be based on the lowest cost, highest-impact opportunities that are identified through the modeling effort. The reference models are a critical enabling activity for the program to

meet the Congressional mandate included in FY 2010 appropriations to report on the technical and economic viability of MHK technologies in 2013.

Preliminary resource assessments indicate that MHK technologies may have the potential to contribute materially to the country's energy portfolio. Many of these resources also offer the potential of highly predictable energy generation within close proximity of coastal load centers. Through focused developmental program activities occurring at National Laboratories and via industry projects, the program will be able to identify the major technology improvement opportunities and address them through targeted future technology development partnerships.

DOE is uniquely positioned to develop needed test infrastructure and to evaluate a wide range of device and component designs developed by dozens of different companies, and conduct economic assessments in order to identify the most promising technologies that will accelerate rapid cost reductions and performance improvements within the industry.

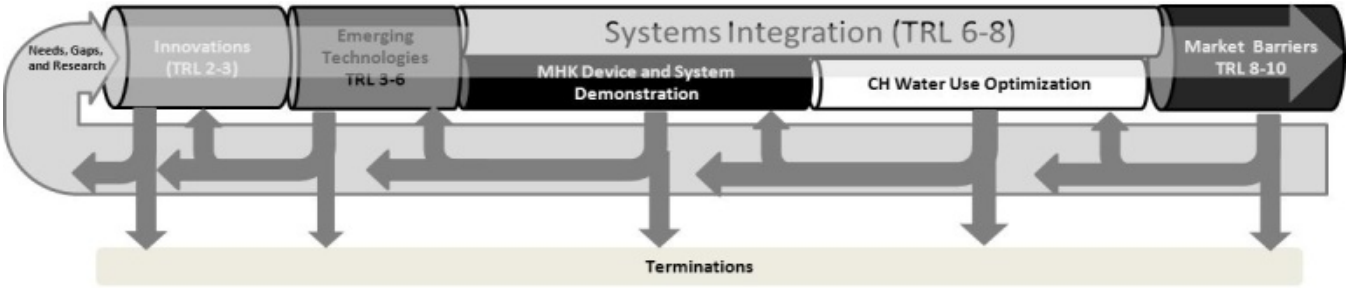
Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	7,508	24,330	7,068
SBIR/STTR	0	742	222
Total, Systems Integration	9,067	25,072	7,290

Sequence



Description

To support the systems integration of marine and hydrokinetic technology, the Water Program has awarded multi-year competitively selected technology demonstration projects for full scale, field testing. The program investment will advance the technical and operational readiness of demonstration-ready marine and hydrokinetic systems and components. The program's investment in demonstration projects is vital to ensuring the success of the nascent MHK industry.

The program aims to demonstrate and test at least ten MHK devices by 2013. Additionally, the program also seeks to ensure that necessary facilities exist to test devices at full and sub-scale to generate and collect data.

In FY 2013, the program will fund the development and demonstration of a novel combined energy-environment optimization approach at real world sites that vary in hydrological conditions and environmental and market constraints.

Key Technology and Focus Areas

MHK Technology Demonstration — The objective of Marine and Hydrokinetic demonstration testing projects is to prove device and system functionality under real world operating conditions within the marketplace so that technologies can be evaluated for their commercial readiness. As devices are tested and data are generated, DOE will also continue to compile, analyze, and disseminate information to accurately characterize and evaluate the performance of marine and hydrokinetic projects.

These industry cost-shared projects include:

- Development of a 5 unit, grid-connected array of cross-flow tidal turbines.
- A public utility deployment, operation, monitoring, and evaluation of two innovative seabed mounted turbines for generating electricity from tidal currents.

CH Efficiency Improvement Assessments — The Hydropower Advancement Project will be discontinued in FY 2013, with the completed Best Practices Catalogue and Assessment Manual providing guidance for the CH industry to conduct further assessments to identify efficiency improvement opportunities.

Hydropower Optimization Toolbox — The initial core R&D and software design has been completed by a team of National Lab scientists, but the functionality and efficacy of the new optimization processes, some of which employ unique algorithms not yet tested in industry, must be proven in a real world environment to facilitate adoption and commercialization of these methodologies by industry. To that end, the program will demonstrate in FY 2013 the energy and environmental gains associated with the application of these advanced optimization tools at select hydropower systems. Specifically, the development team will continue to improve the software and will demonstrate the integrated set of models by completing and reporting on three preliminary studies of potential gains from environmental and energy optimization at these existing sites.

Benefits

Demonstration of marine and hydrokinetic technology will test the economic viability of various marine and hydrokinetic devices. Risk reduction achieved by demonstration projects will result in higher technology maturity and a reduced risk profile, thereby attracting private financing for further technology development and commercial scale deployments and making the industry more self-sustaining as a whole. The Water Power Program's support of MHK technology demonstration projects accelerates the commercialization of technologies that have successfully completed systems development and limited testing.

Commercial-ready technologies will have risk profiles and sufficient operational data to attract private investment. Environmental permitting processes and procedures will also be greatly informed by testing a variety of marine and hydrokinetic devices in the field.

CH investments will improve the operation of existing hydropower facilities. Operational improvements can yield up to 15 percent increases in generation. Through the development of this integrated water use optimization toolset, industry and the public will benefit from better use of water resources to generate more renewable electricity without the impact of developing new power plants. Plant operators will benefit from increased revenue from increased generation and flexibility of existing hydropower plants. DOE's role in performing innovative meteorological and environmental research that results in the development and dissemination of standardized optimization tools can help to increase sustainable generation across the industry. DOE is uniquely positioned to help produce an industry-wide standard to improve CH performance, based on a combination of prior DOE research and the best practices that exist, but which have not been disseminated throughout the industry.

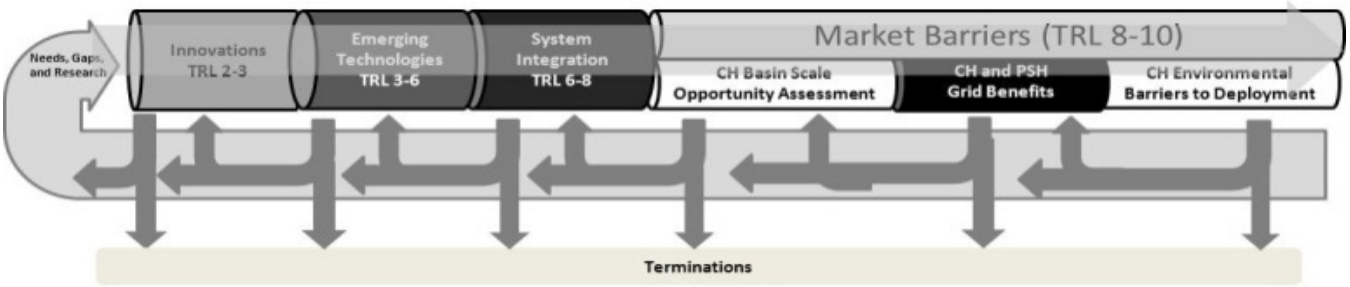
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	6,617	4,546	2,459
SBIR/STTR	0	139	77
Total, Market Barriers	6,617	4,685	2,536

Sequence



Description

FY 2012 projects focused on market barriers that reduced the uncertainty related to environmental impacts of fish travelling downstream through hydropower turbines and the appropriate quantity, timing, and quality of water releases at hydropower facilities. By addressing these market barriers, the program aims to reduce challenges to licensing and permitting. Market barrier work completed in FY 2012 also determined the national new hydropower potential, identifying areas with the largest capacity for new, sustainable and low impact hydropower deployment.

Also in FY 2012, the program completed the funding of advanced engineering and market analysis which detailed the ability of CH and PSH to provide grid-services and integrate variable renewables at time scales ranging from sub-second to yearly.

As part of the sustainable hydropower MOU between DOE, the US Army Corps of Engineers, and the Bureau of Reclamation, in FY 2012 the program completed its first opportunity assessment aimed at increasing both hydropower generation and environmental benefits across a river basin. A systematic methodology was developed to identify specific opportunities where hydropower value/generation could be increased while simultaneously improving the environmental quality of the river basin. This integrated, stakeholder-driven approach emphasized sustainable, low impact hydropower within the context of environmental protection/restoration. By demonstrating that "win-win" scenarios are possible above and beyond the status quo, hydropower deployment by the CH industry can be increased.

A complex patchwork of hydropower ownership and regulation often results in development and operational patterns in hydrological basins (in which hydropower facilities are fundamentally connected and constrained by the flow of water, movement of fish species, and many other factors) that produce suboptimal outcomes in terms of energy production, environmental sustainability, and local economic benefits. In FY 2013, the program will support the modeling and demonstration of a unique analysis methodology, a "Basin Scale Opportunity Assessment", under development by DOE National Laboratories and local stakeholders to determine the process, technology, and new development efforts necessary for increased energy and environmental performance across the hydropower basin. By conducting a second case study of how stakeholder coordination can lead to "win-win" environmental and clean energy outcomes, the program seeks to further refine the approach, increasing its applicability to a wider array of river basins and further national deployment of hydropower.

The program will also fund targeted research to improve water quality associated with hydropower projects and reduce the impacts on aquatic species. This will include research to expand the operating ranges of advanced environmentally-friendly turbines, so that they can be deployed at a wider range of sites, as well as site-specific studies to quantify ecological benefits associated with

various operational flow regimes intended to improve water quality and habitat.

Key Technology and Focus Areas

The program maintains a robust environmental and market R&D portfolio to identify technology development opportunities, target R&D to the most promising resource areas, and develop next generation cost-effective environmental mitigation technologies that assist the hydropower industry in meeting regulatory requirements and increasing environmental sustainability. These activities include

- Basin Scale Opportunity Assessments — improving the energy and environmental performance of a system of hydropower plants on a river basin; and
- Specific applied environmental studies to increase deployment.

Benefits

The river basin scale approach to planning is designed to benefit all stakeholders across a river basin by capitalizing on the key opportunities. Opportunities are instances where it is feasible to realize measurable gains in hydropower and environmental value within the context of other uses. Proving out the positive outcomes of this coordination and analysis framework will improve hydropower and environmental productivity and will compliment DOE's small hydro and environmentally friendly turbine R&D by eliminating non-technology barriers to otherwise sustainable development. DOE, as an unbiased moderator and expert authority, is uniquely positioned to develop the new assessment processes and facilitate and demonstrate the potential opportunities gained by optimizing the use and development of an entire river basin.

Environmental research that will reduce the risk associated with deploying hydropower systems, which are already commercially-ready and cost-effective, can rapidly increase clean, carbon-free electricity generation.

Wind Energy Program
Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Wind Energy Program			
Technology Development and Testing	67,006	72,518	69,950
Technology Application	11,828	18,710	22,917
SBIR/STTR	0	2,026	2,133
Total, Wind Energy	78,834	93,254	95,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Wind Energy Program			
Innovations	29,739	27,279	35,480
Emerging Technologies	40,919	29,317	22,321
Systems Integration	1,214	24,186	24,280
Market Barriers	6,962	10,446	10,786
SBIR/STTR	0	2,026	2,133
Total, Wind Energy	78,834	93,254	95,000

Public Law Authorizations

P.L. 94-163, "Energy Policy and Conservation Act (EPCA)" (1975)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act" (1989)
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act" (1990)
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 109-58, "Energy Policy Act of 2005"

Overview

The mission of the Wind Energy Program is to accelerate widespread U.S. deployment of clean, affordable, reliable, and domestic wind power to promote national security, economic growth, and environmental quality. The program manages investment in the development of U.S. wind power technologies to maximize the impact of research, development, demonstration and deployment (RDD&D) for domestic renewable energy production. Increased wind power deployment can make significant contributions to economic vitality and environmental quality by providing domestic energy production, creating and maintaining domestic jobs, strengthening U.S. competitiveness in the global wind market, and reducing greenhouse gas emissions.

The program directly contributes to the President's goal for the U.S. to achieve 80 percent of its electricity from clean energy sources by 2035. The program is also aligned with Department of Energy's Strategic Plan to "transform U.S. energy systems" by reducing the costs of renewable energy technologies and accelerating large-scale use of carbon-free electricity sources.

The program has RDD&D activities which are applicable to utility-scale land and offshore wind markets, as well as small and midsize wind turbines which are typically interconnected on the distribution grid at or near the point of end-use. The majority of the RDD&D activities of the program have cross-cutting benefits for all market types.

The program has a unique role in the RDD&D of wind systems that are not being undertaken by the U.S. wind industry due to real or perceived cost, risk, or their need to focus on near-term investment returns. The program conducts R&D that addresses high risk, transformational technological innovations that are essential for the advancement of U.S. wind systems that individual industry participants typically do not pursue due to the proprietary and competitive nature of their business. Federal projects can also address different time-scales or engage comprehensive competencies that industry alone cannot tackle. The program also addresses inter- and intra-governmental agency issues related to wind energy and leverages development of solutions that also engage the Department of Defense, Department of Health and Human Services, Department of Transportation, Department of Interior, and other agencies.

[a] SBIR/STTR funding transferred in FY 2011 was $1,166,000.

Specific program objectives include lowering the cost of energy from utility-scale and offshore wind plants so that wind energy can compete with the electricity costs from conventional energy sources, including fossil sources, without subsidization, as well as increasing the number of certified small wind systems and reducing the cost of energy of small and midsize wind turbines used in community and distributed electricity systems to compete with the retail electricity rates.

Wind energy cost goals are:

- Reduce the unsubsidized market levelized cost of energy (LCOE) for offshore wind energy systems from a reference of $.253/kWh in 2010 to $.093/kWh by 2020 and $.06/kWh by 2030.
- Reduce the unsubsidized market LCOE for land-based wind energy systems from a reference wind cost of $.08/kWh in 2010 to $.06/kWh by 2020, which would compete with the predicted LCOE of electricity generation from natural gas.

Meeting these LCOE goals will enable meeting the following deployment goal:

- From 40 GW of total wind installed capacity today (0 GW of offshore) to 125 GW of capacity by 2020, and 300 GW total by 2030 (including 54 GW of offshore). This total wind installed capacity is estimated to be 20 percent of U.S. electricity demand in 2030.

For the Nation to achieve this wind deployment goal and accomplish the President's clean energy objectives, investments will be required in LCOE reductions in turbine or plant technology, as well as reductions in substantial market barriers that impede market investment and development such as transmission, wildlife, siting, financing, and other market challenges.

Strategy

Improvements in cost and performance for utility-scale and offshore wind plant systems are required to achieve LCOE parity with conventional fossil fuel derived energy generation. An integrated systems approach to advances in technology development is necessary, as no single component or subsystem improvement will achieve the required LCOE goal. The relative contributions of: 1) capital cost reduction by components and subsystems, 2) improved energy capture through technology innovation and siting at higher wind speed locations (including offshore), 3) innovation to achieve larger turbine platforms, and 4) reduced financing risk premiums can each contribute to significantly reduce LCOE for utility-scale and offshore wind plants.

The program works to accelerate the pace of technology innovation and reduce wind LCOE by: 1) sponsoring high risk research and development (R&D) on industry-wide technology improvements beyond industry's current capabilities; 2) reducing technical sources of risk that hinder the financing and deployment potential of wind energy in the U.S.; and 3) reducing market barrier costs. LCOE will be reduced by improving the cost, performance, and reliability of wind technology at both the turbine and plant level. Deployment barriers affecting LCOE are to be addressed and component and system validations performed to help investors become more confident in new innovative wind technology and demand less of a risk premium in financing. Deployment goals will be met both by reducing LCOE and by addressing "show-stopper" barriers that block large-scale market adoption of wind technologies. These include individual environmental or radar impacts that if not thoroughly studied could prevent some wind farms from being built, but when understood can allow these farms to be built in such a way as to minimize the impact.

The program includes a strong focus on offshore wind because it is an immature industry in the U.S., where there is an abundant offshore wind energy resource, and its progress has been significantly stifled by numerous technology, infrastructure, financial, and market barriers. Federal investment can stimulate the domestic industry and tackle barriers uniquely suited for the Department of Energy (DOE) to address.

Major strategies for technology innovation to reduce LCOE for both land-based and offshore wind systems include:

- Developing larger light weight turbine architectures that reduce overall mass (weight) and provide access to better wind resources (larger rotors, taller towers) and improved systems performance (capacity factor). Component material improvements (cost, strength, weight, fatigue) facilitate turbine innovation and improve reliability. Systems level design of wind turbines and wind plants are used to optimize energy production and minimize cost from an integrated systems perspective;
- Reducing integrated wind plant systems (energy) losses, reducing offshore construction costs and reducing other balance-of-station costs such as power collection, grid interconnection, and large array wake effects. Reducing siting costs and risk through streamlined siting study requirements for transmission access, wildlife and radar impacts, as well as increasing the certainty of siting outcomes. High performance computer modeling of complex wind plants is essential to assess wind plant underperformance, define intra-array operating environments, quantify micro and macro climatology impacts, reduce failure rates and increase energy output through optimized siting;

- Improving plant system performance including operations and maintenance (O&M) efficiency, component reliability, and longer component lifetimes;
- Validating systems through laboratory and field testing, demonstrating technology innovation, and validating construction, generation and operations costs to reduce risk and attract investment capital in innovative technologies at lower financing costs — especially deep-water offshore; and
- Improving transmission access and reducing siting and permitting constraints that limit access to higher wind class areas.

Achieving deployment goals requires reducing perceived financial risk and overcoming market barriers to deployment, in addition to LCOE reductions. As wind penetration increases, several existing market barriers are becoming more dominant. Major strategies to address market barriers and increase access to high-quality (higher wind speed) markets for deployment of land-based and offshore wind plants include:

- Improving technologies for transportation, construction and O&M infrastructures;
- Improving domestic supply chain capabilities and infrastructures, including a trained domestic workforce;
- Improving transmission grid planning and assessment, national and regional power forecasts, dispatch and integration strategies and developing associated government regulatory roles and responsibilities;
- Improving research databases for siting issues for informed decision-making, as well as developing barrier mitigation methods and technologies;
- Increasing information available to permitting officials, utilities, developers, investors, and other key constituents to inform decision making; and
- Providing unbiased information and reporting to enable policymakers to make informed policy and legislative decisions, as well as providing timely and accurate industry data to the entire industry.

The program has a collaborative strategy and leverages a variety of resources to conduct its activities. Specifically, the program is able to ensure the effectiveness of its investments by utilizing directed and competitively selected, cost-shared RD&D projects with industry, universities, other government agencies, and DOE's National Laboratories as well as participating in partnerships with Federal, state, and other stakeholder groups.

Benefits

The program benefits the wind industry by conducting high risk R&D, and creating analysis tools, models, and technologies that are beyond industry's current capabilities, but benefit the entire industry by accelerating the innovation process toward lower cost technologies and enabling increased deployment speed and scale. The program also accomplishes important functions industry is not well-suited to accomplish by developing and leveraging inter- and intra-agency relationships to reduce market barriers and by acting as an honest broker of critical information that can be shared industry-wide.

As stated, meeting the program's LCOE goals supports achieving the goal of 20 percent of projected U.S. electricity demand by 2030.

As detailed in the 2008 DOE report "20 Percent Wind Energy by 2030"[a], one scenario for meeting the 20 percent goal would require annual installations averaging 13 GW per year for an installed capacity of 250 GW of utility-scale wind and 54 GW of offshore wind by 2030. This scenario also projects the following impacts in 2030: displacement of U.S. natural gas consumption; reduced electricity sector water consumption; increased annual employment directly supporting manufacturing, construction and operations related to wind energy; increased local revenue from property taxes and land lease payments; and increased operations-related economic activity.

Key Accomplishments

The program initiated three major competitions in 2011 that will continue over the next five years. These competitions focused on offshore wind technology, offshore wind market barriers, and advanced drivetrains. In addition, the program developed and demonstrated advanced turbine control algorithms that reduce fatigue loads up to 40 percent, as compared to the industry standard baseline; developed carbon-hybrid blades and created a composites materials database used extensively by industry for the commercial design of blades and rotors; and developed analytical and technical approaches to modeling grid power system behavior with various levels of wind and other variable generation deployment.

On September 8, 2011, the U.S. Energy Secretary Steven Chu announced the award of 41 projects across 20 states to speed technical innovations, lower costs, and shorten the timeline for deploying offshore wind energy systems. These projects will advance wind turbine design tools and hardware, improve information about U.S. offshore wind resources, and accelerate the deployment of offshore wind by reducing market barriers such as supply chain development, transmission and infrastructure.

[a] http://eere.energy.gov/wind/pdfs/41869.pdf

These awards will help the U.S. to compete in the global wind energy manufacturing sector, promote economic development and job creation, and support the development of an emerging industry that will provide clean electricity to American families.

“The U.S. has an abundant offshore wind resource that remains untapped,” said Secretary Steven Chu. “Through these awards, the DOE is developing the critical technology and knowledge base necessary to responsibly develop this resource, enhance our energy security, and create new clean energy jobs.”

The projects focus on technical approaches to advancing offshore technology and approaches to reducing market barriers to responsible offshore wind energy deployment.

Of the 41 projects announced in September, 2011, 19 are offshore wind technology development projects that will seek to address technical challenges and provide the foundation for a cost-competitive offshore wind industry in the U.S. Awardees, in collaboration with industry, will develop the engineering modeling and analysis tools required to lower overall offshore facility costs and to design the next generation of innovative utility-scale turbines optimized for installation and operation in the marine environment. These projects include R&D for innovations in key components such as floating support structures and turbine rotor and control subsystems that may lead to capital cost reductions of up to 50 percent.

The remaining 22 projects announced in September 2011 are market barrier removal projects that will research factors limiting the deployment of offshore wind in the Nation’s coastal and Great Lakes regions. Topic areas include project design factors such as environmental impact assessment and characterization of the offshore wind resource; subjects related to investment and infrastructure development such as categorization of financial risks and long-term manufacturing needs and port requirements; and technical offshore wind interface topics such as transmission grid integration, and assessment of potential impact on offshore navigation and communication systems.

On June 28, 2011, Secretary Steven Chu announced that six projects in four states — California, Colorado, Florida, and New York—have been selected to advance next-generation designs for wind turbine drivetrains. Drivetrains, which include a turbine's gearbox and generator, are at the heart of the turbine and are responsible for producing electricity from the rotation of the blades. The advances in drivetrain technologies and configurations supported through R&D projects will help the U.S. maintain its position as a global leader in wind energy technologies, support American manufacturing, construction and planning jobs in a key renewable energy market, and reduce the cost of wind energy in the future. These projects will also help promote and accelerate the deployment of advanced turbines for offshore wind energy in the U.S.

"Developing innovative drivetrain technologies will allow U.S. manufacturers to build larger, more cost-effective, and more efficient wind turbines than any in operation today," said Secretary Steven Chu. "These projects will help the U.S. to lead the global wind energy industry in this critical technology area, diversify our domestic energy portfolio, and create new jobs for American workers."

These early R&D projects will focus on reducing the cost of wind energy by increasing component reliability or redesigning drivetrains to eliminate the need for some components altogether. For example, direct-drive generators eliminate the need for a gearbox, which reduces weight, eliminates a number of moving parts, and improves reliability. Increased component reliability means fewer operations and maintenance costs over the lifetime of a wind turbine. Other projects receiving funding will work to increase the amount of energy drivetrains can produce, help develop drivetrain designs that minimize the use of rare earth materials, and evaluate new alternatives to critical materials.

Strategic Plan and Performance Measures

The program works to enable greater use of the Nation's abundant wind resources for electric power generation to help meet the Administration’s goals of providing the U.S. with a clean, affordable, reliable, and domestic energy supply to strengthen national security, economic vitality and environmental quality. The program’s strategic goals follow directly from the goals of the Administration, DOE’s Secretary, and Energy Efficiency and Renewable Energy (EERE) senior leadership.

The Wind Energy Technology Roadmap identified key technology pathways for reducing LCOE, which are as follows:

- Lowering wind turbine capital cost and increasing performance;
- Improving overall wind plant performance;
- Improving wind plant reliability and reducing operating expenses;
- Reducing risk and deployment barriers affecting cost; and
- Reducing financing costs by conducting system validation activities that demonstrate reliability, system output, and construction costs which reduces investment risk.

The program reduces market barriers to enable deployment by addressing:

- Infrastructure and supply chain development, which

includes shared data on domestic component sources as well as development of advanced installation techniques and equipment, of advanced manufacturing techniques, and of technical training curricula and certification standards;
- Transmission and integration planning; and
- Siting and permitting constraint reduction.

Performance drivers that contribute to either reduction in LCOE or market barriers include:
- Rotors — Greater rotor diameter for a larger swept area;
- Drive Trains — Lighter, low maintenance integrated drive train;
- Balance of Station — Innovative platform improvements and cost effective transport;
- Plant Performance Optimization — Reduced integrated (multi-turbine) plant losses (from 10 percent to 8 percent for utility-scale wind and from 12 percent to 10 percent for offshore wind);
- Towers — Increased hub height (80-110m) allows access to better resources but must not adversely impact weight or structural integrity;
- Replacement Costs — Improved component useful life (from 10 years to 20 years before replacement);
- Deployment Barriers and Costs — Improved access to sites with higher wind speed (m/s), by addressing barriers such as wind-radar interference mitigation;
- System Validation — Reducing the difference between today's financing costs and "low risk" financing. With program RDD&D activities, investors become more confident in technology and demand less of a risk premium in financing; and
- Market barriers — Dissemination of unbiased data on wind benefits and challenges, and distribution of results of technical studies on reliability, economic and environmental impacts.

The program has developed specific targets related to these goals to enable program performance measure analysis and evaluation.

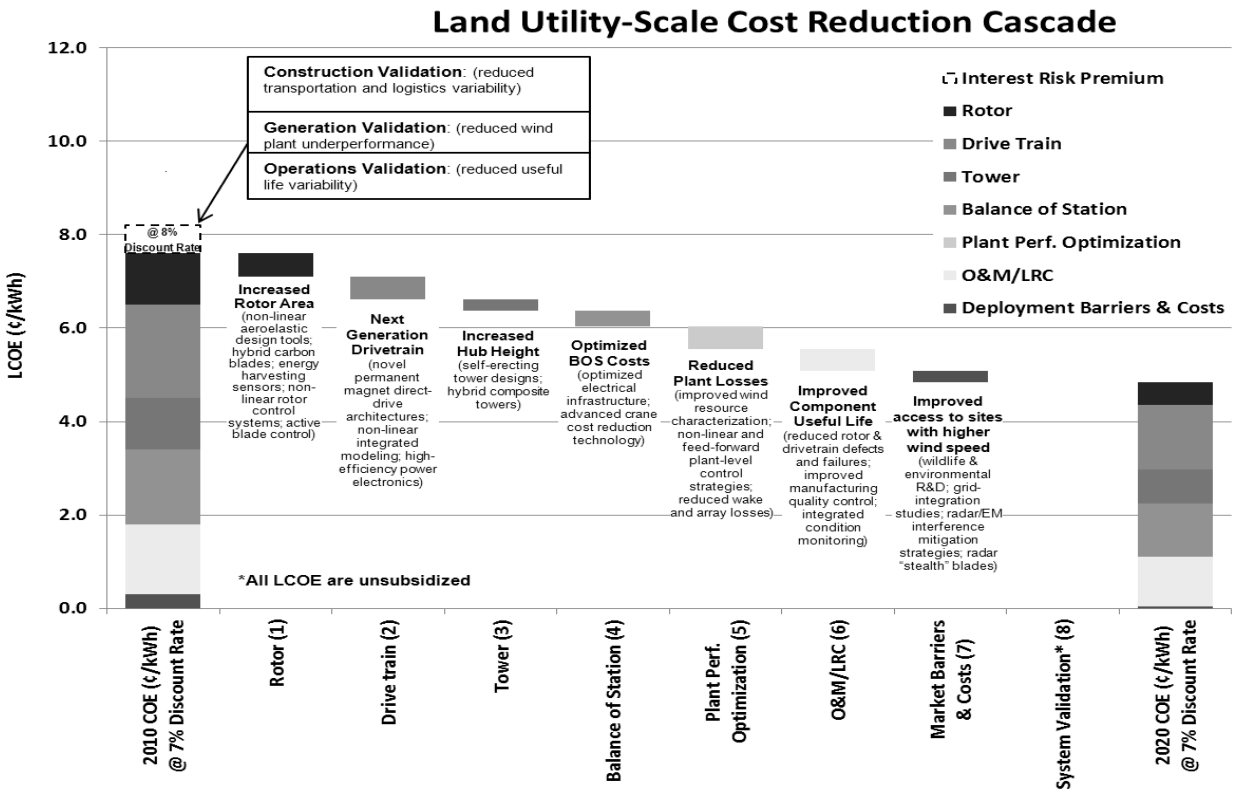
Performance Measure Analysis

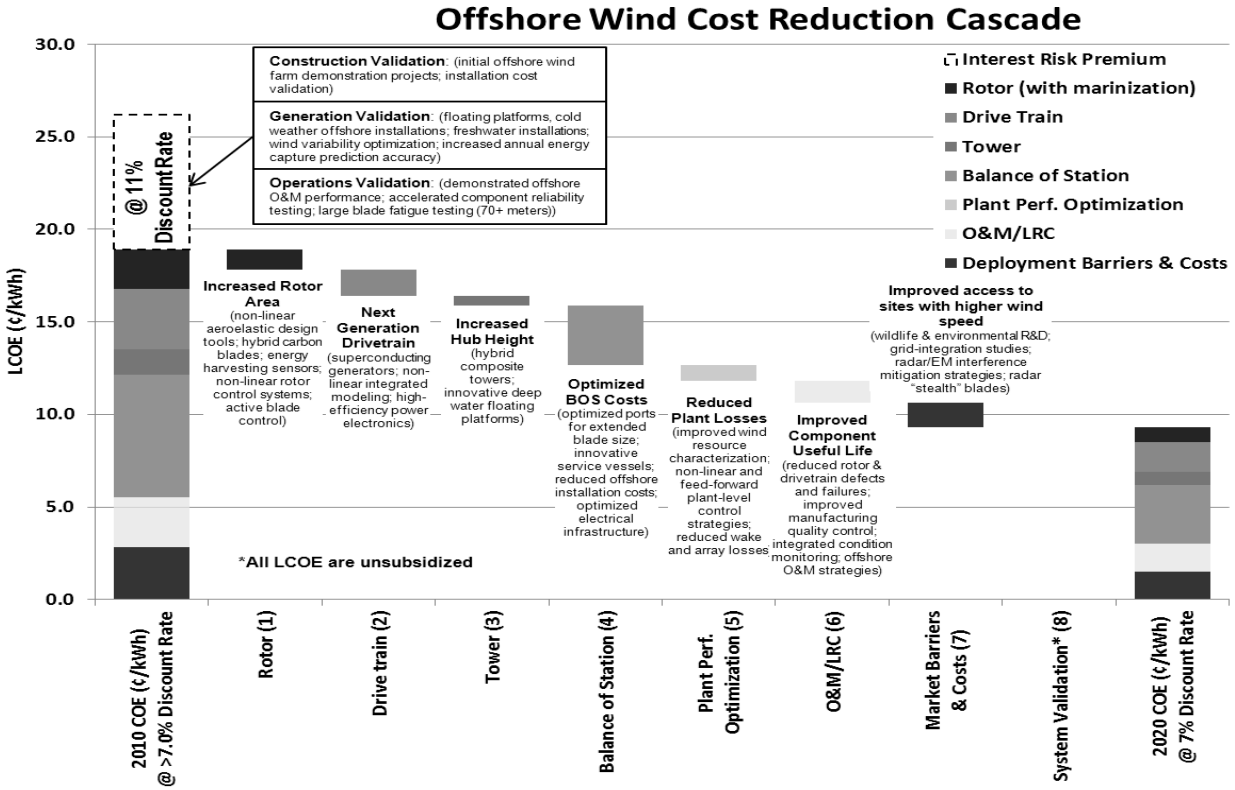
The utility-scale and offshore Wind LCOE goals were established on an internal analysis of high likelihood projected lowest cost of natural gas during the same period, with the acknowledgement that wind electricity generation is valued lower by the market due to time of day and variability of wind electricity generation.

Technical innovations to achieve target capacity factors are projected to require increasing the size of turbines from current 1-3 MW based systems to 5 MW systems for land-based utility-scale and 10 MW systems for offshore applications. Achieving wind plant generation targets will require High Performance Computing (HPC) modeling and data collection of wind resource characterizations and turbine-to-turbine wind wake interactions as well as real time control and feedback systems. Wind component extended useful life with lower maintenance costs will require innovations in blades, generators and gearbox designs.

In addition to the LCOE reductions to the wind system components and plant design, substantial research and technology development is required for the reduction of market barriers, such as radar interference and wildlife interactions.

The charts on the following page show the specific pathways for the program's roadmap of cost reduction by 2020 for utility-scale wind systems. The program has a unique role to accelerate high risk/high performance innovations which will benefit the U.S. wind industry and enable market investment in unsubsidized, cost competitive wind systems.





As stated, R&D to reduce utility-scale wind LCOE will benefit both land-based and offshore systems. The

greatest reductions in target LCOE for utility-scale wind are projected to come from reducing installed capital cost followed by reducing technological and performance risks which increase financing costs. The potential for reducing financial risk and technology uncertainty for the less mature offshore wind technology is so great that they account for nearly three-quarters of the projected reduction in offshore LCOE over the next decade.

The contributions of major components to offshore wind capital cost reduction are different than that for land-based wind, with turbine capital cost and balance of station reductions of equal magnitude, followed by plant performance optimization. Progress toward offshore wind LCOE goals will be measured and validated both in non-U.S. installations by U.S. suppliers and in future U.S. installations, and compared to historical non-U.S. cost data.

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Wind Energy Program			
Innovation — An increase in this area is due to new critical path innovation activities including offshore wind specific technology research such as deep-water foundation design and modeling, marine system engineering (new types of anchors, moorings, and marinization of components), systems optimization (wind plant performance) and computational modeling of complex environments (coupling of wind and sea states and complex terrain).	27,279	35,480	+8,201
Emerging Technologies — The program will complete some gearbox and blade industry cooperative agreements will reduce or eliminate out-year advanced drivetrain funding (from FY 2011 FOA) and will further reduce land based component development activities. There will also be reductions to wind turbine testing facility support and upgrades in FY 2013.	29,317	22,321	-6,996
Systems Integration — Minimal total change in this area. Offshore wind remains a focus including continued investment in an offshore wind demonstration project (construction competed in 2012) to reduce technical and economic risks of offshore wind power plants in U.S. waters. Some reductions in the land-based wind system integration activities were made possible by the completion of large capital equipment investments made in 2012.	24,186	24,280	+94
Market Barriers — A slight increase in market barrier subprogram work supports offshore wind permitting, siting and environmental challenges. Additional market barrier work is addressed through innovative and emerging technology research on issues with broad national application such as mitigating the effects of wind turbines on wildlife and radar.	10,446	10,786	+340
SBIR/STTR are calculated based on research and development funding allocations.	2,026	2,133	+107
Total, Wind Energy	93,254	95,000	+1,746

Explanation of Changes

The most significant thematic changes in the program between FY 2012 and FY 2013 are the expansion of the Offshore Research Innovations activities and Demonstration of Offshore Technologies, which are offset by the reductions in completed gearbox and blade Industry cooperative agreements.

Funding Opportunity Announcement Background

The program posts current and past funding opportunities for all program areas, R&D for technology development, technology application, systems integration, and market barriers projects at the programs webpage http://www1.eere.energy.gov/wind/financial_opportunities.html. Links to related opportunities from DOE national laboratories and other Federal agencies are available.

This open, competitive solicitation process is designed to meet the top technology needs identified by evaluating the appropriate government role and through development of a technology roadmap with industry. Funding opportunities encourage collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local governments and non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance. The currently anticipated FY 2012 and FY 2013 FOAs are provided below.

Anticipated FOAs

(Dollars in Thousands)

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2012	WE 5.0 Offshore Wind FOA - Advanced Technology Demonstration Projects FOA	Systems Integration	20,000
Project Description: The primary goals of the Advanced Technology Demonstration Projects are to: (1) install offshore wind turbines in U.S. waters in the most rapid and responsible manner possible, and (2) expedite the development and demonstration of innovative offshore wind energy systems with a strong potential for lowering the LCOE.			
FY 2013	Large Scale Inflow, Wake, and Loads Data Collection, Modeling and Validation	Innovations	25,000
Project Description: The Large Scale Inflow, Wake, and Loads Data Collection, Modeling and Validation FOA would provide one to three awards to conduct accelerated wind plant field data collection, wind tunnel testing, and High Performance Computing modeling to increase wind plant performance and reduce LCOE. Typical wind plants fail to capture 10-15 percent of the wind energy they are designed to extract due to uncertainties in complex wind flow patterns and the resulting loading conditions placed on individual wind turbines. An effective field testing and data validation research program would require access to commercial-scale wind turbines, utility-scale wind tunnel testing facilities, and HPC resources. Furthermore, this R&D effort would involve a sizable collaborative effort amongst national laboratories, universities, and industry participants.			
FY 2013	Mid-size Turbine Verification and Validation Testing	Emerging Technologies	600
Project Description: The Mid-size Turbine Testing FOA would provide two awards to perform Wind turbine certification testing of new mid-size wind turbines. This is a follow-on effort to the FY 2010 Mid-size Turbine Development FOA and would provide certification tests on a dynamometer or at a field test site for newly certified US products for the mid-size turbine market (100 kW-1 MW).			

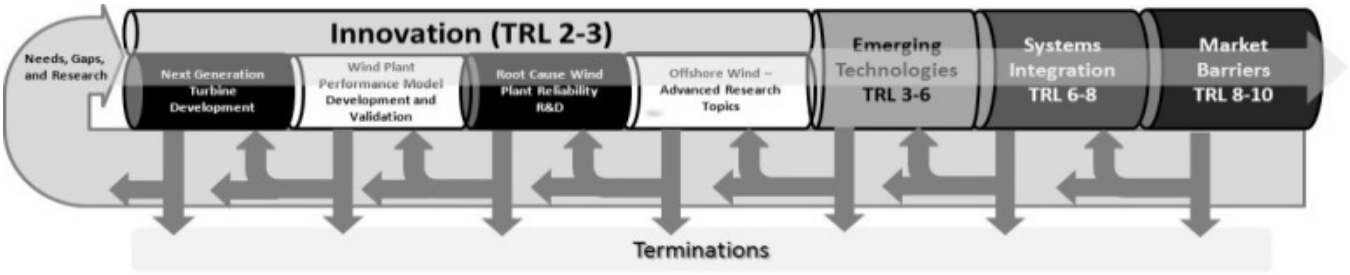
Innovations

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	29,739	27,279	35,480
SBIR/STTR	0	805	1,083
Total, Innovations	29,739	28,084	36,563

Sequence



Description

The program is focusing on innovative research activities which have the highest projected impact to lowering the LCOE from wind energy systems. The program has a unique role in advancing the state-of-the-art in order to achieve LCOE reductions and is therefore investing $35.5 million in the Innovations subprogram, which is comprised of TRLs 2 and 3 and accounts for 38.2 percent of the total FY 2013 program budget.

While the U.S. wind industry focuses on incrementally reducing costs through innovation in turbine size and reducing levelized replacement costs, the program's focus and unique role is drive down costs through high-risk, transformational technology research, which benefits the entire industry. The program's prior year's research activities have been critical to the success of the U.S. wind industry and have included the launch of an offshore wind initiative through 2 FOAs, interagency coordination via Memoranda of Understanding with Department of Interior and National Oceanic and Atmospheric Administration (NOAA), a Drivetrain FOA, grid integration studies (Eastern Wind Integration and Transmission Study and Western Wind and Solar Integration Study), and offshore wind publications including the National Offshore Wind Strategy and the assessment of opportunities and barriers for large-scale offshore wind power in the U.S.

The approach of the Wind Program for FY 2013, through the Innovations subprogram, is to:

- Lower wind turbine capital cost while increasing performance;
- Improve overall wind plant performance; and
- Improve wind plant reliability and reduce operating expenses.

Major program research focus areas include turbine architecture, wind plant performance modeling, and novel component development for reliability. Increasing the industry's understanding of the issues surrounding integration of significant amounts of renewable generation into the power grid and innovations relating to siting and environmental challenges are also addressed.

Major Innovations activities include:

- Reduction of Turbine Capital Cost per kWh through research into to the architectures, components, and manufacturing methods that can enable U.S. wind designers, manufacturers and operators to lead globally.
- Improve U.S. wind plant performance (capacity factor) through research into designs and modeling of integrated active rotor control for load mitigation; adaptive controls; advanced concepts for integrated health monitoring; and advanced sensor systems. High Performance Computing is used to predict inter array flow dynamics and assess impacts on macro and micro climatology which require design tools to assess wind turbine design and performance as an integrated subsystem for both land and offshore applications. Grid modeling is applied to address grid reliability and to better understand the effects of high penetrations of wind energy on the bulk power system, as well develop mitigation strategies for intermittency and variability.

- Research for improvement of component useful life and low maintenance costs via damage and defect surveys to characterize the types of problems existing in the field; studies to determine how defects affect the strength and life of wind turbine components; validation of failure analysis models; and collection of industry-wide reliability, availability, and maintainability data.
- Addressing the potential for wind power plants to provide active power control to support power system reliability.

Key Technology and Focus Areas

Key technology and focus areas for the wind program's Innovation subprogram include:

Next Generation Turbine Architecture Development — Researching the architectures for larger, light weight turbines that reduce overall mass (cost) and provide access to better wind resources (larger rotors, taller towers) and improved systems performance (capacity factor). Specific FY 2013 research projects include: physics-based system engineering models of advanced components; particle image velocimetry (PIV) for validation of aerodynamic and aeroacoustic models and codes; offshore wind specific advanced rotors and reliability; and offshore wind specific research of deep-water foundation designs and related impact on performance.

Wind Plant Aerodynamic Flow Model Development and Validation — High Performance Computing models of complex aerodynamic flows in and around wind plants are essential to eliminating plant underperformance, defining intra-array operating environments, and quantifying micro and macro climatology impacts. These activities are aimed at reducing failure rates and increasing energy output (capacity factor). FY 2013 research activities target a multi-year effort for large-scale inflow, wake, and loads data collection, modeling, and validation; complex flow statistical analysis and modeling; and offshore wind-specific deep-water modeling and standards development.

Root Cause Wind Plant Reliability R&D — Research on advanced materials and components for improvements in turbine cost, strength, weight, and fatigue will lead to reduced O&M costs and reduce the failure rate for large components such as blades, gearboxes, and generators. FY 2013 research projects include: composite materials database; load alleviation technologies; blade and gearbox reliability analysis and collaborative; advanced testing technology development; and generator and power electronics failure analysis and reliability collaborative.

Transmission and Infrastructure — Lack of transmission capacity is one of the largest barriers to increasing the Nation's electricity from wind power. Lack of transmission access is driving project developers to choose sites with less wind potential, which increases the resulting cost of energy. The average wind power class for projects installed in 2011 was in a Class III resource (compared to an optimum Class IV, V or VI resource for land-based wind), continuing a downward trend over time. For utilities to invest in new transmission infrastructure, information must be provided to better understand wind generation's impact on the power grid. This is best accomplished through integration studies and research into fundamental model relationships in the transmission network. The program focus includes grid integration studies to assess potential policies; grid integration support for utility owners and operators; wind generation modeling for use by transmission planners; the development of active power controls methodologies; metric development and technical solutions to wind resource variability.

Offshore Wind - Advanced Research Topics — Consistent with the "National Offshore Wind Strategy," funding supports research activities such as high performance computing of atmospheric physics impacting turbine dynamics and array effects and establishment of an offshore meteorology reference facility for validation of new models and instruments. The work is expected to simultaneously improve offshore wind plant performance parameters and energy projections accuracy, directly contributing to the EERE goal of lowering the cost of energy in areas such as plant performance optimization.

Environmental Studies — Meteorological and other environmental studies are critical to understanding and reducing non-LCOE market barriers hindering wind deployment. FY 2013 research projects include high performance computing, meteorology reference station development and environmental roadmap development.

Benefits

- Industry Benefits — The entire wind industry benefits from the program tackling high-risk research (with potential game-changing implications) that individual manufacturers cannot typically attempt. The program also plays a unique role through interagency coordination for national needs, such as access to wind characterization data collected by NOAA.
- Public Benefits — Innovative research sponsored by the program leads to technologies and practices that allow the U.S. to cost-effectively access its domestic clean and renewable wind energy resource. This delivers improved energy security and health benefits by reducing dependence on fossil fuels and associated fossil fuel emissions.
- Economic Benefits — Innovative research provides the basis of energy cost reductions, reliability improvements, and market barrier reduction that will enable wind power technology cost parity with traditional energy sources, without any subsidies.

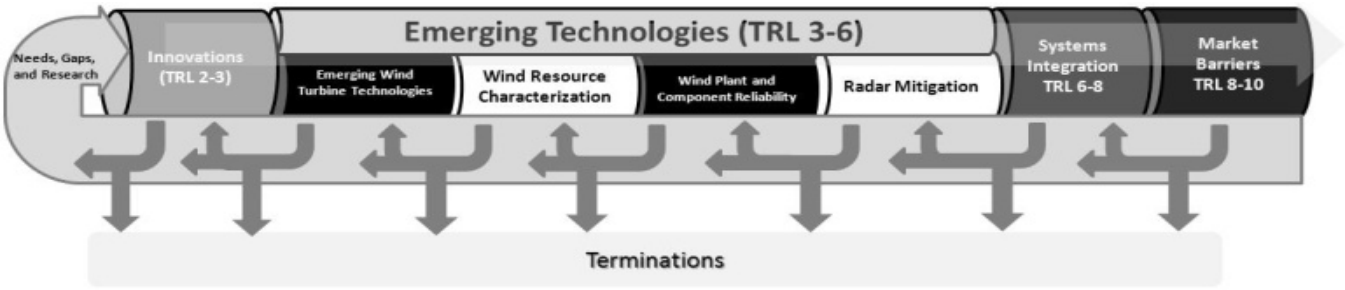
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	40,919	29,317	22,321
SBIR/STTR	0	865	680
Total, Emerging Technologies	40,919	30,182	23,001

Sequence



Description

The Emerging Technologies subprogram is a collection of development activities in TRLs 4-6. This research is primarily aimed at taking innovative materials and designs from conception through detail design and prototyping, validating components and subsystems. The program also focuses on understanding how to predict the wind resource and its effect on component reliability. The program is investing $22.3 million in emerging technologies (24 percent of FY 2013 wind budget) and this development activity will support achieving the LCOE target of $.06/kWh, by 2020 for land, and $.06/kWh by 2030 for offshore.

An example of a prior year innovation that has graduated to emerging technologies is a grid simulator. Once a conceptual design, now it is being integrated into wind turbine test facilities to more accurately represent the electronic environment to which the turbine must integrate.

For FY 2013, the approach of the program, through the Emerging Technologies subprogram, is to:

- Lower wind turbine capital cost while increasing performance;
- Improve overall wind plant performance;
- Improve wind plant reliability and reduce operating expenses; and
- Research and implement technology solutions to overcoming deployment barriers, such as reduction of radar interference.

The program aims to improve the reliability, productivity, and operation of wind turbines with more reliable components, better wind forecasting tools to provide high confidence projections of resource and power production, and equipment that can more effectively operate in our complex environment. The program has a unique role in providing the U.S. component manufacturers with existing, updated, and expanded test facilities that assist in overcoming challenges to today's industry and in designing and evaluating tomorrow's break-through solutions. The program also has a clear role and responsibility to develop and coordinate wind-radar mitigation solutions with other Federal agencies to address National Airspace System issues.

Key Technology and Focus Areas

Wind Turbine Detailed Designs — The Emerging Technologies subprogram moves beyond conceptual architectures and preliminary design models in the previous Innovations phase, into the development of pragmatic detailed designs and operational flow models. The program supports the development of detailed product design tools, which are used by industry, government, and universities to model the physics behind aerodynamic inflows and the wind turbine dynamic structural response for specific implementations. Stakeholders use these tools to integrate new designs into a modeled, operational wind turbine in order to predict the impact of these innovations on performance. Design tools are being developed in the fields of plant-scale aerodynamics, turbulence, rotor design, drivetrain design, tower design, floating platform design, offshore substructure design, mooring interactions, and overall system dynamics. Advanced controls are another topic of research for FY 2013. The program's funded research aims to improve existing controls systems in order to enhance energy capture at both the turbine and plant level, as well as to improve reliability. FY 2013 projects will include the development and validation of non-linear controls systems, enhanced offshore wind design tools, and component validation testing with industry partners.

Wind Plant Complex Flow Performance Optimization — Several FY 2013 projects are aimed at expanding the underlying models funded in prior period Wind Innovations budgets, to understanding the complex flow of the resource encountered by a wind turbine and the wake effect that a wind turbine has on surrounding turbines in order to more accurately predict the electricity output. In FY 2013, there will be an effort to collect wind plant performance data, using large-scale high-performance computing modeling to quantify how atmospheric phenomena affect wind turbine performance and reliability. Other activities include improving wind resource and power output forecasting in the hours-ahead through day-ahead time frame through weather model improvements and determining the effect on utility operations (reserves required) and power markets.

Wind Plant and Component Reliability — Laboratory and field testing of critical wind turbine components, such as generators, gearboxes and blades, will lead to a better understanding of static, dynamic and fatigue failures for emerging wind turbine technologies. FY 2013 projects will target deficiencies in the design process that are contributing to substantial shortfalls in service life for most designs. New design-analysis tools will be developed to model the test configuration in detail. Once components are tested individually and deficiencies are identified, new designs are investigated to validate their improved performance. Example cooperative projects with industry include the Gearbox Reliability Collaborative and the Blade Reliability Collaborative.

Grid Disturbance Testing — Testing infrastructure at the National Wind Technology Center provides a wide breadth of testing for all market segments. For example, in order to understand the behavior of wind turbines experiencing grid disturbances, it is necessary to perform a series of tests and accurate transient simulation studies. Such tests could include low voltage ride-through, active power set-point control, ramp rate limitations, and reactive power capability tests. Significant cost and test-time reduction can be achieved if these tests are conducted in controlled laboratory environments that replicate grid disturbances and simulation of wind turbine interactions with power systems. An initiative to design and construct a 9-MVA grid simulator to operate with the existing 2.5 MW and new upcoming 5 MW dynamometer facilities (that have been funded through the Recovery Act) will fulfill this role and bring many potential benefits to the U.S. wind industry with the ultimate goal of reducing wind energy integration costs. Impacts of variable generation like wind power on the amount of operating reserves required will be simulated and planned.

Radar Mitigation, Manufacturing & Supply Chain, and IEA — In FY 2013, the program will continue development of wind turbine - radar interaction solutions in order to mitigate electromagnetic interference and enable the industry to identify and employ mitigation technology or techniques. The objective is to reduce the cost of energy from wind power by increasing the access to high quality wind resources in previously constrained/restricted areas. In conjunction with other Federal agencies, the program will develop, test, and evaluate software and hardware radar interference mitigation technologies. The program will identify an initial set of acceptable mitigation technologies that can meet the operational and mission requirements of radar agencies.

The program also conducts work in advanced manufacturing and supply chain development so that emerging technologies evolve locally and jobs are created domestically. International partnerships promote the U.S. leadership role while leveraging knowledge overseas and encouraging foreign investment into domestic products.

Benefits

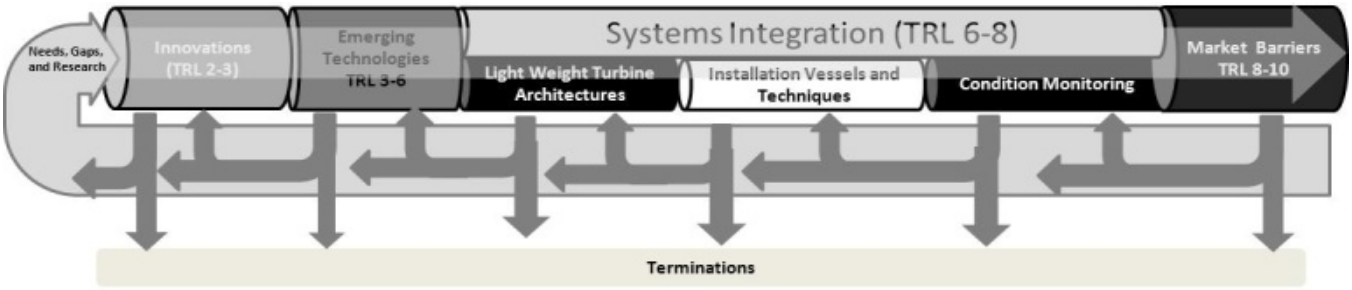
- Industry Benefits — The wind industry benefits from this work by identifying and solving systematic technology issues before new components are deployed in the field.
- Public Benefits — The translation of innovative research into emerging technologies brings wind power closer to offering the public benefits of more reliable wind energy at lower cost.
- Economic Benefits — Incorporation of emerging wind technologies to lower the cost of wind energy will encourage diversity in the national energy mix, reduce the economic impacts of fluctuating fuel prices, and help create productive jobs domestically.

Systems Integration
Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	1,214	24,186	24,280
SBIR/STTR	0	356	370
Total, Systems Integration	1,214	24,542	24,650

Sequence



Description

The program has a unique role in wind energy system integration and demonstration projects. Demonstration of technology innovation, development of components, verification and validation of performance and operations are essential to reduce risk and attract investment capital in innovative technologies — especially offshore wind. The program is investing $24.3 million in systems integration, which is 26.1 percent of the total FY 2013 wind budget.

An integrated systems approach for advances in technology development is necessary as no single component or subsystem improvement will achieve the required LCOE goals.

In FY 2011, the program focused on overcoming four key challenges relating to offshore wind: the relatively high cost of offshore wind energy; technical challenges surrounding installation, operations, and grid interconnection; and lack of site data and experience with project permitting processes. The program released two competitive solicitations for offshore wind which will continue into FY 2013 offshore demonstration activities.

Offshore Wind Advanced Technology Demonstration Projects continuing FY 2012 FOA — The primary goal of this ongoing effort will be to have offshore wind turbines tested in U.S. waters in the most rapid and responsible manner to validate the technology, to reduce technical risk, and provide feedback for lowering the cost of energy from offshore wind plants. Successful implementation of advanced technology demonstration projects will help make offshore wind cost competitive with other generation through the reduction of uncertainties and refinement of technology. By providing funding, technical assistance and government coordination to accelerate implementation of offshore projects, the program can help mitigate investment risk and facilitate the development of the U.S. offshore wind industry. An example of specific objectives include gathering and disseminating performance validation data, and developing, testing, and refining infrastructure for offshore wind plant construction and improved reliability in the harsh marine environment.

Key Technology and Focus Areas

Floating platform offshore wind technology, to be deployed with ocean floor depths of greater than 60 meters, is in the pilot stages of development with no commercial installations. The potential to decouple the turbine architecture from costly subsurface foundation designs has two major benefits: 1) providing access to significant resources (>3,000 GW) in deep water using various mooring and anchoring strategies, and 2) allowing mass production of turbine platforms independent of bathymetry and foundation design; making this technology an attractive future alternative for cost-effective installation. Key floating offshore innovations include:

- Light Weight Turbine Architectures;
- Installation Vessels and Techniques; and
- Condition Monitoring.

Benefits

- Industry Benefits — System Integration of offshore wind benefits the industry by demonstrating and validating the viability of the plant to decrease technical risk and financing costs.
- Public Benefits — Testing and improving offshore wind technology in U.S. waters will help develop a major new market for power generation from a clean, affordable, reliable and domestic source.

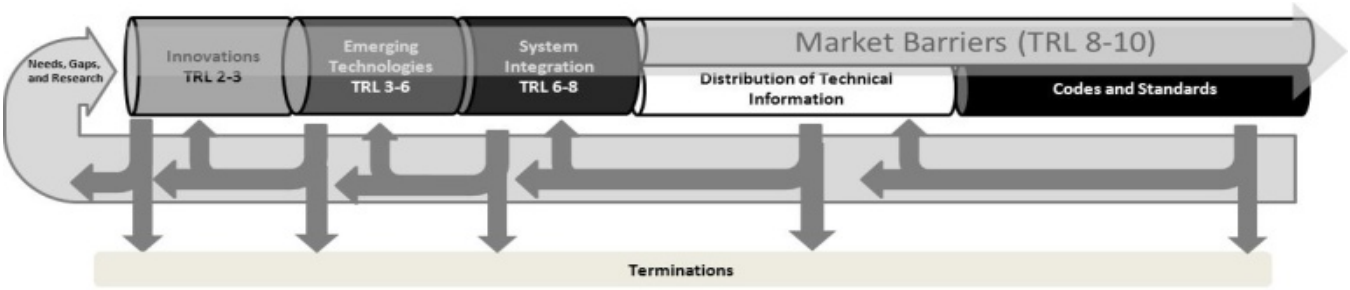
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	6,962	10,446	10,786
Total, Market Barriers	6,962	10,446	10,786

Sequence



Description

Reducing deployment market barriers lowers the cost of wind energy by improving market access to higher wind speed areas, both on land and offshore. The program reduces market barriers by conducting and sharing basic research findings on technology, test results, wildlife interactions, social acceptance, and policy impacts with the entire wind industry and collaborating government agencies to enable new innovative pathways toward lower cost of energy and increased deployment. The program also provides independent evaluation of methods, theories, models, policies, components and system technologies intended to reduce the risk of deploying innovative new lower cost technologies and accelerate deployment.

The program is investing $10.8 million in the Market Barriers subprogram, which is 11.6 percent of the total FY 2013 wind budget. The funding is split among transmission access activities, distribution of test and analysis results, and development and dissemination of codes and standards.

Public concerns are largely driven by perceptions of wind power's negative impacts on landscape aesthetics, environmental resources, property values, and competing land or water uses. The program's focus includes developing and disseminating objective wind energy information and decision tools on wind energy to stakeholders and policymakers; providing direct and indirect technical support to state and local governments working on wind issues; and funding scientific research on issues of public concern.

Wind market barriers activities will include projects that study transmission access needs for renewable energy deployment and integration planning; siting and permitting barrier reduction; and policy and market analysis. Successful outcomes result in streamlined, predictable permitting processes; increased access to more and higher quality wind resources; and reduced project development costs.

Key Technology and Focus Areas

Technical Analysis and Distribution of Results — Proposed sites for wind plants often face opposition based on actual or perceived wildlife impacts, concerns of civilian and military radar interactions, and competing land/sea use. Objective analysis of issues, including aesthetics and sound as well as potential property values impacts, are of concern to project neighbors and may become more significant as the footprint of wind energy continues to expand. Reducing these perceived or actual risks of wind energy through targeted research can allow accelerated deployment of wind where cost of energy is not the primary barrier. The program focus includes interagency collaboration and technical data publication of radar cross-section interference and acoustics signature, and collaborative research to reduce risks and develop innovative mitigation measures related to wildlife, other environmental impacts, electromagnetic interference, and land and ocean uses such as agriculture (land-based) and navigation (offshore).

Codes and Standards — The program has a unique coordination role to help develop codes and standards for new turbine designs that enter the market. The distributed wind industry, for example, has added hundreds of new manufacturers to the marketplace with limited or no safety or performance standards. The program will continue working with industry groups to develop best practices for wind plant collector design and protective relaying.

Offshore wind market barriers work will focus on providing annual market data, analysis of emergent policy and economic questions, and proactive planning and siting such as coordinated marine spatial planning.

Benefits

- Industry Benefits — The Market Barriers subprogram benefits the industry by providing wind resource maps, market data, and an unbiased data source for the utility customer regarding benefits and challenges of wind power.

Advanced Manufacturing Office (formerly Industrial Technologies Program)

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Industrial Technologies Program			
Next Generation Manufacturing Processes	0	62,086	198,748
Next Generation Materials	0	32,877	52,352
Industrial Technical Assistance	24,449	17,730	31,000
Manufacturing Energy Systems	0	0	0
Industries of the Future (Specific)	5,841	0	0
Industries of the Future (Crosscutting)	75,609	0	0
Advanced Manufacturing Office	0	0	0
SBIR/STTR	0	2,887	7,900
Total, Industrial Technologies Program	105,899	115,580	290,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Advanced Manufacturing Office (formerly Industrial Technologies Program)			
Innovations	34,541	38,705	44,112
Emerging Technologies	45,677	55,916	107,614
Systems Integration	1,232	342	99,374
Market Barriers	24,449	17,730	31,000
SBIR/STTR	0	2,887	7,900
Total, Advanced Manufacturing Office (formerly Industrial Technologies Program)	105,899	115,580	290,000

Public Law Authorizations[a]

P.L. 95-91, "U.S. Department of Energy Organization Act" (1977)
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The mission of the Advanced Manufacturing Office (AMO) is to research, develop, and demonstrate at a convincing scale new energy-efficient manufacturing processes and materials technologies to reduce the energy intensity and life-cycle energy consumption of manufactured products and promote a corporate culture of continuous improvement in energy efficiency among existing facilities and manufacturers.

The goal of the Program is to reduce energy consumption of manufactured goods across targeted product life-cycles by 50 percent over 10 years by enabling the production, use, and/or deployment of advanced manufacturing technologies. These savings will be realized from lower energy intensity manufacturing techniques and the production of higher performance products with the potential to save energy throughout the product life-cycle (e.g., reduced weight of components in moving machinery).

Based on the Energy Information Administration 2006 Manufacturing Energy Consumption Survey data, energy use across the industrial sector was as follows: steam (29 percent), process heat (28 percent), machine drive (25 percent), non-process (10 percent) and other processes (8 percent). The program addresses key energy systems to decrease energy use by targeting energy reductions in steam, process heating and machine drive. It is appropriate to note that steam production is an indirect use of energy (e.g., boiler fuel); approximately half of the

[a] SBIR/STTR funding transferred in FY 2011 was $2,342,000.

energy required to generate steam use is additionally attributable to process heating energy demand.[a]

Specifically the Program aims to:

- Advance broadly applicable manufacturing processes that use energy efficiently. Examples of such processes include additive manufacturing, out-of-the-autoclave composite fabrication, titanium production and roll-to-roll processing of metallic, polymeric and ceramic foils;
- Develop and demonstrate pervasive materials technologies that reduce life-cycle energy requirements for production of low-cost, high-performance products for high-value industries such as the renewable energy industry. Example materials include low-cost carbon fiber, low-cost titanium, resilient coatings, and lightweight magnet materials; and
- Promote effective energy management through standardized energy management tools and protocols that enable established and emerging industries to identify and invest in energy efficiency improvements to reduce costs, comply with international energy management standards (ISO 50001), adopt new flexible/adaptable processes and materials, deploy in-line sensors and adaptive controls, and educate, re-train and certify the U.S. workforce to adopt and implement new manufacturing processes and technologies.

Industry accounts for approximately 30 percent of energy consumption in the U.S. The energy use in industrial and manufacturing facilities is expended primarily as thermal energy and therefore significant energy savings can only be realized when this proportion is reduced. To this end, the Program has been formed as a cross cutting activity to address the energy expenditures in manufacturing by focusing on new energy-efficient processes to manufacture products.

On June 24, 2011, President Obama launched the Advanced Manufacturing Partnership, a national effort bringing together industry, universities, and the Federal government to invest in emerging technologies and help manufacturers reduce costs, improve quality, and accelerate product development. DOE was named as one of the key Departments to execute the President's vision through vehicles like EERE's Innovative Manufacturing Initiative, which seeks to develop transformational manufacturing technologies and innovative materials that could enable manufacturing facilities to dramatically increase their energy efficiency. The Program's Next Generation Manufacturing Processes and Materials key focuses are aligned with this initiative.

Strategy

To meet its mission, the Program will invest in cross-cutting manufacturing development activities and technology deployment efforts. These investments will span Technology Readiness Levels (TRLs) 2-9 and provide significant support of advanced technologies during the emerging technologies, systems integration, and market barrier stages of the technology readiness pipeline in order to demonstrate technology at a scale meaningful to manufacturers. To address the wide variety of challenges faced by industry, AMO activities are directed through three key focused areas: Next Generation Manufacturing Processes, Next Generation Materials and Technology Deployment.

Next Generation Manufacturing Processes will provide critical energy improvements and reduce energy-related environmental impacts while increasing the competitiveness of U.S. manufacturing industries. Achieving highly-efficient processing will require the reduction and/or integration of process steps, adaptable manufacturing strategies, development of alternative low-energy pathways, and development of entirely new processes and unit operations. The focus of this thrust is on the development and demonstration of new manufacturing processes and of manufacturing simulation tools and technologies. Also included are pervasive/foundational technologies such as the development and demonstration of intelligent manufacturing sensors, in-situ monitoring, real-time adaptive process control, and process models to achieve low energy, high-yield production. Manufacturing technologies like these can reduce energy losses from steam, motors, process heating, and other systems by optimizing the use of heat, reducing the number of processing steps, replacing high-temperature processes with lower-temperature or non-thermal alternatives, and otherwise improving system efficiencies.

Example processes that have the potential to reduce energy use by a factor of 10 include: additive manufacturing; spatially-selective processing treatment of net shape parts, e.g., spatially-selective induction heating of components; titanium extraction; powder production; out-of-the-autoclave composite manufacture; roll-to-roll production of membranes; processes for bio-derived precursor chemicals; low temperature, water-based selective extraction of critical materials from low grade ores, obsolete electronic equipment and waste landfills; and in-situ manufacturing monitoring and process controls technologies for multi-component systems, e.g., in-line systems for assuring infiltration of a battery porous plate by the electrolyte.

[a] Source: U.S. Energy Information Administration 2006 Manufacturing Energy Survey and AMO Carbon Footprint Analysis of energy use in select energy-intensive industries. http://www1.eere.energy.gov/industry/rd/footprints.html

New Generation Materials provide an expanded opportunity to create products for energy efficiency and renewable energy generation. New materials allow for energy savings in current energy intensive processes and applications and permit a new design space for renewable energy generation in austere environments. For example, low-density blade materials can reduce loads on hubs and gears in wind blades reducing design constraints and costs in those components. Similarly, new superlattice thermoelectric materials allow for improved extraction of electricity from low temperature heat via a unique combination of thermal and electrical conductivities.

Example materials that have the potential to reduce energy use across multiple applications include: carbon fiber; titanium alloys; magnetic materials; corrosion- and oxidation- resistant alloys for use in offshore applications, high temperature combustion and chemical industry applications; functionally graded composites to optimize properties; biomass (cellulosic) derived resin systems for low cost composites; high temperature superconductor bundles; amorphous and meta-surfaces and structures for magnetic applications; and self-monitoring, self-reporting and self-healing material systems for long term application in austere environments.

As proposed and funded in FY 2012, the program is also exploring technologies and approaches that increase the availability and reduce or eliminate the need for critical materials for energy efficiency and renewable energy systems through a new Critical Materials Hub. The Hub will assess the functionalities that are imparted by critical materials in specific application domains and will investigate scalable manufacturing technologies that reduce the need for or make the use of critical materials in these domains obsolete. In FY 2013, the Hub investments will be targeted for continued progress towards the technical approaches, specific goals, and quantitative and measurable milestones defined through the foundational FY 2012 hub efforts. Hub progress will be continually reviewed to assess the relevance of the specific technology domains addressed and the potential for efficient manufacturing and application suitability.

CM Hub efforts are designed to complement AMO's support of the Administration's Materials Genome Initiative (MGI). AMO will focus on challenges specific to the production and manufacturing of innovative materials by:

- Focusing on producibility issues and later TRL stages to capitalize on earlier stage material research and development;
- Targeting scale-up opportunities for material production;
- Researching production process-derived material characteristics such as crystallographic structure in addition to chemical composition; and
- Requiring a significant industry cost-share to ensure cost-effectiveness and commercial applicability.

Technology Deployment will help provide the U.S. manufacturing industry with competitive advantages by reducing barriers to deployment of existing and emerging technologies that promote effective energy management. These activities will help manufacturing industries to:

- Foster the energy management industry;
- Apply standardized energy management tools and protocols to identify and invest in energy efficiency improvements that reduce energy consumption and costs;
- Adopt, comply with, and support the development of international energy management standards (ISO 50001);
- Adopt new energy efficient flexible/adaptable processes and materials;
- Deploy in-line sensors and adaptive controls to increase efficiencies; and
- Implement education, re-training and certification programs to help the U.S. workforce acquire and master knowledge of new energy efficient manufacturing processes and technologies.

Technology Project Execution – The Program supports pervasive technologies that have the potential to benefit many other EERE program offices, other agencies, and industries. The Program is cross-cutting to enable development of technologies with applications across multiple sectors (e.g., wind, vehicle, etc.). The Program encourages co-investments with other offices and agencies (at DOE, DOD, and elsewhere) and the use of external rotating project officers (including from other EERE programs, other offices in DOE, DOD, DOC, industry, academia, etc.) to ensure synergies and complementary, coordinated spending across agencies and industry.

Next Generation Materials and Manufacturing Processes activities fund projects in focused technology areas for finite and short period of time (typically 2-4 years) with significant support during the emerging technologies, systems integration, and market barrier stages of the technology pipeline. This funding model bridges the "Valley of Death" for vulnerable, higher-risk next generation technologies and leverages the private sector to addresses the significant costs of scaling technologies from demonstration stages to full-scale industrial applications. Technologies funded within these focus areas must include pervasive materials or broadly applicable processes to ensure that projects are pre-

competitive in nature. These technologies must also show significant potential for increased energy efficiency and productivity and for clean energy manufacturing cost reduction. These focus areas do not support the development of marginally innovative products to be sold competitively in established markets.

Products and services for our national defense share materials and manufacturing technologies with commercial products across the economy. These pervasive, dual-use technologies can be cost-effectively developed through strategic collaboration between the Department of Energy and the Department of Defense on projects that support emerging technologies' transition to low-cost, volume production. The Advanced Manufacturing Office's work in advanced processes and materials technologies that reduce energy consumption for manufactured products and enable life-cycle energy savings complements Department of Defense investments to maintain the economic and technological competiveness of the U.S. industrial base.

To create synergies between these common interests, the Department has included legislative language to allow the flexibility for EERE appropriations to be transferred to the Defense Production Act Fund to pursue opportunities with clear mutual benefits. Collaboration through the Defense Production Act enables trusted sources for components for government applications while driving down costs for commercial applications and accelerating the availability of emerging technologies for commercial and defense applications. Candidate technologies include energy storage devices, carbon fiber, and wide band gap semiconductors and potential manufacturing processes include out-of-the-autoclave composite manufacture or additive manufacturing.

Benefits

The Program goal to reduce the energy consumption of manufactured goods across targeted product life-cycles by 50 percent over 10 years will lead to significant benefits to U.S. Manufacturers. Efficiency is a proven, cost-effective approach to energy and energy cost savings. Energy intensity has historically decreased at a rate of about 1.2% per year but a significant potential for energy efficiency improvement still remains. Doubling this rate of improvement across all of industry for 10 years would result in more than $100 Billion in energy cost savings to U.S. manufacturers and a 25% improvement in industrial energy efficiency.

The Next Generation Materials and Manufacturing Processes focus areas support technologies that allow U.S. manufacturers to be more globally competitive, adaptable, robust, and profitable by bringing next generation technologies to the market rapidly. The Program supports relatively few projects but provides significant support during the emerging technologies, systems integration, and market barrier stages of the technology pipeline (TRLs 4-9) to ensure a high success rate. Next generation technologies are inherently risky, so a strong funding model that helps advance technologies all the way through scale-up to implementation at manufacturing facilities is crucial to project success. Government support of revolutionary pre-competitive technologies is crucial because these same risks limit private sector funding to evolutionary, marginally innovative technology advances. Once demonstrated and deployed at the industrial scale, next generation technologies will be available to provide energy savings, production increases, higher product quality, alternative production pathways, and a variety of other benefits to a very broad base of U.S. manufacturers.

Next Generation technologies have the potential to leapfrog evolutionary technology advancements to achieve dramatic energy savings. For example, powder processing of titanium provides one example of potential order-of-magnitude changes in energy use achieved through low-temperature processing. Powder processing eliminates several melt processing steps, which involve heating titanium to over 1600^{o}C. Successfully changing the process by which net-shape titanium components are made could result in an almost 10-fold reduction in process energy demand.

Selective heating of composite parts provides a second example of energy savings that have been demonstrated through an AMO cost-shared public-private partnership using next generation injection molding processes. Standard autoclave processing heats not only the part, but also the associated tooling and adjacent processing system. In some cases more than 75 percent energy savings can be achieved by making composite parts by a different process; for example, electromagnetic heating tailored to the susceptibility of specific materials; thereby using energy only where it is needed. A manufacturer can selectively heat only the composite part; alternatively, the thin face of the die can be selectively heated. In both cases, the entire autoclave does not need to be heated, reducing energy use.

The Market Barrier subprogram plays a crucial role in achieving energy and cost savings across the existing U.S. manufacturing base by promoting an industry-wide culture of continuous improvement in energy efficiency. The subprogram also provides the tools and resources needed to achieve energy savings. Public support can assist companies in identifying and achieving these energy savings because significant energy efficiency and cost savings opportunities remain in the industrial sector by implementing technology solutions that are readily

available. Market barrier focus areas and tool development activities are structured to address the various barriers to achieving these savings, as follows:

- A network of Industrial Assessment Centers (IACs) supported by AMO conducts energy audits for small and medium size manufacturers and simultaneously trains students to become energy management professionals;
- Superior Energy Performance – an implementation of ISO 50001 – provides a platform for measuring, certifying, and recognizing energy savings using international standards to encourage replication of energy management practices across the private sector;
- Clean Energy Regional Application Centers (RACs) provide outreach and technology assistance to industry stakeholders to accelerate the adoption of clean energy technologies – principally combined heat and power (CHP) – to save manufacturers energy and money; and
- The Better Buildings, Better Plants Challenge and Program are focused on creating energy efficiency oriented American jobs through a network of public/private partnerships. In this program, corporate partners make ambitious energy savings commitments to execute energy saving programs and technologies and share best practices and examples/test cases with the rest of industry.

These activities will focus on capturing approximately five quads of energy over the next ten years by promoting a corporate culture of continuous improvement in energy efficiency among existing facilities and manufacturers.

Key Accomplishments

One example of a recent technology project accomplishment was the successful demonstration of an induction consolidation molding process for thermoplastic components. This pervasive manufacturing process developed in partnership with The Boeing Company has demonstrated potential impacts in multiple EERE programs and industry domains, including:

- 75 percent reduction in energy intensity and 10x increase in production rate for an aerospace component;
- 60 percent reduction in energy intensity for vehicle components at the same production rate; and
- 40 percent reduction in energy intensity and 6x increase in production rate for large composite structures applicable to wind turbine blades.

There have been significant recent program accomplishments through technology deployment activities:

- IACs have performed over 15,000 energy audits for small and medium size manufacturers and have trained over 3,000 students;
- Superior Energy Performance and other Program activities directly support ISO 50001, which was implemented by 34 companies in 19 states in 2010; and
- Clean Energy Application Centers have educated over 25,000 stakeholders on CHP, supported over 225 assessments, and provided over 700 technical support activities to CHP projects representing over 1.5GW of installed or developing capacity.

Strategic Plan and Performance Measures

The goal of the Program is to incent and drive manufacturing industries to improve energy and emission performance and increase U.S. competitiveness. In order to achieve these positive outcomes, the performance of program output is assessed based on effectiveness of funding choices. In this assessment, the program uses metrics and milestones to measure cross-industry impacts, including energy savings. The program milestones are measured against established impacts and tracking methodology developed by Pacific Northwest National Laboratory.

Continuous program improvement is determined as a function of portfolio investment decisions; successful decision-making results in higher impact per government dollar investment. AMO uses a prioritization tool to balance the risks, impacts, and cost-effectiveness of investment decisions across the investment portfolio to ensure the office goal is met. The AMO prioritization tool will also support wider analysis efforts across EERE and help quantify product life-cycle impacts, consistent with the office mission.

Performance Measures Analysis

AMO utilizes both prospective (forward-looking) analyses to guide investment decisions, and retrospective (backward-looking) analyses to assess the effectiveness of those decisions. These analyses guide investment decisions across the AMO portfolio by quantifying the risk, cost-effectiveness, and energy savings potential for all supported or potentially supported technologies. Though investment decisions will vary by industrial sector to account for disparities in technology types and energy savings potential, the overall investment portfolio will support the office goal. High-risk, high-impact investments in sectors/technologies with significant potential (i.e. savings beyond the program goal) will be balanced by less-risky, less-impactful investments in sectors/technologies with lower efficiency improvement potential to maintain a balanced and effective portfolio. The absolute size of the investment will also be

addressed on a cost-effectiveness basis to maximize impact per dollar invested.

Prospective analyses are based upon well-founded principles of innovation diffusion. Funding decisions favor portfolio investments that lead to market acceleration of technologies with the greatest projected impact. For example, if the impact of interest is energy, energy savings impacts can be estimated by measuring the area between the two technology penetration curves: the base case market adoption curve (without government funding), and the accelerated curve (with government funding). Since the industrial sector is so diverse and complex, technology penetration curves are highly variable and depend on technology, cost and market factors. Prospective analyses are informed by quality data from industry roadmaps, technical experts, market analyses, and other sources. Prospective technology deployment impacts are estimated by peer-reviewed methods that consider past assessment data and a variety of other metrics that help associate impacts with funding levels at the subprogram level.

Retrospective analyses of RD&D projects are tracked and managed by the Pacific Northwest National Laboratory. Data for commercialized projects is actively tracked on a project-by-project basis to estimate technology impacts. Metrics include the number of units sold, installed and operating in the U.S; energy and emissions savings; quality and productivity improvements; etc.

Technology deployment activities are tracked using a peer-reviewed methodology by Oak Ridge National Laboratory (ORNL) across the suite of deployment activities. The results of these analyses are publically available[a].

[a] http://www1.eere.energy.gov/industry/about/pdfs/impacts2009_full_report.pdf

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Advanced Manufacturing Office			
Innovations – This increase reflects an increased emphasis on identifying and researching advanced and highly-functional materials for manufacturing and energy systems.	38,705	44,112	+5,407
Emerging Technologies – This funding change reflects a shift towards funding next generation technologies across the technology "Valley of Death" that includes the emerging technologies stage. In addition to ongoing support of public-private partnerships in specific industrial manufacturing domains through the Innovative Manufacturing Initiative, this increase includes multi-user, national-level Manufacturing Demonstration Facilities (MDFs). The MDF's promote development, integration, evaluation, and exploitation of advanced materials and energy-efficient, flexible manufacturing technologies to facilitate rapid dissemination of technology developments across the supply chain of manufacturers.	55,916	107,614	+51,698
Systems Integration – The new AMO funding profile includes a significant emphasis on TRLs 6-8 to ensure that technologies make it through the "Valley of Death". Funding at this stage is crucial to reduce or eliminate technical risk and validate that technologies are further scalable to industry. This funding increase reflects the establishment of essential program elements including Manufacturing Demonstration Facilities, Research/Industry Manufacturing Awards, and Manufacturing Challenges. Many projects funded through the Innovative Manufacturing Initiative FOA will also advance into TRL stages 6-8 as technologies are scaled up and demonstrated at a convincing scale to prove reduction in energy intensity for industrial applications.	342	99,374	+99,032
Market Barriers – This change reflects the ramp up of the Better Buildings, Better Plants program and the shift of the Clean Energy Application Centers into the Technology Deployment budget for a more integrated and consistent deployment effort.	17,730	31,000	+13,270
SBIR/STTR are calculated based on research and development funding allocations.	2,887	7,900	+5,013
Total, Advanced Manufacturing Office	115,580	290,000	+174,420

Explanation of Changes

In FY 2013, Advanced Manufacturing efforts and initiatives will align to support the important role the Department, and the U.S. Government as a whole, play in creating and maintaining a pipeline of innovative manufacturing ideas though its investments in research. Increased funding will support development and demonstration of innovative energy efficient manufacturing processes and materials technologies. Increased funding will allow the program to accelerate development of cross-cutting manufacturing process technologies and advanced industrial materials that will enable U.S. companies to cut the costs of manufacturing by using less energy while improving product quality and accelerating product development. Increased funding will support later stage scale up of manufacturing processes and advanced material technologies, where innovative solutions are often required to address the

new challenges that arise at larger scale. These later-stage projects will seek to demonstrate these materials and processes at a convincing scale to prove reductions in energy intensity and in the life-cycle energy consumption of manufactured products, providing the private sector with the information necessary to enable commercialization of high-impact technologies.

Funding Opportunity Announcement Background

The U.S. Department of Energy (DOE) Advanced Manufacturing Office posts current and past funding opportunities for all program areas, including research and development (R&D) for next-generation materials, next-generation manufacturing processes, systems integration, and market barriers projects at the program's webpage http://www1.eere.energy.gov/industry/financial/index.html. Additional information on existing FOAs is also available.

In carrying out its vision and mission, the Program conducts a broad portfolio of specific goal-directed activities to identify, explore, develop, and demonstrate new, pre-competitive, energy-efficient processes and materials technologies to help U.S. manufacturers increase energy productivity and gain competitive advantage.

This open, competitive solicitation process is designed to meet the top technology needs identified by industry's roadmaps and by the program's prospective analyses. Funding opportunities encourage collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local governments and non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance.

Anticipated FOAs

(Dollars in Thousands)

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2012	Next Generation Manufacturing Processes and Materials: Innovative Manufacturing Initiative	Innovation, Emerging Technologies, and Systems Integration	40,000
The objective of this opportunity is to develop research and development of transformational technologies that offer solutions to core technical problems facing an industry or group of industries, that, if solved hold the potential to produce large improvements in energy productivity, environmental performance, product yield, and economic benefits. Transformational technologies are manufacturing processes, technologies, and materials that offer a dramatic departure from current practice and demonstrate the potential for substantial cost, time, energy and environmental benefits over the incumbent technology. The emphasis is on new processes and materials that are revolutionary and can be commercialized within the next five to seven years.			
FY 2012	Critical Materials Hub	Innovation, Emerging Technologies, and Systems Integration	20,000
The CM Hub will focus on the development, demonstration, and deployment of "platform technologies" to explore technologies and approaches that increase the availability and reduce or eliminate the need for critical materials for energy efficiency and renewable energy systems. Such innovations can lead to stronger domestic critical materials supply capabilities, enhance the Nation's ability to produce other strategic materials that are not currently considered "critical", and/or render critical materials obsolete in specific technology domains. Cradle-to-cradle processing of materials will be considered in the optimization and evaluation of these technologies.			
FY 2012	Manufacturing Demonstration Facilities (MDFs)	Innovation, Emerging Technologies, and Systems Integration	6,000-10,000
MDFs promote development, integration, evaluation, and exploitation of advanced materials and energy- efficient, flexible manufacturing technologies to facilitate new applications and rapid dissemination of technology developments. The MDFs provide members of the manufacturing community access to unique research capabilities and a range of multi-user facilities on a timely and affordable basis while protecting intellectual property. Each MDF will focus on manufacturing-specific challenges in specific technology domains.			
FY 2013	Next-Generation Materials	Innovation and Emerging Technologies	10,000 -15,000
Funding for cost-shared research and development of transformational materials technologies to advance the clean energy economy. Projects will be focused on increasing industrial and manufacturing energy efficiency, delivering breakthroughs to significantly reduce energy and carbon intensity throughout the economy over the coming decades, revitalizing existing manufacturing industries, and supporting the development of new products in emerging industries. Awards are evaluated			

(Dollars in Thousands)

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
over a performance period of up to 3 years with go/no-go funding decisions every year based on performance, schedule adherence, milestone objective completion, compliance with reporting requirements, and overall contribution to AMO goals and objectives. Successful projects will achieve significant reduction in energy consumption through the development and implementation of innovative materials with increased functionality. Advanced materials offer significant benefits in a wide range of clean energy applications and can potentially increase the global competitiveness of U.S. industrial products. Investment in advanced materials now will help revive the U.S. manufacturing sector, provide U.S. jobs, and support clean energy technologies at a moment of critical need. This solicitation is broadly focused and inclusive to allow for the support of only the most innovative technologies.			
FY 2013	Next-Generation Manufacturing Processes	Innovation, Emerging Technologies, and Systems Integration	12,500
Funding for cost-shared research and development of transformational manufacturing process technologies to advance the clean energy economy. Projects will be focused on increasing industrial and manufacturing energy efficiency, delivering breakthroughs to significantly reduce energy and carbon intensity throughout the economy over the coming decades, revitalizing existing manufacturing industries, and supporting the development of new products in emerging industries. Awards are evaluated over a performance period of up to 3 years with go/no-go funding decisions every year based on performance, schedule adherence, milestone objective completion, compliance with reporting requirements, and overall contribution to AMO goals and objectives. Successful projects will advance the clean energy economy by increasing industrial and manufacturing energy efficiency through advanced process technologies that can reduce costs, reduce energy use, reduce pollution, improve product quality, and enhance productivity for American manufacturing. Advanced manufacturing technologies offer significant benefits in a wide range of clean energy applications and can potentially increase the global competitiveness of U.S. industrial products. Investment in advanced manufacturing processes now will help revive the U.S. manufacturing sector, provide U.S. jobs, and support clean energy technologies at a moment of critical need. This solicitation is broadly focused and inclusive to allow for the support of only the most innovative technologies.			

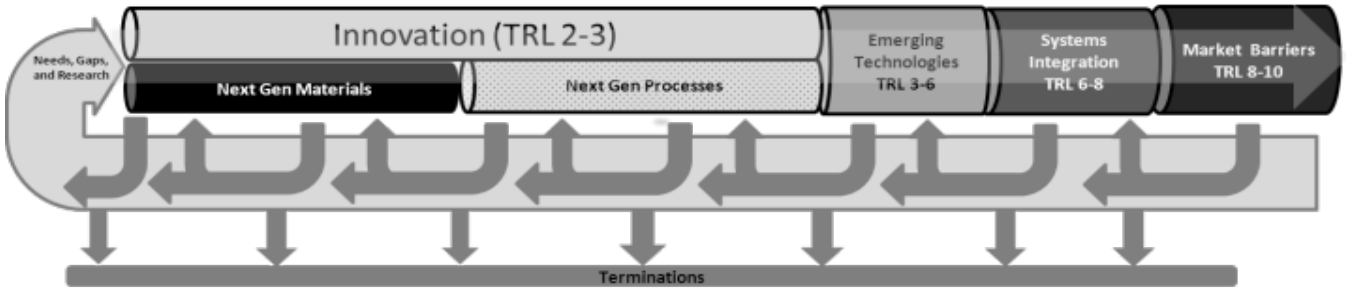
Innovations

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	34,541	38,705	44,112
SBIR/STTR	0	1,177	1,388
Total, Innovations	34,541	39,882	45,500

Sequence



Description

Investment in early stage R&D innovation is a critical focus of the Program's mission to improve the energy productivity of U.S. industry over the next ten years. New manufacturing methods and new materials are often needed by U.S. producers to compete in world markets and often also lead to sharply increased energy productivity. This activity supports the identification of novel processes and materials at the pre-competitive and high-risk TRL stages. The Program will thereby increase the number of technologies available for private sector R&D by supporting the most innovative technologies in the earlier and riskier TRL stages. Successful technologies funded through this activity may mature into the Program emerging technologies and systems integration activities, then to the private sector.

This activity focuses on the early stages for innovative technology breakthroughs with the potential to achieve significant increases in energy productivity but relies primarily on other DOE elements (e.g. DOE Office of Science) and U.S. Agencies (e.g., NSF) to identify new materials and processing options.

Key Technology and Focus Areas

Next Generation Manufacturing Processes – Innovative manufacturing concepts will provide critical energy and environmental improvements to increase the competitiveness of U.S. manufacturing industries. Achieving low-temperature, energy-efficient processing will require the reduction and/or integration of new process steps, development of alternative low-temperature pathways, and development of entirely new processes and unit operations, for example processing materials under magnetic fields, micro-fluidic-based manufacturing and bio-manufacturing using plants as new expression platforms for the production of feedstocks for the chemical industries reducing reliance on petroleum. New processes also provide the opportunity for the development of novel materials, with unique properties that enhance the performance of existing technologies and/or create entirely new markets.

This key area focuses on evaluating innovation and research as it applies to manufacturing processes and to manufacturing simulation tools and technologies. This includes a broad range of innovative manufacturing technologies including pervasive and foundational technologies like new intelligent manufacturing sensors for in-situ monitoring (e.g., fempto-second lasers), new process control strategies, and new process models.

Next Generation Materials – New materials and associated production technologies can reduce costs, reduce energy use, reduce pollution, improve product quality, and enhance productivity for American manufacturing. Breakthroughs in materials science and engineering are needed to enable these new capabilities. New materials allow for energy savings in current energy intensive processes and applications and enable a new design space for renewable energy generation in austere environments. For example, rotating components made from low-density materials can reduce loads on hubs and gears thereby reducing design constraints and costs in those systems and have cascading benefits across multiple domains (e.g., wind generators, vehicles etc.). Next generation thermo-electric materials designed at the atomic and molecular level can, for example, potentially enable cost-effective power generation from waste heat.

This key area focuses on the research to identify and selectively invest in materials that offer the potential for major energy, carbon, and economic benefits. Areas of interest include thermal and degradation resistant materials, highly-functional/high-performance materials, and lower cost materials for energy systems.

Benefits

This activity will strengthen the competitiveness of U.S. industry by providing a method for identifying and selecting new processes and materials that could move to development to achieve significant increases in energy productivity. Because early-stage technologies are far from the market, government support is needed for basic and early applied research where there is less of a profit incentive for the private sector. Investments in innovations will be used to identify the truly innovative, next generation technologies that are pre-competitive, high-risk, and a good fit for advancing to the Emerging Technologies and Systems Integrations subprograms. Investments at this stage will maximize the potential longer-term energy savings from Program-supported projects once they are commercially developed.

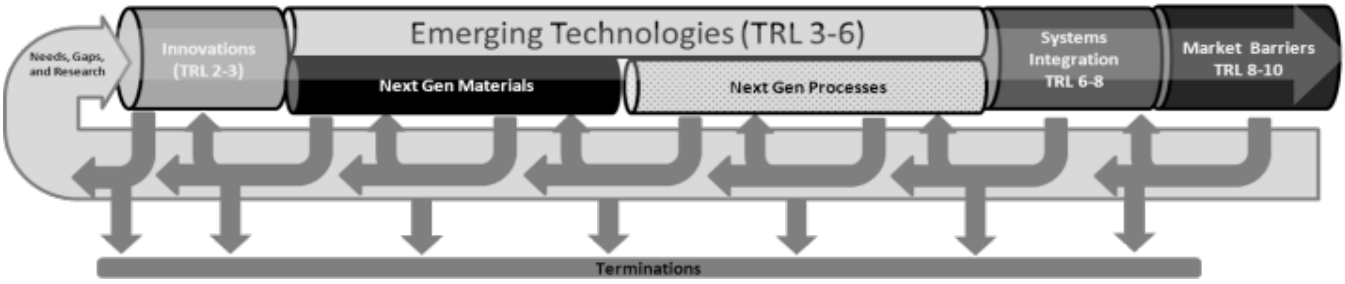
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	45,677	55,916	107,614
SBIR/STTR	0	1,700	3,386
Total, Emerging Technologies	45,677	57,616	111,000

Sequence



Description

Investment in the emerging technologies stage is a critical focus of the Program mission to improve the energy productivity of U.S. industry over the next ten years. There is an urgent need for government to partner with industry in energy-efficient technology development (TRL 3-6), as the transition of basic knowledge into competitive manufacturing product and process technologies is increasingly inhibited by the high cost and risk associated with the development of complex technologies. Successful technologies funded through this activity may mature into the Program's systems integration activities and eventually to the private sector.

The Program's emerging technologies activities support the development of novel production systems and materials at the high-risk technology "Valley of Death", which includes TRL stages 3-6. This is the valley of death that stands between basic research and commercialization. Traversing it can be accelerated by an intelligent blend of public and private sector investment, targeting the most promising innovations. This applied research domain is critical in developing the technological data base on which subsequent, commercially relevant prototype investments can be made.

DOE's Critical Materials Hub will develop scalable processing and manufacturing technologies that can accelerate increasing the availability of or reducing the need for critical materials in energy efficiency and renewable energy systems. The Hub will target functionalities that rely on critical materials in specific renewable energy or energy efficiency application domains. CM Hub activities will leverage a significant industry cost-share for these materials manufacturing-oriented activities.

Key Technology and Focus Areas

Next Generation Manufacturing Processes

New manufacturing technologies are needed to enable companies to rapidly produce the energy-efficient, competitively priced, high-quality products that could rejuvenate U.S. manufacturing. Innovative manufacturing concepts will provide critical energy and environmental improvements to increase the competitiveness of U.S. manufacturing industries. Achieving low-temperature, energy-efficient processing will require the reduction and/or integration of process steps, development of alternative low-temperature pathways, and development of entirely new processes and unit operations, for example powder-based additive manufacturing, titanium powder production, out-of-the-autoclave composite manufacturing, low temperature reactions and separation membranes, waste heat minimization and recovery etc. New processes also provide the opportunity for the development of novel materials, with unique properties that enhance the performance of existing technologies and/or create entirely new markets.

This key area focuses on the development of new manufacturing processes and manufacturing simulation tools and technologies. This includes a broad range of innovative manufacturing technologies including pervasive and foundational technologies like the development of shop-floor intelligent manufacturing sensors, in-situ monitoring, real-time adaptive process control, and process models to achieve low energy, high-

yield production. Example technical areas of interest include reactions and separations, additive manufacturing, low temperature processing, waste heat minimization/recovery, bio- manufacturing, and new titanium and other critical element production processes.

Next Generation Materials

New materials and associated production technologies can reduce costs, reduce energy use, reduce pollution, improve product quality, and enhance productivity for American manufacturing. Development in materials science and engineering are needed to enable these new capabilities. New materials allow for energy savings in current energy intensive processes and applications and enable a new design space for renewable energy generation in austere environments. For example, ubiquitous use of low cost carbon fiber can save energy in multiple industries such as wind generators, aerospace structures and vehicles.

This key area focuses on the development and maturation of innovative materials that offer the potential for major energy, carbon and economic benefits. Areas of interest include thermal and degradation resistant materials, highly-functional/high-performance materials, and lower cost materials for energy systems, for example alumina-forming stainless steels that approach the temperature capability of Nickel-based super alloys at 5X reduced costs and without the reliance on critical materials. Example technical areas of interest also include low cost carbon fiber, amorphous metals and coatings, nano-structured and nanotube-based materials, thermal and degradation resistant materials, self-monitoring materials, and low cost materials for energy systems.

Benefits

Private sector investment in marginally innovative products typically ramps up as technologies mature into TRL stages 3-6. However, truly innovative next-generation manufacturing technologies like those funded through the Program's Innovations subprogram tend to receive less private support due to higher risks associated with producing technologies that have little established or uncertain markets. Public support is needed to push innovative technologies through the entire technology pipeline so that strong products are available to establish new markets across multiple industrial sectors. The Emerging Technologies subprogram is a crucial stage in the Program's funding profile. Technologies funded through this program could help establish new markets, enable new employment opportunities, increase the adaptability of manufacturing systems, and provide new energy efficient and cost effective production techniques once commercially established through the Program's accelerated funding strategy.

For example, a recent success funded through the Program has led to a demonstration of significant impact in multiple EERE programs and industry domains. By substituting for a traditional energy intensive process, induction consolidation molding with thermoplastics, achieved significant cost and energy savings:

- 75 percent reduction in energy intensity and 10x increase in production rate for an aerospace component,
- 60 percent reduction in energy intensity for vehicle components at the same production rate, and
- 40 percent reduction in energy intensity and 6x increase in production rate for large composite structures applicable to wind turbine blades.

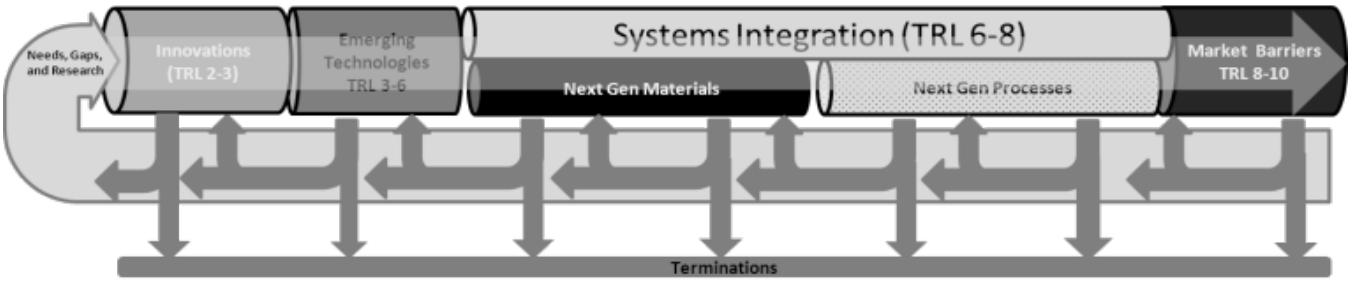
Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	1,232	342	99,374
SBIR/STTR	0	10	3,126
Total, Systems Integration	1,232	352	102,500

Sequence



Description

The transition to commercially-relevant scale manufacturing typically requires significant investments (10-100X that of basic research) to achieve manufacturing-pertinent prototypes, and to develop the database of engineering information that demonstrates manufacturability at cost, schedule and quality standards and fitness for intended use. Further, the need for and criticality of these "transition investments" will likely continue to grow amidst very competitive global markets. Preservation of US manufacturing competitiveness in an era of heightened global competition requires much more efficient and cost-effective manufacturing technology life-cycle management strategies that can be achieved through targeted, pre-competitive public/private partnerships. The Program's systems integration activity supports the development of novel production systems and materials at the later end of the "Valley of Death" which includes TRL 6-8 stages.

Achieving highly efficient processing will require the reduction and/or integration of process steps, adaptable manufacturing strategies, development of alternative low-energy pathways, and development of entirely new processes, materials, and unit operations. The interest here includes "above shop floor" activities such as "design for manufacturing" tools, human machine (robot) interfaces; quality control procedures and means for rapid development of property databases for accelerated qualification and certification of processes and materials for intended use.

This subprogram is focused on addressing challenges that are unique to industry. Technologies must be proven at the manufacturing scale to be meaningful to industry, especially when markets for the technology aren't established. The broad applicability and pervasiveness of Program funded project presents a further scaling challenge, as technologies must be adapted to multiple industries. Because of these challenges, technologies that are truly innovative and industrial in nature benefit significantly from public support at the systems integration stage (TRL 6-8).

Key Technology and Focus Areas

Next Generation Manufacturing Processes – Candidate manufacturing processes ready for demonstration projects include but are not limited to:

- Out of the autoclave composite manufacturing;
- Additive manufacturing;
- Titanium powder production;
- (Low Temperature) membrane/appliqué production; and
- Bio-processing for production and purification.

The specific technologies to be demonstrated will be selected through open solicitations and other interactions with industry and other Government Agencies (e.g., DOD Manufacturing Technology Office, DOC/NIST). These technologies have matured sufficiently and can now be demonstrated at a generic and pre-competitive prototype level in public/private partnerships with participation from large and small (supply chain) companies and industry trade groups and consortia.

The Innovative Manufacturing Initiative (IMI) is a Funding Opportunity Announcement to support cost-shared research and development of transformational

manufacturing processes and materials technologies to advance the clean energy economy by increasing industrial and manufacturing energy efficiency. The IMI targets core technical problems facing an industry or group of industries, that, if solved hold the potential to produce large improvements in energy productivity, environmental performance, product yield, and economic benefits. Due to an overwhelming response from industry that included over 1,400 Letters of Intent requesting a total $4.3 billion in support, significant funding will be provided through the Systems Integration stage.

New challenges arise for advanced manufacturing technologies through the systems integration stage. To retire the technical risk of these technologies, demonstrations must be scaled to operate in systems that have a production volume meaningful and relevant to manufacturers. As systems near production scale, process control technologies like in-line in-situ monitoring and intelligent manufacturing become increasingly important and enable adaptable, robust processes that are also cost effective.

Barriers at the System Integration stage are addressed through specifically tailored program elements:

- Manufacturing Demonstration Facilities reduce technical risk and enable pathways for revolutionary technologies by facilitating the accelerated insertion of technologies into manufacturing systems and identifying scale-related and system-level issues. The objective of the MDF's is to create a collaborative, shared infrastructure around targeted technical areas that will facilitate the development and exploitation of energy efficient, rapid, flexible manufacturing technologies and to enable broad and rapid dissemination of manufacturing technologies. The MDF provides physical and virtual tools from design to evaluation and testing/verification for rapidly prototyping new technologies and optimizing critical manufacturing processes. These shared tools provide small- and medium-sized enterprises access to innovative tools and resources that would otherwise be cost-prohibitive;
- Laboratory/industry manufacturing awards provide incentives for collaboration between industry and researchers outside of the private sector, including National Laboratories; and
- Manufacturing Challenges establish open competitions to address non-conventional solutions to pervasive large-scale problems.

Benefits

Private sector investments typically drive product demonstration for marginally innovative technologies in the TRL stages 6-8. However, truly innovative next-generation manufacturing technologies like those funded through the AMO Innovations subprogram tend to receive less private support as they reach TRL stages 6-8 due to higher risks associated with producing technologies that have little established or uncertain markets. Public support significantly accelerates innovative technologies through the entire technology pipeline so that strong products become more quickly available to establish new markets across multiple industrial sectors.

The Systems Integration subprogram is crucial to the Program funding profile because costs increase dramatically as technologies are demonstrated at a scale meaningful to manufacturers. This sub-program addresses this industrial-specific challenge while ensuring that Program goals to establish next generation technologies at-scale are met. Technologies demonstrated through this program will establish new markets, enable new employment opportunities, increase the adaptability of manufacturing systems, and provide new energy efficient and cost effective production techniques once commercially established through the Program accelerated funding strategy. In support of the Program mission, technologies funded through the Systems Integration stage must demonstrate the potential to significantly improve energy productivity compared to existing technologies.

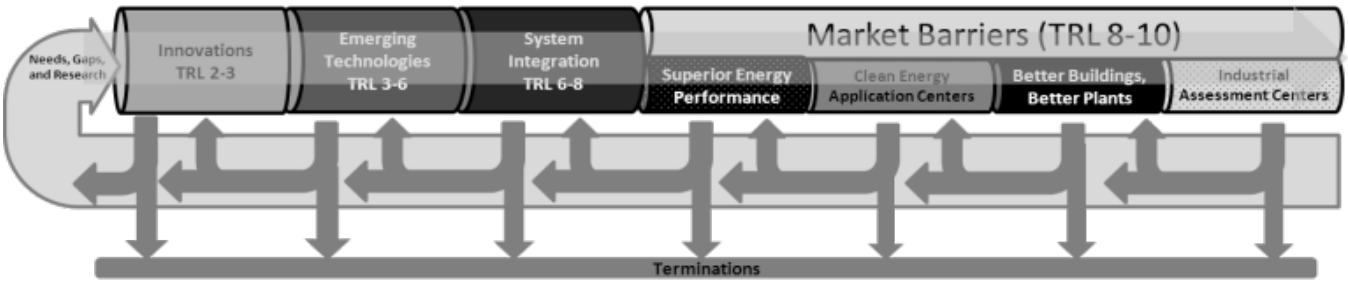
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	24,449	17,730	31,000
Total, Market Barriers	24,449	17,730	31,000

Sequence



Description

Technology deployment activities are focused on capturing competitive advantage and increasing the energy productivity of U.S. manufacturers. Market barriers to energy efficiency technologies and practices are addressed through activities that foster the energy management industry, work to develop standardized energy management tools and protocols, accelerate deployment of industrial technologies to increase efficiencies, and develop education, training, and certification programs. Technology deployment energy management programs are closely aligned with international energy standards, especially ISO 50001.

Key Technology and Focus Areas

Superior Energy Performance – In FY 2013, the Program will continue to support the launch of a credible, transparent industrial energy efficiency certification program that uses recognized standards (ISO 50001 Energy Management Standard, Measurement and Verification (M&V) protocol, and system assessment standards). This certification program will provide a systematic mechanism to demonstrate continual energy performance improvement; provide third-party verification of the implementation of the ISO 50001 energy management standard and performance improvement; and develop a workforce of professionals (certified practitioners) with expertise in energy management, systems assessments, and M&V.

Clean Energy Application Centers – Combined heat and power and other waste heat utilization systems offer significant opportunities to substantially reduce energy consumption and carbon emissions. In FY 2013, this activity will provide outreach and technical assistance to end users, policy, utility, and industry stakeholders with the objective to accelerate the adoption of combined heat and power and other clean energy technologies via the DOE Clean Energy Regional Application Centers. By supporting the more widespread implementation of these energy efficient means for cost and emissions reduction, the Clean Energy Application Center activities will contribute to the competitive position of American Industry.

Better Buildings, Better Plants Challenge and Program (BBBPC&P) – In FY 2013, The Program will continue to grow membership in the Better Buildings, Better Plants Challenge and Program. The BBBPC&P is the industrial component of a Department-wide leadership initiative that calls on chief executive officers, university presidents and state and local leaders to create American jobs through energy efficiency. "Challenge Partners" commit to: setting ambitious energy savings goals; implementing significant, near-term energy saving projects; and providing enhanced transparency on the innovative approaches they are taking on energy efficiency. "Program Partners" commit to a 10-year energy intensity improvement target and report verified progress annually to DOE--this group is made up primarily of industrial firms that previously partnered with the Program through its Save Energy Now LEADER program. DOE's role in these initiatives is to motivate companies to reach for significant energy savings, broadly share innovative approaches and lessons learned to encourage replication, and provide limited technical assistance to help companies reach their goals.

Industrial Assessment Centers (IACs) – The Energy Services Development activity funds a network of universities that provide extensive in-class and hands-on training for undergraduate and graduate engineering

students in industrial processes, energy assessment procedures, and energy management principles. Led by faculty directors, students perform assessments at small- and medium-sized manufacturers in their geographic region that result in energy savings, waste reduction, and sustainability and productivity improvements for the manufacturers and real-world experience for the students. In FY 2013, this activity will train nearly 300 students at 24 participating IACs and conduct more than 400 facility assessments at small and mid-sized facilities.

Benefits

The Market Barrier subprogram plays a valuable role in achieving energy and cost savings across the existing U.S. manufacturing base by promoting an industry-wide culture of continuous improvement in energy efficiency. The Market Barrier subprogram also provides the tools and resources needed to achieve energy savings. Public support can assist companies in identifying and achieving these energy savings because significant energy efficiency and cost savings opportunities remain in the industrial sector by implementing technology solutions that are readily available. Market barrier focus areas and tool development activities are structured to address the various barriers to the public sector to achieve these savings.

The Program's market barrier activities benefit the Nation by:

- Motivating industry to achieve deep energy efficiency improvements;
- Promoting the replication of breakthrough business models that overcome barriers to energy efficiency;
- Providing companies with tools and standard methodology to measure energy and savings; and
- Promoting the adoption of standard energy management principles, including ISO 50001.

Building Technologies Program

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Building Technologies Program			
Commercial Buildings Integration	37,308	31,913	61,079
Emerging Technologies	75,694	84,694	108,344
Equipment and Buildings Standards	35,000	58,302	98,250
Residential Buildings Integration	37,308	31,282	35,872
Technology Validation and Market Introduction	22,000	8,500	0
SBIR/STTR	0	4,513	6,455
Total, Building Technologies Program	207,310	219,204	310,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Building Technologies Program			
Innovations	13,300	10,894	17,567
Emerging Technologies	45,826	48,417	89,660
Systems Integration	91,184	88,578	98,068
Market Barriers	57,000	66,802	98,250
SBIR/STTR	0	4,513	6,455
Total, Building Technologies Program	207,310	219,204	310,000

Public Law Authorizations

P.L. 94 163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94 385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95 91, "Department of Energy Organization Act" (1977)
P.L. 95 618, "Energy Tax Act" (1978)
P.L. 95 619, "National Energy Supply Policy Act" (NECPA) (1978)
P.L. 95 620, "Power Plant and Industrial Fuel Use Act" (1978)
P.L. 96 294, "Energy Security Act" (1980)
P.L. 100 12, "National Appliance Energy Conservation Act" (1987)
P.L. 100-357, "National Appliance Energy Conservation Amendments" (1988)
P.L. 100 615, "Federal Energy Management Improvement Act" (1988)
P.L. 102 486, "Energy Policy Act of 1992"
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

In November 2009, the President set a national goal to reduce carbon emissions by 17 percent by 2020 and 83 percent by 2050, from a 2005 baseline. Energy efficiency is one of the most cost-effective and immediate steps to achieving the President's goals. The Department of Energy's goal is to catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies.[a] The Building Technologies Program (BTP or Program) supports the DOE goal by addressing opportunities to produce more goods and services with less energy, by enabling improved energy efficiency in the buildings sector. The buildings sector currently accounts for approximately 40 percent of U.S. energy use and carbon emissions.[b]

Building energy efficiency in the U.S. provides an inexpensive energy resource that addresses national concerns involving energy affordability, reliability and

[a] SBIR/STTR funding transferred in FY 2011 $3,190,000.
[a] http://www.energy.gov/media/DOE_StrategicPlan_Draft.pdf
[b] U.S. DOE Energy Efficiency and Renewable Energy, 2009 Buildings Energy Databook. November 2009: http://buildingsdatabook.eren.doe.gov/Default.aspx.

greenhouse gas (GHG) emissions. The Program reduces building energy consumption in the U.S. through the development and deployment of advanced, innovative technologies. Currently, buildings use over 70 percent of the electricity in the U.S., so a reduction in energy and electricity use has an added benefit of reducing demand within the electric power industry. New and advanced technologies developed through the Program and manufactured by domestic industry will build upon institutional building science and contribute to a transformation in the manner with which the U.S. currently uses energy, resulting in energy savings for Americans. These new products will help create jobs, spur economic growth, and continue America's role as a global innovator and exporter of high-tech products.

Based on the DOE's strategic goals and other policy and legislative drivers, the Program focuses specifically on improving the efficiency of new and existing residential and commercial buildings, through research and development on building systems as well as building components, through building integration demonstrations, and through market priming, equipment standards, and building code activities. In addition, the Program's progress depends upon the coordination of other EERE program efforts including: the Solar Technologies Program, which will accelerate the research and development (R&D) and large scale commercialization of distributed photovoltaic (PV) technology for buildings; the Weatherization and Intergovernmental Program (WIP), which will deploy energy retrofit technologies for low-income families and address local building efficiency needs; and the Federal Energy Management Program (FEMP), which will promote energy efficiency at Federal facilities.

The Program has set out to reduce building-related energy costs by reducing energy use by 50 percent by 2030. The State Energy Data System indicates residential and commercial energy expenditures totaled $416 billion in 2010. If this BTP program goal is met, the net savings in the U.S. would be tens of billions of dollars per year by 2030, after accounting for both the energy savings and the capital investments required.

The Program pursues this goal, reducing building-related energy costs by reducing energy use by 50 percent by 2030, through three interwoven pathways (shown below in Figure 1). This figure shows how the Program's pathways for research and development (shaded boxes), combined with reducing market barriers and raised standards, can further enable the private market to subsequently seize the full potential available (outlined white box) for cost effectively reducing energy efficiency in buildings. It is important to note these pathways are highly complementary; increasing market pull builds on R&D while standards builds on the increased market penetration. All three pathways are needed to optimize program impact.

Figure 1: Energy Savings Potential

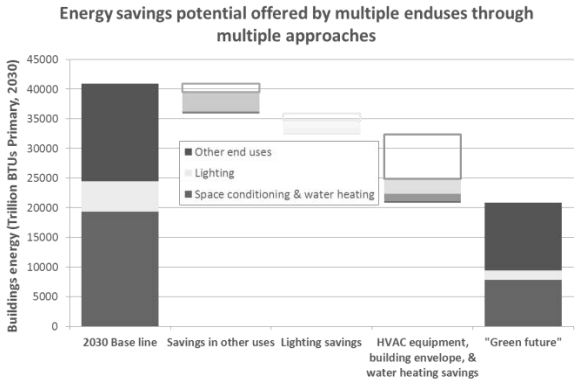


Figure 1 shows the market opportunity for buildings related energy savings and expected BTP benefits in three major end uses categories: heating, cooling and water heating; lighting; and other end uses.

Strategy

The Program supports innovation, emerging technologies, systems integration, and reducing market barriers of advanced technologies to improve energy efficiency in America's buildings.

The primary barriers to improved building efficiency are technological (greater energy efficiency) and market-based (acceptable cost to purchase) in nature. The principal strategy of BTP is to support research, development, demonstration and deployment (RDD&D) of technologies that have the potential to achieve significant improvements in building efficiency. The Program also supports market-priming measures to ensure that these technologies overcome the barriers to widespread adoption, such as first cost, the various building trades' acceptance of new technology, and insufficient availability of consumer information. Widespread adoption of building efficiency technologies is critical to the success in meeting the Program's goals and includes both voluntary efforts such as Energy Star and the BetterBuildings Program (Residential and Commercial) as well as regulatory activities, such as, the Appliance Standards Program.

The Program strategy is divided into three interwoven pathways, each of which can result in lowering building energy use:

- Improve building components (solid state lighting, windows, heating ventilation and cooling, building envelope, sensors and controls), both performance and cost to manufacture/install, through ground-breaking research and development; and develop whole building energy simulation programs such as Energy Plus that engineers, architects, and

researchers can use to model energy and water use in buildings;
- Increase market pull from private industry through cooperation with stakeholders, improvement of building design and audit tools, and the creation of reliable efficiency benchmarks and databases to facilitate energy efficiency financing and to define efficiency's value-add to consumers (BetterBuildings Residential and Commercial, HUB, Energy Star); and
- Raise the standards for new energy consuming equipment and new buildings with continually updated equipment and model building codes based on cost effective, higher performing technology that has been successfully commercialized.

The Program faces a number of challenges, many of which are largely related to a market characterized by the general public's lack of certainty or knowledge in building technology and energy efficiency, high up-front product costs, limited workforce and product availability and overall fragmentation of the markets involved in energy efficiency technology. The Program's FY 2013 portfolio will achieve rapid gains in building energy efficiency through a balanced set of strategies. This includes expanded research on components and integrated systems that can dramatically increase energy efficiency and provide long-term cost savings, without sacrificing functionality or safety.

The Program will achieve its goals by working with its partners in industry, academia, the National Laboratories, the Office of Science, Advanced Research Projects Agency - Energy (ARPA-E), and other relevant stakeholders. The Program systematically identifies technology, market, informational, and financial and policy barriers to the development and commercialization of energy efficient building components and their incorporation into new and existing buildings.

The Program engages with the National Laboratories, industry, and academia via competitive solicitations, which are targeted at the Programs specific Research, Development, Demonstration and Deployment (RDD&D) goals described below. Reviews of projects and awards are conducted at least annually or in stepped phases of performance milestones, resulting in cancelling of projects, revisions and/or redirection as necessary to ensure an effective portfolio. Expert stakeholder and independent review panels assess the efficacy and quality of the processes used to solicit, review, recommend, monitor, and document proposal actions. Panels also asses the quality of the resulting portfolio, specifically the breadth and depth of portfolio elements and the national and international standing of the elements.

Benefits

Residential and commercial buildings account for approximately 40 percent of the total U.S. energy consumed[a] and more than 70 percent of the electric energy consumed in the U.S. By helping to reduce this significant demand, the Program aligns with DOE's goal to provide clean, secure energy by developing reliable, affordable, and environmentally sound energy efficiency technologies, which significantly reduce the energy consumption of both new and existing residential and commercial buildings.

Figure 2: BTP Energy Efficiency Goals[b]

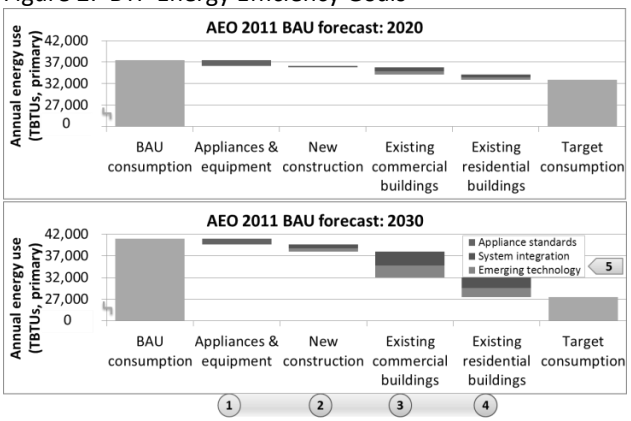


Figure 2 shows BTP's energy efficiency goals, expressed as a reduction in nationwide building energy use in 2020 and 2030 (Provided by the EIA's Annual Energy Outlook, 2010). Capturing these benefits requires applying all three interwoven pathways to pursue market opportunities aligned with five mid-term goals:

- **Appliance and Equipment:** Provide cost-effective energy savings through national appliance and equipment standards; issue 23 final rules by the end of FY2015; deliver 1,350 trillion BTUs annual savings by 2030;
- **New Construction:** Reduce the energy required to operate new residential and commercial buildings by 50 percent, at less than the cost of the energy saved. Prove existing technologies and practices and accelerate deployment through model building codes to deliver:
  - 350 trillion BTUs in annual savings by 2020;
  - 1,600 trillion BTUs in annual savings by 2030;
- **Existing Commercial Buildings:** Reduce the energy required to operate existing commercial buildings by 40 percent, at less than the cost of the energy saved.

[a] Including the energy lost in the generation, transmission, and distribution of electricity delivered to residential and commercial buildings.

[b] BAU represents AEO 2010 forecast excluding "unspecified" commercial end uses. Goals 2-4 include impact of future standards.

Bring needed technologies and practices to market delivering:
  - 1,600 trillion BTUs in annual savings by 2020;
  - 6,000 trillion BTUs in annual savings by 2030;
- **Existing Residential Buildings:** Reduce the energy required to operate existing residential buildings by 50 percent at less than the cost of the energy saved. Bring needed technologies and practices to market delivering:
  - 1,250 trillion BTUs in annual savings by 2020;
  - 4,500 trillion BTUs in annual savings by 2030; and
- **Technology Development:** Bring to market technologies that save 70 percent of lighting, 60 percent of water heating, 40 percent of HVAC, and 20 percent of other appliances energy use at less than the cost of the energy saved.

All energy savings goals represent bottom-up calculations of estimated impacts derived from specific BTP activities. These calculations evaluate the technical energy savings potential, the cost effectiveness of consumer investment, and the speed of market up-take. For example our analysis suggests:

- Investing in research to develop light-emitting diodes, using labeling and testing to accelerate their market adoption, and evaluating the possibility of setting future standards for their performance can result in present value energy savings of over 1 quadrillion BTUs.

- The technical specification developed with manufacturers and consumers of commercial roof-top air-conditioning units will increase market adoption of advanced (SEER 17) units from under 1 percent per year to approximately 5 percent per year resulting in present value energy savings of over 1 quadrillion BTUs.

Current analysis efforts include an examination of over 500 diverse energy saving measures including technologies, voluntary agreements and specifications, building codes, appliance standards, behavior change, and other approaches to develop an effective portfolio of activities for BTP to pursue.

The Program generates the following benefits:
The U.S. building sector is responsible for 38 percent of total U.S. carbon dioxide emissions.[a] The Program contributes to the reduction of GHG emissions by providing technologies that, when commercialized, will make the Nation's buildings more energy efficient. The efficiency gains from these advanced technologies not only reduce the overall energy demand from buildings but also reduce consumption of electricity generated from fossil fuels. The use of energy efficient components and whole-building (systems integrated) design strategies will eventually permit low carbon buildings to become an everyday reality, while keeping the net costs of new components at or below the level of existing technologies.

Advanced efficiency technologies can directly reduce oil use in regions of the country that rely on home heating oil, making the residents of those homes less vulnerable to oil supply disruptions or price spikes. RDD&D activities focused on components such as advanced envelope and window technologies reduce heating loads in buildings, which reduces building energy use, and therefore reduces the utilization of source energy used in power plants.

Reduced energy use in buildings can be expected to reduce energy bills for American families and businesses. New technologies developed with the help of the Program and manufactured by the domestic industry will help create jobs, spur economic growth, and continue America's role as a global innovator and exporter of high-tech products. Efficient buildings have the added benefit of mitigating the need for the electric power industry to construct expensive new power plants.

Key Accomplishments

Examples of recent program accomplishments are below:

- Research Triangle Institute received an R&D 100 award for its development of photoluminescent nanofibers that can be used to produce an aesthetically pleasing light with better color rendering properties in Solid-State Lighting (SSL) applications.
- Work from Sandia National Laboratories has transitioned into a successful SSL R&D manufacturing project. Under Core Technologies Research, Sandia developed novel pyrometry tools to directly measure wafer growth temperature versus measurement of the ambient reactor temperatures. Under manufacturing R&D research, Sandia is teaming with Vecco Process Equipment, Inc., a major U.S. reactor manufacturer, to incorporate new technology into reactors designed for Light Emitting Diode (LED) growth.
- Philips Lumileds successfully demonstrated a neutral white LED with a light output of 950 lumens (lm), an efficacy of 115 lumens per Watt (LPW) at a current of 700 mA, correlated color temperature (CCT) of 3798 K, and a color rendering index (CRI) of 79. Achieving these specifications improves the quality of light, with better CCT and CRI making LEDs more durable, more pleasing to the eye, and more

[a] [BED] Building Energy Data Book, U.S. Department of Energy, 2010

efficient compared with similar non-LED lighting. The prototype was a 2x2 array of 2 mm^2 LEDs.

- By the end of FY 2011, the Program will have completed a large number of enhancements to EnergyPlus, its whole building energy simulation program. These enhancements include new models for ground source heat pumps, cooling fluids and mixtures, variable refrigerant flows, and radiant slabs, as well as an adaptive comfort model and expanded capabilities for control system specifications. FY 2012 modeling enhancement activities will focus on auto-sizing of components, solar shading, ice storage for cooling, multi-speed fans, multi-zone air-handling units, and increased outdoor-air ventilation options.
- DOE has aggressively pursued the commercialization of cost effective, highly insulating windows over the last several years through several R&D and market transformation strategies. In 2011, several window suppliers began offering cost effective R-5 windows. These windows reduce energy loads by approximately 40 percent compared to ENERGY STAR windows, with a less than $2 to $4 per square foot price premium over typical ENERGY STAR windows. Furthermore, a soon-to-be-completed windows project has devised an innovative automated manufacturing strategy to produce highly insulating windows in high volume and at low material and labor costs, thereby further increasing cost effectiveness.
- General Electric introduced an electric heat pump water heater (HPWH) into the market in 2011 that was a direct result of a partnership with Oak Ridge National Laboratory. Energy savings is approximately 50 percent as compared to standard electric storage models, reliability is high, and payback can be achieved in less than 4 years.
- Building America has expanded its program scope to include integration research on existing homes, identifying the most cost-effective measure packages to achieve 15 percent and 30 percent energy savings across 30 metropolitan areas within the 5 major climate zones. By bundling or integrating several energy efficiency technologies or improvements together into a home retrofit project, Building America scientists come to understand the level of increased energy savings possible by these technologies. For example, a team may bundle new air sealing, insulation, and duct sealing technologies into a retrofit project. From this project they learn how to install these systems more efficiently, how to reduce the total cost of the retrofit and how to mitigate any adverse effects such as moisture build-up or poor indoor air quality that may occur. By learning how to integrate these technologies into a retrofit, it may be possible to safely achieve greater energy savings at lower costs. In addition, the National Laboratories have focused on achieving 50 percent energy savings in key climate zones for new and existing homes. By focusing on the 50 percent energy savings, the National Laboratories are developing cutting edge technology that may be required in the future to meet this ambitious energy target. Once demonstrated in the laboratories, this technology is then transferred to the market place through the Building America Program and other outreach activities. Building America teams and National Laboratories have also provided technical assistance to the deployment efforts under the BetterBuildings Neighborhood program and the Home Energy Score, ensuring a strong technical underpinning to these efforts.
- Commercial Building Energy Alliances (CBEAs) provide a mechanism for building owners and operators to collaborate on the common challenge of energy efficiency. Working groups face key challenges in their respective areas (retailers, commercial real estate companies, and hospitals), and benefit from information-sharing. Alliance members use their collective market share to enable high speed and scale market uptake of advanced technology and best practices. Working with CBEAs, high-performance specifications are developed to demonstrate capabilities and stimulate demand for advanced technologies identified as large opportunities for energy savings. For example, the US spends approximately 20 billion a year on commercial space cooling, with packaged rooftop climate control units accounting for nearly half of this. CBEAs developed a specification for high-efficiency rooftop units that reduces energy use by as much as 50 to 60 percent compared to the current ASHRAE 90.1-2010 standard. Similarly, nearly 8 percent of US lighting electricity use is consumed by outdoor area lighting. CBEAs have successfully completed five of these technology specifications in high-priority applications: high efficiency site parking lot lighting, high efficiency parking structure lighting, high efficiency roof top climate control units, high efficiency 2x2 recessed troffer lighting, and LED refrigeration case lighting.
- In FY 2011, DOE issued energy conservation standard final rules for clothes dryers, room air conditioners, residential refrigerators, residential furnaces, and central air conditioners and heat pumps. In the same fiscal year DOE issued test procedure final rules for walk-in coolers and freezers, battery chargers, external power supplies, fluorescent lamp ballasts, room air conditioners, clothes dryers, refrigerators, furnaces, and boilers. Altogether,

these final rules are expected to save consumers tens of billions of dollars off their utility bills through 2030.

- For Building Codes, in FY 2011, DOE issued the final determinations for the IECC 2009 (and 2006 and 2003), as well as ASHRAE 90.1-2007 and ASHRAE 90.1-2010 standards. DOE also developed and deployed compliance tools and pilot programs to assist states with establishing a compliance baseline, and achieved 30 percent efficiency improvement in national model energy building codes – using the 2006 IECC as the baseline for residential and ASHRAE 90.1 2004 as the baseline for commercial buildings.

Strategic Plan and Performance Measure

BTP program goals and mid-term objectives align with specific performance metrics. These measurable performance metrics are critical to determine overall progress to overcome major challenges and serve as steps to reach program goals. BTP faces a number of challenges related to program goals. These challenges are largely related to a current market characterized by the general public's lack of certainty or knowledge regarding building technologies and energy efficiency, high initial product costs, limited trained workforce and product availability, and overall fragmentation of the markets involved in energy efficiency technology. Performance metrics contribute to attaining mid-term objectives and ultimately to surmounting or lessening the barriers which hinder program goals to reduce U.S. energy use.

Performance Measure Analysis

The Program's case studies and handbooks will document means, methods, and technology solutions for commercial building owners to achieve savings in six building types. With FY 2013 funding the Program will further document solutions with building owners that include overcoming implementation barriers; quantifying the opportunity, savings, and impacts; and documenting the technology solutions for six building types in all climate zones. Working through the Commercial Building Energy Alliances and the Better Building Challenge, uptake and impact of these solutions will be measured.

Under the BetterBuilding Neighborhood Program, DOE is working with utilities to receive pre-retrofit and post-retrofit utility bills for homes retrofitted under this grant program to gauge energy savings resulting from the retrofits. In addition, BTP is developing a database that will collect and store retrofit data associated with actual energy savings. This database will allow analysis of the magnitude of savings associated with types of improvements by climate region. Both efforts will help DOE improve its estimates of energy savings associated with retrofits. Also, the BetterBuilding neighborhood Program tracks the number of retrofits that occur with its grantees.

Many of the test procedure and standards rulemakings are legislatively mandated by the Energy Policy and Conservation Act. The number of proposals and final rules are determined by the typical rulemaking cycle, whose completion dates are specified by legislation. For ENERGY STAR, DOE estimated the number of proposals based on the Environmental Protection Agency's work plan for specification development. These activities assist in achieving this goal by improving the efficiency of new appliances and equipment, establishing test procedures to measure product efficiency, and verifying compliance with these test procedures and specified efficiency levels. The ENERGY STAR program also provides a complementary role to the research and demonstration activities of the Building Technologies Program.

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Building Technologies Program			
The Innovation Subprogram activities address the technological barriers to improved energy efficiency in buildings. The subprogram supports research of lighting; heating ventilation, air conditioning; building envelope and windows; and sensors and controls. Research will be expanded to develop improved OLED efficacies by as much as 65 percent as compared to baseline devices. New critical path innovations added this year will include researching low global warming potential (GWP) working fluids, alternative heating and cooling systems, heat exchanger technologies and theoretical investigations of light generation and extraction at molecular scales. Additional research will include projects to improve building systems operations with innovative sensors for temperature, humidity, air flow, motion/occupancy, light level, and carbon.	10,894	17,567	+6,673
The Emerging Technologies Subprogram is to move building technologies along the RDD&D continuum from lab testing to prototype validation. Emerging Technologies activities support the development of advanced lighting, building envelope, windows, space conditioning, water heating, solar thermal, and appliance technologies and analysis tools; The increase in the Emerging Technologies Subprogram will be focused on conducting new FOAs in the areas of HVAC; building envelope and windows; and sensors and controls. DOE will also initiate combined Building Integrated Photovoltaic (BIPV) (in conjunction with the Solar Energy Program) and Advanced Roofing Strategies activities to reduce total net energy roofing load by 35 to 75 percent, while increasing PV output due to lower operating temperatures. This Subprogram will also develop a technology roadmap for non- Solid State lighting technologies, to identify and begin prioritizing other opportunities to reduce lighting related energy use. We will also be working with the Advanced Manufacturing Office (AMO) to prioritize and fund (potentially co fund) projects to develop technologies and processes to reduce the manufacturing costs of more efficient products, and thus improve the speed of market uptake for these highly efficient products. The Building Energy Innovation Hub will begin work on scalable strategies for hosting validated high performance computational simulation, design, control, and optimization tools in an open computing environment which is readily and seamlessly accessible by architects, engineers, and other energy efficient retrofit (integrated design) process participants. Approximately 500 buildings in the Philadelphia region are expected to be identified as candidates for full spectrum energy retrofit based on high return-on-investment opportunities. Direct retrofit of 10-20 buildings utilizing Hub strategies and tools is planned.	48,417	89,660	+41,243

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
The Systems Integration Subprogram focuses on demonstrating and testing new technologies, both those developed by DOE as well as new technologies from academia and industry, and on accelerating the introduction of these highly efficient technologies and practices for new and existing residential and commercial buildings. Additional funding will be used to conduct demonstrations of commercial buildings retrofits (>30 percent of U.S. electricity demand) critical to achieving BTP's goal of reducing building related energy use by up to 50 percent cost effectively, as well as increasing deployment of the specifications and technical demonstrations of cost effective retrofits. Better Buildings Commercial will work on a competitive solicitation with Emerging Technologies with a focus on building envelope and windows, and one on sensors and controls with the intent to improve ongoing building energy use. Building America has expanded to include integration research on existing homes. It will continue to identify the most cost effective measure packages to achieve 15 percent energy savings and enable/demonstrate the cost effectiveness and reliability of systems required to meet the International Energy Conservation Code (IECC) 2012 code revision. In addition, the Building America Program as well as the National Laboratories will expand their research into achieving 50 percent energy efficiency savings over IECC 2009. These goals are targeted for completion for all climate zones by 2017. The additional funding will expedite this research, allowing for a more comprehensive study of the technologies to help achieve this 50 percent target.	88,578	98,068	+9,490
Market Barriers Subprogram addresses market challenges or failures in the adoption of energy efficient technologies, through both market priming activities as well as regulatory activities, which identify cost-effective solutions for building equipment and new model construction energy codes. The funding increase in 2013 will allow DOE to increase the scope and effectiveness of its energy conservation standards by accelerating the test procedure and standards rulemakings that are currently scheduled, allowing for the increased use of DOE's existing authorities to establish standards for additional products that have large energy savings potentials. The increase in funding for the Equipment and Appliance standards program will be used to initiate approximately 6 new conservation standards rulemakings and the corresponding test procedure rulemakings. DOE remains committed to meeting all of its legislatively mandated deadlines for covered appliances and equipment and actively enforcing its existing standards to provide a level playing field for all manufacturers. DOE will prioritize the selection of the new standards by evaluating the benefits resulting from such adoption. DOE will also expand its activities in certification and enforcement in order to increase the effectiveness of existing energy conservation standards. Certification and enforcement improvements will include updates to existing certification and reporting requirements for manufacturers along with increases in the frequency and scope of product testing to verify compliance with DOE standards.	66,802	98,250	+31,448
SBIR/STTR are calculated based on research and development funding allocations.	4,513	6,455	+1,942
Total, Building Technologies	219,204	310,000	+90,796

Explanation of Changes

The major changes to the Innovation Subprogram is expanding the research to include low global warming potential (GWP) working fluids, alternative heating and cooling systems, and heat exchanger technologies and theoretical investigations of light generation and extraction at molecular scales as well more focused R&D in sensors and controls. The increase in the Emerging Technologies Subprogram will be focused on conducting new FOAs in the area of HVAC; building envelope and windows (including BIPV), and sensors and controls. We will also partner with the AMO program on a FOA to reduce the manufacturing costs of the most energy efficient products, such as SSL. Increases in the Systems Integration Subprogram will focus on demonstrating and testing new technologies in retrofitting commercial and residential buildings. The Market Barrier Subprogram continues to increase the scope and effectiveness of its energy conservation standards and test procedures.

Funding Opportunity Announcement Background

The Program posts current and past funding opportunities for all program areas, including research and development (R&D) for (old subprograms), systems integration, and market barriers projects at http://www1.eere.energy.gov/buildings/financial_opportunities.html. Links to related opportunities from DOE National Laboratories and other federal agencies are available. In carrying out its vision and mission, the Program conducts a broad portfolio of specific goal directed activities to transform America's buildings sector by 2020, such that the efficiency of existing and new buildings has been significantly improved by 20 percent for commercial buildings and energy demand growth has been curbed through the development and deployment of conservation technologies, strategies, and practices. Improvements in energy efficiency are among the most cost effective and immediate steps toward achieving our national energy goals. Economy-wide efficiency can be achieved through the development of technologies, techniques and tools to create aggregated improvements in the U.S. building stock and make individual buildings more energy efficient, productive and affordable.

This open, competitive solicitation process is designed to meet the top technology needs identified by industry's roadmaps and by program assessments. Funding opportunities encourage collaborative partnerships among industry, universities, National Laboratories, federal, state, and local governments and non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance.

Anticipated FOAs

(Dollars in Thousands)

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2012	Solid State Lighting Core Technologies – Round 8	Emerging Technologies	1,130
The objective of this opportunity is to conduct the applied research needed to fill technology gaps, provide enabling knowledge or data, and advance the technical knowledge base for Solid-State Lighting to be used for general illumination applications. Specific emphasis is given to achieving the performance and cost goals (including manufacturing related costs) stated in the annual Solid-State Lighting Research and Development: Multi-Year Program Plan (MYPP). The Energy Policy Act of 2005 (EPACT) directs the Secretary of Energy to support research, development, demonstration, and commercial application activities related to advanced SSL technologies. Under this authorization, this will be the 8th annual opportunity for Core Technology research. Breakout awards will be conducted with budget period decision points which include annual project peer review and evaluation with active go/no-go management. Successful awards will target relevant MYPP metrics such as internal quantum efficiency (IQE), external quantum efficiency (EQE), thermal stability, etc. It is anticipated that more than 30 applicants from academia, National Laboratories, small businesses, and other research institutions will apply.			
FY 2012	Solid-State Lighting U.S. Manufacturing – Round 3	Emerging Technologies	3,387
The objective of this opportunity is to achieve cost reduction of Solid-State Lighting for general illumination through improvements in manufacturing equipment, processes, or techniques. The goals are to reduce costs of SSL sources and luminaires; improve product consistency while maintaining high quality products; and encourage a significant role for domestic U.S. based manufacturing in this industry. Specific emphasis is given to achieving the performance and cost goals stated in the annual Solid-State Lighting Manufacturing Roadmap. EPACT directs the Secretary of Energy to support research, development, demonstration, and commercial application activities related to advanced SSL technologies. Under this authorization, this will be the 3rd annual opportunity for U.S. Manufacturing research. Breakout awards will be conducted with budget period decision points which include annual project peer review and evaluation with active go/no-go management. Successful awards will directly contribute to the 2015 goal of 110 lumens per dollar. It is anticipated that more than 30 applicants will apply.			
FY 2012	Solid-State Lighting Product Development – Round 8	Emerging Technologies	1,693
Project Description: The objective of this opportunity is to focus on the development or improvement of commercially			

(Dollars in Thousands)

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
viable Solid-State Lighting source, component, or integrated luminaire products. Technical activities are focused on a targeted market application with fully defined price, efficacy, and other parameters necessary for success of the proposed product. Specific emphasis is given to achieving the performance and cost goals (including manufacturing related costs) stated in the annual Solid-State Lighting Research and Development: Multi-Year Program Plan (MYPP). EPACT directs the Secretary of Energy to support research, development, demonstration, and commercial application activities related to advanced SSL technologies. Under this authorization, this will be the 8th annual opportunity for Product Development research. Breakout awards will be conducted with budget period decision points which include annual project peer review and evaluation with active go/no-go management. Successful awards will directly contribute to the 2015 goal of 154 lumens per watt. It is anticipated that more than 30 applicants will apply.			
FY 2012	Heating Ventilation and Cooling	Emerging Technologies	1,600
Competitive awards for HVAC, water heating, working fluids and appliance technologies that have high potential to provide 50 percent reduction in energy consumptions in 2020. These include but are not limited to researching low global warming potential (GWP) working fluids, Not-in-kind (NIK) technologies, heat exchanger technologies and advanced appliances. NIK technologies can replace or be integrated with conventional vapor compression technologies to provide 50 percent reduction in energy consumption with relevant environmental benefits. These different NIK technologies should be comparable or have better performance than state-of-art (SOA) vapor compression systems. Highly efficient heat exchangers developed by the Program are used not only in refrigeration, heating and air conditioning but also nearly every application that generates waste heat.			
FY 2012	Advanced Building Envelope and Windows	Emerging Technologies	1,725
Competitive awards for the Building Envelope and Windows sub-program for FY 2013 will support the goal for a reduction of 50 percent energy consumption in buildings by 2030. Additionally, these awards will be directed at projects within the innovation and emerging technology stages of commercialization that have also been identified as technologies with high potential impact. These may include but are not limited to: advanced materials for building technologies, highly insulating windows, dynamic windows, window films/attachments, thermal insulation, cool roofs and radiant barriers. Projects will address performance, cost and market goals to foster the acceleration of the technologies through the commercialization pipeline.			
FY 2013	Solid-State Lighting Core Technologies – Round 9	Emerging Technologies	2,000
The objective of this opportunity is to conduct the applied research needed to fill technology gaps, provide enabling knowledge or data, and advance the technical knowledge base for Solid-State Lighting to be used for general illumination applications. Specific emphasis is given to achieving the performance and cost goals (including manufacturing related costs) stated in the annual Solid-State Lighting Research and Development: Multi-Year Program Plan (MYPP). The Energy Policy Act of 2005 (EPACT) directs the Secretary of Energy to support research, development, demonstration, and commercial application activities related to advanced SSL technologies. Under this authorization, this will be the 9th annual opportunity for Core Technology research. Breakout awards will be conducted with budget period decision points which include annual project peer review and evaluation with active go/no-go management. Successful awards will target relevant MYPP metrics such as internal quantum efficiency (IQE), external quantum efficiency (EQE), thermal stability, etc. It is anticipated that more than 30 applicants from academia, National Laboratories, small businesses, and other research institutions will apply.			
FY 2013	Solid-State Lighting U.S. Manufacturing – Round 4	Emerging Technologies	5,000
The objective of this opportunity is to achieve cost reduction of Solid-State Lighting for general illumination through improvements in manufacturing equipment, processes, or techniques. The goals are to reduce costs of SSL sources and luminaires; improve product consistency while maintaining high quality products; and encourage a significant role for domestic U.S. based manufacturing in this industry. Specific emphasis is given to achieving the performance and cost goals stated in the annual Solid-State Lighting Manufacturing Roadmap. EPACT directs the Secretary of Energy to support research, development, demonstration, and commercial application activities related to advanced SSL technologies. Under this authorization, this will be the 4th annual opportunity for U.S. Manufacturing research. Breakout awards will be conducted with budget period decision points which include annual project peer review and evaluation with active go/no-go management. Successful awards will directly contribute to the 2015 goal of 110 lumens per dollar It is anticipated that more than 30 applicants will apply.			
FY 2013	Solid-State Lighting Product Development – Round 9	Emerging Technologies	3,000
Project Description: The objective of this opportunity is to focus on the development or improvement of commercially viable Solid-State Lighting source, component, or integrated luminaire products. Technical activities are focused on a targeted market application with fully defined price, efficacy, and other parameters necessary for success of the proposed			

(Dollars in Thousands)

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
product. Specific emphasis is given to achieving the performance and cost goals (including manufacturing related costs) stated in the annual Solid-State Lighting Research and Development: Multi-Year Program Plan (MYPP). EPACT directs the Secretary of Energy to support research, development, demonstration, and commercial application activities related to advanced SSL technologies. Under this authorization, this will be the 9th annual opportunity for Product Development research. Breakout awards will be conducted with budget period decision points which include annual project peer review and evaluation with active go/no-go management. Successful awards will directly contribute to the 2015 goal of 154 lumens per watt. It is anticipated that more than 30 applicants will apply.			
FY 2013	Heating Ventilation and Cooling	Emerging Technologies	9,285
Competitive awards for HVAC, water heating, working fluids and appliance technologies that have high potential to provide 50 percent reduction in energy consumptions in 2020. These include but not limited to researching low global warming potential (GWP) working fluids, Not-in-kind (NIK) technologies, heat exchanger technologies and advanced appliances. NIK technologies can replace or be integrated with conventional vapor compression technologies to provide 50 percent reduction in energy consumption with relevant environmental benefits. These different NIK technologies should be comparable to or have better performance than state-of-art (SOA) vapor compression systems. Highly efficient heat exchangers developed by the Program are used not only in refrigeration, heating and air conditioning but also nearly every application that generates waste heat.			
FY 2013	Advanced Building Envelope and Windows	Emerging Technologies/Systems Integration	10,000
Competitive awards for the Building Envelope and Windows sub-program for FY 2013 will support the goal for a reduction of 50 percent energy consumption in buildings by 2030 in conjunction with Better Buildings Challenge. Additionally, these awards will be directed at projects within the innovation and emerging technology stages of commercialization that have also been identified as technologies with high potential impact. These may include but are not limited to: advanced materials for building technologies, highly insulating windows, dynamic windows, window films/attachments, thermal insulation, cool roofs and radiant barriers. Projects will address performance, cost and market goals to foster the acceleration of the technologies through the commercialization pipeline.			
FY 2013	Sensors and Controls	Emerging Technologies	5,000
Competitive awards in the area of Sensors and Controls will support the development of technologies that have the potential to provide energy savings in buildings through advanced sensing and controls solutions. More specifically, awards will be directed at projects within the emerging technology stage of commercialization with topics such as the development of enhanced sensor networks and/or a superior controls platform to optimize building energy performance.			
FY 2013	Manufacturing	Emerging Technologies	5,000
We will be working with the Advanced Manufacturing Office (AMO) to develop competitive awards and targeted technology development focused on reducing the manufacturing costs for some of the most energy efficient products. This technology and process development is very important in reducing consumer costs for these products, and thus increases the speed of market adoption. R&D on these pre-commercial manufacturing technologies and processes will be selected based upon market opportunity of the products impacted by these improvements, as well as the technical opportunity to reduce the overall manufacturing costs for an industry sector(s), and will likely include SSL as one of the areas of focus.			

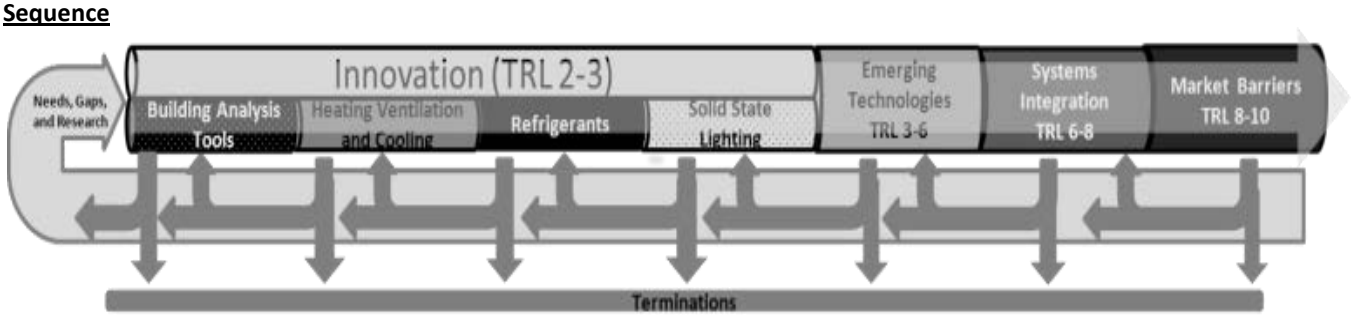
Innovations

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	13,300	10,894	17,567
SBIR/STTR	0	351	550
Total, Innovations	13,300	11,245	18,117

Sequence



Description

The role of the Innovation subprogram is to move building technologies along the RDD&D continuum, including Technology Readiness Levels (TRL) levels 2-3, from basic research to establishing proof of concept. The Innovation subprogram activities address the technological barriers to improved energy efficiency in buildings. The subprogram supports research of lighting, heating, ventilation and cooling (HVAC) and sensors and controls. The Innovation activities accelerate research of highly efficient technologies and practices for both new and existing residential and commercial buildings. In moving technologies along the Technology Readiness Level pathway, the Building Program coordinates with the Office of Science and ARPA-E.

Key Technology and Focus Areas

The Innovations Subprogram focuses on examining and displaying proof of concept for potential energy efficient technologies. It relies on applied research to prove these concepts, and the Program is expecting to explore a number of technology areas in FY 2013. These include new concepts in lighting and heating/ventilation and cooling (HVAC), two of the largest energy using areas in today's buildings.

Solid State Lighting (SSL). The objective of lighting innovation efforts is to conduct the applied research needed to fill technology gaps, provide enabling knowledge or data, and advance the technical knowledge base for Solid-State Lighting (SSL) to be used for general illumination applications. Specific emphasis will be given to achieving the performance and cost goals stated in the annual Solid-State Lighting Research and Development Multi-Year Program Plan (MYPP).

Example areas of study include theoretical investigations of light generation and extraction at molecular scales; material properties of substrates, encapsulants, or polymers; software tools that capture scientific principles to expedite the decision process of design; modeling of heat transfer principles to estimate temperature profiles within a semiconductor reactor; and mapping of scientific principles that explain the interactions of dopants and hosts or metal alloys to create light of a specified spectrum. Goals for Core Technology Research are specific to the approaches proposed and relate to those metrics defined in the annual MYPP. A specific goal for FY 2013 is to demonstrate violet/blue laboratory semipolar LED devices with internal quantum efficiencies that exceed 80 percent at 150A/cm2 and 100°C.

With regard to SSL, DOE desires to ensure that technologies resulting from Core Technology Research are readily available for product developers to license and also to encourage U. S. manufacture of such technologies. Therefore, recipients of core technology research have been granted an Exceptional Circumstances Determination under the Bayh-Dole Act. Under the Determination, all entities at any tier retaining patent rights to inventions made under resulting awards will be subject to a requirement to offer to each member of the Next Generation Lighting Industry Alliance (NGLIA) the first option to enter into a non-exclusive license upon terms that are reasonable under the circumstances, including royalties, for these inventions.

The NGLIA is a competitively selected industry group which was established by EPACT. It is anticipated that technology will advance from core technology research into the SSL product development research through this mechanism.

Space Conditioning and Refrigeration. The long-term goal for the Space Conditioning and Refrigeration Innovations activity is to research and gain the engineering proficiency to determine cost effective advanced Space Conditioning and Refrigeration technologies that have the potential to provide 50 percent reduction in energy consumptions by 2020. These technologies include researching low global warming potential (GWP) working fluids, Not-in-Kind (NIK) technologies, and heat exchanger technologies.

Current air conditioners, refrigerators, and heat pumps utilize compression cycle technology with high-GWP working fluids. Refrigerants and blowing agents are used in wide variety of appliances, air conditioning, and refrigeration equipment. New findings and policy developments regarding climate change are putting new pressures on the HFC alternatives, because of their high-GWP values (e.g., 1430 for HFC- 134a, 2088 for HFC-410a). As a result of the need to find suitable alternatives for higher global warming refrigerants, a family of new low-GWP refrigerant molecules have been identified, most notably HFO-1234yf & HFO-1234ze. NIK technologies can replace, or be integrated with, conventional vapor compression technologies to provide 50 percent reduction in energy consumption with relevant environmental benefits.

The lower GWP effort will be to assess the overall environmental impacts for alternative refrigerants using a life cycle climate performance (LCCP) model based on such factors as leak rates and energy consumption. Candidate refrigerants will be modeled, tested, and evaluated to achieve alternatives with high energy efficiencies at minimal risk, cost, and changes to equipment.

Sensors and Controls. The Program is actively engaged in commercial building sensor and controls research to improve management effectiveness of building environments to achieve comfort, cost reductions, security, and reliability in commercial and residential buildings. Sensors and Controls activities include:

- Improving buildings systems operations with innovative sensors for temperature, humidity, air flow, and motion/occupancy, light level, and carbon dioxide including fault detection and diagnostics for HVAC commercial units, self-correcting and self-configuring HVAC controls to compensate for faults in the system, and developing micro sensor units to accommodate multiple and varied sensor heads.
- Utilizing new energy harvesting/ storage technology to reduce the costs of purchase, installation, and maintenance of sensors and controls through an SBIR topic for new approaches.
- Developing and testing wireless, RFID, and other network relay and retransmission approaches to meet security, data integrity and validation, control system, and operator requirements, and evaluating commercial control goals and paradigms for effectiveness in actionably reducing energy use.
- Developing a more granular strategy for the Program to identify targets of opportunity for new technology projects, with other companies and organizations participating through an industry workshop.

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

Benefits

Innovation activities will identify and provide proof of concept for new, highly efficient technologies and practices for both new and existing residential and commercial buildings. Innovation activities support the Program's goals through R&D of advanced lighting, space conditioning, sensors and controls. Without advanced components and subsystems, such as the SSL technologies developed by these activities, the goal of maximizing cost effective energy efficiency in buildings will not be met.

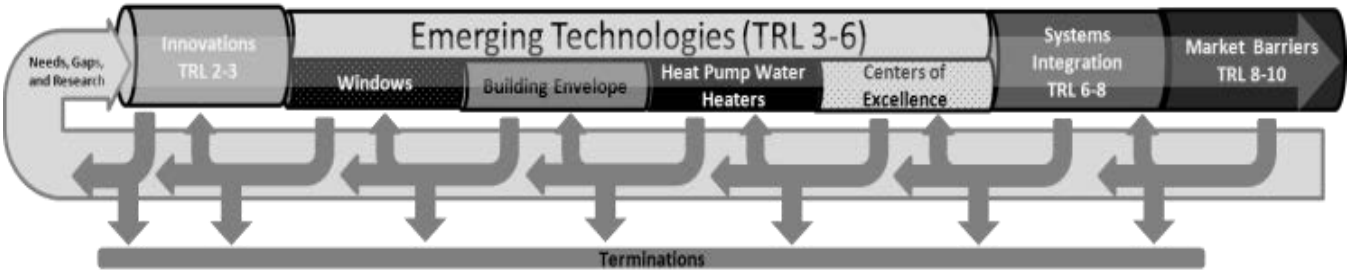
Emerging Technologies

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	45,826	48,417	89,660
SBIR/STTR	0	1,500	2,856
Total, Emerging Technologies	45,826	49,917	92,516

Sequence



Description

The role of this Emerging Technologies Subprogram is to move building technologies along the RDD&D continuum, including TRL levels 4-6, from lab testing to prototype validation. Emerging Technologies activities support the development of advanced lighting, building envelope, windows, space conditioning, water heating, and appliance technologies and analysis tools; and accelerate the introduction of highly efficient technologies and practices for both new and existing residential and commercial buildings.

Key Technology and Focus Areas

The Emerging Technologies Subprogram is able to take those concepts proven in innovations and develop working prototypes through collaborative efforts with the national laboratories, universities and manufacturers. The Program is expecting to explore a number of new technology areas in FY 2013. These include new prototypes in lighting, HVAC, building envelope, water heating, and analysis tools.

Solid State Lighting. Emerging Technologies will conduct laboratory performance testing on SSL prototypes to evaluate product utility, market, health, and safety issues. Feedback from the owner/operator and technical data gathered from testing will be used to improve prototype designs. Further design modifications and re-testing will be performed as needed. Along with the technical aspects of product development, the Program will complete market and fiscal studies to ensure a successful transition from product development to demonstration and commercialization. To be positioned for success, new products must exhibit cost and/or performance advantages over commercially available technologies. New and continuing areas of study include substrate development, semiconductor material, phosphor development, LED package architecture, novel luminaires, low-cost electrodes, panel out coupling, and panel reliability.

Heating, Ventilation, and Cooling. The Program is also developing a CO2 Heat Pump Water Heater (HPWH) with an Energy Factor greater than 2.0 for residential applications. This HPWH activity will improve the energy efficiency and the use of low GWP refrigerants. Also this water heater will employ innovative techniques to adapt a mature water heating technology to the U.S. market requirements (specifications, cost, and performance targets). In 2008 residential water heating accounted for 3.03 Quads of primary energy[a], of which 1.52 Quads are from electric water heaters. When fully deployed, the CO2 HPWH may provide up to 0.8 Quads of primary annual energy savings, equivalent to 47 million tons of CO2 emission reductions[b], without the need for HFC refrigerants with much higher GWP.

A more efficient window air conditioner unit is also being pursued. Minimum efficiency levels for window air conditioners are currently set at 9.7 to 9.8 EER for the most popular product classes. A window air conditioner with an Energy Efficiency Ratio (EER) of 13 would result in a 25 percent energy savings. In addition, because of the low first cost of window air conditioners, typically in the $300 to $500 range, research will focus on cost effective improvements. In the U. S., there are approximately 57 million installed window air conditioning units with an estimated annual energy consumption of 0.33 quads. Since the first cost of an Energy Star unit (10 percent above NAECA standard efficiency levels) is generally the same as a standard-efficiency model, window air conditioners provide

[a] 2010 building energy data book Table 2.1.5
[b] 2010 building energy data book Table 1.4.8

an excellent opportunity for energy savings.

BTP will work with the Advanced Manufacturing Office (AMO) to develop competitive awards and targeted technology development focused on reducing the manufacturing costs for some of the most energy efficient products. This technology and process development is very important in reducing consumer costs for these products, and thus increases the speed of market adoption. R&D on these pre-commercial manufacturing technologies and processes will be selected based upon market opportunity of the products impacted by these improvements, as well as the technical opportunity to reduce the overall manufacturing costs for an industry sector(s), and will likely include SSL as one of the areas of focus.

A high efficiency Cold Climate Heat Pump (CCHP) that minimizes, or even eliminates, the need for backup strip heating is being explored. Resistive heating is limited to a 1.0 energy performance factor while multi-stage heat pump heaters can provide higher energy efficiency, i.e. significant energy savings over current technologies (> 70 percent compared to strip heating). The Program is also pursuing the development and market introduction of an air-source integrated heat pump (AS-IHP) suitable for new or existing residences with the technical potential to reduce annual HVAC, dehumidification, and water heating energy consumption by 50 percent. Analyses and testing at Oak Ridge National Laboratory (ORNL) indicate that this technology can approach the 50 percent energy savings goal over a range of climates for HVAC/WH in an energy efficient residential building when compared to a similar home operating with a baseline system consisting of current minimum efficiency HVAC and water-heating equipment. In FY 2012, the Program validated seasonal (heat/cool) predictions with field data in support of its market introduction and completed the engineering developmental stage for this effort and product demonstration is anticipated by late FY 2013.

Advanced Building Envelope and Windows. Additionally, with the building envelope technologies, the long-term goal is to enable dynamic annual performance of attics and walls equivalent to greater than R-40 performance with no increase in 30 year life cycle cost by 2015. The Program is developing advanced envelope materials in response to needs identified by the Systems Integration subprogram. The Program will conduct large scale whole house, full scale applications for insulation with phase change materials that offer thermal mass effects to dramatically reduce peak loading. In FY 2013, studies will be continued along with work on new ASTM test standards to provide a metric to market dynamic insulation systems.

Also, with window technology, there exists the potential to develop R-10[a] windows and reduce the incremental cost to $3 per square foot by 2020 (the current industry average for R-10 windows is $13 per square foot). Funds will support further applied R&D and market transformation activities to overcome technical, manufacturing and market barriers, thereby making highly insulating windows more cost competitive and enhance market penetration. For example, one such project will explore further development of vacuum insulated glass at low cost. The Program will also work on cost effective R-10 highly insulating windows with conventional low cost multi-pane designs, as well as higher risk, high performance vacuum glazing.

Building Energy Modeling. In FY 2013, the Program will continue to focus on developing enhanced modeling capabilities for whole buildings. The FY 2013 focus is expected to be on fully-general system control, district heating and cooling systems, and improved modeling of ducts, pipes, and plenums. These support the Program's goals of providing design and engineering practitioners with tools — Building Energy Modeling (BEM), in this specific instance — that allow them to build high-performance buildings and building systems. In FY 2013, the Program will focus on enhancing the credibility and robustness of building energy modeling, as well as reducing phase I modeling effort for existing buildings via automated model acquisition. The goals, respectively, are to increase confidence in building energy modeling and to facilitate the use of BEM in deep retrofit projects.

Commercial Building Energy Alliances. Emerging Technologies is also focused on commercial partnerships that seek out innovative and new technologies that might be unrepresented in the industry for direct deployment to CBEA and create market action via recruiting partners for demonstration projects who exhibit a commitment to energy targets, implementation schedules, building commissioning, performance evaluations and collaboration with other CBP partners. This effort will also work with partners and project teams to develop energy efficiency technology package and technical assistance services.

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

Benefits

Emerging Technologies activities will accelerate the introduction of highly efficient technologies and practices for both new and existing residential and commercial buildings. Emerging Technologies activities support BTP

[a] A measure of the capacity of a material, such as insulation, to impede heat flow, with increasing values indicating a greater capacity. A typical wall has an R-value of R-19 while the current off the shelf double paned window has an R-value of 2.

goals through R&D of advanced lighting, building envelope, windows, space conditioning, water heating, and analysis tools. Without advanced components and subsystems, such as the SSL technologies developed by these activities, the BTP goal of developing and deploying technologies, tools and codes and standards to achieve 50 percent building energy savings at half the cost of energy from new generating facilities by 2030 will not be met.

When fully deployed, the CO2 HPWH may provide up to 0.8 Quads of primary annual energy savings, equivalent to 47 million tons of CO2 emission reductions (2010 building energy data book Table 1.4.8), without the need for HFC refrigerants with much higher GWP.

Cumulative energy savings potential of 2.5 quads for the period 2010 – 2035 are estimated for a 13 EER window air conditioner compared to typical new units with an EER of 9.8. One quad is roughly equivalent to 1% of annual energy use in the U.S.

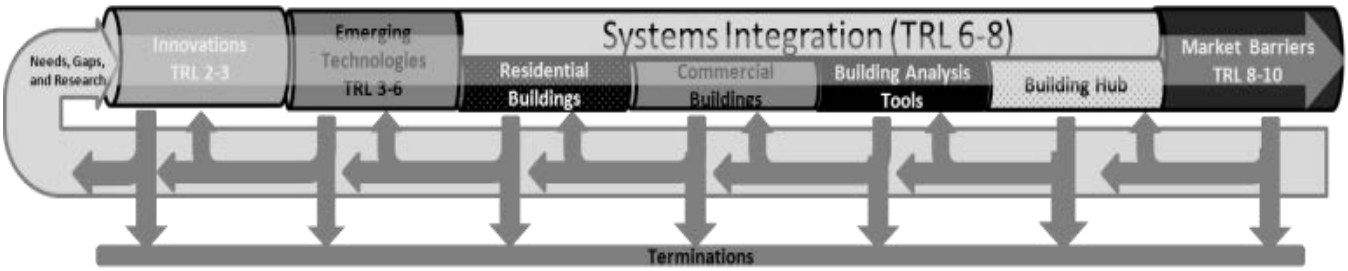
Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	91,184	88,578	98,068
SBIR/STTR	0	2,662	3,049
Total, Systems Integration	91,184	91,240	101,117

Sequence



Description

The Systems Integration Subprogram serves as the proving ground for emerging energy efficiency technologies and practices, many of which are developed in prior years by the Emerging Technology Subprogram. This subprogram moves the various technologies along the TRL continuum, where each activity is focused on demonstrating that a technology (or suite of technologies) will work in its final form and under expected conditions. It also includes demonstrations of actual system prototypes as an input into the final stage.

Key Technology and Focus Areas

The Systems Integration subprogram focuses on demonstrating and testing new technologies, both those developed by DOE as well as new technologies from academia and industry. Each technology is demonstrated and tested in "real world" settings to understand how they perform.

COMMERCIAL

Better Buildings Challenge. A priority is the implementation of innovative approaches to retrofits and the attraction of industry investment in commercial buildings through the Better Buildings Challenge. The Program is supporting the implementation of the Better Buildings Challenge to deploy successful models that increase investment in commercial building energy efficiency and improve this efficiency by at least 20 percent by 2020. It is also participating in a joint research effort with Emerging Technologies to develop advanced envelope and window technologies for commercial building retrofits.

Superior Energy Performance and Global Superior Energy Performance. To support the robust challenge to corporations to continuously maintain energy improvements they have achieved in their properties in the commercial and industrial sectors, DOE will accelerate the introduction of the Superior Energy Performance program (SEP), the national program being implemented in alignment with the GSEP initiative. GSEP was announced internationally as part of the Clean Energy Ministerial and will coordinate national level certification programs. These voluntary programs will require commercial facilities to implement energy management systems such as the ISO 50001 energy management standard and related measurement and verification protocols. To deploy the program, region-focused and specialty-focused extension centers will develop energy management systems tools and resources and certification materials to use nationally and share internationally in support of the GSEP. Once companies take up the challenge to make and maintain energy efficiency improvements, corporations' acceptance and action on the challenge will then create demand within the commercial retrofit marketplace.

Commercial Building Energy Alliances. The Program will also work with industry via technical support to stimulate demand for and deployment of more efficient commercial building technologies through Commercial Building Energy Alliance (CBEA) membership. Activities include:

- Deploying energy-saving technologies in partnership with industry members via CBEA high-efficiency technology specifications (Commercial Roof Top Units (RTU), Lighting, Refrigeration, etc.)

- Disseminating sector-specific technical information and guidance to assist industry members in improving the efficiency of their existing building portfolios
- Demonstrating cost-effective new construction and retrofit techniques to achieve deep energy savings (30-50 percent above code)
- Demonstrating the impact of energy management and continuous improvement encouraged by SEP program

Systems Integration is also establishing a reliable/reputable national commercial building disclosure method and associated asset and operational ratings. Activities include:

- Development and validation of a low cost building asset rating method with a required minimal amount of data collection
- Development and validation of an operational rating that can be directly tied to asset rating
- Development of a standard database design for state and local governments to use in holding the building energy information they receive as a result of disclosure ordinances

In FY 2013, BTP will also continue to invest in research and deployment activities in the areas of building operations, maintenance, commissioning, and auditing. The Commercial Buildings Program will extend its work with NIST's commercial building extension program with universities. This partnership will allow university students and professors to work within their communities to grow the auditing, operations, and commissioning activities with local businesses. It also provides a national network for easily disseminating information and data regarding commercial building retro-commissioning and retrofits. In FY 2013, CBI will fund 8 extension programs with universities and community colleges.

RESIDENTIAL

Building America Program. For Residential technologies and systems, the Program relies on the Building America Program to conduct energy efficiency technology evaluations. Building America is an industry-driven research program designed to accelerate the development and adoption of advanced building energy systems for existing and new homes. Building America research teams work with all segments of the residential building industry to develop, analyze, and implement strategies that achieve significant energy savings. Building America addresses residential building system integration R&D through private/public research partnerships focused on accelerated development of cost-effective and reliable market-driven solutions that benefit consumers by reducing utility bills by 30-50 percent. Building America has expanded to include integration research on existing homes; has identified the most cost effective measure packages to achieve 15 percent energy savings; and enabled/demonstrated cost effectiveness and reliability of systems required to meet the International Energy Conservation Code (IECC) 2012 code revision. Building America industry teams will focus on system research required to achieve the 30 percent source energy savings on a community scale nationwide, relative to current code IECC 2009 for new construction and pre-retrofit conditions for existing homes. Building America will also support accomplishment of BTP goals by accelerating the development of 50 percent energy savings solutions to be integrated into test homes in future years.

BetterBuildings Neighborhood Program. The BetterBuildings Neighborhood Program is using $508 million of ARRA and FY 2010 appropriation to fund 41 state and local governments to test innovative models for energy efficiency retrofit program delivery that overcome market barriers to consumer-driven energy efficiency. The Program is developing self-sustaining markets through outreach and sharing of successful and replicable business models for delivering low cost retrofits. DOE will integrate Home Performance with ENERGY STAR as well as State Energy Efficiency Action Project (SEE Action) into the BetterBuildings Neighborhood Program. BTP will continue to evaluate BetterBuildings Neighborhood Program grantee business models and assist them in successfully transitioning their grant-funded programs into sustainable models capable of delivering home energy efficiency upgrades to consumers.

Home Energy Score. The Home Energy Score was developed to help homeowners easily and affordably compare their homes' energy performance with other homes in the same area, similar to a vehicle's mile-per-gallon rating. It was established in response to a 2009 request from the Vice President and White House Council on Environmental Quality, and in November 2010, after a year of homeowner and expert research and development, the U.S. Department of Energy (DOE) launched pilot tests. To ensure the effectiveness of the new scoring method, DOE is partnering with utilities, non-profit organizations, and state and local governments across the country to test the program through summer 2011.

DOE completed a set of successful pilots for the Home Energy Score in the summer and fall of 2011. The tests indicated homeowner preference for the tool, ease of use by the home auditor, and results that agreed with comparable but more expensive auditing tools. The results also allowed BTP to make improvements in the

presentation of the results to homeowners, and to improve several internal calculations for more accurate results. Upon completion of the pilot phase in which between 1,000 and 2,000 homes will have been scored, DOE hopes to complete 10,000 scores in 2013. DOE aims to complete 10,000 scores in 2013 by working with home energy raters, building performance contractors, home inspectors and other home improvement professionals who have demonstrated competence in the use of the tool. It is through this network of qualified technicians that BTP plans to meet this goal of 10,000 score in 2013. BTP will roll out the Home Energy Score to this network in 2012.

Building Innovation Hub. The Building Innovation Hub identifies and assesses relevant technologies for integrated building systems, subsystems, components, sensors, controls, and diagnostics necessary for scalable retrofit solutions that can meet the stringent economic demands of the whole-building retrofit market with the expectation of substantial market penetration capabilities.

- Assessment of the value of measured indoor environment characteristics including lighting levels and spectral distribution, air quality (particle counts and humidity ratios), and sensible temperatures relative to occupant satisfaction.
- Assessment of the value of energy efficient building retrofits addressing factors such as occupant health, safety and security, community well-being, and worker productivity, creativity and innovation, as well as reduced energy consumption.

Building Energy Modeling. Building energy modeling (BEM) is one method to demonstrate to consumers the potential benefits of energy efficiency technology. The Program is focused on reducing the cost of BEM, thus enhancing its business case and encouraging its productive use in a greater number of projects, for both new construction and deep retrofits. The current too-high cost components of BEM are data gathering and entry, and model calibration. Slow execution speed is also a detriment in some scenarios, e.g., value engineering. We are addressing the data issues with data schemas that connect BEM to Computer Aided Design (CAD) tools and other simulation engines and databases of simulation-ready component data. The pre-computed performance maps —and some of innovation/emerging technology work undertaken in FY 2012 to utilize them — will address calibration.

BEM is a key tool in designing buildings and building retrofits with aggressive energy targets. Buildings are complex systems whose total performance is due as much to interactions between sub-systems as it is to the individual performance of these sub-systems. The complete building system cannot be understood and optimized without detailed simulation. The classic example is the combined use of (natural) day lighting with dimming controls on the electric lights. The combined effects include reductions in lighting electricity use and heat gain from lights, but also increased heat gain through larger windows and more open spaces.

Calculating the net effect on cooling and heating loads requires quantitatively balancing these concerns while taking building program requirements and local weather conditions into account. For a given building, detailed energy simulation is the only reasonable way of doing this — physical experimentation is prohibitively expensive.

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

Benefits

The Program's Systems Integration activities will validate energy efficient technologies and solutions that improve the performance of residential and commercial buildings. These activities and outputs lead directly to decreased energy use in homes and businesses, contributing to the Department's goal of transforming our energy systems, reducing carbon emissions, contributing to the Administration's goal to reduce energy related greenhouse gas emissions by 17 percent by 2020, and lower energy bills.

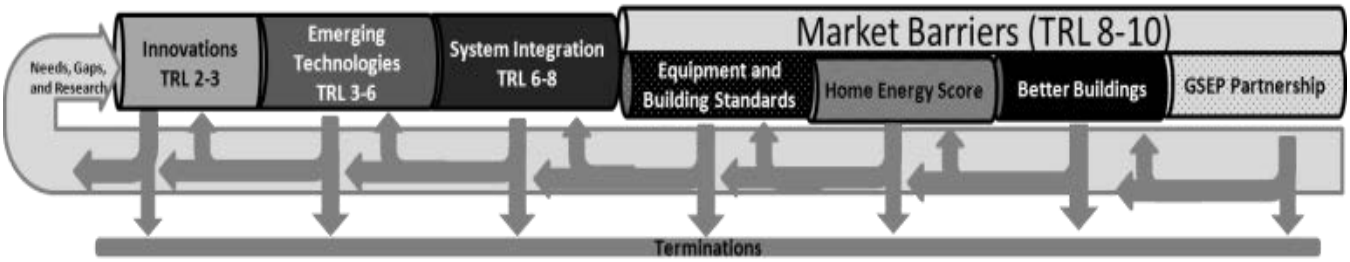
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	57,000	66,802	98,250
SBIR/STTR	0	0	0
Total, Market Barriers	57,000	66,802	98,250

Sequence



Description

The Program's activities under Market Barriers address market failures in the adoption of energy efficient technologies, through both market priming activities as well as regulatory activities, which identify cost-effective solutions for building equipment and new model construction energy codes. Appliance standards, accelerated development and adoption of new model building codes, building labels, and other methods will accelerate adoption of new efficiency technologies.

Key Technology and Focus Areas

The Program's Market Barrier activities focus on providing information to the market to facilitate the adoption of energy efficient technologies while also saving consumer's energy and dollars through regulatory activities such as Federal energy efficient equipment standards and energy efficiency model building codes.

Equipment Standards. Equipment standards and analysis activities lead to improved efficiency of appliances and equipment by conducting analyses and developing standards that are technologically feasible and economically justified. Since minimum standards effectively eliminate non-efficient products from the market place, equipment standards contributes to the goal by ensuring energy efficient technologies are purchased, installed and operated. In FY 2013 DOE will continue to take all necessary and feasible steps to finalize legally required efficiency standards consistent with all applicable judicial and statutory deadlines. DOE will build upon prior year activities by accelerating or initiating new energy conservation standards, test procedures, and labeling rulemakings for certain types of consumer products and commercial equipment. Several of the new products for which DOE has identified rulemaking opportunities include commercial fans, blowers, and pumps, as well as certain types of consumer electronic equipment. With the funding increase, DOE expects to have the ability to conduct 6 additional energy conservation standards rulings, which could potentially save consumers $100 billion on their energy bills over 30 years. DOE will pursue these new rulemakings following a well-defined schedule and plan that allows sufficient time for comprehensive review. .

Building Codes. For Building Codes, in FY 2011 DOE issued the final determinations for the IECC 2009 (and 2006 and 2003), as well as ASHRAE 90.1-2007 and ASHRAE 90.1 2010. DOE also developed and deployed compliance tools and pilot programs to assist states with establishing a compliance baseline, and achieved 30 percent improvement in national model energy building codes using the 2006 IECC as the baseline for residential and ASHRAE 90.1 2004 as the baseline for commercial building. In FY 2012, DOE will provide technical assistance to States to adopt, update, implement, and enforce their energy codes to meet the 2009 IECC and Standard 90.1-2010; issue the final determination for the 2012 IECC, the Notice of Proposed Rulemaking (NOPR) for Manufactured Housing Standard, and the final rule for Sustainable Design and Fossil Fuel; and initiate analyses and support for upgrading the next generation of IECC and ASHRAE 90.1 codes and standards with an increased emphasis on cost-effectively achieving 50 percent energy savings over the baseline. For FY 2013, DOE will build upon prior year activities to achieve the 50 percent upgrade of the IECC and ASHRAE 90.1 and provide significant technical assistance to states for code adoption and compliance.

Better Buildings Challenge. The Program's market barrier activities support the implementation of the Better Buildings Challenge to deploy successful models that increase investment in commercial building energy efficiency and improve this efficiency by at least 20 percent by 2020.

Energy upgrades performed in the commercial building market are currently impacted by a variety of barriers including lack of public awareness, lack of successful models, lack of private sector investment, and lack of overall knowledge of proper specifications or resulting impacts. The BetterBuildings Challenge addresses a multitude of barriers by deploying successful cost-effective retrofits and market-tested implementation models that make energy performance and assessments more transparent and understandable, demonstrate integrated building systems, and promote public and private sector commitments to energy efficiency investments. Through research and development, technical assistance, resources, and grants, the Program supports the implementation of the BetterBuildings Challenge: to deploy successful models of public–private partnerships to increase investment in commercial building energy efficiency and to assist building owners and private sector investors in identifying cost effective options for integrated energy upgrades.

The Program's Market Barrier activities also include the Building Performance Database and the Energy Performance and Disclosure Platform, two tools to provide greater ability for investors and building owners to predict and insure energy savings from retrofit projects.

Building Innovation Hub. The Buildings Innovation Hub is focused on developing tools for integrated design; integrated technologies and systems; policy, markets, and behavior; and commercialization and deployment. These areas address the vision established by DOE to advance "highly promising areas of energy science and engineering from the early stage of research to the point where the technology can be handed off to the private sector." The Hub, located at the Philadelphia Navy Yard, will function as a living laboratory for collaborative development and demonstration of new system integrated and operational technologies, policies, business models, and process integration methods spanning design, construction, commissioning and operation. Activities include:

- Document quantified improvement in occupant health and safety and worker productivity, as well as reduced energy consumption in retrofitted buildings.
- Begin to assist building component and system manufacturers in Greater Philadelphia to produce cost-effective and optimized whole building systems for installation in retrofitted buildings by building type.
- Identify existing and proposed public policies and practices at local, state, and national government levels influencing integrated energy efficient retrofit of average size commercial and multi-family residential buildings in Greater Philadelphia.
- Work with building owners, educational institutions, labor, workforce investment boards, and others to meet the demand for building operators with the skills needed to operate buildings with sophisticated controls, HVAC and lighting management systems.

Solar Decathlon. The Solar Decathlon is an award-winning program that challenges collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive. The winner of the competition is the team that best blends optimal energy production and maximum efficiency with affordability, consumer appeal, and design excellence. The first Solar Decathlon was held in 2002; the competition has since occurred biennially in 2005, 2007, and 2009. The FY 2011 event was held on the National Mall's West Potomac Park in Washington, D.C. September 22 through October 2, 2011. The overall goal of the Solar Decathlon is to raise public awareness about affordable clean-energy products that are available today to save money and reduce energy use. The Program accomplishes this goal by holding a fair and safe competition, supported by effective industry and association partnerships, and disseminating key messages to the public.

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

Benefits

Equipment Standards and Analysis activities lead to improved efficiency of appliances and equipment by conducting analyses and developing standards that are technologically feasible and economically justified. In 2013, the Program will complete 7 final rules. Test procedures and energy conservation standards developed by this subprogram correlate directly to energy policy objectives, such as increasing energy savings, reducing peak electricity demand, and reducing carbon emissions. According to a study commissioned by DOE and prepared by Lawrence Berkeley National Laboratory, a typical household saved approximately

$175 in utility bills per year due to the standards promulgated by DOE.[a]

Building Energy Codes activities include submitting code proposals, supporting the upgrading of model building energy codes, and providing technical and financial assistance to States to update, implement, and enforce their energy codes to meet or exceed model codes in support of Section 304 of ECPA. It also promulgates standards for manufactured housing as required by Section 413 of EISA. These activities and outputs increase the energy performance of newly constructed homes and commercial buildings, assist consumers in reducing energy bills, and contribute to job creation in the construction industry.

Solar Decathlon is a high-profile university competition that promotes public awareness of highly efficient building technologies and energy efficient homes using solar energy. The competition fosters innovation and encourages incorporation of new building technologies and design practices into engineering and architecture university curricula.

[a] Lawrence Berkeley National Laboratory, Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards Adopted from 1987 through 2010, Publication forthcoming.

Federal Energy Management Program

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Federal Energy Management Program			
Project Financing	10,699	9,640	9,581
Technical Guidance and Assistance	7,942	9,640	8,419
Planning, Reporting and Evaluation	3,701	4,832	4,000
Federal Fleet	2,170	1,793	2,000
DOE Specific Investments	5,890	3,986	3,000
Federal Energy Efficiency Fund	0	0	5,000
Total, Federal Energy Management Program	30,402	29,891	32,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Federal Energy Management Program			
Market Barriers	30,402	29,891	32,000
Total, Federal Energy Management Program	30,402	29,891	32,000

Public Law Authorizations

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95-91, "DOE Organization Act" (1977)
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 102-486, "Energy Policy Act (EPACT) of 1992"
P.L. 109-58, "Energy Policy Act of 2005"
P.L 110-140, "Energy Independence and Security Act of 2007(EISA)"

Overview

The Federal Energy Management Program's (FEMP) mission is to provide the services, tools, and expertise to Federal agencies to help them achieve their Federal energy management goals. These are delivered through project funding mechanisms, technical assistance, and communications and training. By increasing its use of energy efficiency and renewable energy, the Federal sector leads by example, reduces its greenhouse gas (GHG) emissions, meets more of its energy requirements from clean technologies and secure sources, and spurs innovation and commercialization of clean energy technologies.

FEMP will help agencies achieve their goals by facilitating their use of directly appropriated funds or performance contracting. Federal agencies may use energy saving performance contracts (ESPCs), utility energy service contracts (UESCs), and power purchase agreements, and FEMP provides guidance and expertise on their use. The program facilitates the award of ESPCs and UESCs for multiple Federal agencies. In addition, FEMP provides technical guidance and assistance to all Federal agencies and reports to Congress on Federal energy efficiency, Federal fleets, renewable electric power and agency compliance with relevant public law and Executive Order (E.O.) requirements.

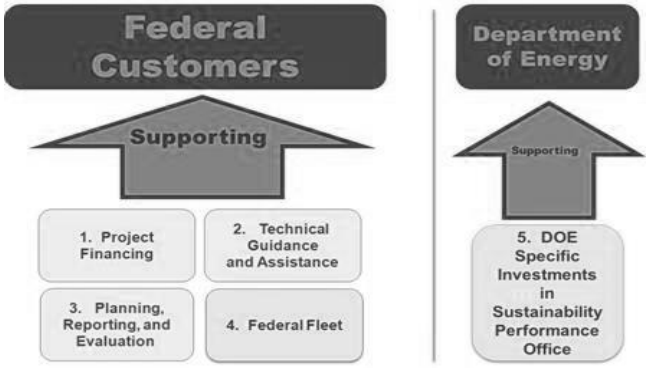
FEMP directly supports the 22 Federal agencies that report annual energy consumption to the Department of Energy (DOE), and assists OMB in assessing their performance. FEMP collaborates with agency leadership, energy and facility managers from other Federal agencies, and State and industry partners to identify key opportunities for enhancing energy efficiency and the use of renewable energy at Federal facilities. FEMP convenes and facilitates regular meetings among Federal agencies and industry partners; including the Federal Interagency Energy Management Task Force, Interagency Sustainability Working Group, and the Federal Utility Partners Working Group.

DOE's internal sustainability efforts are coordinated and implemented through the Sustainability Performance Office (SPO). Activities include evaluating, analyzing and reporting data for DOE on its sustainability goals and federal mandates, including the annual development and

submission of DOE's greenhouse gas inventory, as well as implementing and updating the DOE Strategic Sustainability Performance Plan (SSPP), OMB Sustainability/Energy Scorecard, internal sustainability scorecards, and oversight of all DOE sustainability efforts.

FEMP's assistance will help agencies reach the goals set forth by EPAct 2005, E.O. 13423, EISA 2007, and E.O. 13514. Current Government-wide goals include:

- Improve energy efficiency and reduce GHG emissions of each agency, through reduction of energy intensity by three percent annually or 30 percent by the end of FY 2015, relative to the baseline of the agency's energy use in FY 2003 (EISA 2007);
- Ensure that at least five percent of Federal electricity consumption is generated from renewable sources in FY 2010 through FY 2012; and seven and a half percent in FY 2013 and each fiscal year thereafter (EPAct 2005);
- Ensure that at least half of the statutorily required renewable energy consumed by the agency in a fiscal year comes from new renewable sources (after 1999) and, to the extent feasible, the agency implements renewable energy generation projects on agency property for agency use (E.O. 13423);
- Reduce water consumption intensity by two percent annually or 26 percent by the end of FY 2020 as compared to the FY 2007 base year (E.O. 13514); and
- For agencies operating a fleet of at least 20 motor vehicles, ensure that agencies reduce the fleet's total consumption of petroleum products by two percent annually through the end of FY 2015, relative to their respective baselines for FY 2005 (EISA 2007).



Strategy

FEMP's program strategy addresses key market barriers through six major pathways, of which five are illustrated in the above diagram. First, FEMP can provide advisory assistance in support of Federal agencies' appropriations in order to fund the energy efficiency and renewable projects required to meet the goals set forth in law and E.O. Project Financing services provide support to facilitate Federal agencies' use of performance contracting tools to fund energy efficiency improvements through ESPCs, power purchase agreements, and UESCs. FEMP provides Federal Finance Specialists who can guide agencies through the process including determining whether an ESPC project is feasible and helping to form an agency acquisition team. FEMP also provides project facilitators that guide agencies through the next stages of an ESPC project including consulting on contractual, financial, technology and measurement and verification issues.

Second, Federal agencies need guidance and technical assistance to make the most cost effective choices in clean energy technologies. 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.

Third, the Federal agencies need a centralized reporting function and need to be aware of the most effective solutions. Planning, Reporting and Analysis services include the collection, tracking and verification of Federal data (as required by Congress), strategic communication and marketing, and a recognition awards program. Annual awards include the Federal Energy and Water Management Awards and Department of Energy (DOE) Sustainability Awards.

Fourth, reductions in petroleum use in Federal vehicles are hampered by the lack of a coordinated strategy to substitute alternative fuels for petroleum use. Federal Fleet provides guidance and assistance to help implement Federal legislative and regulatory requirements mandating reduced petroleum consumption and increased alternative fuel use.

Fifth, oversight is needed within DOE to manage its internal strategic approach to meeting the mandated goals. For this reason, a Sustainability Performance Office (SPO) was established separate from FEMP, funded from the DOE Specific Investments line. SPO is DOE's corporate lead for sustainability, including energy, water, and resource use conservation; GHG emission reductions; sustainable acquisition; green IT and data centers; and other issues related to sustainability. To this end, the SPO facilitates departmental compliance with and reports progress on sustainability goals. Additionally, the SPO is charged with the implementation, coordination, and oversight of the Department's SSPP, which is a requirement of Executive Order 13514.

Sixth, in FY 2013, FEMP will reinvigorate the Federal Energy Efficiency Fund, which has been authorized since 1992. This program provides government-wide

assistance and grants to agencies to help them leverage federal and private sector funding to meet mandated energy efficiency and water requirements. In the two years that this program had spending authority (FY 1994 and FY 1995), Fund grants of $7.9 million were provided to 37 projects which leveraged $3.6 million in Federal-agency funding and $0.9 million in non-Federal funding. The estimated energy and water cost savings over the useful life of these projects was $54 million.

Benefits

The Federal Government, as the nation's largest energy consumer, has a tremendous opportunity and clear responsibility to lead by example. Because of its size, the Federal Government can help spur commercialization of new technologies in which the U.S. Government has already invested. FEMP is central to this responsibility, guiding agencies to use funding more effectively in meeting Federal and agency-specific energy management objectives. Combined with our partners at the National Laboratories, FEMP has technical expertise that other Federal agencies do not typically have. Instead of each agency trying to determine effective energy management on their own, FEMP is in the position to develop, analyze and provide guidance on best practices in energy management that can then be disseminated to all agencies. FEMP's centralized role also makes it uniquely capable of providing expertise on performance contracting, overcoming barriers to the use of alternative fuels in the vehicle fleet, providing centralized reporting and data collection and strategic communication.

FEMP activities contribute to reducing the energy intensity at Federal facilities, lowering their energy bills and providing environmental benefits. By providing interagency coordination, technical expertise, training, reporting tools, financial resources and contracting support, FEMP helps agencies make cost-effective investments in energy efficiency and renewable energy technologies at Federal facilities and in Federal fleets.

FEMP provides support to Federal agencies to meet their GHG reduction goals established by the requirements of EO 13514. FEMP also assists agencies in tracking their GHGs by providing guidelines, tracking tools, and one-to-one technical assistance. Since GHG emissions are primarily driven by energy use, reducing GHG emissions are primarily accomplished by reducing energy use and lowering its cost to the Federal Government.

By promoting the use of alternative fuel in Federal agency fleets, the Federal Fleet program helps to decrease our government's dependence on oil. Private sector development of alternative fuel stations at Federal sites will be supported to demonstrate opportunities for further petroleum displacement.

DOE Specific Investment activities ensure implementation of Federal and Departmental sustainability goals throughout the DOE complex. These activities further DOE's strategic goal of energy security by ensuring that DOE increases its energy productivity and energy diversity, and reducing GHG emissions and energy use. DOE is committed to reducing Scope 1 and 2 GHG emissions by 28 percent and Scope 3 emissions by 13 percent by 2020, through efforts to meet federal statutory and Executive Order mandates noted above and ensuring 15 percent of facilities meet the Guiding Principles (GP) for Federal Leadership in High Performance Sustainable Buildings (HPSB) by FY 2015.

Through the DOE Specific Investments activity, the SPO supports the Department's strategic mission of making the Federal government a leader in sustainability. SPO contributes to this mission through a variety of activities including oversight and execution of energy, water, and resource assessments at DOE sites and National Laboratories. These assessments provide the basis for cost-effective implementation of energy conservation measures and efficiency improvements that reduce the Department's overall energy use and associated GHG emissions.

Through the Federal Energy Efficiency Fund, FEMP will provide government-wide financial assistance to Federal agencies to increase their investments in energy efficiency, water conservation and renewable energy. The focus will be on cost-effective investments that are highly leveraged by other Federal or non-Federal sources.

Key Accomplishments

Accomplishments for FEMP include:

- Saved Federal facilities over $5 billion in energy costs from 2006 to the present through guaranteed cost savings for contracts through its Indefinite Delivery, Indefinite Quantity Energy Savings Performance Contracting;
- Trained more than 11,000 Federal employees and others on energy saving practices in its seminars;
- DOE reduced Scope 1 & 2 greenhouse gas emissions by 13 percent between FY 2008 and FY 2010, as reported for DOE's annual GHG Inventory;
- FY 2009 and FY 2010 were the Project Financing program's most effective years with 60 Task Order ESPC awards and private-sector project investment totaling $921 million. FY 2011 was a rebuilding year and the first full year under new contracts. ESPC project pipeline is proceeding apace with 85 projects under development;
- Five UESC projects were awarded government-wide in FY 2011 with a total investment of over $44 million;

- Completed the review and update of 10 of the 13 FEMP-designated product category efficiency requirements; and
- Provided ongoing, responsive technical support to enable agencies to apply best practices in the implementation of their Strategic Sustainability Performance Plans and helping them meet the requirements of all federal sustainability statutory and E.O. mandates.

Strategic Plan and Program Performance Measures

By providing interagency coordination, technical expertise, training, financing resources and contracting support, FEMP helps agencies take those critical steps to make cost-effective investments in energy efficiency and renewable energy technologies at Federal facilities which result in strategic benefits in climate change, energy security and positive economic impacts.

In FY 2012, FEMP is funding the Pacific Northwest National Laboratory to conduct an evaluation on actual and verifiable energy savings and carbon emissions reductions from Federal energy management investments across the Federal Government. The specific goals of this project are to assist agencies in compiling and reporting implemented project investment and savings data; characterize energy, water, and greenhouse gas savings from implemented energy and water efficiency projects; and assess the cost-effectiveness of various types of energy conservation measure investments implemented across the Government.

Performance Measure Analysis

Federal agencies have a statutory mandate to reduce facility energy intensity by 30 percent in 2015 compared to 2003 (42 USC 8253(a)). Achieving this goal Government-wide requires a reduction of 59 trillion Btus from 2010 levels. Use of on-site renewable energy projects also contributes to the reduction by displacing fossil and other conventional energy sources. In addition, these efforts are the primary pathway for reducing GHGs. For FY 2013, FEMP's performance target is 47 trillion lifecycle Btus of projected energy savings that result from its project financing and technical assistance activities. The SPO issues internal DOE performance scorecards to report and project progress against sustainability goals.

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Market Barriers – An increase in $2.1 million for FEMP will allow it to restart the Federal Energy Efficiency Fund (FEEF). Other areas will be decreased by $2.9 million to bring the total for the FEEF to $5.0 million.	29,891	32,000	+2,109
Total, Federal Energy Management Program	29,891	32,000	+2,109

Explanation of Changes

In FY 2013, FEMP will be allocating $5.0 million to reinvigorate the FEEF which will provide direct funding and leveraged cost-sharing for other Federal agencies for capital projects and other initiatives to increase the energy efficiency, water conservation and renewable energy investments at agency facilities. Technical Guidance and Assistance is reduced by $1.2 million which will decrease activities in product procurement, emerging technologies, GHG mitigation strategies and technical assistance for water conservation. Planning, Reporting and Evaluation is reduced by $0.8 million which will be accomplished by streamlining activities in data collection and planning. DOE Specific Investments is reduced by $1.0 million which will streamline the technical assistance and project transaction services provided to DOE sites.

Additionally, FEMP will work in partnership with the General Service Administration's Office of Federal High Performance Green Buildings to introduce competition among energy savings companies to achieve deep reductions in energy use. Furthermore, FEMP will work on developing a process for agencies to use when incorporating onsite renewable energy projects into an ESPC and for having those projects reviewed in advance. FEMP will also be working on a financing program for energy efficiency and water projects at smaller facilities that have been traditionally underserved.

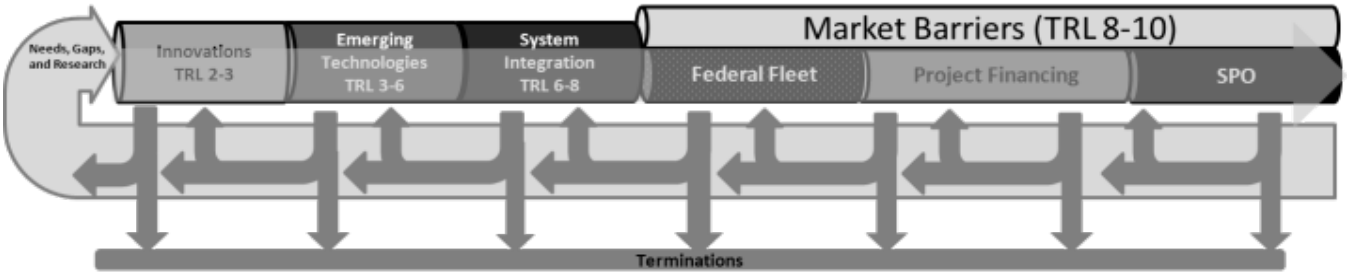
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	30,402	29,891	32,000
Total, Market Barriers	30,402	29,891	32,000

Sequence



Description

FEMP is investing $32.0 million dollars to address market barriers. These barriers include: competing priorities wherein Federal agencies often find the pursuit of reducing their energy intensity to be a significant challenge; insufficient guidance and support to agencies to make the most cost effective choices in achieving their energy efficiency and renewable energy goals; the need for a centralized reporting system to track the progress in meeting those goals; the lack of an adequate infrastructure to support alternative fuel use for Federal vehicles; the lack of broad agency support for acquisition and use of energy efficiency and renewable technologies; and the lack of a fully implemented sustainability strategy.

FEMP provides the services, tools, and expertise to Federal agencies to help them achieve their Federal energy management goals. These are delivered through project funding mechanisms, technical assistance, and communications and training. These goals are accomplished through performance contracting 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 in meeting E.O. and statutory requirements.

Key Technology and Focus Areas

Project Financing – Federal agency use of ESPCs was authorized by Congress to provide a supplement to direct appropriations for funding energy-efficient improvements in Federal facilities. By using ESPCs and UESCs, agencies can take advantage of private sector expertise with little or no upfront cost to the Government. The Government pays for the investment through energy cost savings achieved over the life of the project. ESPC and UESC projects can include energy and water-efficiency improvements, renewable energy technologies, alternative fuel (biomass/landfill), combined heat and power, advanced metering and power management. FEMP's assistance includes the management of the DOE indefinite delivery, indefinite quantity ESPC contract. The National Energy Conservation Policy Act (NECPA) first gave Federal agencies the authority to enter into shared-energy savings contracts with private-sector energy service companies (ESCOs). It was superseded by the Energy Policy Act of 1992. The Department of Energy (DOE) promulgated regulations for their use in 1995. ESPC authority was made permanent in 2007.

FEMP will assist agencies to meet the goals set forth in the Presidential Memorandum on Performance Contracting (December 2, 2011). In this memo, Federal agencies are tasked to enter into a minimum of $2 billion in performance-based contracts in Federal building energy efficiency within 24 months. For this effort, FEMP will provide Federal Financing Specialists to assist site staff and management with initial decision-making on performance contracting, project facilitators to guide agencies through ESPC project development and implementation, and beginning and advanced training for Federal personnel in project financing. FEMP tracks and monitors ESPCs over the life of the contracts at Federal agencies to make sure that the contracts are performing well.

Technical Guidance and Assistance – FEMP's broad range of assistance includes analytical support to Federal agencies for implementation new technology,

development of Federal agency efficiency standards, specification of energy-efficient products for agency procurement, energy assessments, and assistance to help other agencies develop comprehensive planning and internal processes to reduce their energy use and to achieve Federal water consumption goals. Special areas of focus include energy efficiency at laboratories, renewable energy and data center technologies. EPAct 2005 and EISA 2007 establish FEMP's responsibility for carrying out a number of activities, including developing product specifications and issuing guidance on metering, new construction, and other energy-related building topics.

Planning, Reporting and Evaluation – Data collection, verification and reporting continue to be centralized for the Federal agencies at FEMP. Information will be made available on Federal progress toward statutory and E.O. goals on the FEMP website and technical updates to web-based materials will continue for the Federal sector. Activities include preparing Annual Reports to Congress as required by EPACT 2005 and EISA 2007 regarding progress by Federal agencies toward the goals that address energy efficiency and renewable energy usage; providing outreach and communication regarding new technologies, fact sheets and guidelines to agencies; support for the GovEnergy Conference; website improvement and training; and the DOE and Federal Awards program.

Federal Fleet – FEMP provides guidance and assistance to help implement Federal legislative and regulatory requirements mandating reduced petroleum consumption and increased alternative fuel use for the Federal fleet. FEMP's efforts include assisting agencies with implementing and managing energy-efficient and alternative fuel vehicles and facilitating a coordinated effort to reduce petroleum consumption and increase alternative fuel use and tracking and reporting Federal progress annually. FEMP provides information and resources for Federal requirements, technology resources, technical assistance on infrastructure development, data analysis and trends, coordination of INTERFUEL (an interagency working group for vehicle fleets), and resources for Federal fleets including publications, online tools, and related links on vehicles, alternative fuels, and fleet management deployment strategies. Federal agencies must report vehicle acquisitions and alternative fuel consumption annually. FEMP outlines reporting requirements and processes, including regulations, timelines, and tools to help Federal agencies meet annual requirements.

DOE Specific Investments – These activities are managed by the DOE Sustainability Performance Office in support of the Deputy Secretary of Energy as DOE's Senior Sustainability Officer, and in conjunction with FEMP, DOE corporate offices, the Under Secretaries, Program Support Offices, National Laboratories and DOE Sites. The SPO ensures the integration and coordination of sustainability activities across the Department and represents DOE in sustainability-relevant interactions with other Federal agencies. These activities include support and technical assistance for operations and maintenance, retro commissioning and audits of DOE sites; assistance for mission critical energy intensive buildings and processes, including supercomputers and scientific computing, data centers, accelerators, lasers, laboratories and their supporting structure; support for meeting the requirements of E.O. 13423, E.O. 13514, and related statutory sustainability requirements and internal DOE policies and orders; technical assistance and information on HPSBs and sites; implementation of ESPCs, UESCs, and renewable power purchase agreements at DOE facilities; establishing incentive awards; advising on meeting sustainable design principles and implementation; identifying alternative energy, energy efficiency, water and renewable energy technologies for potential cost-effective deployment within DOE; assisting with development and implementation of site energy, metering, water and other sustainability plans. Administrative and technical support will be provided to DOE workgroups, the National Laboratory Directors Council (NLDC), the Energy Facilities Contractor Group (EFCOG), as well as interagency sustainability groups and task forces.

Federal Energy Efficiency Fund – FEMP will provide direct funding and leveraged cost-sharing at Federal agencies for capital projects and other initiatives to increase the energy efficiency, water conservation and renewable energy investments at agency facilities. Grants from the Fund will be awarded after a competitive assessment of the technical and economic effectiveness of each agency proposal which will consider the life cycle cost-effectiveness of the project, the amount of energy and cost savings anticipated to the Federal Government, the amount of funding committed to the project by the agency requesting financial assistance, and the extent that a proposal leverages financing from other non-Federal sources.

Benefits

FEMP is in a unique position to provide technical expertise to Federal agencies in a centralized fashion. FEMP develops its expertise with its partners at the National laboratories. Instead of each agency trying to determine effective energy management on their own, FEMP is in the position to develop, analyze and provide guidance on best practices in energy management that can then be disseminated to all agencies. FEMP's centralized role also makes it uniquely capable of providing expertise on performance contracting to implement energy conservation measures at Federal facilities, overcoming barriers to the use of alternative fuels in the vehicle fleet, providing centralized sustainability reporting, and data collection and strategic communication.

FEMP's broad range of activities to support Federal agencies yields several benefits. First, FEMP's activities will contribute to reducing the energy intensity at Federal facilities, lowering their energy bills and providing environmental benefits. FEMP provides support to Federal agencies to meet their GHG reduction goals which were established according to the requirements of EO 13514. By promoting the use of alternative fuel in Federal agency fleets, the Federal Fleet program helps to decrease our government's dependence on oil.

DOE Specific Investments activities ensure implementation of Federal and Departmental sustainability goals and mandates throughout the DOE complex.

The Federal Energy Efficiency Fund will be available to all agencies to help them meet mandatory energy efficiency and water requirements through grants to agencies to help them leverage federal and private sector funding.

Vehicle Technologies

Funding Profile by Subprogram

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Vehicle Technologies			
Batteries and Electric Drive Technology	103,163	117,740	203,594
Vehicle and Systems Simulation & Testing	42,647	47,198	56,218
Advanced Combustion Engine R&D	55,987	58,027	55,261
Materials Technology	47,748	40,830	48,475
Fuels Technology	10,692	17,904	11,634
Outreach, Deployment and Analysis	32,914	39,266	33,945
SBIR/STTR	0	7,842	10,873
Total, Vehicle Technologies	293,151	328,807	420,000

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current[a]	FY 2012 Enacted	FY 2013 Request
Vehicle Technologies			
Innovations	121,312	143,978	182,638
Emerging Technologies	111,315	113,567	168,209
Systems Integration	17,567	19,875	14,043
Market Barriers	42,957	43,545	44,237
SBIR/STTR	0	7,842	10,873
Total, Vehicle Technologies	293,151	328,807	420,000

Public Law Authorizations[a]

P.L. 95-91, "U.S. Department of Energy Organization Act" (1977)
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The mission of the Vehicle Technologies Program (VTP) is to develop and promote energy-efficient and environmentally friendly transportation technologies that will enable America to use significantly less petroleum and reduce greenhouse gas (GHG) emissions while meeting or exceeding drivers' performance expectations and environmental requirements. To accomplish this, VTP seeks to catalyze and transform our Nation's energy system by conducting research, development, demonstration, and deployment of advanced vehicle technologies and integrating innovative solutions for highway transportation. This investment will help improve the Nation's energy security and strengthen U.S. economic competitiveness in the global clean energy race.

VTP's activities primarily focus on highway vehicles (passenger and commercial), which account for 55 percent of total U.S. oil use, more than all U.S. domestic oil production.[b] Investments are being made in all aspects of vehicle efficiency technologies, including lower cost battery and electric drive component manufacturing, vehicle electrification deployment and infrastructure development, higher efficiency combustion engines, vehicle light-weighting, and alternative fuels utilization and deployment because of the associated contributions to reduced transportation energy use. The efficiency gains and fuel alternatives associated with VTP's investments will improve air quality, reduce CO_2 emissions, and enhance energy security.

The FY 2013 activities focus on meeting the President's 2015 electrification goal, and addressing key program goals through 2020 and beyond, specifically:

[a] SBIR/STTR funding transferred in FY 2011 $6,849,000.

[b] Tables 1.13, 1.14, and figure 1.8 in the 29th edition of the Transportation Energy Data Book, 2010. See http://cta.ornl.gov/data/index.shtml.

- Invest in developing electric vehicle technologies enabling one million electric drive vehicles on the road by 2015;Develop and deploy advanced battery manufacturing capacity to support 500,000 plug-in hybrid electric vehicles (PHEVs) a year by 2015;
- Save 1.8 million barrels per day of highway petroleum use by 2020 (compared to EIA's AEO-projected baseline in 2020);
- Develop technologies enabling the improvement of the fuel economy of new vehicles to achieve an average corporate average fuel economy (CAFE) standard of 144 gCO2/mi (61.6 miles per gallon (mpg)) for cars and 203 gCO2/mi (43.7 mpg) for light trucks by 2025; and
- Under the SuperTruck initiative, develop technologies to improve the fuel economy of heavy-duty, class 8 vehicles by 50 percent with respect to a comparable 2009 vehicle, by increasing engine efficiency, reducing aerodynamic drag and weight, and hybridization.

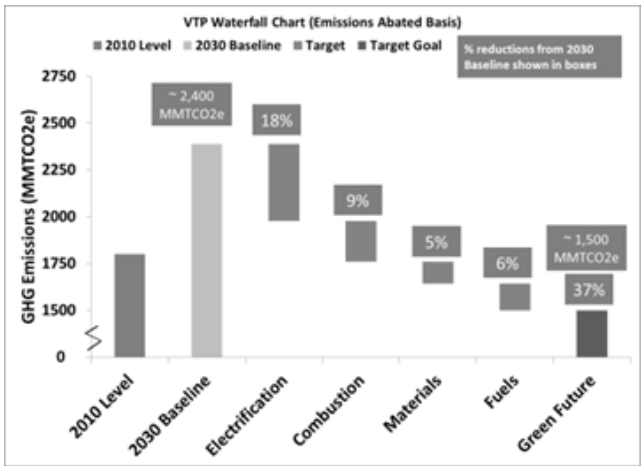
However, the rate at which new efficiency technology is adopted by vehicle manufacturers influences the rate at which efficient vehicles are adopted in the market. On average it takes about 15-20 years for a technology to reach maximum market penetration. Replacement of the existing fleet of 240 million lower efficiency vehicles would take an additional 20 years, assuming all new vehicles have higher efficiency. Additionally, the interest of consumers in fuel economy and alternative fuels can be very dependent on the market price of fuels.

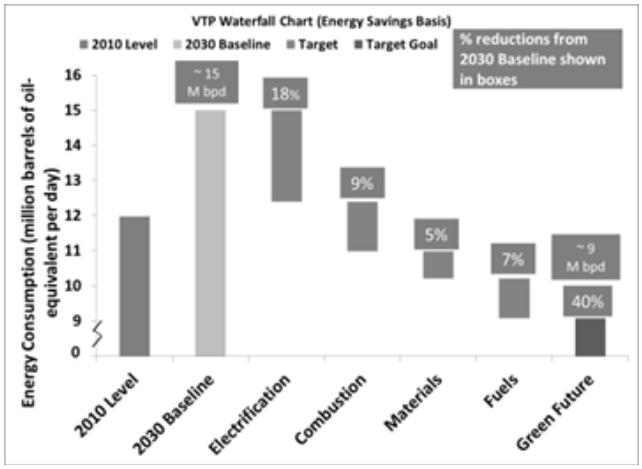
To accelerate the introduction and market acceptance of electric vehicles, the program continues its emphasis on the vehicle electrification (i.e., new generations of hybrid electric vehicles, plug-in hybrids, electric vehicles). This will be accomplished through research and development (R&D) on batteries, power electronics, electric motors, and electric drive systems to improve performance and cost, development of electric vehicle supporting infrastructure (e.g., advanced chargers, streamlined codes and standards), and efforts to help communities across the country become early adopters of electric vehicles. The President's goal of one million electric drive vehicles on the road by 2015 is ambitious, but achievable, and the VTP request robustly supports the research, development and deployment activities required to help reach the goal and to subsequently increase market penetration.

To be a global leader in the production and sale of electric drive vehicles, the U.S. must rapidly develop improved technology, significantly reduce the cost of these vehicles, and improve the charging infrastructure. To that end, the FY 2013 budget request includes funding for the Electric Vehicle Grand Challenge which will help ensure that the U.S. leads the world in next generation electric vehicle technology and will help accelerate market acceptance of these vehicles. The Grand Challenge will emphasize accelerated research and development on advanced battery technology with a major concentration on advanced battery design optimization and battery manufacturing to significantly improve performance and reduce system cost. Additional research will focus on the development of high performance and low cost power electronics, improved drive motor technologies that require reduced or no rare earth materials, and the development of advanced charging technology that allows these vehicles to conveniently and efficiently charge from the electric grid.

Analysis shows that the combined portfolio of the program's technologies could reduce energy consumption and GHG emissions by nearly 40 percent from projected 2030 levels in the Annual Energy Outlook (AEO) 2011 (http://www.eia.gov/forecasts/aeo/). These benefits are displayed graphically in the waterfall charts below. Investment in vehicle electrification will yield the technologies necessary for advanced battery electric and plug-in hybrid vehicles with the sufficiently long ranges, sufficiently low costs, and broad consumer appeal that are expected to result in significant market penetration potential. Based on VTP analyses of technology and cost potential and subsequent vehicle system modeling and simulation, these vehicles' superior on-board efficiencies could contribute to an 18 percent reduction in energy consumption and GHG emissions compared to an AEO-projected 2030 baseline case assuming the use of low-carbon electricity.

Advanced combustion engine technologies for conventional, hybrid, and plug-in light-duty vehicles — as well as for heavy trucks — offer near-to mid-term efficiency improvements along a path to novel combustion regimes and greater longer-term efficiency improvements, potentially resulting in an additional 9 percent reduction in energy consumption and GHG emissions. Coupling the preceding advanced powertrain technologies with lightweight structural and advanced powertrain materials (a 5 percent reduction) as well as advanced lubricants and fuels (a 6-7 percent reduction) offer a combined additional reduction of about 11 percent.





Strategy

To accomplish its strategic goal of transforming our transportation energy systems, VTP supports research, development, demonstration, and deployment of advanced technologies to improve America's energy efficiency.

The primary barriers and opportunities for improved vehicle efficiency are technological. Therefore, the principal strategy of the program is 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 alternatives that can be produced domestically. The program strategy also supports activities to facilitate market adoption of new technologies by reducing market barriers, and activities to inform program planning.

The R&D strategy is divided into three technology pathways, each of which can result in lowering vehicle oil use (fuel economies below measured with respect to average 2010 vehicle), GHG emissions, and operating cost:

- Improve electric drive components (up to 300 percent improvement in fuel economy);
- Reduce the weight of vehicles (up to 30 percent improvement in fuel economy); and
- Improve combustion engine efficiency and fuel characteristics (up to 60 percent improvement in fuel economy and displacement of oil by non-petroleum fuels).

In pursuing these technology pathways, the key focus areas are energy storage; power electronics and electric motors; advanced combustion engines; materials; fuels; vehicle and systems simulation and testing; and outreach, deployment and analysis. Improvements resulting from work conducted in these focus areas 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 for commercial vehicles. The technologies resulting from these R&D pathways contribute to the ability of vehicle manufacturers to cost-effectively meet and potentially exceed CAFE standards.

Benefits

By using advanced efficiency technologies and non-petroleum fuels, oil use can be substantially reduced, making the Nation less vulnerable to oil supply disruptions or price spikes. PHEVs will allow consumers to displace petroleum with electricity, based on price and convenience.

VTP contributes to reducing GHGs (most importantly CO_2) by providing technology which will make the Nation's highway vehicles more efficient and make it possible to use low carbon fuels. Lightweight materials, advanced combustion, and hybrid or all-electric drive-trains all reduce CO_2 emissions. For example, a hybrid vehicle that combines advanced, more efficient combustion engines with lightweight materials and a hybrid drive-train could double the fuel efficiency of a conventional vehicle — resulting in half the GHG emissions.

New technologies developed and manufactured within the U.S., and fuels produced domestically, will create jobs and economic growth. Achieving the program goal of reducing the cost of advanced vehicle technologies will save the consumer money that can stimulate other areas of the economy and accelerate the adoption of efficient vehicles.

Program portfolio benefits are quantified in terms of energy consumption reduction and GHG emissions abated, as described in two figures and accompanying discussion in the preceding 'Program Overview' section. Some specific program measures include:

- Increase efficiency of internal combustion engines to enable fuel economy improvements for passenger

vehicles of 25 percent in 2015 and 35 percent in 2020, and for commercial vehicles of 20 percent in 2015 and 30 percent in 2020 when compared to a 2009 baseline vehicle.
- Reduce battery pack costs to $300/kW-hr by 2015 and $125/kW-hr by 2020, allowing for a 40 kW-hr battery pack (enabling a vehicle range in EV mode of 150-200 miles) costing no more than $5,000.
- Reduce light duty vehicle weight 30 percent and heavy duty tractor weight by 16 percent by 2025.

Key Accomplishments

Some examples of recent accomplishments that contribute to meeting the program goals include:

- The program has demonstrated, in a laboratory engine, the potential for fuel economy improvements of over 75 percent for passenger vehicles and 20 percent for commercial vehicle engines.
- VTP developed and demonstrated prototype PHEV battery technology that achieved a cost of $650 per kilowatt-hour of useable energy based on high volume manufacturing cost projections, using a peer reviewed cost model, which is a 50 percent cost reduction from the 2008 baseline.
- To date, the advanced vehicle testing activity has accumulated over 15 million test miles on approximately 1,600 electric-drive vehicles representing 107 different models. In FY 2011, VTP initiated the collection and analysis of data from electric-drive vehicles and charging infrastructure deployed through the American Recovery and Reinvestment Act. Enabled by the largest deployment of electric-drive vehicles and infrastructure ever undertaken in the U.S., this data collection effort will provide valuable information regarding how consumers utilize grid-connected vehicles and charging stations, paving the way for a much broader deployment in the future.
- New deployment awards ($ 8.5 million) were implemented in FY 2012 for electric vehicle readiness and infrastructure development planning in communities across the country.
- Petroleum reduction projects will be completed in FY 2012 that will deploy over 500 alternative fuel and advanced technology vehicles and approximately 180 new fueling/charging stations.
- Over 600 million gallons of gasoline and diesel fuel displacement and/or reductions were reported from VTP deployment activities and projects undertaken by Clean Cities Coalitions in FY 2011 (based on both measured and estimated impacts).

Strategic Plan and Program Performance Measures

As stated above, the VTP strategy follows technology pathways, each of which can result in lowering vehicle oil use and GHG emissions. These are 1) improve electric drive components (up to 300 percent improvement in fuel economy); 2) reduce the weight of vehicles (up to 30 percent improvement in fuel economy); 3) improve combustion engine efficiency and fuel characteristics (up to 60 percent improvement in fuel economy and displacement of oil by non-petroleum fuels).

Component and subsystem improvements are assessed through bench-scale testing to measure progress toward the various program goals. These individual achievements are combined through an ongoing program of vehicle modeling to document how these improvements combine to progress toward the creation of integrated advanced technology vehicles capable of between 200 and 400 percent increased fuel economy per vehicle for passenger vehicles and 40 to 50 percent for commercial vehicles, which addresses the goal of transforming the Nation's energy system.

Performance Measure Analysis

As part of the effort to transform the Nation’s energy system and secure US leadership in clean energy technologies, VTP seeks to develop highway transportation technologies that use significantly less petroleum and reduce greenhouse gas emissions. In order for clean highway technologies to make an appreciable difference in petroleum consumption and greenhouse gas emissions, advanced vehicle technology performance must be improved and costs must be reduced. The specific performance measures described in the EERE Overview demonstrate efforts to lower costs and improve performance so that new vehicles are attractive to consumers on a life-cycle cost basis, which leads to market penetration and, in turn, reduced petroleum use and greenhouse gas emission abatement. The sum total of technology pathways pursued will help provide Americans with greater freedom of mobility and energy security, with lower costs and lower environmental impacts.

Comparable Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Vehicle Technologies			
Innovations – Lightweight materials research will investigate the structural and chemical behavior of lightweight magnesium alloys. Through the EV Grand Challenge, research in batteries and power electronics will be accelerated. Specifically, research will be expanded to develop and demonstrate new battery materials and cells that are capable of achieving a 2X improvement in performance and cost over the projected target status at the end of FY 2012. Research on revolutionary battery manufacturing technology will be initiated. Research on wide band gap semiconductors will be enhanced.	143,978	182,638	+38,660
Emerging Technologies – Through the EV Grand Challenge, development of batteries, electric drive motors, advanced charging technology, and high efficiency HVAC system technologies will be enhanced. New activities focusing on battery pack design innovations to reduce cost and the development of low cost processes for the production of advanced battery materials will be initiated. New research and development of low cost, non-rare earth electric traction drive system will be initiated. Development support for non-ARRA SuperTruck awards will increase. Combustion development will decrease slightly as engine laboratory testing is completed. Research on lubricants and the vehicle impacts of direct petroleum replacements will be maintained; work on fuels as enablers of advanced combustion engines will be decreased in tandem with the reduction in funds requested for Combustion. Lightweight materials will develop high performance light-metal joints, demonstrate the manufacturing of low-cost carbon fiber composite components, and apply modeling and simulation techniques to the design of lightweight vehicle structures.	113,567	168,209	+54,642
Systems Integration – With the conclusion of the competitively selected industry projects under the PHEV Technology Advancement and Demonstration Activity and the Electric-Drive Cargo Transport Demonstration in FY 2012, vehicle systems integration efforts will be reduced.	19,875	14,043	-5,832
Market Barriers – Vehicle systems and simulation testing market barrier activities will be sustained, to continue supporting improved transition of advanced vehicle technologies to the private sector.	43,545	44,237	+692
SBIR/STTR are calculated based on research and development funding allocations.	7,842	10,873	+3,031
Total, Vehicle Technologies	328,807	420,000	+91,193

Explanation of Changes

To be a global leader in the production and sale of electric drive vehicles, the U.S. must rapidly develop improved technology, significantly reduce the cost of these vehicles, and improve the charging infrastructure. From FY 2012 to FY 2013 there will be increased emphasis on advanced battery technology with a major concentration on advanced battery design optimization and battery manufacturing to significantly improve

performance and reduce system cost. Additional research and development will focus on high performance and low cost power electronics, improved drive motor technologies that require reduced or no rare earth materials, and technology that allows these vehicles to charge from the electric grid conveniently and efficiently, such as wireless charging systems. Additional research and development will focus on high-efficiency HVAC system technologies. In addition, lightweight materials will develop high performance light-metal joints, demonstrate the manufacturing of low-cost carbon fiber composite components, and apply modeling and simulation techniques to the design of lightweight vehicle structures.

Funding Opportunity Announcements Background

VTP posts current and past funding opportunities for all program areas, including research and development (R&D), systems integration, and market barriers projects at http://www1.eere.energy.gov/vehiclesandfuels/financial/index.html. Links to related opportunities from DOE National Laboratories and other Federal agencies are also available.

In carrying out its vision and mission, the program conducts a broad portfolio of specific goal directed activities to develop and promote energy-efficient and environmentally friendly transportation technologies that will enable America to use significantly less petroleum and reduce GHG emissions while meeting or exceeding drivers' performance expectations and environmental requirements.

Most of these activities are carried out through open, competitive solicitations designed to meet our top technology needs. Funding opportunities encourage collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local governments and non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance. Below is a summary of both FY 2012 Vehicle Technology FOA awards and FY 2013 anticipated awards.

Anticipated FOAs

(Dollars in Thousands)

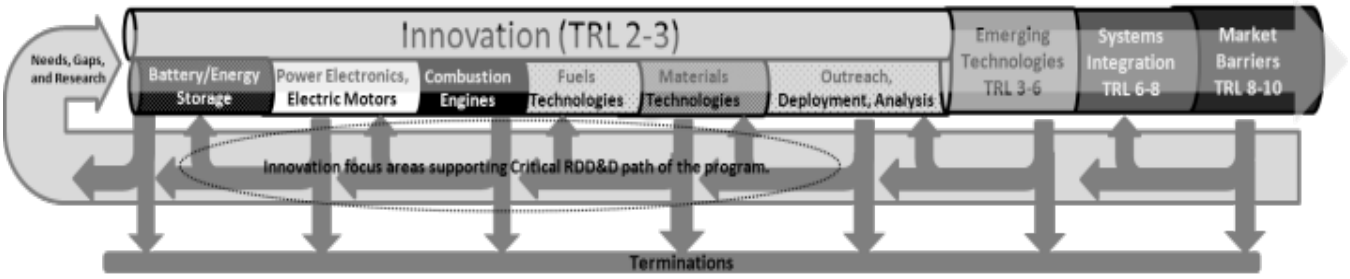
Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2012	Lightweight Materials	TBD	8,200
A broad area announcement for lightweight materials technologies, including alloys and composites.			
FY 2012	Vehicle and Systems Simulation and Testing	TBD	3,000
A single area of interest announcement for wireless charging for electric vehicles.			
FY 2012	Vehicle and Systems Simulation and Testing	TBD	5,000-10,000
A single area of interest announcement for Zero Emission Cargo Transport (EISA Section 131(c), “Near-Term Transportation Sector Electrification Program”).			
FY 2012	Outreach, Deployment, and Analysis	Analysis	3,000
The commission of a National Academies study on electric vehicle market barriers.			
FY 2012	Electrochemical Energy Storage	Battery Development	2,500
A single area of interest announcement for electrochemical energy storage.			
FY 2013	Vehicle Technologies Broad Area Announcement	TBD	182,500
A FOA will cover major aspects of the Vehicle Technologies portfolio, including electrochemical energy storage, power electronics, electric motors, and electric traction drive systems, advanced HVAC systems, advanced combustion engines, lightweight and propulsion materials, and Clean Cities. The purpose of the FOA will be to continue to increase the number of competitive awards while allowing the widest possible range of participants in the program.			

Innovations

Comparable Funding Profile by Subprogram

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovations	121,312	143,978	182,638
SBIR/STTR	0	4,376	5,746
Total, Innovations	121,312	148,354	188,384

Sequence



Description

The primary barriers and opportunities for improved vehicle efficiency are technological. The program supports research 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 alternatives that can be produced domestically. The Innovations Subprogram addresses the technical barriers which currently prevent vehicles from operating at their potential maximum theoretical efficiency. These activities focus on identifying the maximum potential across the full breadth of vehicle technologies, including battery energy storage, power electronics and electric motor efficiency, combustion engine efficiency, and the minimum vehicle weight possible, and then developing technologies and strategies to overcome the technical and economic barriers being confronted by each technology group. These improvements can be combined to create integrated advanced technology vehicles capable of between 200 to 400 percent increased fuel economy per vehicle for passenger vehicles and 40 to 50 percent for commercial vehicles.

Key Technology and Focus Areas

Batteries/Energy Storage – Longer term R&D in FY 2013 will focus on research in the area of extremely high energy battery chemistries for use in EVs and PHEVs, and high power systems for HEVs. Higher energy and higher power electrode materials promise to significantly lower system cost by reducing the amount of material and the number of cells needed for the entire battery pack. The focus of this work will be on the development of new materials and electrode couples that offer a significant improvement in either energy or power over today's technologies. Some specific technologies which are of interest include, but are not limited to: the design and development of robust cells that contain high voltage (5V) and/or high capacity (>300mAh/g) cathode materials; metal alloy or lithium metal anodes; lithium/air and lithium/sulfur electrochemical systems; and high voltage and solid polymer composite electrolytes. In addition to new high-capacity electrode materials and high-voltage electrolytes, research efforts will be devoted to the development of novel electrolyte formulations and additives to form a stable solid electrolyte interphase for improved tolerance to abusive conditions, longer life, low temperature operation, and fast charge capability. In coordination with the Office of Science/Basic Energy Science (BES), ARPA-E, and Office of Electricity Delivery and Energy Reliability, the VTP battery/energy storage activity will participate in integrated activities to support development of nanoscale materials and architectures for electrical energy storage. Nanomaterials can exhibit superior performance over conventional battery materials in terms of high pulse discharge and recharge power, and improved performance at low temperatures. However, the behavior of these materials is not well understood and is thought to be more than just a length-scale effect. New diagnostic tools and techniques will be developed to investigate these materials.

With additional funding, two new activities will be started in FY 2013: (1) next generation "beyond lithium" technology development and (2) battery manufacturing innovations. The purpose of the beyond lithium technology development activity will be to move extremely high-energy and low cost, next generation

technologies from the university and national laboratory arena to the first stages of industry development through the development and testing of full cells. Some examples that may be pursued are solid-state (lithium metal with solid electrolytes) lithium, lithium sulfur, and lithium air batteries. All of these promise energy densities from two-to-five times that of traditional Li ion. In addition, some non-lithium couples (e.g., magnesium, zinc) may show promise in the low cost arena in the long-term. The goal of these projects will be to develop (and deliver to DOE for testing) cells using beyond Li ion materials that deliver two to five times the energy density of current cells, or significantly lower cost than current cells. The battery manufacturing innovations activity will develop game-changing lithium-ion battery manufacturing approaches that leapfrog current battery manufacturing processes and provide significant cost reduction.

Power Electronics and Electric Motors (PEEM) – Longer term R&D will focus on cost reduction of power electronics, electric motors and other electric propulsion components as well as thermal management technologies necessary for increased vehicle electrification. The activity funds R&D of inverters and motors (permanent magnet [PM] and non-PM), DC-to-DC power converters, chargers, semiconductor components, innovative topologies and devices, advanced thermal systems, and motor control systems. These R&D efforts will reduce electric drive system costs while meeting performance and reliability requirements, and also achieving weight and volume reductions. Subcomponent R&D concentration areas are high-temperature capacitors, improved magnets including non-rare-earth magnets, and wide band-gap materials (such as silicon carbide [SiC] and gallium nitride [GaN]). Emphasis will increase on reducing the use of rare earth materials in electric motors, and long-term research to develop novel, low cost magnetic materials without any rare earth content that can meet automotive requirements.

Advanced Combustion Engines – Research will focus on improving the fuel economy of passenger and commercial vehicles through improvements in engine efficiency. Increasing the efficiency of internal combustion engines is one of the most cost effective approaches to reducing petroleum consumption of the Nation's fleet of vehicles in the near- to mid-term. Using these advanced engines in HEVs and PHEVs will enable even greater fuel savings benefits for several decades. Improvements in engine efficiency alone have the potential for dramatically increasing vehicle fuel economy, and reducing GHG and criteria emissions. Accelerated research on advanced combustion regimes, including homogeneous charge compression ignition (HCCI) and other modes of low-temperature combustion, lean-burn gasoline, and multi-fuel operation, is aimed at realizing this potential. This activity develops technologies for advanced engines with the goal of improving thermal efficiency by optimizing combustion, fuel injection, air handling, emission control, and waste heat recovery systems, along with reducing friction and pumping losses, while ensuring that no new toxic air emissions are generated. Research will be conducted in collaboration with the Office of Science/BES on fundamental combustion with optically accessible engines and laser diagnostics; computer modeling and simulation of combustion in engines; and fuel injector spray visualization and modeling. Research will include fundamental catalyst material characterization for exhaust emission control systems with computer modeling and simulation of components to reduce cost and energy use and increase performance and durability of NO_x reduction and PM oxidation devices. Project areas include development of low-cost base metal catalysts (to replace expensive platinum group metals), lighter and more compact multifunctional components, and new control strategies. Work on high-efficiency thermoelectric generators will produce electricity from waste heat, as well as investigate thermoelectrics in heating and air conditioning applications.

Fuel and Lubricants – Research enables advanced combustion engine development. As engines become more complex, and as emissions standards become more stringent, the sensitivity of engine performance and emissions to variations in fuel properties increases. Understanding fuel effects on combustion and fuel-engine interactions is critical to supporting the broadest possible application of new, clean engine technologies in vehicles of the future. Additionally, fuel substitution is another important potential route to petroleum displacement. There are many potential alternative fuels, including “drop-in” biofuels, and their characteristics vary widely. Research on such fuels and their interaction with combustion engines and with related infrastructure is a necessary part of differentiating the value of competing alternative fuel options. Lubricants research presents a rare opportunity to develop a retrofittable technology that can be very quickly deployed through existing market mechanisms. There are opportunities for improvement of engine and transmission lubricants, but those opportunities can only be exploited through an improved understanding of the fluidic- and material-science basis of friction and wear resistance.

Materials – Research will focus on enabling the weight reduction of vehicles by addressing fundamental technical barriers and developing new materials to enable improved efficiency for next-generation internal combustion engines, hybrid-electric drive power-

electronics and motors, and devices that convert waste heat into usable energy or work. Longer term R&D in FY 2013 will focus on improved characterization and performance of advanced high strength steels, aluminum, magnesium, carbon fiber, and carbon fiber composites. (Projects on advanced materials will be closely coordinated with Advanced Manufacturing Office, with collaboration planned in some areas to maximize impact and prevent duplication.) Decreasing the lead time for development of new materials and processes requires a more complete understanding of the fundamental mechanisms that drive material behavior. Research activities will address fundamental needs in structural materials. Results from these materials research activities provide input for simulations, development concepts, and the automotive engineering community.

Research will use advanced characterization, materials simulation, materials synthesis, and advanced Integrated Computational Materials Engineering (ICME) approaches to develop materials that meet the property requirements of long-term next-generation advanced vehicle powertrain technologies. Examples of these include new catalysts and substrate materials for improved exhaust after-treatment devices; new materials that reduce dependence on rare-earth components; and new thermoelectric materials to improve the performance of solid-state waste heat energy conversion and heating, ventilation, and air conditioning devices.

Research in the area of legacy fleet improvement will assess compatibility of tread components and surface modifiers for tires, investigate the feasibility of various synthesis methods, and evaluate performance of polymer films.

Activities such as technical, market, economic and other analyses; peer reviews; and data collection and dissemination will be supported.

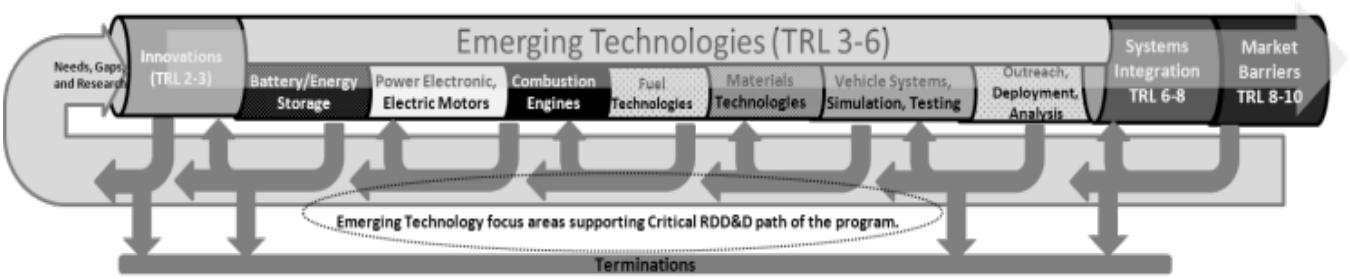
Benefits

Advances in batteries and battery materials are helping to significantly reduce the cost of batteries and improve battery performance. With lower cost batteries, companies will be able to increase the range and/or lower the prices of electric drive vehicles. Higher energy and higher power electrode materials for electric drive batteries promise to significantly lower system cost by reducing the amount of material and the number of cells needed for the entire battery pack. A specific accomplishment in FY 2011 is the development and technology transfer of a new cathode material by Argonne National laboratory. Argonne's composite cathode material has a unique combination of lithium- and manganese-rich mixed-metal oxides that will lower battery cost and extend electric vehicle operating range. The enhanced stability of the composite material permits battery systems to charge at higher voltages, which leads to a substantially higher energy storage capacity. Argonne's cathode technology was successfully licensed to General Motors Corporation and LG Chem Corporation for further development and use in GM's Chevy Volt Extended Range Electric Vehicle battery.

Increasing the efficiency of internal combustion engines is a cost -effective approach to reducing petroleum consumption of the Nation's fleet of vehicles in the near- to mid-term. Using these advanced engines in HEVs and PHEVs will enable even greater fuel savings benefits for several decades. Research on advanced combustion regimes and emission controls has resulted in significant improvement in engine-efficiency while reducing emissions to near-zero levels. Improved materials and advanced fuel and lubricant formulations are critical enablers to further engine-efficiency improvements. Recent accomplishments include laboratory demonstration of high efficiency engines with potential for over 75 percent improvement in passenger vehicle fuel economy and 20 percent improvement in heavy-duty diesel engine efficiency.

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Emerging Technologies	111,315	113,567	168,209
SBIR/STTR	0	3,465	5,127
Total, Emerging Technologies	111,315	117,032	173,336

Sequence



Description

The Emerging Technologies Subprogram supports development 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 alternatives that can be produced domestically. The subprogram advances promising research from the laboratory bench to actual test devices. This work develops technologies that push the efficiency and performance of vehicle systems beyond the current technical limits. These activities focus across the full breadth of vehicle technologies, including developing batteries, power electronics, electric motors, internal combustion engines, and vehicle structures that redefine state-of-the-art for each technological area. Promising technologies are pushed to the Systems Integration Subprogram where technologies are demonstrated as complete integrated prototype vehicles. These improvements can be combined to create integrated advanced technology vehicles capable of between 200 to 400 percent increased fuel economy per vehicle for passenger vehicles and 40 to 50 percent for commercial vehicles.

Key Technology and Focus Areas

Batteries/Energy Storage – Full system development will continue in cooperation with industry both through the United States Advanced Battery Consortium (USABC) and direct contracts with DOE. All subcontracts are awarded under a competitive process and are cost-shared by developers. This focus area will accelerate the development of batteries for PHEVs and EVs. The focus of this work will be on the development of robust cells or systems that contain new materials and electrodes that offer a significant reduction in battery cost over existing technologies. Research will be conducted to expedite the development of more efficient electrode and cell designs and fabrication processes to reduce the cost for high-volume production of large format lithium-ion batteries. Three new activities will be started in FY 2013: (1) pre-production electric vehicle (EV) battery prototypes, (2) scale-up of advanced battery materials, and (3) battery computer aided engineering (CAE) design tools and standards development. EV battery prototypes will focus on pack-level innovations that reduce the weight and cost of thermal management systems, structural and safety components, and system electronics. Currently, these "non-active" components of a battery increase the volume, weight, and cost of the finished product. Approaches to reduce the size of these inactive components in the cell and battery will be pursued. VTP will also accelerate the market entry of advanced batteries by supporting the scale-up, pilot production, and commercial validation of new battery materials and processes. New materials for advanced cathodes, anodes, and electrolytes are being developed by universities, National Laboratories, and industry to address barriers such as battery cost, life, and safety, but the commercial scale-up of such materials is often limited in scope. This activity will develop automated metrology tools and lower cost large scale processes that enable accurate and reproducible production of advanced battery materials.

VTP's CAE activity will accelerate the development of advanced battery computer aided engineering tools capable of identifying an optimal design in days or weeks, compared to months or years for a hardware-based process. This activity will greatly broaden the focus of an

existing CAE development effort. The focus of this new activity will be to develop, strengthen, and validate life and abuse models to increase the confidence of battery developers and automotive OEMs in the real world performance of their electric drive vehicle (EDV) batteries. In coordination with this modeling effort, VTP will support the accelerated development of standards for battery design, and will encourage and facilitate the implementation of these standards throughout the industry.

Studies of recycling and reuse of lithium batteries will continue. This activity will also continue to validate requirements and refine standardized testing procedures to evaluate performance and life of PHEV and EV batteries, as well as identify areas requiring additional R&D. The focus of the high-power battery development will be to significantly reduce the cost of lithium-ion batteries and improve the performance of ultracapacitors, and advanced lead acid batteries for conventional HEVs.

Power Electronics and Electric Motors – Partnerships with industry will continue in efforts to develop power electronics and electric motors with a focus on advanced, low cost technologies and topologies compatible with the high-volume manufacturing of motors, inverters, and DC/DC converters for electric drive vehicles. These activities will enable substantial reductions in cost, weight, and volume while helping to ensure a domestic supply chain for electric drive vehicle components. Emphasis will be placed on R&D for advanced packaging, enhanced reliability, and improved manufacturability. Efforts will also accelerate technology transfer from research organizations to domestic manufacturers and suppliers. New competitively awarded cost-shared grants to develop electric traction drive systems with potential to realize significant breakthroughs (such as wide band gap devices) for how power electronics and electric motors are structured, integrated, and executed will begin. Specifically, cost reductions may be realized through the elimination of rare earth materials, emphasis on scalability and improvements in manufacturability, and/or the integration of other drive system components such as chargers and DC/DC converters. VTP is working collaboratively with ARPA-E to develop revolutionary technologies to achieve significant cost reductions and performance improvements for power electronics and electric drive motors.

Vehicle and Systems Simulation and Testing – Emerging technologies will include support for the development of advanced charging solutions for electric-drive vehicles through an industry/university/National Laboratory consortium, focused on static wireless charging in the near-term, while examining the economics of and pathways for dynamic (in-motion) wireless charging in the long-term.

Support for SuperTruck will target system-level solutions to improve efficiency in heavy-duty vehicles, including hybridization, reduction of accessory loads, and aerodynamic optimization. Industry/university/National Laboratory teams will be competitively contracted to develop high-efficiency heating, ventilation, and air-conditioning (HVAC) systems to increase the range of electric-drive vehicles and improve the fuel-efficiency of vehicles powered by internal combustion engines. Other mechanisms to reduce parasitic losses from friction and wear, thermal loads, and accessory loads will also be investigated. The test mule vehicle will be utilized to perform component-level laboratory and field evaluations of advanced, prototype energy storage systems, to analyze how these devices interact with other electric-drive components in real-world operating conditions. Modeling and analysis of advanced technology options will also continue to determine the petroleum reduction potential of the electric-drive, advanced combustion, and lightweight materials technologies developed by VTP.

Materials – Lightweight materials development activity focuses on accelerating the integration of various weight reduction approaches, determining the viability of new technology, and addressing additional technology gaps that must be overcome in order to introduce new light weight technologies to effectively lightweight the vehicle. Development efforts in materials support maturation of promising technology in advanced high strength steel, aluminum, magnesium, carbon fiber, and carbon fiber composites. Achieving improved materials performance at acceptable cost is often limited by advances in manufacturing techniques hence emphasis in materials development is given to processing/forming techniques, joining and multi-material enabling technologies, and process simulation. Propulsion materials development efforts focus on the processes to produce components from materials previously developed in earlier stages of research, such as high strength and high temperature alloys for engine structure, exhaust valves, and turbo-machinery.

Work will also evaluate the efficiency benefits, life cycle performance, component cost, and implications of fuel formulations on new materials within the powertrain. Promising technologies will be advanced to key technical teams within the program for further development or demonstration.

Advanced Combustion Engine – Activities focus on full system development in cooperation with industry and the National Laboratories to demonstrate engine efficiency improvements that meet sub-program goals. For example, development of a complete engine system for SuperTruck will incorporate technologies for heavy-duty diesel engines, such as optimized combustion, fuel injection, emission control, and waste heat recovery systems while reducing

parasitic, friction and pumping losses to meet these engine system goals. The activity will emphasize accelerating the development of laboratory testing of new combustion engine concepts; laboratory evaluation of novel emission control components; demonstration of complete emission control systems; and demonstration of high-efficiency prototype engine concepts. The activity will demonstrate thermoelectric modules in vehicle applications with the potential to cost-effectively improve vehicle fuel economy by up to 5 percent, and will also investigate scaling up production of thermoelectric modules that can produce electricity from engine waste heat for demonstration.

Fuels and Lubricants – Development activities will evaluate the fitness-for-service of candidate biofuels being pursued by the Office of the Biomass Program and other entities, and will support work to optimize the performance of vehicle engines when operated on advanced renewable, alternative fuels and lubricants.

Outreach, Deployment and Analysis – Work to improve the legacy vehicle fleet and reduce vehicle miles travelled will focus on analyzing and fabricating prototypes of an integrated automatic tire inflation system, and prototype tires which incorporate novel tread compounds and barrier coatings, and will develop algorithms for route planning and driving data management. Peer reviews of vehicle research and development activities will continue to inform decisions about program focus.

Activities such as technical, market, economic and other analyses; and data collection and dissemination will be supported.

Benefits

A significant barrier toward widespread consumer adoption of electric vehicles is the high cost of the battery. For this reason, the subprogram seeks to develop the necessary technologies to achieve significant cost reductions in electric drive vehicle batteries. A major accomplishment in FY 2011 was the reduction of the cost of lithium-ion battery packs for plug-in hybrid electric vehicles (PHEV) by 35 percent since 2008, from $1,000 to $650 per kilowatt-hour; efforts are on track to reduce costs 70 percent to $300 per kilowatt-hour by 2014.

Prototype development and validation enhance industry and consumer confidence in new technologies thereby encouraging market adoption. Recent accomplishments include demonstration of 10 percent engine efficiency improvement utilizing waste heat from a commercial vehicle engine. A production prototype thermoelectric generator was installed in a passenger vehicle that will produce electricity from engine waste heat. Recently completed projects in advanced engine combustion also resulted in a greater than 10 percent efficiency improvement in efficiency for light and heavy-duty engines.

Vehicle systems development activities provide improved understanding of the real-world performance and petroleum-displacement potential of advanced energy storage systems, electric motors, lightweight materials, advanced combustion engines, and other vehicle systems (e.g., HVAC components) to guide future R&D activities and focus investments on the most promising technologies.

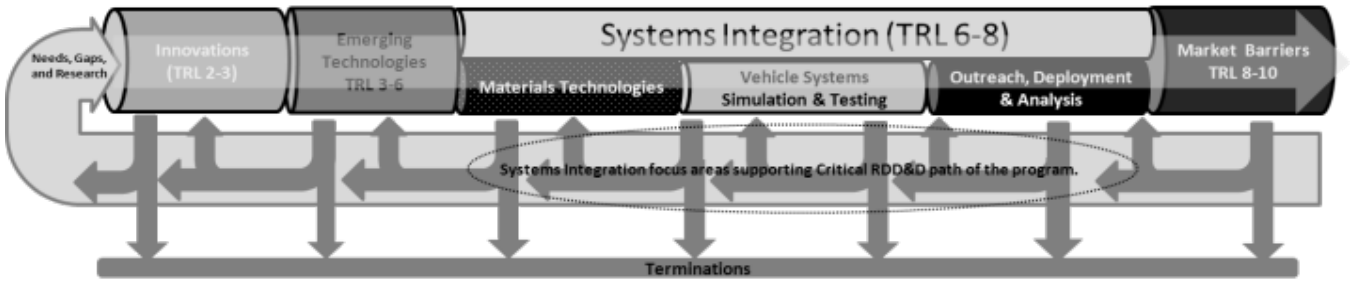
Systems Integration

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Systems Integration	17,567	19,875	14,043
SBIR/STTR	0	0	0
Total, Systems Integration	17,567	19,875	14,043

Sequence



Description

Vehicle technologies systems integration activities demonstrate prototype and pre-prototype technologies to validate technology performance in real world environments. Promising technologies across the full breadth of vehicle technologies are demonstrated as complete integrated prototype vehicles. As new technologies are developed in program R&D activities, systems integration combines these improvements in order to eventually demonstrate integrated advanced technology vehicles capable of between 200 and 400 percent increased fuel economy per vehicle for passenger vehicles and 40 to 50 percent for commercial vehicles. The program supports university-oriented activities to demonstrate advanced automotive technologies, which create graduate education opportunities and encourage undergraduate engineering students to gain experience in these technologies.

Key Technology and Focus Areas

Vehicle and Systems Simulation and Testing – Activities focused on systems integration will involve the evaluation of codes and standards related to electric-drive vehicles, in order to identify requirements and gaps that must be addressed to enable the successful integration of plug-in vehicles and the electric grid. Laboratory and field evaluations will continue, in order to provide feedback to the vehicle R&D Community as well as the modeling and simulation activities to validate component models and characterize sub-system interactions. Modeling and simulation efforts, in turn, will be used to evaluate potential interactions of advanced components as they emerge from laboratory R&D activities and are integrated into vehicle systems. Additionally, the benefits of various advanced aerodynamic drag reduction techniques and devices applied to commercial vehicles will be evaluated.

Outreach, Deployment and Analysis – Advanced Competitions supports a three-year collegiate engineering competition that provides hands-on, real-world experience to demonstrate a variety of advanced vehicle technologies and designs and to educate the next generation of automotive engineers in the process. The Graduate Automotive Technology Education activity establishes, develops, and expands course work for graduate engineering degrees with a focus or certificate in critical automotive technology areas. The activity includes university research focused on developing and demonstrating advanced vehicle technologies as part of the educational experience. Efforts focused on reducing vehicle miles travelled will install prototype driver feedback devices on pilot vehicles and evaluate performance in real-world driving conditions.

Materials – Implementing new lightweight automotive materials requires validated material performance, suitable manufacturing techniques, and accurate simulation tools. Demonstration projects help to provide this validation while identifying remaining technology gaps. Structural component (or system) performance is a complicated function of design, processing & manufacturing, and material behavior; construction of lightweight vehicles and vehicle sub-systems simultaneously addresses an integrated approach to

component performance while providing significant insight into new materials. Demonstration projects for low-cost, energy efficient lightweight materials can support wider adoption of advanced metals and composites by reducing the technical risk of implementation. The crash behavior of many advanced materials is complicated and difficult to predict; demonstration projects develop, improve, and validate the accuracy of models predicting the behavior of new lightweight materials under crash conditions, enabling vehicle designers to optimize designs for structural systems. Propulsion materials systems integration efforts will validate component performance and system efficiency improvements through on road/track tests of vehicles utilizing the new powertrain components developed with new materials resulting from research innovation activities. Technologies will be demonstrated on either heavy-duty platforms in the SuperTruck demonstration projects or in light-duty platforms being evaluated in the vehicle and systems integration activity.

Activities such as technical, market, economic and other analyses; peer reviews; and data collection and dissemination will be supported.

Benefits

The demonstration and validation of a multi-material vehicle (MMV) that is 50 percent lighter compared to a 2002 mid- size vehicle should enable a minimum of 30-40 percent improvement in vehicle energy efficiency. The demonstration of the MMV is a systems integration of developed emerging technologies for a new architecture of the vehicle that enables significant weight reduction while preserving cost effectiveness and safety.

Vehicle systems activities will integrate advanced electric drive components and parasitic load reduction technologies into high-efficiency grid connected vehicles utilizing smaller energy storage systems for overall performance enhancement and cost reduction. The development and adoption of a comprehensive and consistent set of codes and standards governing the interface between electric-drive vehicles and the electric grid is critical if the petroleum reduction benefits of these vehicles are to be realized. The data collected from laboratory and field evaluations, as well as the development validated component models, will improve understanding of the interaction among the various sub-systems in advanced vehicles, ensuring that program-wide research is considered within the context of the complete vehicle system to achieve maximum efficiency benefits.

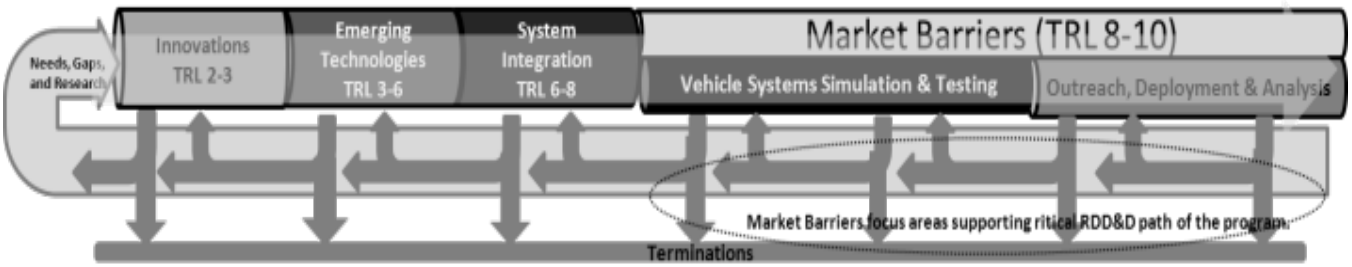
Market Barriers

Comparable Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Market Barriers	42,957	43,545	44,237
SBIR/STTR	0	0	0
Total, Market Barriers	42,957	43,545	44,237

Sequence



Description

The Vehicle Technologies Program supports activities to facilitate market adoption of new technologies, train local leaders and safety officials in advanced technologies, and inform program planning. Deployment efforts accelerate market transformation by increasing public awareness and adoption of new vehicle technologies that are being developed through the program's R&D and vehicle and systems simulation and testing activities. These initiatives help support the achievement of petroleum and emissions reductions by addressing market barriers, stimulating infrastructure development, training local service industries, building government/industry partnerships, and facilitating technology transfer when R&D is completed.

Key Technology and Focus Areas

Vehicle and Systems Simulation and Testing – Deployment efforts will include codes and standards activities to remove barriers to the market penetration of grid-connected vehicles and charging infrastructure, including communications and interoperability. Laboratory and field evaluations of advanced vehicles and refueling infrastructure will continue, to characterize the performance, life-cycle cost, and efficiency benefits of the latest technologies to be deployed.

Outreach, Deployment and Analysis – Vehicle technology deployment activities, primarily through Clean Cities, support four main focus areas: 1) Local Community/Coalition Support: DOE helps convene key community and business leaders to develop and implement projects & policies, leverage resources, and address local barriers; 2) Public Information, Outreach, and Education: DOE-developed tools help consumers save money on fuel cost and help fleets understand their options for cost-effective alternatives to gasoline and diesel fuel; 3) Technical & Problem Solving Assistance: DOE experts help local leaders address permitting and safety issues, technology shortfalls, and other project implementation barriers; and 4) Competitively-Awarded Financial Assistance: Federal cost-share encourages initial private sector match and long-term investment related to infrastructure development and other vehicle deployment initiatives.

The Graduate Automotive Technology Education activity is focused on establishing, developing, and expanding course work and research to support graduate engineering degrees with a focus or certificate in critical automotive technology areas. The engineers are knowledgeable about, and experienced in, developing and commercializing advanced automotive technologies to help overcome technology barriers preventing the development and production of cost-effective, high-efficiency vehicles for the U.S. market.

Technical assistance for State and Alternative Fuel Provider rulemaking activities will include revision of the Alternative Compliance regulations to make it easier to get a waiver and support the development of advanced fuels and technologies.

Activities such as technical, market, economic and other analyses; peer reviews; and data collection and dissemination will be supported.

Benefits

Vehicle systems activities will help remove regulatory and market acceptance barriers to wide-spread adoption of advanced grid connected vehicles and infrastructure by validating performance, reliability, and life-cycle costs and characterizing consumer utilization patterns leading to improved vehicle designs and infrastructure placement. Efforts will support the adoption of codes and standards that will ensure vehicle/grid inter-operability while driving down costs associated with multiple charging formats and guaranteeing consumer safety. In order to quantify the petroleum reduction benefits of technologies developed by the program, it is imperative that the usage patterns of these vehicles are understood as they are adopted by consumers. Laboratory and field evaluations of new vehicle technologies will provide this insight. Interoperability between all plug-in vehicles and charging infrastructure is required to provide consumer confidence so that electric-drive vehicles can reach large-scale commercial acceptance. Codes and standards activities will enhance consumer acceptance, accelerating the rate at which plug-in vehicles are adopted.

Petroleum reduction projects will be completed in FY 2012 that will deploy alternative fuel and advanced technology vehicles and the fueling/charging infrastructure needed to support them. Over 600 million gallons of gasoline and diesel fuel displacement and/or reductions were reported from program deployment activities and projects undertaken by Clean Cities Coalitions. In addition, new deployment awards were implemented for electrical vehicle readiness and infrastructure development planning in communities across the country.

Weatherization and Intergovernmental Activities

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Weatherization and Intergovernmental Activities			
Weatherization Assistance Grants	171,000	65,000	135,700
Weatherization Training and Technical Assistance	3,300	3,000	3,300
State Energy Program	50,000	50,000	49,000
Tribal Energy Activities	7,000	10,000	7,000
Total, Weatherization and Intergovernmental Activities	231,300	128,000	195,000

Public Law Authorizations

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Supply and Production Act" (ECPA) (1976)
P.L. 95-619, "National Energy Supply Policy Act" (NECPA) (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The mission of the Weatherization and Intergovernmental Activities Program (WIP) is to significantly accelerate, in partnership with state and local organizations, the deployment of energy efficiency and renewable energy technologies and practices by a wide range of government, community, and business stakeholders.

WIP addresses both the supply and demand sides of energy security by facilitating investments in clean energy generation and energy efficiency. The program provides a combination of financial and technical assistance to State, local, U.S. territory, and tribal governments. Grantees utilize these resources for residential energy retrofits, renewable energy planning, emergency energy management, financing of clean energy projects, and sustainable energy policies development.

Key program challenges include:

- Continuing to leveraging high private sector investments; and
- Providing technical support to communities to continue clean energy deployment after Recovery Act investments have been completed.

Strategy

WIP's strategic objective is to "deploy the clean energy technologies we have." These typically near-term activities produce almost immediate results in the form of greater energy efficiency, lower energy use, expanded renewable energy capacity, and economic development.

Program Goals:

- Reduce energy demand by supporting state, local, U.S. territory, and tribal implementation of energy efficiency programs in the buildings, industry, transportation, and utility sectors.
- Expand the clean energy supply through the deployment of safe, low-carbon renewable energy technologies (e.g., wind, solar, geothermal).
- Enable low-income families to reduce energy costs and save money by weatherizing their homes.
- Prepare a network of workers for careers in commercial and residential energy retrofit and other energy-related fields.

Key WIP FY 2013 priorities are to:

- Develop and disseminate best practice, assessment, planning, and decision-making tools to facilitate clean energy technology delivery.
- Establish partnerships with national and regional organizations representing key decision-makers (e.g., governors, mayors, state legislators, tribal leaders).
- Provide strategic, objective expert assistance on specific grantee requested clean energy policies and issues.
- Improve cost effectiveness and technical approach in the residential energy retrofit process.
- Expand certified training programs for a network of workers in residential energy retrofits and other energy-related fields.
- Utilize integrated web-based systems for reporting, monitoring, communication, and provision of technical assistance.
- Actively manage and monitor the progress of awardees and ensure the effective and efficient use of funds.

WIP addresses regulatory, finance, and planning market barriers associated with energy efficiency and renewable

energy technologies. WIP grantees address local market barriers by:

- Reducing market barriers through removal of local regulatory disincentives for energy conservation;
- Lowering the cost of capital through new business models and finance mechanisms; and
- Standardizing and simplifying renewable energy siting, permitting, environmental review, and grid connection policies.

The program focuses primarily on improving the energy efficiency of new and existing residential and commercial buildings. WIP actively supports State-led utilization of EERE's Building Technologies Program products and processes, including the adoption of improved appliance standards and building energy codes.

Benefits

WIP contributes directly to achieving the Retrofit High Priority Performance Goal (HPPG), a multi-agency effort to weatherize 1,200,000 homes by the end of FY 2013. Information on the intermediate performance may be found through http://performance.gov/.

Through the retrofit and other efforts, the program produces key benefits. Specifically:

- Residential energy retrofits reduce energy consumption while concurrently reducing energy costs for low-income families.
- State energy project support serves as an important foundation for reducing energy use and costs, developing environmentally conscious state economies, and increasing renewable energy generation.
- In partnership with tribal governments, tribal energy activities are particularly valuable in advancing sustainable clean energy development and deployment on tribal lands.

WIP also achieves reductions in greenhouse gas (GHG) emissions through the deployment of clean energy technologies and sustainable energy policies.

Key Accomplishments

Grantee reporting, monitoring, and validation systems developed for Recovery Act programs also benefit regular program activities. The Performance and Accountability for Grants in Energy (PAGE) system is a tool that provides DOE and formula grantees, including state and local governments, and tribal organizations, with the ability to electronically submit and manage grant performance and financial information.

WIP manages over $10 billion in State and local Recovery Act formula grants. Through FY 2011, 2,400 funding recipients utilized $6.8 billion to:

- Reach 50 percent of DOE goal for 1 million residential energy retrofits – 3 months ahead of schedule;
- Process $1 billion in energy-related loans and grants; and
- Conduct 50,000 commercial and residential lighting retrofits.

Other significant achievements are provided in the subprogram budget sections.

Strategic Plan and Performance Measures

WIP, in cooperation with the Golden Field Office and DOE Laboratories, accelerates the deployment of energy efficient and renewable energy technologies, practices, and policies. Eligible grant recipients include States, U.S. Territories, the District of Columbia, and select Native American tribal governments. The program supports the Market Barrier component of the research, development, demonstration and deployment (RDD&D) continuum with a TRL level of 10. State and community smart policies and regulations and financial incentives provide feedback and lay the ground work for the acceptance and adoption of emerging technologies.

WIP utilizes the following pathways:

- Formula grants to support core capabilities of state and weatherization offices.
- Competitive grants to support high impact and innovative energy efficiency and renewable energy projects.
- A wide range of technical assistance (including evaluation and outreach) activities to improve program effectiveness.

WIP will implement the following strategies:

- Expand collaborative "best practices" approaches and incentives focusing on high-impact highly leveraged sustainable energy integration and clean energy deployment projects.
- Bridge gap between "demonstration" and "deployment" for emerging energy efficiency and clean energy technologies.
- Lead comprehensive national certifications and standards processes for residential energy retrofit worker training, energy audits, and weatherization methods.
- Utilize web-based integrated grantee reporting, approval, and monitoring system to facilitate program implementation and effectiveness.
- Coordinate with the DOE Office of Indian Energy Policy and Programs on crosscutting efforts to simplify processes for working directly and effectively with tribal governments.
- Leverage Federal dollars by requiring or attracting State, local and private sector matching funds on a more than one to one basis.

- Effectively manage program activities to ensure alignment with timely utilization of grant funds and provision of technical assistance.

Performance Measure Analysis

WIP performance measures align with the program's technology deployment mission and the DOE goal to build a competitive, low-carbon economy and secure America's energy future. The weatherization metric represents residential energy efficiency deployment and is used in estimating energy savings and lowering of greenhouse gases from these activities. Average annual heating and cooling savings of 29 million Btus per retrofit based on Oak Ridge National Laboratory (ORNL) evaluation.

The state energy performance measure directly estimates the energy impact from the deployment of clean energy technologies and policies. The energy saving targets and success measurements are based on a methodology developed by ORNL in: "Estimating Energy and Cost Savings and Emissions Reductions for the State Energy Program Based on Enumeration Indicators Data" (January 2003); and "An Evaluation of State Energy Program Accomplishments: 2002 Program Year" (June 2005). State energy activities are greatly enhanced by the leveraging of non-DOE funds; based on the 2003 ORNL study, each dollar invested by DOE can be estimated to leverage an additional $11 in non-DOE funds.

In FY 2013, collection and analysis of data from Recovery Act projects will enable updated estimates of programmatic impacts on energy and cost savings, leveraged funds, and other metrics.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Weatherization Assistance Grants – In FY 2012, weatherization activities were supported through the use of prior year balances from Recovery Act awards and the performance-based distribution of FY 2012 funds. The increase in the FY 2013 request will sustain essential weatherization production, training, and infrastructure for grantees as the remaining Recovery Act projects are completed.	65,000	135,700	+70,700
Weatherization Training and Technical Assistance – Supports the continuation of certified training programs for a network of workers in residential energy retrofit and other energy-related fields.	3,000	3,300	+300
State Energy Program – Supports the development and maintenance of state and local renewable energy and energy efficiency programs.	50,000	49,000	-1,000
Tribal Energy Activities – Continues to support the assessment and planning of sustainable energy options, renewable energy installations, and cost effective energy projects on tribal lands.	10,000	7,000	-3,000
Total, Weatherization and Intergovernmental Activities	128,000	195,000	+67,000

Explanation of Changes

WIP provides the financial resources and technical expertise needed by grantees to design, manage, and implement a wide range of successful energy efficiency and renewable energy programs. For the State Energy Program and Tribal Energy Activities the types and amounts of assistance will be similar to the mix in FY 2011.

In FY 2012, Congress provided the latitude to allocate weatherization appropriations reflecting the balances accumulated while states were drawing down Recovery Act awards. With the anticipated expenditure of accumulated balances, the increase in the FY 2013 request will sustain essential weatherization production, training, and infrastructure for grantees.

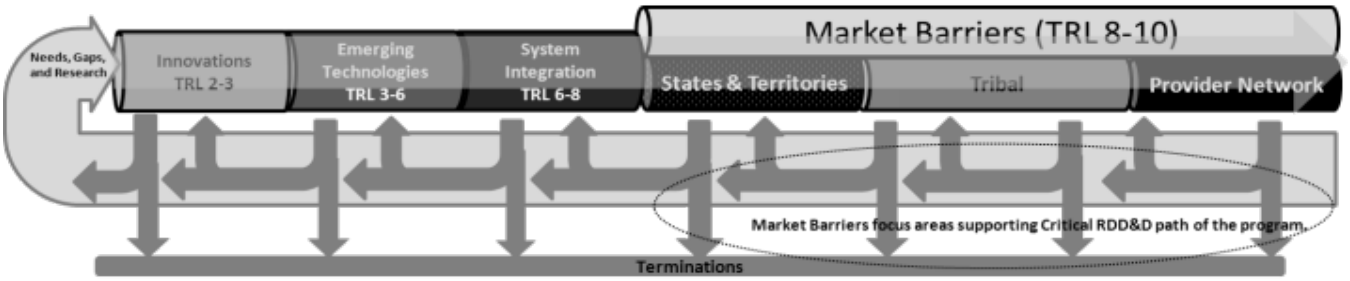
Weatherization Assistance Grants

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Weatherization Assistance Grants			
Weatherization Assistance (Formula Grants)	171,000	65,000	135,700
Weatherization Training and Technical Assistance	3,300	3,000	3,300
Total, Weatherization Assistance Grants	174,300	68,000	139,000

Sequence



Description

Low-income weatherization assistance activities reduce the cost of residential household energy bills, which are a significantly disproportionate share of income compared to higher income households. Typical energy conservation measures include: installing insulation; sealing ducts; repairing or replacing heating and cooling systems; reducing air infiltration; improving hot water production and use; and reducing electric base load consumption. There are up to 40 million low-income households in the U.S. that are eligible for low-income housing energy assistance.

The FY 2013 performance target is to weatherize 21,286 low-income homes. The activity also leverages both Federal and non-Federal funding sources to expand both the array of services available for each home or increase the number of homes weatherized.

Recent achievements in the Weatherization area include:

- Since 1976, the program has helped 7 million American families reduce energy costs while increasing the comfort and safety of their homes.
- Average first-year energy savings of $437 per household in 2011 with each dollar invested in retrofit returning $2.51 in benefits, including $1.80 in energy-related benefits.[a]
- Retrofitted more than 500,000 homes with Recovery Act funding through FY 2011, saving low-income homeowners over $215 million in annual energy bills.
- Recovery Act investments directly supported more than 15,400 new full time jobs.
- Publication of "*Workforce Guidelines for Home Energy Upgrades"* to foster the growth of a high-quality home energy retrofit industry and a skilled and credentialed workforce.
- Development of a suite of resources to facilitate the implementation of energy efficiency retrofits in multi-family housing, and mobile homes.
- Expansion of the "Weatherization plus Health Initiative" — a nationwide effort to enable the comprehensive, strategic coordination of resources for energy, health, and safety in low-income homes.

Key Deployment and Focus Areas

Weatherization Formula Grants – Support the largest and most technically advanced network of residential energy retrofit providers. Funds are allocated on a formula basis and awarded to states, U.S. territories, the District of Columbia, and select Native American tribal governments to increase the energy efficiency of homes occupied by low-income families. These agencies, in turn, contract with over 1,000 local governmental or nonprofit agencies to deliver weatherization services to low-income clients in every geographic area of the country. Weatherization service providers choose the best package of efficiency measures for each home based on a comprehensive energy audit. The consistent delivery of quality services

[a] For details on these estimated benefits, see the ORNL report, "Weatherization Assistance Program Technical Memorandum: Background Data and Statistics" (March 2010).

is addressed through active Federal, regional and state training and technical assistance programs. In FY 2012 weatherization activities and the weatherization assistance network were supported through the use of prior year balances from annual and Recovery Act awards and the performance-based distribution of the FY 2012 appropriation.

Weatherization Training and Technical Assistance – DOE directed weatherization training and technical assistance activities improve program effectiveness and efficiency. The resources support the expansion of certified training programs for a network of workers in residential energy retrofits and other energy-related fields. Other activities include: strategic planning and analysis; program performance measurement and documentation; and facilitation of (e.g., through pilot programs, publications, training programs, workshops and peer exchange) advanced techniques and collaborative strategies. An ongoing national evaluation is assessing the overall energy savings and cost-effectiveness of the program.

Benefits

Weatherization assistance deployment activities:

- Reduce national energy consumption and lower energy costs for low-income households;
- Expand clean energy training and employment opportunities;
- Improve health and safety of homes occupied by low income families; and
- Average leveraging of one dollar in non-Federal contributions for each weatherization assistance grant dollar.

States and utility companies also contribute funds for weatherization activities. A state-by-state breakout of this information is available through the Weatherization Assistance Program Training Assistance Center (WAPTAC) website (http://www.waptac.org), under the "WAP Basics" tab in the funding survey section. Information is updated in June of each year. The following table displays the current information:

Weatherization Assistance Funding

(Whole Dollars)

State/Territory	Source of Non-Federal Funds[a]	FY 2013 DOE Request[b]	FY 2010 Non-Federal Funds[c]
Alabama	ABC Trust Fund	1,450,342	350,000
Alaska	State Funds	1,027,863	36,000,000
Arizona	Utility Funds	820,412	2,600,000
Arkansas	N/A	1,251,452	0
California	N/A	3,770,228	0
Colorado	Utility Funds	3,303,894	2,559,660
Connecticut	Utility Funds	1,519,066	750,000
Delaware	Utility Funds	363,663	800,000
Dist. Columbia	Sustainable Energy Trust	408,471	4,323,955
Florida	N/A	1,145,971	0
Georgia	Utility Funds	1,756,152	2,257,690
Hawaii	Other	141,147	500,000
Idaho	Utility Funds and Other	1,202,494	1,805,050
Illinois	Utility Funds	8,299,774	7,500,000
Indiana	N/A	3,938,353	0
Iowa	Utility Funds	3,006,565	5,062,500
Kansas	N/A	1,531,439	0
Kentucky	N/A	2,723,138	0
Louisiana	PVE	1,036,343	2,180,234
Maine	N/A	1,858,053	0
Maryland	Utility Funds	1,604,068	3,681,946
Massachusetts	Utility Funds	3,938,116	30,000,000
Michigan	Utility Funds	9,114,485	10,361,522
Minnesota	Utility Funds and Other	5,926,606	2,920,002

[a] State-by-state breakout from the "Weatherization Assistance Program Funding Survey PY 2010" report by the National Association for State Community Services. Programs' (NASCSP).
[b] Allocated on a formula basis
[c] FY 2011 non-Federal funding data not available until June 2012.

Weatherization Assistance Funding

(Whole Dollars)

State/Territory	Source of Non-Federal Funds[a]	FY 2013 DOE Request[b]	FY 2010 Non-Federal Funds[c]
Mississippi	N/A	998,101	0
Missouri	Utility Funds	3,606,511	2,952,972
Montana	Utility Funds	1,530,476	2,242,181
Nebraska	N/A	1,512,924	0
Nevada	FEAC	518,367	3,082,653
New Hampshire	Utility Funds	923,572	3,603,858
New Jersey	N/A	3,068,151	0
New Mexico	Utility Funds	1,162,820	2,048,178
New York	N/A	12,076,428	0
North Carolina	N/A	2,494,925	0
North Dakota	N/A	1,516,907	0
Ohio	N/A	8,236,468	0
Oklahoma	Utility Funds	1,562,777	150,000
Oregon	Public Purpose and Utility Funds	1,710,557	8,361,313
Pennsylvania	Utility Funds	8,815,744	1,500,000
Rhode Island	Utility Funds	711,928	1,686,089
South Carolina	N/A	1,073,166	0
South Dakota	N/A	1,168,126	0
Tennessee	N/A	2,517,218	0
Texas	N/A	3,293,602	0
Utah	State Funds and Utility Funds	1,264,121	1,027,480
Vermont	State Funds	785,541	4,602,033
Virginia	N/A	2,417,754	0
Washington	State Funds and Utility Funds	2,740,771	8,300,000
West Virginia	Utility Funds	1,942,232	825,000
Wisconsin	State Funds	5,152,509	55,796,318
Wyoming	State Funds	724,160	1,085,206
American Samoa	SEEARP and Other	130,138	303,619
Guam	N/A	133,261	0
Puerto Rico	N/A	506,345	0
Northern Mariana Islands	N/A	130,729	0
Virgin Islands	N/A	135,576	0
Headquarters T&TA	N/A	3,300,000	0
Total, Weatherization Assistance Funding		139,000,000	211,219,459

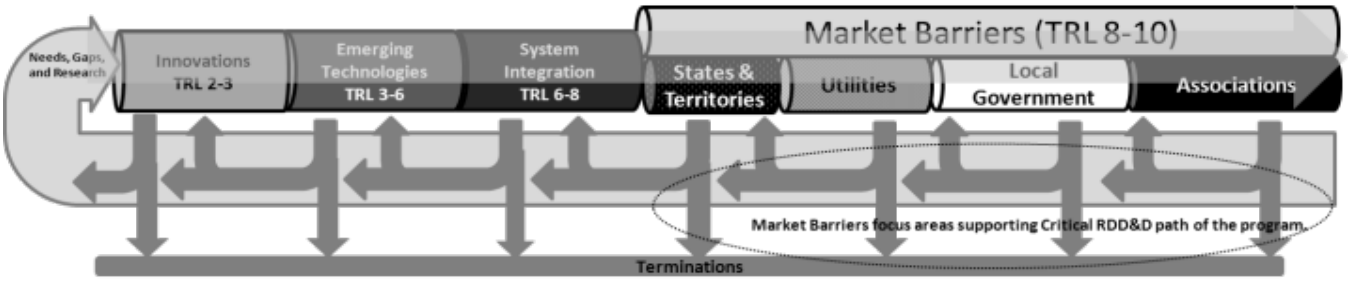
State Energy Program

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
State Energy Program	50,000	50,000	49,000
Total, State Energy Program	50,000	50,000	49,000

Sequence



Description

State energy activities have the capacity to greatly leverage private sector investments to create sustainable jobs in a new, expanding clean energy economy. State Energy Offices play a crucial role in the set up or reform of local policy and market infrastructures — often the last critical step to successful technology adoption.

Typical leveraged results[a] from an annual State Energy Program appropriation (non-ARRA) are:

- 15,000 energy audits of residential, commercial, and industrial buildings;
- 13,000 energy efficiency building retrofits;
- 6,400 alternative fuel vehicles purchased or converted;
- 92,000 energy-efficient LED traffic signals installed;
- $30 million in loans and $12 million in grants awarded to businesses and non-profits to support energy efficiency and clean energy projects;
- 600,000 students taught about energy efficiency; and
- 78 energy emergency plan elements developed and adopted.

Key Deployment and Focus Areas

State Energy Formula Grants – The formula grants are awarded to States, U.S. Territories, and the District of Columbia and support a nationwide infrastructure of state energy offices. The purpose is to increase market transformation for energy efficiency and renewable energy technologies through policies, strategies and public-private partnerships that facilitate their adoption and implementation. They also facilitate state-based activities, such as: financing mechanisms for institutional retrofit programs; loan programs and management; energy savings performance contracting; comprehensive residential energy programs for homeowners; transportation programs that accelerate use of alternative fuels; and programs that remove barriers and support supply side and distributed renewable energy.

State Energy Competitive Financial Assistance – Competitive financial assistance allows states to compete for funding designed to meet EERE nationally focused initiatives. They also provide opportunities for states to submit innovative proposals which highly leverage Federal funding and create sustainable or clean energy projects focused on specific high-impact market transformation and cross-cutting solutions. The overall objective is for states and territories to develop public-private partnerships to deploy technologies that have the best opportunity for local geographic and economic impact.

State Energy Technical Assistance – Technical assistance is an interdependent component to the financial assistance activities, making deployment of technology more efficient and effective and enhancing the likelihood of program success. Thousands of states and communities have obtained technical assistance to become more energy efficient and benefit economically from the transition to clean energy. Communities rely on the data collected, the analysis of technologies and

[a] ORNL report, "An Evaluation of State Energy Program Accomplishments: 2002 Program Year" (June 2005)

policies, the technology transfer to communities, and the peer to peer exchange made possible through local capacity-building efforts. Technical assistance resources are integral to: 1) tools development, decisional information, and other technical assistance to grantees and sub-recipients; 2) national energy initiatives and strategic partnerships focused on deployment and best practices; 3) development of web-based reporting and monitoring systems; and 4) metrics and evaluation of efficacy of State planning, analysis, and evaluation activities.

Benefits

State energy deployment activities:

- Reduce energy use and increase renewable energy generation capacity;
- Leverage an estimated $11 in non-Federal contributions for each dollar in state energy grants[a]; and
- Allow states to select their highest priorities for capacity building efforts, through funding flexibility.

[a] ORNL report, "Estimating Energy and Cost Savings and Emissions Reductions for the State Energy Program Based on Enumeration Indicators Data" (January 2003)

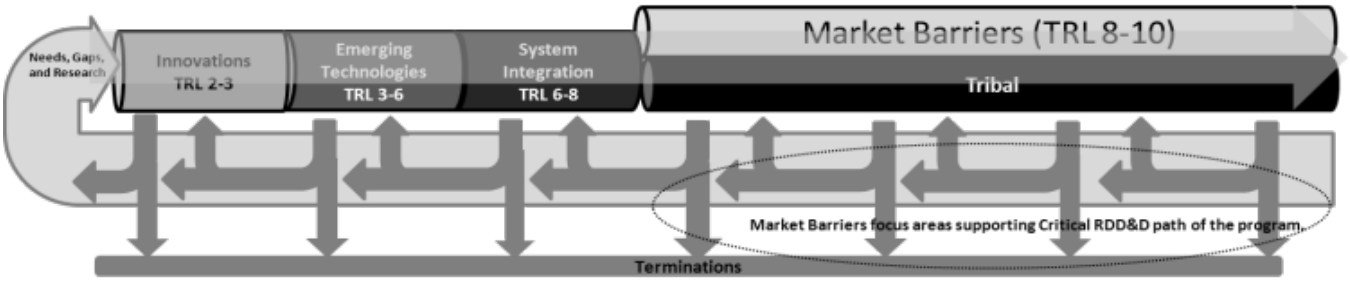
Tribal Energy Activities

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Tribal Energy Activities	7,000	10,000	7,000
Total, Tribal Energy Activities	7,000	10,000	7,000

Sequence



Description

Tribal energy activities build partnerships with the 565 federally recognized tribal governments to address residential, commercial and industrial energy and environmental priorities. In FY 2010, $13.6 million in tribal energy competitive grants were combined with $27 million in contributions from other sources to fund 36 tribal energy projects. Technical assistance activities spur both specific and broader project development. Performance goals are a 200 MW increase in renewable energy capacity on tribal lands and a 30 percent reduction in energy use in tribal buildings by 2020. Successful sustainable energy projects bolster tribal government energy and economic security.

Key Deployment and Focus Areas

Tribal Energy Competitive Financial Assistance – Tribal energy activities are particularly valuable in advancing sustainable clean energy development and deployment on tribal lands. The program utilizes financial assistance to support the assessment and planning of sustainable energy options, renewable energy installations, and cost effective energy efficiency projects. Between FY 2002 and FY 2010, 129 tribal energy projects totaling $30.4 million in DOE funding were awarded on a competitive basis.

Tribal Energy Tools Developments and Dissemination – The emphasis is on ways to better leverage existing public and private financing to accelerate the deployment of tribal energy projects. Product areas include: model contracts, sample project development documents, e.g., power purchase agreements; decision matrices, primers, and checklists; primers on business structures and tax implications; and economic and cash flow models. In FY 2013, the program will continue to improve and distribute these tools through the EERE website, webinars, and regional and national training sessions.

Other Tribal Energy Technical Assistance – To improve program performance, a peer review by outside experts will be conducted in FY 2012. Continuing technical assistance efforts include:

- Regional and national workshops on energy efficiency and renewable energy technologies;
- Access to clean energy deployment experts on specific project and crosscutting issues; and
- Through Sandia National Laboratory, renewable energy internships for Native American graduate students.

Benefits

Tribal energy deployment activities:

- Reduce energy use and increase renewable energy generation capacity;
- Leverage $2 in non-Federal contributions for each dollar in tribal energy grants; and
- Address tribal government priorities for energy sufficiency and economic development through sustainable energy projects.

Facilities and Infrastructure

Funding Profile by Subprogram

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Facilities and Infrastructure, National Renewable Energy Lab			
Operations and Maintenance			
General Plant Projects	4,693	11,419	10,294
General Purpose Equipment	4,012	3,185	4,399
Maintenance and Repair	3,000	3,300	3,300
Safeguards and Security	0	8,407	8,407
Construction			
Energy Systems Integration Facility	39,295	0	0
Total, Facilities and Infrastructure	51,000	26,311	26,400

Public Law Authorizations

P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The National Renewable Energy Laboratory (NREL) is the Nation's only National Laboratory with a primary mission dedicated to the research, development, demonstration, and deployment (RDD&D) of energy efficiency, renewable energy, and related technologies. The Office of Energy Efficiency and Renewable Energy (EERE) is NREL's steward and primary client and sponsors NREL's designation as a federally funded research and development center. The Department of Energy's Office of Electricity Delivery and Energy Reliability and the Office of Science conduct additional RDD&D activities at NREL. NREL also provides services to other Federal and non-Federal clients.

Benefits

The Facilities and Infrastructure (F&I) budget funds NREL mission and operational projects and activities necessary to create, operate, and maintain the world-class laboratory capabilities required by EERE to achieve its mission goals. Included in this budget are:

- Capital Line Items (CLI): CLI funding is used to acquire or modify specific science and support capabilities, including all Construction projects;
- General Plant Project (GPP): GPP funding is used for small (<$10M) real property and operational projects necessary to support the safe and efficient operation of NREL;
- General Purpose Equipment (GPE): GPE funding is used to acquire science and support equipment shared broadly across NREL;
- Maintenance and Repair (M&R): M&R funds are used for basic maintenance and repair of site infrastructure; and
- Safeguards and Security (S&S): S&S funds are used to create and maintain physical, personnel, and cyber security programs to protect people, information, and property.

Strategy

EERE's funding of NREL's science, property, people, and support infrastructure is designed to create and maintain the physical and operational assets required to achieve NREL's assigned mission in a safe, secure, and efficient manner. EERE's investments are guided by DOE investment standards.

Key Accomplishments

The program has dependably delivered the capital construction projects, small site projects, and equipment required to operate a RDD&D institution at cost, scope, and schedule. The program investments have ensured that EERE's science and support investments are maintained in an excellent condition in service of the mission as evidenced by DOE corporate benchmarks such as the Facilities Condition Index. The program investments have ensured a safe and secure environment for employees and visitors. All projects have been completed within the original cost, scope, and schedule. The Research Support Facility is a prime

example of EERE project management, finishing under the Total Project Cost of $80 million with an ultra-high efficiency facility that achieved Leadership in Energy and Environmental Design (LEED) Platinum. The Energy Systems Integration Facility (ESIF) is tracking similarly and is currently within cost and scope and is 25 percent ahead of schedule.

F&I-funded projects and activities are developed in accordance with DOE Directives and EERE strategic goals.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Operation and Maintenance			
General Plant Projects – The decrease in FY 2013 funding reflects the projected level of resources required to maintain EERE's real property at an acceptable level of safety and operational availability.	11,419	10,294	-1,125
General Purpose Equipment – The increase in FY 2013 funding reflects the restoration of this funding category to the EERE recommended level required to maintain EERE's equipment investment at an acceptable level of service and availability.	3,185	4,399	+1,214
Maintenance and Repair – No change.	3,300	3,300	0
Safeguards and Security – No change.	8,407	8,407	0
Total, Operation and Maintenance	26,311	26,400	+89
Total Funding Change, National Renewable Energy Laboratory	26,311	26,400	+89

Explanation of Changes

The FY 2013 funding restores the Facility and Infrastructure budget to a level that will maintain NREL operations at EERE's recommended level to support the current planned research activities. No new major construction activities have been requested in FY 2013.

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

General Plant Projects (GPPs) are construction projects that are less than $10 million and necessary to adapt facilities to new or improved scientific capabilities or production techniques, to effect economies of operation, and to reduce or eliminate health, fire, and security problems. Facilities are evaluated using the Department's Condition Assessment Survey process and programmatic needs are evaluated to determine capital investment projects. The following table displays total GPP funding by site.

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
General Plant Projects (GPP)			
National Renewable Energy Laboratory	4,693	11,419	10,294
Total, General Plant Projects	4,693	11,419	10,294

GPE funding is used to acquire science and support equipment shared broadly across NREL. Equipment needs are based on requirements to meet mission goals and research milestones set by the EERE Program Managers. The following table displays total Capital Equipment funding for GPE.

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Capital Equipment (GPE)			
National Renewable Energy Laboratory	4,012	3,185	4,399
Total, Capital Equipment	4,012	3,185	4,399

Construction

(Dollars in Thousands)

	Type	Total	Prior-Year Approp	FY 2011 Current	FY 2012 Enacted	FY 2013 Request	Unapprop Balance	Completion Date
Project -ESIF 08-EE-01	TPC	135,000	135,000	0	0	0	0	FY13, Q1
	TEC	131,813	131,813	0	0	0	0	
	OPC	3,187	3,187	0	0	0	0	
No New Projects	TPC	0	0	0	0	0	0	
	TEC	0	0	0	0	0	0	
	OPC	0	0	0	0	0	0	
Total, Non-IT Capital Asset (Construction)	TPC	135,000	135,000	0	0	0	0	
	TEC	131,813	131,813	0	0	0	0	
	OPC	3,187	3,187	0	0	0	0	

In these tables, TPC is the Total Project Cost, TEC is the Total Estimated Cost, and OPC is the Other Projected Cost.

Major Items of Equipment (MIE)

(Dollars in Thousands)

	Type	Total	Prior-Year Approp	FY 2011 Current	FY 2012 Enacted	FY 2013 Request	Unapprop Balance	Completion Date
No Major Items of Equipment	TPC	0	0	0	0	0	0	
	TEC	0	0	0	0	0	0	
	OPC	0	0	0	0	0	0	
No New Project	TPC	0	0	0	0	0	0	
	TEC	0	0	0	0	0	0	
	OPC	0	0	0	0	0	0	
Total, Major Items of Equipment	TPC	0	0	0	0	0	0	
	TEC	0	0	0	0	0	0	
	OPC	0	0	0	0	0	0	

Maintenance and Repair

Maintenance and repair investments maintain EERE's current science and support infrastructure in accordance with DOE's Replacement Plant Value reinvestment guideline of at least a 2 percent investment each year to maintain its facilities in good working order.

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Maintenance and Repair			
National Renewable Energy Laboratory	3,000	3,300	3,300
Total, Maintenance and Repair	3,000	3,300	3,300

Safeguards and Security

Safeguards and Security directly funds the security operations of the laboratory in accordance with DOE's Security Directives for the protection of research activities and to enhance security of people, information, and property. Congress has required DOE to directly fund Safeguards and Security beginning in FY 2012. This is the second year of direct funding for this activity by EERE.

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Maintenance and Repair			
National Renewable Energy Laboratory	0	8,407	8,407
Total, Safeguards and Security	0	8,407	8,407

Program Direction

Funding Profile by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Headquarters (HQ)			
Salaries and Benefits	67,115	82,200	82,200
Travel	3,408	3,600	3,600
Support Services	18,729	18,430	12,740
Other Related Expenses	18,001	14,670	20,060
Total, Headquarters	107,253	118,900	118,600
HQ Full Time Equivalents (FTE)	427	570	591
Golden Field Office (GO)			
Salaries and Benefits	31,253	20,000	20,000
Travel	450	500	500
Support Services	9,542	8,700	8,700
Other Related Expenses	2,318	3,000	3,000
Total, GO	43,563	32,200	32,200
GO FTE	241	164	164
National Energy Technology Laboratory (NETL)			
Salaries and Benefits	8,588	5,800	5,800
Travel	325	500	500
Support Services	6,330	5,400	5,400
Other Related Expenses	3,941	2,200	2,200
Total, NETL	19,184	13,900	13,900
Total NETL Reimbursable FTE	73	61	61
Total Program Direction			
Salaries and Benefits	106,956	108,000	108,000
Travel	4,183	4,600	4,600
Support Services	34,601	32,530	26,840
Other Related Expenses	24,260	19,870	25,260
Total, Program Direction	170,000	165,000	164,700
Total, EERE FTE	668	734	755
Total, NETL Reimbursable FTE[a]	73	61	61

[a] Fossil Energy employees

Overview

Program Direction funds Federal employees, contract support, and operational costs required for the overall implementation and execution of EERE programs including funding for the coordination of the energy portfolio by the Office of the Under Secretary for Energy. This funding allows EERE to advance the President's priorities by enabling accelerated research, development, demonstration and deployment (RDD&D) of EERE technologies to address energy security, economic growth, and the environment with strong transparency, accountability and oversight. This funding enables the EERE workforce to effectively administer an ~$2 billion annual budget and actively manage all current projects. EERE manages thousands of contracts, grants, and agreements in various stages of the budget execution process.

Salaries and Benefits funds over 800 FTE needed to effectively execute the EERE portfolio. EERE personnel provide expertise in implementing and integrating technology programs through comprehensive program and project management and technical assistance. This funding also supports business administration expertise in human resources, budget and financial management, program evaluation, procurement, contract administration, legal services, information technology (IT) business systems, and information services management.

Travel funds enable the proper management and oversight of approximately 6,000 Federally-funded projects, agreements, and grants, including additional audits and on-site monitoring of both new and continuing technology projects and Federal energy assistance programs. This funding allows for frequent, geographically-dispersed reviews of Weatherization Assistance and State Energy Program grants. Travel also supports international activities necessary to address global climate change and supports a number of key bilateral and multilateral initiatives that further the Department of Energy's (DOE) RDD&D goals.

Support Services funding provides technical and administrative contract support; automated data processing such as IT, communications and network systems, including connectivity to separate office building locations, as well as the purchase and installation of desktop computers and systems to ensure rapid response capabilities; and accurate reports and analyses critical for decision-making. This funding also contributes to training, education, safety and health support, Headquarters safeguards and security, computer configuration, and maintenance. Additionally, this request provides for a 77 percent indirect overhead charge for reimbursable work provided by direct/technical Fossil Energy employees at NETL, which includes business administration (budget and financial management, human resources, technical assistance, procurement, etc.); technical and administrative assistance to project managers; facilities and space management; and IT and local-area network operations.

Funding also provides for reports, oversight and analysis, management, and general administrative services for project planning and analysis. These services support the increased accountability and transparency instituted by Congress and the Administration. They are vital to provide the direct support, tools, expertise and services needed to provide timely responses. They additionally enable the flexibility necessary to respond rapidly, efficiently, and professionally to the requirements for corporate level planning, evaluation, reporting, analysis and administrative services.

Other Related Expenses provides office space at Headquarters and the Field; EERE's contribution to the Department's Working Capital Fund (WCF) for common administrative services, such as rent and building operations, telecommunications, network connectivity, supplies/equipment, printing/graphics, copying, mail, contract closeout, purchase card surveillance, and salary and benefit expenses for federal employees who administer the WCF business lines per the Department's new policy being implemented in FY 2012. In addition, WCF services assessed to and used by Headquarters and the Field include online training, the Corporate Human Resource Information System, payroll processing, and the Project Management Career Development Program. Other Related Expenses also includes funding for GSA rent for the Golden Field Office (GFO), as well as supplies and materials for both the GFO and NETL, such as computer equipment, hardware, software, licenses and support, utilities, postage, printing, graphics, administrative expenses, and security, plus workers compensation, publications, conferences, and reimbursable expenses at NETL.

Benefits

- Highly trained Federal staff, including scientific and technical expertise;
- Expert technical support staff;
- Logistical support; and
- Timely reporting and accountability

Strategic Plan and Program Performance Measures

The goal is to achieve operational and technical excellence by optimizing staffing and developing a performance-based culture to ensure projects are properly executed with transparency, oversight and accountability to maximize mission success. The key pathways and areas of performance focus are:

- Workforce Optimization;
- Budget and Procurement Reforms;
- Reduction of Uncosted Obligations; and
- Information Systems Enhancements.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Program Direction			
Salaries and Benefits			
No change.	108,000	108,000	0
Travel			
No change.	4,600	4,600	0
Support Services			
Reduce NETL reimbursable services and contract services by ~16 percent.	32,530	26,840	-5,690
Other Related Expenses			
The increase reflects EERE's increased contribution to the Working Capital Fund (WCF), per the Department's new policy. DOE is working to achieve economies of scale through this enhanced WCF. The WCF increase covers certain shared, enterprise activities including enhanced cyber security architecture, employee health and testing services, and consolidated training and recruitment initiatives.	19,870	25,260	+5,390
Total, Program Direction	165,000	164,700	-300

Support Services by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Technical Support Services			
Development of Specifications	1,035	1,010	800
Trade-Off Analysis	1,494	1,232	500
Economic and Environmental Analysis	1,023	921	400
Surveys or Reviews of Technical Operations	1,669	1,650	1,500
Total, Technical Support Services	5,221	4,813	3,200
Management Support Services			
Analysis of Workload and Workflow	472	770	560
Directive Management Studies	596	662	250
Automated Data Processing	20,331	20,276	18,730
Preparation of Program Plans	1,672	1,170	300
Training and Education	1,845	1,798	1,100
Analysis of DOE Management Processes	1,497	859	800
Reports and Analyses Management and General Administrative Support	2,967	2,182	1,900
Total, Management Support Services	29,380	27,717	23,640
Total, Support Services	34,601	32,530	26,840

Other Related Expenses by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Rent to GSA	631	432	432
Rent to Others	1,098	751	751
Communication, Utilities, Misc.	2,717	1,859	1,859
Printing and Reproduction	58	40	40
Other Services	21	14	14
Training	100	68	68
Operation and Maintenance of Equipment	3,500	2,395	2,395
Supplies and Materials	398	272	272
Equipment	2,516	1,722	1,722
Working Capital Fund	13,221	12,317	17,707
Total, Other Related Expenses	24,260	19,870	25,260

Non-Comparable Structure

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Program Support			
Communications & Outreach	10,000	0	0
Innovation & Deployment	8,000	0	0
International	7,000	0	0
Strategic Priorities & Impact Analysis	3,000	0	0
Planning, Analysis & Evaluation	4,000	0	0
Strategic Programs	0	25,000	58,900
Total, Program Support	32,000	25,000	58,900

Comparable Structure

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Strategic Programs			
Communications & Outreach	10,000	6,500	8,900
Innovation & Deployment	8,000	6,500	33,500
International	7,000	5,000	8,500
Strategic Priorities & Impact Analysis	3,000	7,000	8,000
Planning, Analysis & Evaluation	4,000	0	0
Total, Strategic Programs	32,000	25,000	58,900

Public Law Authorizations

P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 109-58, "Energy Policy Act of 2005"
P.L. 110-140, "Energy Independence and Security Act of 2007"

Overview

The mission of Strategic Programs is to guide, strengthen, and communicate work on Energy Efficiency and Renewable Energy (EERE) technologies. The program ensures that EERE achieves its goals with strong management and with the greatest possible efficiency. Where appropriate, it encourages consistency of approaches and collaboration between programs.

Key Accomplishments

Strategic Programs provided analyses that helped EERE management establish funding priorities and better align EERE's work with Office and Department goals. For example, cost analyses were harmonized to ensure consistency across EERE programs. The results of this analysis are reflected in the budget request for individual programs.

Strategic Programs led the development of the National Training and Education Resource (NTER) online platform in FY 2010 – FY 2011. The platform was launched officially in FY 2012 and is being adopted nationally by Federal Government agencies, higher education institutions and leading energy industry companies offering green jobs training. NTER is transforming the way energy training is delivered, obtained, and stored. Continued adoption will enable it to overcoming stove piped and duplicative systems within DOE, the private sector, and higher education and providing significant efficiencies by consolidating open source training on one platform.

The Innovation Ecosystems grants successfully stimulated the creation of start-up companies. Over the first year of these activities, 10 start-up companies were formed within the five ecosystem projects. For example, a Midwestern start-up, Clean Urban Energy, secured $7 million in venture funds after successfully winning Clean Energy Trust's Clean Energy Challenge, which was developed as part of the DOE grant. Innovation Ecosystems activities help overcome the barrier of

getting new technologies to market by creating infrastructures where innovation and commercialization can flourish.

The National Business Plan Creation Competition launched in FY 2012 will provide six organizations with funds to run regional competitions. This is important for supporting young entrepreneurs and accelerating successful technologies into start-ups. This effort also enables coordination and streamlining of existing competitions in the clean energy space as it reduces inefficiencies and duplicative efforts.

Integrated Deployment worked with state and local governments in the most expensive energy markets in the U.S. to help them with regulatory, financing and private partnership efforts to better implement energy efficiency and renewable energy. These changes have reduced the energy costs of governments, commercial and residential users by tens of millions of dollars and enhanced the comfort and energy security of the affected communities.

EERE's Communications & Outreach work broadens awareness and understanding of new energy solutions. EERE reaches millions of consumers and stakeholders annually through online and other digital tools, news updates, press releases, information for news media, and other information resources. EERE has leveraged public service advertising and partnerships methods that have historically reached very high rates of return, recently launching a Save Energy, Save Money campaign in 2011.

In FY 2011, the EERE International subprogram hosted the second US-China Energy Efficiency Forum in Berkeley, CA as agreed in the Presidential-level U.S.-China Energy Efficiency Action Plan (http://www.whitehouse.gov/the-press-office/us-china-clean-energy-announcements). (China hosted the EE Forum in 2010.) Experts from both countries provided detailed technical presentations that jointly advance our common objectives in four areas: Buildings and Appliance Efficiency, Industrial Efficiency, Financing and Energy Service Companies (ESCOs), and Codes and Standards. Private sector participation from both sides was significant, including two commercial Memorandum of Understanding (MOU) signings. Other new technical collaborations and business opportunities are likely to develop from the interactions. All presentations and other information are available on line at http://www.2ndus-chinaeeforum.org/index.html. The International subprogram teamed with the U.S. Trade and Development Agency to co-host a training visit by 24 Chinese mayors and staff to U.S. cities to share information about sustainable policies, practices, and technology solutions. The trip resulted in a $4 million order for products by Solatube, a U.S.-based maker of innovative day lighting solutions that reduce electric lighting needs.

Program Strategy

Strategic Programs is guided by several principles that ensure its work adds value and is not duplicative.

Strategic Programs:

- Conducts cross-cutting work that must be done on an EERE-wide basis, providing office-wide leadership and leveraging the expertise in the programs;
- Ensures activities are aligned with the DOE goals of economic progress, secure energy, and environmental responsibility; and
- Builds partnerships, with industry, universities, non-profits, the public, and internationally to help catalyze and transform markets for clean energy solutions that provide economic and environmental value.

Strategic Programs' work includes:

- Conducting cross-cutting technology and policy analysis to help guide EERE activities;
- Strengthening EERE's research management through peer review and evaluation;
- Supporting innovation, business development, and commercial adoption of EERE technologies;
- Guiding training of the workforce to produce and install these technologies;
- Ensuring that the best research teams in the U.S. compete for EERE funds and that the selection process is both excellent and efficient;
- Enhancing consumer outreach, engagement, and education on clean energy to help raise awareness, overcome barriers, and speed adoption of new technologies and practices;
- Leveraging existing Congressional authorities to support program goals, technology deployment and overall EERE mission; and
- Collaborating with foreign partners to advance implementation of EERE technologies and market opportunities for U.S. companies.

Benefits

The work of Strategic Programs on cross-cutting technology and policy analysis, and on improved research management, provides critical support for optimized decision-making and management of the EERE portfolio. The focus on market approaches and market solutions provides a critical perspective and link for EERE's technology-specific programs. Work on innovation supports and accelerates startup activities, helping fill key gaps in the process. Work on training is transforming the way energy training is developed and delivered.

Communications serves a key role in disseminating

information on the progress achieved in EERE for maximal impact. Innovations in technology information management increase the interactivity, transparency and accessibility of EERE information, projects, data and modeling solutions through the development of distributable content, mobile applications and interactive destinations provided to audiences of all types.

Through international cooperation on technical research, energy standards and test methods, and energy policy analysis, the EERE International subprogram accelerates domestic technological advancements as well as policies and programs that promote global deployment of U.S. clean energy goods and services and that help increase U.S. exports, create jobs for American workers, and increase U.S. energy security.

Entrepreneurial and innovative initiatives are important to building up a strong workforce for the future. Funding initiatives such as Innovation Ecosystems and the National Business Plan Competition are valuable for reducing duplicative efforts and increasing start-ups, which will ultimately create jobs.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
Communications and Outreach – Will continue to build thorough and easily accessible online resources to help consumers and businesses save energy and money by increasing efficiency or deploying renewable energy systems. More comprehensive online content and better search capability, given the broad reach of internet access across the population, will increase program efficiency.	6,500	8,900	+2,400
Innovation and Deployment– This substantial increase will allow for new collaborative work with the DOE, Office of Science through joint solicitations to accelerate the transition of novel scientific discoveries into innovative, prototype clean energy technologies. It will also accelerate deployment and adoption of EERE technologies through improved collaboration with education and training institutions.	6,500	33,500	+27,000
International – In addition to maintaining existing collaborative relations with key partner countries and multilateral forums, the International subprogram will issue a competitive solicitation aimed at collaborative Energy Efficiency and Renewable Energy research, development, deployment and policy initiatives that seek to advance our domestic program goals while also priming foreign markets for U.S. technologies and services.	5,000	8,500	+3,500
Strategic Priorities and Impact Analysis – Increased emphasis will be placed on transparency and stakeholder access to data and analysis results. Previously supported by Planning, Analysis, and Evaluation.	7,000	8,000	+1,000
Total, Strategic Programs	25,000	58,900	+33,900

Explanation of Changes

In FY 2013, Strategic Programs will continue to guide, strengthen, and communicate work on EERE technologies, and to help build U.S. businesses' domestic and international competitiveness in these technologies.

The additional $27 million for Innovation and Deployment will enable collaborative research and development (R&D) efforts with the Office of Science to fund competitively selected projects at universities, National Laboratories, and small businesses. These efforts will focus on innovative approaches to overcoming the underlying physical challenges to clean energy technologies.

The additional $3.5 million for International efforts will support competitive solicitations aimed at priming foreign markets for U.S. technologies and services and an increase of $2.4 million for EERE Communications and Outreach allows for the improvement of informational resources to help consumers and businesses save energy and money by increasing efficiency or deploying renewable energy systems. The Strategic Priorities and Impact Analysis funding increase of $1 million will allow for increased emphasis on transparency and stakeholder access to data and analysis results.

Funding Opportunity Announcement Background

EERE uses an open, competitive solicitation process to fund work that will help achieve our goals. Funding opportunities encourage collaborative partnerships among industry, universities, National Laboratories, Federal, state, and local governments and non-government agencies and advocacy groups. Solicitations, when available, include financial and technical assistance.

Anticipated FOAs

(Dollars in Thousands)

Fiscal Year	Technology Focus Area	Program Area of Focus	Projected Funding
FY 2012	Accelerating the Deployment of Energy Efficiency and Renewable Energy Technologies in Indonesia	International	1,200
Develop and implement a variety of activities that deploy U.S. technical expertise in areas such as strategic and policy planning and analysis, energy market analysis, energy modeling, workforce development, and technical analysis to prime markets for increased use of energy efficient and renewable energy technologies in Indonesia.			
FY 2012	Sustainable Cities with China and India	International	600
Promote sustainable development or re-development of urban districts in China, India, and the U.S. Research low-carbon development planning, develop guidelines and definitions for eco-cities in terms of greenhouse gas (GHG) emissions, water use and reuse, transportation planning, etc., and establish indicator systems and develop evaluation methodologies. Share experiences on policy approaches.			
FY 2013	Basic & Applied R&D to address "Clean Energy Challenges" (*tentative title*)	Innovation & Deployment	25,000
Enable collaborative R&D efforts with Science to fund competitively selected projects at universities, National Laboratories and small businesses. These efforts will focus on innovative approaches to overcoming the underlying physical challenges to clean energy technologies.			
FY 2013	Accelerating the Deployment of Energy Efficiency and Renewable Energy Technologies	International	2,000
Prime foreign markets for U.S. clean energy technologies and services, in a country or region selected in accordance with the EERE International Strategic Plan that will be finalized shortly.			
FY 2013	Workforce Development and Education Online Training Platform	Innovation & Deployment	1,000
Permanently transfer the management of the NTER to a private sector custodial agent. DOE oversight through a multi-year contract is necessary to ensure proper commercialization of NTER and to preserve it as a public good.			

Communications & Outreach Subprogram

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Communications & Outreach	10,000	6,500	8,900
Total, Communications & Outreach	10,000	6,500	8,900

Description

Communications and Outreach (CO) provides strategic communications and outreach support for EERE's activities and scientific and technology achievements to help raise awareness, overcome informational barriers, and speed adoption of new energy efficiency and renewable energy technologies and practices. CO creates and manages public engagement tools and products that keep stakeholders advised of the status of EERE programs, activities, and technologies, the impacts of implemented policies on technology development and adoption, and how the adoption of these emerging technologies contributes to DOE and U.S. economic, environmental, and energy security goals.

Key Technology and Focus Areas

CO ensures information is available to, and actively engages with, the general public and other stakeholders through a wide variety of communication channels. These channels include, but are not limited to, web-based content and services, print products, displays and events, multimedia, radio, television, and content for mobile devices. CO actively communicates with a range of stakeholders, including the general public, industry, students, educators and educational institutions, other Federal, state, and local government entities, and non-governmental organizations.

To expand EERE's reach, CO also works with industry, state and local governments, educational institutions, non-governmental organizations, and media producers to produce and disseminate information. For example, CO leverages public communication assets, such as public service announcements, to raise public energy awareness by providing information and education to help inform public and private energy decisions.

CO provides timely and relevant information to help consumers make informed energy choices to reduce energy use, demand, and associated costs. Examples of CO activities include, but are not limited to, the following:

- CO will manage and continually update the EERE website and content delivered through other sites, and expand mechanisms for electronic outreach. This includes EERE's main website, as well as content for the primary consumer portal, EnergySavers.gov, which together attract millions of online visitors per year. CO works to deploy the latest effective electronic and online communications technologies, which requires continual investment in new server technologies and web tools for the operation and maintenance of EERE's public internet websites while leveraging shared EERE IT infrastructure funding.
- CO will continue to engage stakeholders online with periodic news updates and program information. This includes delivering information to tens of thousands of stakeholders who have requested to receive EERE information, as well as leveraging new media tools and online multimedia to further engage and inform EERE stakeholders;
- CO will continue to reach stakeholders via public service advertising methods;
- CO will continue to maintain a publicly available online catalogue of thousands of EERE information products, including publications, CDs, and analytic tools; and
- CO will continue to leverage the resources of other agencies and promote collaborations among Federal, state and local entities to advance public and stakeholder knowledge regarding renewable energy sources and energy efficiency, and provide interactive tools and resources that educate consumers about energy solutions and technologies.

Benefits

CO contributes to EERE's goals and E-government initiatives by helping the public and other stakeholders learn about clean energy – to overcome informational barriers and speed adoption of new technologies and practices.

Innovation & Deployment Subprogram

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Innovation & Deployment	8,000	6,500	33,500
Total, Innovation & Deployment	8,000	6,500	33,500

Description

Innovation & Deployment works to accelerate the commercialization and adoption of EERE technologies, thereby enabling the Nation to realize the benefits associated with energy security, economic competitiveness, and environmental quality. The subprogram achieves this through collaboration with universities and small businesses, National Laboratories, utilities, local governments, and education and training institutions, and through improved external reviews of EERE programs and projects.

Key Technology and Focus Areas

The Innovation & Deployment subprogram is comprised of five key areas of focus:

- Integrated Deployment accelerates the in-field validation of energy efficiency and renewable energy technologies in the most expensive energy markets in America. Committed local governments receive technical assistance to transform energy use in areas with unusually high energy costs from relying on fossil fuels to better utilizing cleaner energy sources. Activities assess the integration of multiple EERE technology pathways to cost-effectively achieve clean energy goals, and they explore non-conventional ways of being able to move deployment forward, such as innovative partnerships, financing arrangements and policy options.
- Innovation activities continue the Innovation Ecosystem and National Clean Energy Business Plan competitions that help bridge the commercialization "valley of death" and accelerate the transition of innovative technologies to business and industry, and provide value to the American taxpayer by more rapidly bringing technologies out of the labs and into the market. Partnering the strengths of research institutions and universities around business plan competitions, graduate student research and entrepreneurship, and business mentoring provides strong support for technological innovation by small businesses and new cost-effective scientific and engineering solutions to America's energy challenges. New collaborative efforts with the Office of Science will be initiated through joint, competitive solicitations aimed at accelerating the transition of novel scientific discoveries into innovative, prototype clean energy technologies. The focus will be on university and small business R&D activities aimed at overcoming the underlying physical challenges related to clean energy technology and designing and testing next-generation clean energy devices. These efforts will improve coordination of energy-related research across the Department and better leverage investments in basic science for meeting clean energy goals.
- Technology Information Management increases the transparency and accessibility of EERE information and software tools using state-of-the-art information technology including interactive destinations, distributable content, and mobile applications. Low cost, easily accessible tools make EERE's work available to the broadest possible audiences helping ensure that EERE's information is available in a way that is convenient and accessible to many different groups that can benefit from EERE work. For example, the program will develop a comprehensive searchable database of current and previously funded projects, with non-confidential information made publically accessible. Making EERE information easily available in a transparent way ensures contact with the broadest possible set of research organizations and other stakeholders.
- Workforce Development and Education (formerly Green Job Training) focuses on expanding the training curricula and tools needed to help ensure there is a highly skilled workforce available for the new jobs in energy efficiency and renewable energy industries that are coming online now and into the future. Expanded use of EERE technologies is dependent on the capacity of the U.S. to produce, install, maintain, and service these emerging and advanced technologies. Workforce Development and Education integrates advanced training technologies and methods to improve EERE's

response to both immediate job needs, such as "Troops to Energy" (focused on veterans), as well as to develop a future workforce by focusing, for example, on improving Energy Literacy to inspire youngsters and young adults to pursue a green job career path. Activities will include partnering with universities, community and technical colleges, and corporate and union training facilities to develop green job training, and helping EERE programs develop curricula that not only incorporate the latest research findings but also make use of reusable, interactive online tools that will enable the workforce to train rapidly and fully for new jobs created by EERE technologies.

- Research Management identifies and enables best practices to ensure that the highest-quality and most innovative R&D projects are selected and supported by EERE. This includes robust merit review processes and tools; and utilizing mechanisms, such as the EERE Federal Advisory Committee, to get expert advice on the EERE portfolio. These efforts help EERE programs to make effective use of high quality peer review and innovative solicitation methods to ensure that the most creative and qualified minds are engaged to solve EERE research challenges.

Benefits

Reduces duplication and increases effectiveness of all EERE programs by providing specialized expertise in mission-critical areas like research management, innovation, deployment, workforce development, and other areas.

International Subprogram

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
International	7,000	5,000	8,500
Total, International	7,000	5,000	8,500

Description

The EERE International subprogram leads collaborations with partner countries and international organizations to: accelerate the pace of domestic technology innovation through research coordination and leveraging resources; create opportunities for the export of U.S. clean energy technologies and services through demonstration, deployment, and policy analysis; and promote energy security by helping to reduce global demand for oil.

Key Technology and Focus Areas

EERE's International subprogram seeks to achieve three objectives:

- Accelerate the research and development of energy efficiency and renewable energy technologies through collaboration with international partners.
  - Through partnerships with other countries at the cutting edge of clean energy R&D, EERE will leverage DOE resources to accelerate development and cost reductions for energy efficiency and renewable energy technologies. These partnerships can help EERE achieve its RD&D technical and cost goals. For example, the subprogram facilitates collaborations under the US-EU Energy Technology Council, such as the Wind Program teaming with leaders in off-shore wind technology, including the UK and Denmark. Collaboration facilitated through the Council can help the Wind Program learn from Europe's experience and better target FOAs on key technical hurdles, reducing the time and resources needed for the program to meet its offshore wind cost reduction goals.
- Accelerate the deployment of EERE technologies to help meet growing demand for energy and to reduce greenhouse gas (GHG) emissions.
  - Partnerships with key countries advance the deployment of clean energy technologies and can achieve substantial, measurable environmental impacts on GHG emissions and related sustainability factors. For example, the International subprogram teamed with the U.S. Trade and Development Agency to co-host a training visit by 24 Chinese mayors and staff to U.S. cities to share information about sustainable policies, practices, and technology solutions. The trip resulted in a $4 million order for products by Solatube, a U.S.-based maker of innovative day lighting solutions that reduce electric lighting needs. The program will also continue to monitor long-term outcomes, such as whether subnational relationships established during the trip could lead to even more sales of U.S. goods and services, foreign direct investment in U.S. cities, and new sustainable policy changes in U.S. cities informed by China's experience.
- Develop global markets for U.S. clean energy solutions through policy and technology analysis and technical assistance.
  - EERE investments in diverse clean energy technologies set the stage for the development of a robust clean energy export market for the U.S. with commensurate employment and related economic effects. Rapidly growing countries like China, India and Brazil are constructing power plants, commercial buildings, industrial facilities and housing at an unprecedented rate. Priming markets and building capacity in these countries through policy support, developing codes and standards, and addressing technology product reliability will help this development occur with the cleanest energy profile possible. These activities also generate market pull for energy efficiency and renewable energy technologies, which can be met with U.S. clean energy exports. For example, a technical workshop in Brazil (50 percent cost shared by industry) is aimed at facilitating Brazil's adoption of U.S. test methods and efficiency rating systems for windows, which would create a competitive advantage for U.S. window manufacturers in a large and growing market.

Benefits

Technology Development

- Accelerate the progress of DOE's domestic R&D programs by leveraging the resources and expertise of partner countries.
- Collaborate with rapidly growing and emerging economies to establish innovative and replicable platforms for testing new U.S. technologies and policy approaches.
- Incorporate lessons learned from collaborative projects at the national, state, and local level into the Department's technology research programs.

Market Development

- Prime markets in major emerging economies for goods and services from U.S. companies.
- Increase U.S. exports of clean energy technologies and create U.S. jobs through collaborative projects focused on product testing, minimum standards, and certification.

Energy Security

- Increase the use of alternative energy sources abroad, thereby reducing global demand for oil.

Strategic Priorities & Impact Analysis Subprogram

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Strategic Priorities & Impact Analysis	3,000	7,000	8,000
Total, Strategic Priorities & Impact Analysis	3,000	7,000	8,000

Description

Strategic Priorities and Impact Analysis (SPIA) provides integrated, cross-cutting analysis to inform EERE corporate and program decisions. Analysis results enable a better understanding of how EERE RD&D can drive penetration of efficiency and renewable energy, strengthen economic recovery and growth, improve energy security, and reduce harmful emissions.

SPIA informs EERE corporate decisions and supports program implementation through application of a portfolio-wide perspective. SPIA's work enables consistent comparison of R&D investments across technology programs. Open, transparent, well-documented, peer-reviewed assumptions and analysis methods are used to estimate and compare the expected benefits of different investments.

SPIA informs the development of strategic plans and priorities through cross-cutting technology analyses. Analytical work advances the understanding of technologies, systems, and the related legislative, regulatory, and market landscape. Performance measurement and evaluation activities help monitor and measure success, increase program effectiveness, and meet requirements for objective and independent assessment.

SPIA provides transparent, quality information through coordination and integration. This work cuts across multiple technologies, programs, and offices, and thus builds upon and broadens technology-specific analyses conducted by EERE programs. Work is conducted in constant collaboration with others. For example, SPIA provides technology cost and performance data for use in policy analysis completed by the Office of Policy and International Affairs. Results are clearly communicated to EERE and DOE management to guide decisions, to EERE programs to shape their work, and to external stakeholders to enable knowledge and the advancement of DOE's strategic priorities.

Key Technology and Focus Areas

- Data Resources provides up-to-date, trustworthy data on the cost and performance of EERE technology essential for both private and public decision-makers. This focus area provides high-quality, continuously improved, peer reviewed data on EERE technologies in formats that can be directly accessed by users and that can interface with software tools. Resources are built from real-world market data, modeled cost and performance data, and reviews of other published studies.
- Energy Systems Analysis informs technology solutions that can enable U.S. markets to effectively meet national clean energy goals. Thorough understanding of system implications links the more specific technology work housed in the programs to a broader context of energy systems and markets. Energy system analysis strengthens existing modeling approaches, ensures that they are up to date, and uses them to support EERE decision-making. Most of these tools will be available online. Studies, which are developed in close collaboration with Office of Electricity Delivery and Energy Reliability and other DOE offices, include the development of strategic plans for transportation (including technologies and strategies from the Vehicles, Fuel Cell, and Biomass Programs) and electric grid (including technologies from the Solar, Wind, and renewable energy and efficiency programs that can provide demand side management through smart buildings and manufacturing). These studies show how energy technologies shape markets and cost/performance targets for other technologies. Tools will also be available to estimate the environmental impacts of different energy futures scenarios and to estimate impacts on business opportunities and employment.
- Market Analysis puts technology opportunities into perspective. The DOE Quadrennial Technology Review emphasized the importance of considering materiality and market potential. This work helps EERE evaluate both for its technologies. Work includes analysis of technology financing structures and tools; identification of supply chain bottlenecks; and implications of market conditions for manufacturing

and supporting industries. It also includes a review of private-sector corporate research underway in EERE-relevant fields to help craft research strategies ensuring that EERE funding facilitates and accelerates private innovation, while avoiding areas which are well covered with private funds.

Benefits

The activities of this subprogram are essential to provide a consistent office-wide methodology for strategic technology planning. This work provides core support for decision-making in EERE and DOE by demonstrating the possible results and impacts of various research portfolios and technology policy scenarios.

Each activity informs decisions and helps to optimize the allocation of resources within and among the EERE and related energy programs. SPIA's analysis results enable senior management and the technology programs to select portfolios and pathways that will most effectively and productively advance DOE's economic, environmental, energy security, and management excellence goals.

The same foundation of unbiased, quality information created and used by EERE to make decisions is made available to external stakeholders to inform policy decisions at all levels of government, as well as to facilitate private investment to promote the rapid development and adoption of clean energy technologies.

Planning, Analysis & Evaluation Subprogram

Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Planning, Analysis & Evaluation	4,000	0	0
Total, Planning, Analysis & Evaluation	4,000	0	0

Description

The Planning, Analysis, and Evaluation subprogram focus areas were moved to Strategic Priorities & Impact Analysis in FY 2012. This change reflects an effort to consolidate similar activities and support a streamlined management structure.

Key Technology and Focus Areas

The Planning, Analysis, and Evaluation subprogram activities were moved to Strategic Priorities & Impact Analysis in FY 2012.

Benefits

The Planning, Analysis, and Evaluation subprogram focus areas were moved to Strategic Priorities & Impact Analysis in FY 2012.

Electricity Delivery and Energy Reliability

Electricity Delivery and Energy Reliability

Table of Contents

Electricity Delivery and Energy Reliability

Proposed Appropriation Language

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for electricity delivery and energy reliability activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, $143,015,000, to remain available until expended: Provided, That $27,615,000 shall be available until September 30, 2014 for program direction.

Office of Electricity Delivery and Energy Reliability
Overview
Appropriation Summary by Program

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Office of Electricity Delivery and Energy Reliability			
Research and Development	102,060	99,136	103,400
Permitting, Siting and Analysis	6,000	6,976	6,000
Infrastructure Security and Energy Restoration	6,100	5,981	6,000
Program Direction	27,610	27,010	27,615
Subtotal, Electricity Delivery and Energy Reliability	141,770	139,103	143,015
Transfer from State Department	100	0	0
Rescission of Prior Year Balances	-3,700	0	0
Total, Electricity Delivery and Energy Reliability	138,170	139,103 [a]	143,015

[a] FY 2012 Enacted reflects a rescission of $396,552 associated with savings from the contractor pay freeze.

Office Overview and Accomplishments

The Office of Electricity Delivery and Energy Reliability (OE) leads national efforts in electric grid research and development (R&D) and electricity policy, while also serving as the Federal government's focal point in responding to energy security emergencies.

A modern electric grid is critical to meeting the nation's energy, environmental, and security goals. In support of these goals, OE pursues activities that improve the following electric system characteristics, which together describe a modern grid:

- *Reliability* – high quality , consistent power flow;
- *Flexibility* – the ability to accommodate changing supply and demand patterns;
- *Efficiency* – delivery of electricity with reduced losses and greater asset utilization rates; and
- *Resiliency* – the ability to withstand disruptions and maintain critical function.

Not only is reliable, affordable, efficient, and secure electric power delivery fundamental for the information age, it is necessary for expanding the economic recovery, protecting critical infrastructures, and enabling the transition to low-carbon energy sources and away from the consumption of oil through electrification of transportation. Over the next several decades, the U.S. electric power industry must address three critical challenges simultaneously:

- Meeting increasing demand for electricity driven by growth in population, economic output, and electrification, including possible mass-markets for electric vehicles;
- Integrating a new class of low-carbon alternatives into the nation's power generating resources, including renewable resources, advanced nuclear energy, and coal with carbon-capture; and
- Accomplishing these while maintaining reliability, security and affordability – pillars of the Nation's economic growth and prosperity.

Without development and deployment of "next generation" electric transmission, distribution, and customer technologies, the grid could become a barrier to the adoption of cleaner energy supplies and more energy-efficient demand-side measures; opportunities for innovation and entrepreneurship would be lost in the electricity sector; and sectors that depend on electricity – such as telecommunications, banking and finance, water, and public health and safety – would be left vulnerable.

OE's leadership is developing "next generation" electric grid technologies, tools, and techniques; working with stakeholders to support deployment of these systems amidst a variety of policy and regulatory structures; and enhancing the security of the nation's energy infrastructure is essential to help achieve national energy, economic, and environmental goals.

OE pursues applied research and development investments and technology demonstrations aimed at bringing new and innovative technologies to maturity and helping them transition to market. OE's research and development efforts promote scientific innovation, and leverage the investments of other DOE offices, including the Offices of Science, Energy Efficiency and Renewable Energy, and ARPA-E, as well as the Energy Information Administration and the Federal Energy Regulatory Commission. The mission of OE supports the Secretary's goal to *Catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.*

Within the appropriation, OE funds:

- *Research and Development* – pursues innovative technologies that improve grid reliability, efficiency, flexibility, functionality and security;
- *Technical Assistance* – provides technical assistance to states and regions to improve policies, state laws, and programs that facilitate the growth of electric infrastructure and bring new energy technologies to market; and
- *Emergency Response and Restoration* – enhances the reliability, survivability and resiliency of energy infrastructure, and facilitates recovery from disruptions to energy supply.

In the prior year, OE accomplishments include:

- Validating distribution system models for smart grid architectures and renewables integration;
- Demonstrating grid oscillation detection software - awardee signed a contract to install this system at two transmission control centers;
- Completing bench tests of new flow battery designs and field tests of renewable energy applications for utility-scale storage systems; and
- Released two new cybersecurity situational awareness tools, as well as draft cybersecurity risk management process guidelines.

Explanation of Changes

The Department's request of $143 million for FY 2013 for OE is an increase of $4 million (3%) compared to the FY 2012 appropriation and continues the Department's emphasis on modernizing the grid, critical to transforming the nation's energy system and enabling clean energy technologies.

The FY 2013 request provides $20 million for a new Electricity Systems Hub, a multi-disciplinary approach to addressing challenges to grid modernization.

The FY 2013 request includes $10 million for Advanced Modeling Grid Research to continue development of computational and modeling capabilities necessary to improve understanding and address the needs of an increasingly complex grid. The request also maintains level funding for Cyber Security R&D for the energy sector, preserving efforts to strengthen the Nation's energy infrastructure against cyber threats.

The request decreases the funding level for Energy Storage subprogram (-$5M) due to scaled back research on sodium-ion and lithium-ion batteries for community energy storage. It also decreases funding for the Smart Grid Research and Development subprogram (-$9.5M), reflecting the closeout of OE's research efforts in power electronics for grid applications, and scaled back research on microgrids and smart charging of electric vehicles.

Alignment to Strategic Plan

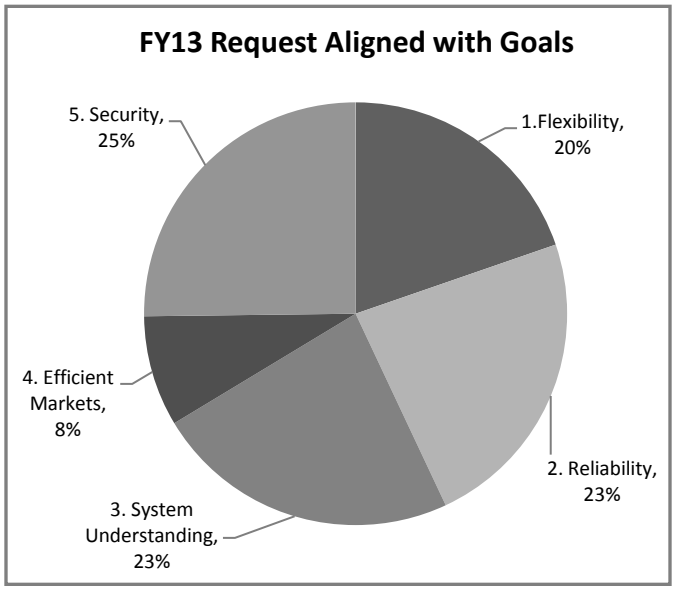
A modern electric power system is fundamental to achieving many of the long-term goals outlined in the Department's May 2011 Strategic Plan. OE activities directly support the strategy to *Modernize the Electric Grid*, within the goal to *Transform our Energy Systems*.

The Department's Strategic Plan identifies three targeted outcomes to achieving this objective, and the Office of Electricity Delivery and Energy Reliability supports all three through its budget request:

- Enable better understanding and control of our electric grid by installing more than 1000 synchrophasor measurement units by 2013.
- Deploy more than 26 million smart meters in American homes and businesses by 2013.
- Reduce utility-scale energy storage costs by 30% by 2015.

In order to achieve these targeted outcomes, OE has established five inter-related and interdependent strategic goals that inform program investment:

1. Enhance **grid flexibility** to incorporate a variety of energy sources, including large amounts of variable and distributed energy resources
2. **Maintain reliability** by developing real-time situational awareness to improve grid operations
3. Build **system-level understanding** needed for innovative approaches to technology and regional planning
4. Promote regulatory structures that encourage **efficiency in electricity markets**
5. **Secure energy systems and assets** against threats and facilitate rapid recovery from disruptions to electricity supply



Goal-Subprogram Alignment Summary

	1. Flexibility	2. Reliability	3. System Understand-ing	4. Efficient Markets	5. Security
Office of Electricity Delivery and Energy					
Research and Development					
Clean Energy Transmission and Reliability	20%	30%	30%	15%	5%
Smart Grid Research and Development	40%	20%	25%	5%	10%
Electricity Systems Hub	20%	15%	50%	10%	5%
Cyber Security for Energy Delivery Systems	0%	20%	10%	0%	70%
Energy Storage	50%	50%	0%	0%	0%
Subtotal, Research and Development	21%	26%	23%	6%	24%
Permitting, Siting and Analysis	10%	10%	30%	50%	0%
Infrastructure Security and Energy	0%	10%	15%	0%	75%
Program Direction	20%	20%	25%	10%	25%
Total, Electricity Delivery and Energy Reliability	20%	23%	23%	8%	25%

Strategic Plan and Performance Measures

STRATEGIC GOAL: Transforming our Energy Systems		
OBJECTIVE: Deploy the Technologies We Have		
TARGETED OUTCOME: Enable better understanding and control of our electric grid by installing more than 1000 synchrophasor measurement units by 2013		
FY 2011 Annual Measure[a] #1 : Demonstrate and implement technologies and tools that improve the monitoring of transmission system health and the ability of operators to respond quickly and effectively to address issues.		
	Target	Actual/ Met or Not Met
Budget Year	Demonstration of adaptive islanding and controlled separation of an interconnection	---- N/A
Current Year	Demonstration of distributed dynamic state estimator prototype	---- N/A
Prior Year	Demonstrate effectiveness of grid stability alarm (analysis of characteristic power oscillation) implemented in 5 control centers	Not needed in all five control centers after successful demonstrations in the first two.
Analysis	These demonstrations show the viability of the technologies to monitor and control the grid using phasor data, and validate progress towards a nationwide synchrophasor network with 100% sensor coverage of the transmission system by 2020. In the prior year, the effectiveness of the grid stability alarm was confirmed by the completion of the second implementation, precluding the need for the other three.	
TARGETED OUTCOME: Deploy more than 26 million smart meters in American homes and businesses by 2013		
Annual Measure #2 : Reductions in load factor (LF) ,duration of outages (SAIDI) on the distribution system, and outage time of critical loads on smart microgrids (CL)		
	Target	Actual/ Met or Not Met
Budget Year	98% CL reduction (demo)	---- N/A
Current Year	12% LF reduction	---- N/A
Prior Year	10% LF reduction	Met
Analysis	If smart meters are used to reduce load factor and outage duration, they will support a self-healing distribution grid that allows for widespread integration of demand response, distributed generation and plug-in electric vehicles by 2020.	

[a] For Performance History or Verification and Validation information for this Annual Measure, please follow the hyperlink to the Annual Performance Measure at http://www.cfo.doe.gov.

TARGETED OUTCOME: Reduce utility-scale energy storage costs by 30% by 2015		
Annual Measure #3 : Lower the cost of grid-scale energy storage technologies		
	Target	Actual/ Met or Not Met
Budget Year	$475/kWh	---- N/A
Current Year	$560/kWh	---- N/A
Prior Year	$625/kWh	Met
Analysis	By reducing cost (expressed as $ per kilowatt-hour) to compete with current peak generation sources, we increase commercial use of grid-scale storage to buffer variable generation sources, leading to grid-scale storage use for this purpose to 5% by 2020.	

Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Office of Electricity Delivery and Energy Reliability			
Research and Development	0	2,925	3,154
Total, SBIR/STTR	0[a]	2,925	3,154

[a] FY 2011 transfer to SBIR/STTR has already occurred and funds are no longer in OE's appropriation. Amount transferred was $2,940,000

Ofice of Electricity Delivery and Energy Reliability
Funding by Site by Program

(dollars in thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Argonne National Laboratory			
Research and Development	1,195	852	900
Infrastructure Security and Energy Restoration	50	0	0
Total, Argonne National Laboratory	1,245	852	900
Chicago Operations Office			
Program Direction	117	0	0
Total, Chicago Operations Office	117	0	0
Idaho National Laboratory			
Research and Development	350	989	1,000
Total, Idaho National Laboratory	350	989	1,000
Lawrence Berkeley National Laboratory			
Research and Development	4,202	7,865	6,900
Permitting, Siting, and Analysis	3,796	4,000	3,500
Total, Lawrence Berkeley National Laboratory	7,998	11,865	10,400
Lawrence Livermore National Laboratory			
Infrastructure Security and Energy Restoration	0	50	50
Total, Lawrence Livermore National Laboratory	0	50	50
Los Alamos National Laboratory			
Research and Development	1,880	652	550
Total, Los Alamos National Laboratory	1,880	652	550
National Energy Technology Laboratory			
Research and Development	47,536	32,179	31,250
Permitting, Siting, and Analysis	990	1,300	1,050
Infrastructure Security and Energy Restoration	235	127	125
Program Direction	8,395	7,973	7,507
Congressionally Directed Activities	0	0	0
Total, National Energy Technology Laboratory	57,156	41,579	39,932

(dollars in thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
National Renewable Energy Laboratory			
Research and Development	3,536	3,297	2,586
Permitting, Siting, and Analysis	625	500	400
Total, National Renewable Energy Laboratory	4,161	3,797	2,986
Oak Ridge National Laboratory			
Research and Development	8,072	7,827	5,885
Permitting, Siting, and Analysis	0	100	100
Total, Oak Ridge National Laboratory	8,072	7,927	5,985
Pacific Northwest National Laboratory			
Research and Development	13,980	17,540	14,723
Infrastructure Security and Energy Restoration	208	825	850
Total, Pacific Northwest National Laboratory	14,188	18,365	15,573
Richland Operations Office			
Infrastructure Security and Energy Restoration	706	950	950
Total, Richland Operations Office	706	950	950
Sandia National Laboratory			
Research and Development	16,771	15,171	10,717
Infrastructure Security and Energy Restoration	65	50	50
Total, Sandia National Laboratory	16,836	15,221	10,767
Washington Headquarters			
Research and Development	4,538	12,764	28,889
Permitting, Siting, and Analysis	589	1,076	950
Infrastructure Security and Energy Restoration	4,836	3,979	3,975
Program Direction	19,098	19,037	20,108
Total, Washington Headquarters	29,061	36,856	53,922
Total, Electricity Delivery and Energy Reliability	141,770	139,103	143,015

Research and Development
Funding Profile by Subprogram with Activities

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Research and Development			
Clean Energy Transmission and Reliability			
Transmission Reliability and Renewables Integration	16,524	15,481	13,573
Advanced Modeling Grid Research	3,888	9,183	9,695
Advanced Cables and Conductors	4,860	0	0
SBIR/STTR	0	750	732
Subtotal, Clean Energy Transmission and Reliability	25,272	25,414	24,000
Smart Grid Research and Development			
Smart Grid Research and Development	22,356	19,336	13,961
Power Electronics	5,832	3,867	0
SBIR/STTR	0	705	439
Subtotal, Smart Grid Research and Development	28,188	23,909	14,400
Electricity Systems Hub			
Electricity Systems Hub	0	0	19,390
SBIR/STTR	0	0	610
Subtotal, Electricity Systems Hub	0	0	20,000
Cyber Security for Energy Delivery Systems			
Cyber Security for Energy Delivery Systems	29,160	29,007	29,085
SBIR/STTR	0	882	915
Subtotal, Cyber Security for Energy Delivery Systems	29,160	29,889	30,000
Energy Storage			
Energy Storage	19,440	19,336	14,543
SBIR/STTR	0	588	458
Subtotal, Energy Storage	19,440	19,924	15,000
Total, Research and Development	102,060	99,136	103,400

Public Law Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 102-486, "Energy Policy of 1992"
Public Law 109-58, "Energy Policy of 1995"
Public Law 110-140, "Energy Independence and Security Act of 2007"

Program Overview and Benefits

The OE Research and Development (R&D) program works in partnership with industry, academia, government, and the public to advance technologies to meet America's need for a reliable, efficient, secure, and affordable electric power.

A modern electric grid provides the necessary infrastructure to enable the adoption of cleaner energy supplies and more energy-efficient demand-side measures. Without it, the electric system could become a major barrier to securing America's clean energy future. The technologies pursued by the Research and Development program will enable greater adoption of variable resources, and enhance economic growth by making the nation's electricity delivery system more reliable, secure, efficient, flexible, and functional.

Each of the five subprograms of the R&D Program advance these goals by promoting the development of an efficient, "smart" electricity transmission and distribution network. This includes national leadership to develop smart grid technologies, tools, and techniques; energy storage systems and power electronics devices for grid modernization; and next-generation control systems that reduce the risk of energy disruptions due to cyber events.

Explanation of Changes

The Department requests $103 million for OE's Research and Development program, a 4% increase over FY 2012 funding levels.

The request initiates the Electricity Systems Hub (+$20M) and maintains funding levels for Cyber Security for Energy Delivery Systems. It proposes reductions in the Clean

Energy Transmission and Reliability subprogram (-$1.4M) reflecting the termination of work focused on transmission-level integration of renewable energy sources (-$2.0M), while maintaining funding for Advanced Grid Modeling Research (+$0.5M).

The decrease in the Smart Grid Research and Development subprogram (-$9.5M) reflects the closeout of Power Electronics (-$4M) research as the Department shifts its emphasis from applied research in power electronics to focus on current device compositions and foundational research carried out by ARPA-E and the Office of Science. The request also decreases funding for the Smart Grid Research and Development (-$5.5M) activity reflecting reduced efforts in microgrid research and integration of distributed energy resources, smart charging of electric vehicles, as well as standards development and communications and control technologies.

It also decreases funding for Energy Storage (-$5M), resulting from scaled-back research on sodium-ion batteries and low-cost, long-life lithium-ion batteries for community energy storage applications.

Program Accomplishments and Milestones

In FY 2011 the Research and Development program achieved significant accomplishments in applications development. These accomplishments include:

- Releasing two new cybersecurity situational awareness tools, including one for the Inter-Control Center Communications Protocol, a complex protocol that electric utilities use to exchange information on the state of the grid
- Developing a new electrolyte chemistry for vanadium redox flow batteries with 70% increased capacity, double the operational temperature range, and 90% increased energy efficiency
- Demonstrating grid oscillation detection software, an operational tool to improve grid stability. The awardee plans to install this system at two transmission control centers

Milestone	Date
Develop roadmap to coordinate research activities (between OE, ARPA-E and Office of Science) in advanced computation and modeling	Mar 2012
Demonstrate light-weight mobile software agents (Digital Ants) that independently monitor specific security-related characteristics of the system	Aug 2012
Finish initial detailed conceptual design for microgrids to be installed at DoD bases through the SPIDERS joint capability technology demonstration program	Sep 2012

Program Planning and Management

OE takes a systems-level approach to developing the technologies and techniques to address the nation's energy challenges. In this role, partnerships are critical, both within the federal government and within the private sector, to ensuring that individual devices and components are integrated seamlessly into grid planning and operations.

We anticipate the need for improved situational awareness at both the transmission and distribution levels. This results from changes in both the electricity demanded and supply mix. Sensors are being deployed in the system to measure critical parameters; this would include both advanced metering infrastructure and synchrophasor technology. We need to feed this newly available data into enhanced tools that help improve decision making by grid operators for improved flexibility, reliability and security.

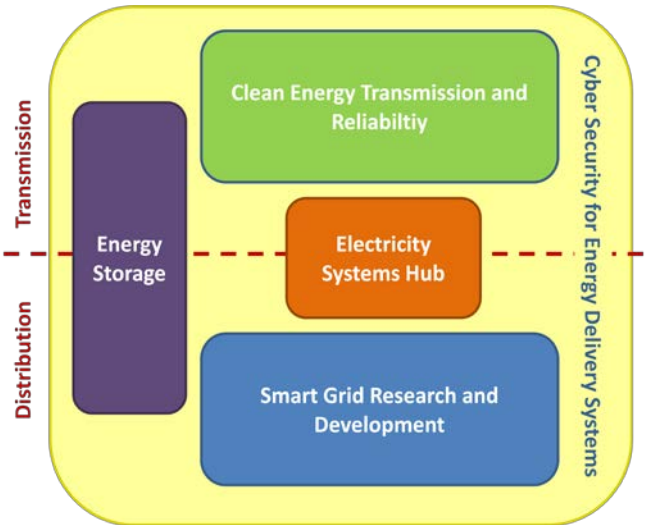
Markets are continuing to evolve on a state-by-state basis to reflect regional and local needs. The intersection of markets and operations raises a variety of questions that will be addressed through modeling and analysis activities under both the Smart Grid R&D and Clean Energy Transmission and Reliability subprograms in collaboration with the Permitting, Siting and Analysis program. The Energy Storage and Cyber Security subprograms remain core components of the office as their cross-cutting functions directly support overarching objectives across the electric system.

In pursuing its mission, the Research and Development program will implement three key strategies to more efficiently and effectively manage the program:

1. Partner with the utility industry, national laboratories, and universities to develop next-generation technologies.
2. Engage multiple utility, manufacturing and university partners through competitive solicitations to demonstrate technologies and applications on operational systems.
3. Collaborate with other DOE programs and other federal agencies to ensure coordinated federal leadership in the grid space.

The R&D program has identified three major external factors that can affect progress towards its goals:

1. Resolution of agreements for sharing data and information among stakeholders, including standards and protocols
2. Complexity of regulatory environments for using demand response, cost recovery for storage, and other innovative smart grid technologies
3. Constant evolution of cyber threats and the increasing sophistication of cyber attacks



The Research and Development program is divided into five subprograms, as shown above. Clean Energy Transmission and Reliability focuses on grid modernization technologies at the transmission level, while the Smart Grid Research and Development subprogram focuses at the distribution level. The Electricity Systems Hub addresses the interconnection between transmission and distribution. The Energy Storage and Cyber Security subprograms support technologies that are applied across the entire grid space.

Program Goals and Funding

In support of Office and Departmental goals, the R&D program uses five strategic goals to inform program investment:

1. Enhance grid flexibility to incorporate a variety of energy sources and responsive loads, including large amounts of variable and distributed energy resources
2. Maintain reliability by developing real-time monitoring, control and protection to improve grid operations
3. Build system-level understanding needed for innovative approaches to technology and regional planning
4. Promote regulatory structures that encourage efficiency in electricity markets
5. Secure energy systems and assets against cyber and physical threats

Goal Areas by Subprogram

	1. Flexibility	2. Reliability	3. System Understanding	4. Efficient Markets	5. Security
Clean Energy Transmission and Reliability	20%	30%	30%	15%	5%
Smart Grid Research and Development	40%	20%	25%	5%	10%
Electricity Systems Hub	20%	15%	50%	10%	5%
Cyber Security for Energy Delivery Systems	0%	20%	10%	0%	70%
Energy Storage	50%	50%	0%	0%	0%
Total, Research and Development	21%	26%	23%	6%	24%

Explanation of Funding and Program Changes

	(Dollars in Thousands)		
	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Clean Energy Transmission and Reliability			
Decreased funding reflects the cessation of funding for research focusing on the effects of integrating large amounts of renewable resources into the transmission system (-$1.9M). This decrease is offset by expanded development of modeling and computational capabilities for grid applications (+$0.5M).	24,664	23,268	-1,396
Smart Grid Research and Development			
The decrease reflects reduced funding for the Smart Grid R&D activity (-$5.4M), and a cessation of power electronics applied research activities, as focus shifts away from current device compositions to foundational research carried out by ARPA-E and the Office of Science (-$3.9M).	23,204	13,961	-9,243
Electricity Systems Hub			
The increase compared to FY 2012 reflects the first year of funding for the Electricity Systems Hub	0	19,390	+19,390
Cyber Security for Energy Delivery Systems			
The apparent increase reflects the slight reduction in FY 2012 as a result of one-time cost for a freeze in pay to integrated contractors. There is no overall change in funding for the program.	29,007	29,085	+78
Energy Storage			
The reduction results from the discontinuation of work on Na-ion batteries and development of low cost, long life Li-ion batteries for community energy storage.	19,336	14,543	-4,794
SBIR/STTR			
The increase results from overall increase in funding from the FY 2012 levels and the increase in SBIR/STTR transfer from 2.95% in FY 2012 to 3.05% in FY 2013.	2,925	3,154	+229
TOTAL Funding Change, Research and Development	99,136	103,400	+4,264

Clean Energy Transmission and Reliability
Funding Profile by Activity

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Clean Energy Transmission and Reliability			
Transmission Reliability and Renewables Integration	16,524	15,481	13,573
Advanced Modeling Grid Research	3,888	9,183	9,695
Advanced Cables and Conductors	4,860	0	0
SBIR/STTR	0	750	732
Total, Clean Energy Transmission and Reliability	25,272	25,414	24,000

Public Law Authorizations:

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 102-486, "Energy Policy of 1992"
Public Law 109-58, "Energy Policy of 1995"
Public Law 110-140, "Energy Independence and Security Act of 2007"

Overview

In supporting the Secretary's goal of *Energy: Build a competitive, low-carbon economy and secure America's Energy Future*, the Clean Energy Transmission and Reliability (CETR) Program supports modernization of the electric power grid through the development of advanced monitoring, control and computational applications to reliably operate the US transmission system. Fed by real-time data collected by a nationwide grid monitoring network, built out with Recovery Act funding, these applications balance generation from all sources to deliver the reliable, low-cost electricity that drives the nation's economy.

R&D activities center on the development of tools that monitor and analyze grid parameters, advanced system models, and new computational techniques to monitor grid health while predicting future scenarios and planning for contingencies to maintain grid integrity. The resulting secure, robust electric power grid underpins the success of other critical energy infrastructure.

To realize the full benefits of a modern electric power system, the CETR subprogram addresses the challenges of:

- Sharing real-time data and high-fidelity system models
- Shifting the nature of grid control from reactive to predictive
- Optimizing electricity markets for maximum efficiency

Subprogram Accomplishments

In FY 2011 the Clean Energy Transmission and Reliability subprogram achieved significant accomplishments in applications development. These accomplishments include:

- Demonstrated grid oscillation detection software, an operational tool to improve grid stability. The awardee plans to install this system at two transmission control centers.
- Transitioned multi-dimensional grid analysis research software framework (SuperOPF) to a commercial-grade research tool for use by the electric utility industry.
- Conducted university workshops to identify computational needs for electric power systems

Explanation of Changes

The Department's request of $24 million in FY 2013 for the Clean Energy Transmission and Reliability Program is a decrease of 6% from FY 2012.

The request reflects decreased funding levels for Transmission Reliability and Renewables Integration (-$2M), resulting from the closeout of activities focused on the integration of renewables into the transmission system. It essentially maintains Advanced Grid Modeling Research at the FY 2012 level.

Strategic Management

The Office will implement three key strategies to more efficiently and effectively manage the program:

1. Partner with the utility industry, national laboratories, and universities to develop real-time synchrophasor applications and advanced computational approaches.
2. Engage multiple utility, vendor and university partners through competitive solicitations to demonstrate applications based on high-speed synchrophasor data on operational systems.
3. Foster the growth of a community of researchers, utility partners, and regulators across the industry to help identify system challenges and achieve real-time situational awareness and maintain grid reliability.

Three external factors present the strongest impacts to the overall achievement of the program's strategic goal:

1. Resolution of agreements for sharing synchrophasor data among utilities and regulators to limit liability and preserve competitive markets.
2. Consumer and State public utility commission must accept the use of demand response through direct control or pricing mechanisms.
3. The development of power systems expertise is necessary to position university programs as engines of innovation that could solve the challenges identified by industry.

Explanation of Funding and Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Transmission Reliability and Renewables Integration			
Decreased funding reflects closeout of research activities focused on the integration of variable resources into the transmission system.	15,481	13,573	-1,908
Advanced Modeling Grid Research			
Increased funding supports analysis to determine the temporal, spatial and conceptual model structures needed for real-time computation.	9,183	9,695	+512
SBIR/STTR			
The decrease reflects the decrease in overall funding.	750	732	-18
TOTAL Funding Change, Clean Energy Transmission and Reliability	25,414	24,000	-1,414

Transmission Reliability and Renewables Integration

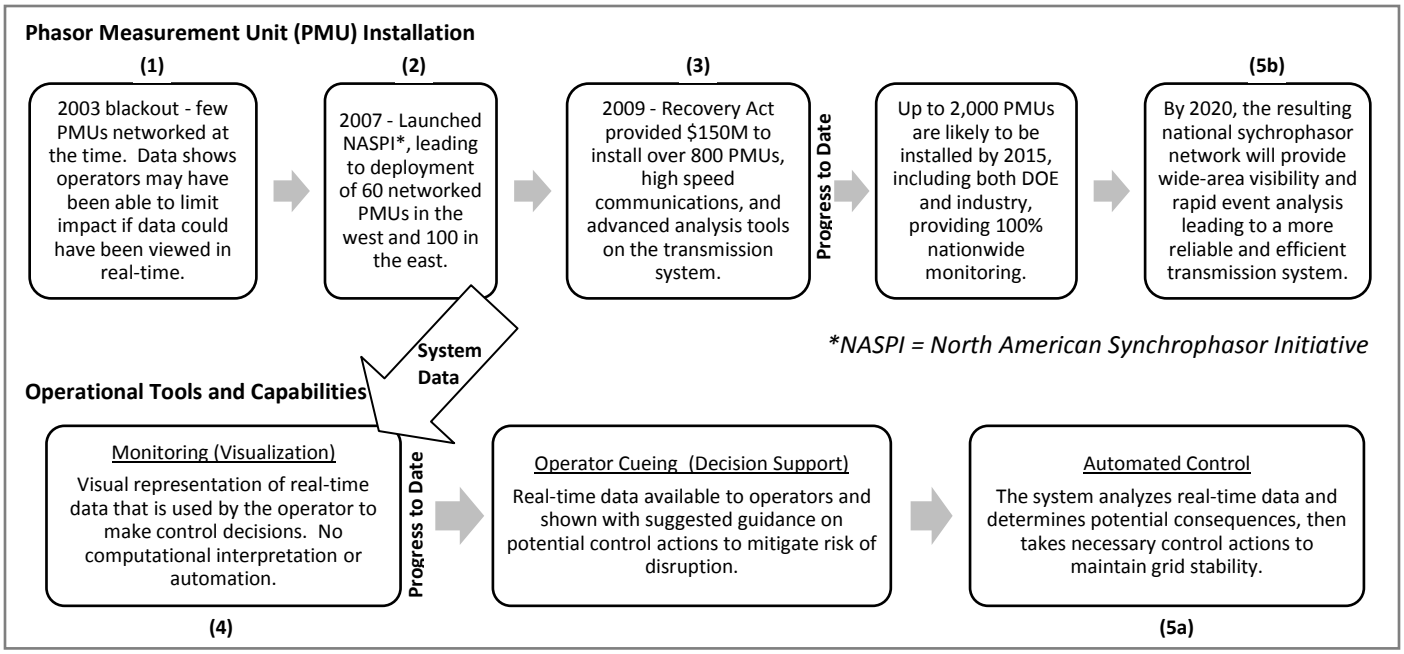
The Transmission Reliability and Renewables Integration subprogram supports partnerships between DOE national laboratories and the electricity industry to conduct research on the reliability of the nation's electricity transmission infrastructure, including the impact of the transition to competitive markets and the ongoing adoption of large amounts of variable generation. Competition and market forces (at the wholesale level) are increasing the volume of power transactions exponentially. Along with the supply transformation, forces are causing the grid to be used in ways for which it was not designed. Time synchronized from advanced sensors installed on the transmission system, known as phasor measurement units (PMUs), monitor the flow of electricity and provide information on system health. This activity supports the development of technologies, tools and operational approaches that use this information to enhance the flexibility and reliability of the Nation's power system.

In FY 2013, the Department will develop and demonstrate real-time systems to monitor and control the grid with advanced analysis, visualization and decision-support tools.

Sequence

The 2003 northeast blackout (1), and subsequent review and report, made clear the need for real-time situational awareness of grid conditions at a system level. Following the report and findings, DOE and NERC joined with North American electric utilities, vendors and researchers to form the North American Synchrophasor Initiative (NASPI) with the goal of improving the reliability of the power system through wide-area measurement and control. The collaborative has worked to deploy networked phasor measurement units and visualization tools nationwide (2). Funding from the Recovery Act accelerated this process, with over 800 additional units planned for deployment by the end of the projects (3).

As data has become available from the networked PMUs, capabilities for operational tools have improved to provide better monitoring through real-time visualization (4). These capabilities will continue to improve over time as more data is collected, leading to automated system control capabilities (5a), full system visibility (5b), and decreases in both the spread and duration of system outages.



Benefits

- Enhances sensing of and response to actual grid conditions (rather than reliance on conservative off-line studies) to allow the transmission system to operate closer to its load limits, reduce operating margins and system congestion, and increase utilization of existing transmission corridors
- Enables integration of transmission-level, variable generation (such as utility-scale solar and wind) into routine operation of the power system, thereby helping to maintain reliability
- Improves situational awareness for faster identification and response to deteriorating or abnormal grid conditions, improved reliability, reduced number and spread of blackouts, and faster restoration of power following blackouts

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Demonstrated grid oscillation detection software, and the awardee signed a contract to install this prototype system at two transmission control centers in the Western US. • Reoriented the focus of the North American Synchrophasor Initiative (NASPI) to provide technical support to maximize the value the OE ARRA synchrophasor deployment projects. • Transitioned a multi-dimensional grid analysis research software framework (SuperOPF) to a commercial-grade research tool for use by the electric utility industry.	16,524
FY 2012	• Demonstrate a prototype adaptive protective relaying concept based on high-speed synchrophasor data at two substations in California. • Demonstrate a distributed dynamic state estimator implemented at two separate utility locations that uses synchronized measurements which measure the state of the grid in seconds rather than minutes. • Investigate the load profiles of individual demand response resources to quantify their capability in terms of timing and capacity to respond to grid efficiency and reliability needs. • Complete award process for dynamic analysis (on regional scale) under scenario of high penetration of variable generation	15,481
FY 2013	• Demonstrate (through simulation studies) adaptive islanding in an interconnection that performs a controlled separation of the grid into smaller islands to improve protection from wide-area blackouts. • The DOE-developed NASPInet, for high-speed, secure and dependable transmittal of synchrophasor data, will demonstrate its speed and accuracy at grid control centers in the Western Interconnection. • Publish results of advanced research in protective relaying based on high-speed synchrophasor data to assess and, if necessary, establish new, corrected relay settings every few seconds to match system conditions. • Coalesce load profile investigations from promising demand response sources (residential water heating, air conditioning, and electric vehicles, commercial building systems, industrial processes, etc.) and combine them into temporally-based virtual and flexible aggregated demand response "units". • Expand research on SuperOPF and Security-Constrained Unit Commitment for scenarios that include high penetrations of variable generation. • Continue regional, dynamic analysis studies (frequency response; voltage support/regulation; transients) to develop innovative system operational control approaches for scenarios. • Complete Western Electricity Coordinating Council-based-scenario balancing area study (in collaboration with EERE).	13,573

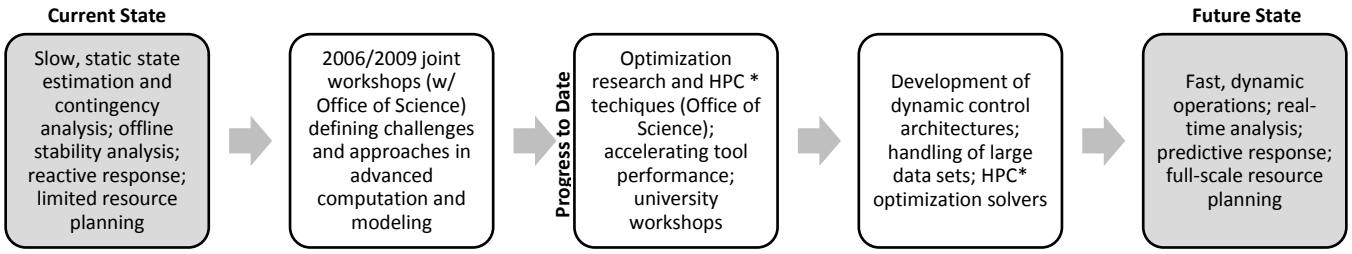
Advanced Modeling Grid Research

This activity will develop the computational, mathematical, and scientific understanding (for suitable application in a large-scale, dynamic, stochastic environment) needed to transform the tools and algorithms that underpin electric system planning and operations. In achieving this goal, it will also foster strategic, university-based power systems research capabilities.

Integration of large amounts of variable generation, mass deployment of electric vehicles, and actively engaged end-users will greatly increase uncertainty in grid operations and planning. The electric system will have to operate closer to its limits than ever before, with planners and operators unable to accurately determine the system's breaking point or to build sufficient equipment redundancies. Decision tools to inform national scale electric grid expansion, regional system operation and electricity markets must be dramatically enhanced, overcoming computational limitations by using real-time measurements and better predictive modeling and simulation tools.

Over time, this activity will take the scientific discoveries made in advanced computation (through the Office of Science) and combine them with the real-time data and sensing from the Transmission Reliability program to improve grid efficiency and reliability.

Sequence



Benefits

- Accelerate performance – improving grid resilience to fast time scale phenomena that drive cascading network failures and blackouts by developing dynamic state estimation and contingency analysis at a sub-second level based on SCADA and PMU data
- Enable predictive capability – relying on real-time measurements and improved models to represent with more fidelity the operational attributes of the electric system, enabling better prediction of system behavior and thus reducing margins and equipment redundancies needed to cover uncertainties

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Evaluate 5-second fast state estimation with actual power system model and data • Conduct university workshop to refine algorithmic requirements and system needs	3,888
FY 2012	• Development of methodologies for large-scale optimization addressing spatiotemporal uncertainty	9,183
FY 2013	• Integrate fast state estimation and parallel contingency analysis approaches into operational tool(s) • Initiate algorithmic and computational research for "online" transient analysis	9,695

Smart Grid Research and Development
Funding Profile by Activity

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Smart Grid Research and Development			
Smart Grid Research and Development	22,356	19,336	13,961
Power Electronics	5,832	3,867	0
SBIR/STTR	0	705	439
Total, Smart Grid Research and Development	28,188	23,909	14,400

Public Law Authorizations:

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 102-486, "Energy Policy of 1992"
Public Law 109-58, "Energy Policy of 1995"
Public Law 110-140, "Energy Independence and Security Act of 2007"

Overview

In supporting the Secretary's goal of *Energy: Build a competitive, low-carbon economy and secure America's Energy Future*, the Smart Grid Research and Development subprogram targets modernization of the electric system at the distribution level, with the goals of self-healing from grid disturbances for improved reliability, and integration of demand-side management for improved system efficiency.

Subprogram activities focus on:

- advanced communications and controls for coordinated operation and protection of grid-connected energy storage, plug-in electric vehicles, and distributed generation (including renewables);
- distribution automation to reduce system outage duration and frequency;
- microgrid development to provide energy security to critical loads including commercial and military installations; and
- smart grid standards and protocols for "plug-and-play" interoperability of components, devices, and systems connected to the electricity delivery network, from generators to consumers.

To maximize the benefits of nationwide smart grid development, work must be done to address the following challenges:

- Integrating demand-side assets for improved system efficiency and reliability
- Managing two-way power flow necessitated by integration of high penetration of renewable and distributed generation
- Enabling plug-and-play, interoperable operations of all grid-connected devices and systems, including legacy systems.

Subprogram Accomplishments

In FY 2011, the Smart Grid R&D subprogram achieved significant accomplishments in the development of smart grid technologies. These accomplishments include:

- Demonstrated 10% load factor improvement on a distribution feeder circuit through integration of renewable and distributed systems,
- Implemented GridLAB-D simulation tool to assess smart grid technology benefits (distribution automation, demand response, distributed generation, energy storage) with resulting policy recommendations
- Established IEEE 2030 Standard on smart grid interoperability and IEEE 1547.4 Standard on microgrids.
- Increased the operating voltage of GaN on Silicon power electronics devices from a few hundred volts to more than 2000 volts. This approaches the level where grid scale operation is possible.

Explanation of Changes

The FY 2013 request decreases the overall funding level for the Smart Grid Research and Development subprogram by$9.5M, a 40% reduction from the FY 2012 appropriation. This reflects a reduction in funding for Smart Grid R&D (-$6M) and the cessation of funding for Power Electronics (-$4M).

Strategic Management

In meeting the challenges to smart grid transformation, the Office will implement three key strategies to efficiently and effectively manage the subprogram:

1. Partner with the private sector, national laboratories, universities, and international partners to develop advanced smart grid technologies.
2. Engage other DOE programs and other Federal agencies for coordinated pursuit of distributed generation, PEVs, demand response, and microgrids.
3. Participate in smart grid development programs to facilitate the development of standards, best practices, and a common assessment framework for smart grid costs and benefits.

Three external factors present the strongest potential impacts to the overall achievement of the program's strategic goal:

1. Potentially insufficient growth in electricity demand could discourage additional private industry investment in smart grid development.
2. Slow development and implementation of national smart grid standards, protocols, and assessment frameworks.
3. Hesitance on the part of consumers to actively participate in their electricity use.

Explanation of Funding and Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Smart Grid Research and Development			
The decrease reflects reduced funding for microgrid research; and scaled back research into smart charging of electric vehicles integration of distributed energy resources and standards development, and communication and control technologies.	19,336	13,961	-5,375
Power Electronics			
The request ceases funding for power electronics research. The Power Electronics activity reflects the Department's shift in emphasis from applied research in power electronics for grid-scale applications to focus on current device compositions and foundational research carried out by ARPA-E and the Office of Science.	3,867	0	-3,867
SBIR/STTR			
The decrease reflects the decrease in overall funding.	705	439	-266
TOTAL Funding Change, Smart Grid Research and Development	23,909	14,400	-9,509

Smart Grid Research and Development

Today's electric distribution system is primarily based on a radial circuit design with one-way power flow. Beyond substations, the system employs few measuring and control devices for situational awareness and control, and most devices are capable of only one-way communication. As the distribution grid becomes increasingly decentralized with growing penetration of distributed energy resources both by utilities and non-utilities, including consumers, two-way power flow will be essential; thus, there is a need for two-way communications and decentralized controls to better match supply and demand in real time, as well as for system integration and adaptive protection coordination.

Further, consumers today have limited information and no opportunity to participate with the electric power system because the system currently lacks the means for two-way information exchanges between the grid operator and consumers. Limited consumer participation hampers the ability to fully realize the market potential for energy conservation and demand response. To address these challenges, the Smart Grid R&D subprogram undertakes projects in the following R&D areas:

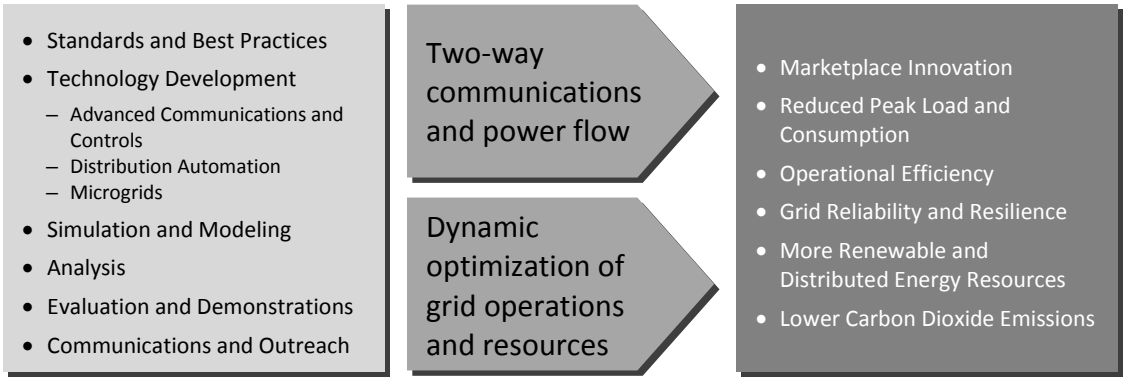
- **Technology Development** encompasses advanced sensing and measurement, integrated communications and security, advanced components and subsystems, advanced control methods and system topologies, and decision and operations support. Included is development of microgrids, which comprise a grouping of local generation/loads that normally operate in connection with the grid, but can disconnect and function autonomously as physical and/or economic conditions dictate.
- **Simulation and distribution architecture modeling** includes development of tools to accurately model the behavior, performance, and cost of distribution-level smart grid assets. This work focusing on operational tool development for the distribution system complements the research on advanced modeling and computational techniques for the transmission system supported in the Clean Energy Transmission and Reliability program.
- **Evaluation & Demonstrations** of new technologies and methods for technical and economic performance as well as for conformance with emerging interoperability and cyber security standard requirements.

Additionally, the Smart Grid R&D subprogram supports R&D efforts with activities in the following areas:

- **Standards & Best Practices** for electrical and communications interconnection, interoperability, testing, and operating practices.
- **Analysis** of measured data and simulations to better understand the impacts and benefits concerning capacity usage, power quality and reliability, energy efficiency, operational efficiency, and clean technology, as well as economic/business environment and crosscutting goals.
- **Smart Grid Communications and Outreach.** A broad-based consumer communications program to increase awareness of the smart grid, and available tools for energy savings and outreach to State regulatory bodies and national smart grid communities to inform them of the importance and status of development.

In the near term, the Department supports the development of smart grid architectures enabling two-way power flow and two-way communications and information exchanges—through employing advanced circuit designs, sensing, communication, and control technologies—as required for integration of high penetration levels of renewable energy, plug-in electric vehicles, advanced microgrid operations, and distribution automation.

Sequence



Benefits

System Efficiency Benefits

- Reduce peak demand through enhanced distribution asset utilization. Currently, 10 - 20% of total electricity costs in the U.S. are attributable to around 100 hours during peak periods each year (i.e., ~1% of the total year-hours).
- Defer investments in generation, transmission, and distribution upgrades and expansion, which would be required if peak demand were not reduced.

System Reliability Benefits

- Reduce duration and frequency of power outages. Currently, one in five electricity dollars is lost to power outages.
- Economic benefits from improved power reliability from smart grid are estimated at $282 billion to $445 billion for the period of 2010 to 2030, in a 2011 report from the Electric Power Research Institute (EPRI).
- Microgrids provide energy surety to critical loads including hospitals, data centers, telecom switch centers, semiconductor fabrications and foundries, and military installations.

Environmental Benefits

- Potential reductions in electricity consumption and CO2 emissions.

Funding and Activity Schedule

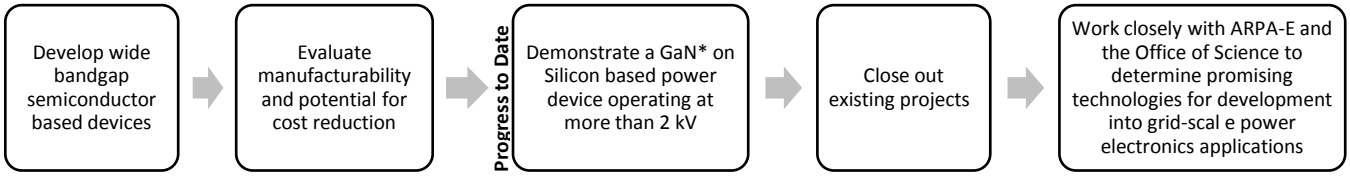
Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Continued R&D on integrated distribution management systems and on advanced sensing, monitoring, and control for intelligent feeder operations (FY 2010 awards) • Continued national lab R&D on modeling and analysis, smart grid standards, control algorithms, and microgrids for military installations	22,356
FY 2012	• Provide final year of funding support to industry- and university-led projects from FY2010 FOA demonstrating technical feasibility of smart grid technologies. • Complete awards for smart grid-capable electric vehicle supply equipment to enable smart charging of PEVs and achieve 50% cost reduction in 2-3 years. • Award smart grid data access projects to enable residential consumers to better manage their electricity consumption through use of standardized data access architecture and consumer-oriented information tools. • Continue collaboration with Department of Defense (DoD) on design and implementation of microgrids at military facilities to increase energy security and ensure availability of mission critical assets, including the SPIDERS (Smart Power Infrastructure Demonstration for Energy Reliability and Security) joint capability technology demonstration with DoD • Advance development of an open-source simulation tool, via a collaborative environment, from a single-objective control framework to a dual-objective one to strengthen business cases for smart grid technologies. • Produce the biennial publication of "The Smart Grid System Report" for submission to Congress, required by Section 1302, EISA 2007.	19,336
FY 2013	• Complete industry and university led projects from FY2010 FOA demonstrating technical feasibility of smart grid technologies. • Continue R&D on integration of distributed energy resource models with distribution system models and testing of advanced sensing, monitoring, and control • Continue R&D on communications for smart grid-capable EVSE • Continue demonstration of tools for smart grid data access by consumers • Continue national lab R&D on modeling and analysis, smart grid standards, and control algorithms; complete microgrid demonstrations at military installations (SPIDERS)	13,961

Power Electronics

The FY 2013 request includes no funding for applied research into grid-scale power electronics devices. The subprogram will be closing out its existing projects and re-evaluating its direction. The Power Electronics subprogram will continue to collaborate closely with other DOE offices performing foundational research, including ARPA-E and the Office of Science, to identify promising technologies for future development into grid-scale power electronics applications.

As the United States transitions to a digital economy, the need to upgrade the nation's aging electric grid is becoming increasingly evident. Electricity demand is projected to increase by 30% between 2008 and 2035 and the U.S. electricity delivery system must be able to meet this demand and ensure the continued supply of reliable, secure electricity. Power electronics plays a critical role in transforming the current electric grid into the next-generation grid. Existing silicon-based power electronic devices enable many grid functionalities but cannot handle the power levels and switching frequencies required by next generation utility applications. Devices based on wide bandgap semiconductor materials can. They will enable utilities to more effectively deliver power to their customers..

Sequence



** GaN = Gallium Nitride*

Benefits

Power Electronics provide increased reliability, security, and flexibility to the bulk power system by:

- Enabling control — PE devices operate like advanced switches to enable precise control of the electric grid. This allows power to move quickly from one line to another in order to optimize the system. The result is reduced equipment requirements and increases asset utilization.
- Increasing transmission and distribution loading —Utilizing the devices' robust switching capabilities, PEs enable transmission and distribution lines to be loaded more heavily without increasing the risk of disturbances on the system. This can defer the need for new transmission lines.
- Enabling connection of electric grids— PE devices enable electricity to flow in both directions between grids and allow the grids to absorb or supply power as needed.
- Enabling renewable resource integration — Renewable energy technologies usually produce either DC power with various magnitudes or AC power with various magnitudes and frequencies. Power Electronics are necessary to convert these into grid-level AC power.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Develop wide bandgap semiconductor based devices.	5,832
FY 2012	• Scale the operating voltage of developed devices to more than 2000 V.	3,867
FY 2013	• Close out projects funded in prior years.	0

Electricity Systems Hub
Funding Profile

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Electricity Systems Hub	0	0	19,390
SBIR/STTR	0	0	610
Total, Electricity Systems Hub	0	0	20,000

Public Law Authorizations:

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 102-486, "Energy Policy of 1992"
Public Law 109-58, "Energy Policy of 1995"
Public Law 110-140, "Energy Independence and Security Act of 2007"

Overview

In support of the Secretary's goal of *Transforming our Energy Systems* through *Modernizing the Electric Grid*, the Electricity Systems Hub will address the basic science, technology, economic, and policy issues that affect our ability to achieve a seamless and modernized grid. In order to effectively increase the amount of renewable energy resources on the bulk transmission system, deploy more electric vehicles and distributed generation on local distribution systems, and utilize advanced information and communication technologies in the electric power system (Smart Grid), these various systems need to be integrated seamlessly in a safe, secure, and cost-effective manner.

The electric grid is a complex system of systems that can be overwhelming in size and scope, but it serves as a key enabler to reaching national goals of reduced greenhouse gas emissions, increased energy independence, and increased economic prosperity. The grid must modernize to meet our aspirations for a clean energy economy while adapting to the on-going changes spurred by policies, economics, and innovations to ensure system reliability. The Electricity Systems Hub will call on a diverse, multidisciplinary group of experts from industry, academia, and government to coordinate, identify, and accelerate solutions to overcome the complex barriers and unique systems integration challenges that the grid faces today and in the future.

To successfully achieve seamless grid modernization, work must be done to address the following challenges:

- Ensuring that an integrated, systems-level approach is taken when looking for transformative solutions
- Developing technologies that can adapt to the constantly evolving power system while maintaining reliability and cost-effectiveness
- Addressing stakeholder fragmentation along with building consensus on the benefits and value streams of modernization

Grid integration is a regional and local issue, with wide heterogeneity around the nation. Since a single hub may not be as effective given the diversity of issues (e.g., technology, market and institutional), two to three regional hubs may be supported to address broad grid challenges.

Explanation of Changes

The FY 2013 request for the Electricity Systems Hub reflects the initial year of funding for Electricity Systems Hub. In FY 2013, a competitive funding opportunity announcement will be issued and awarded to establish the Hub.

Strategic Management

OE will implement three key strategies to efficiently and effectively manage the program:

1. Establish a Hub oversight committee to routinely evaluate the progress and direction of the Hub to ensure that they are meeting milestones and missions.
2. Ensure constant interactions with the Hub leadership to help connect the Hub to other Department activities and R&D successes to increase innovation and eliminate overlap.
3. Leverage cost-share on Hub projects to increase funding, encourage stakeholder interactions, and gain industry buy-in.

Three external factors present the strongest impacts to the overall achievement of the program's strategic goal:

1. Regional differences in the power system may require different solutions or inhibit adoption of proven solutions.
2. Access to data and privacy concerns may limit program efficacy.
3. Stakeholder acceptance and understanding of Hub activities and the potential impacts to their grid may become a barrier to progress.

Explanation of Funding and Program Changes

	(Dollars in Thousands)		
	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Electricity Systems Hub			
The increase compared to FY 2012 reflects the initial year of funding for the Electricity Systems Hub.	0	19,390	+19,390
SBIR/STTR			
Increase reflects increase in funding compared to FY 2012.	0	610	+610
TOTAL Funding Change, Electricity Systems Hub	0	20,000	+20,000

Electricity Systems Hub

This Energy Innovation Hub will address the critical issues and barriers associated with integrating, coordinating, and facilitating the numerous changes that are happening on the distribution and transmission systems. By taking a systems-level approach and a "grid-to-edge" perspective, the Hub will focus on near-term and future solutions that will enable the seamless modernization of the electric grid to meet national goals. The Department will have an oversight role in this Hub as it is designed to emulate the successes of Bell Labs and other mission-driven research centers. This management structure grants freedom for creative risk-taking and accelerates innovation by providing flexibility for dynamic course correction in an integrated environment.

The electric grid is a complex system of systems comprising of a multitude of actors, technologies, and institutions. As we modernize the grid to accommodate and adapt to changes in the generation mix (renewable energy resources, distributed generation, etc.), changing loads (electric vehicles, energy storage, LED lighting, etc.), and the increasing use of information and communication technologies (building energy management systems, demand response, sensors, phasor measurement units (PMUs), etc.), it is vital that a systems-level approach is taken to achieve seamless systems integration. One critical segment of the grid that has not been sufficiently addressed is the "seam" between transmission and distribution which is physically manifested as distribution substations. The main focus of the Electricity Systems Hub will be this nexus of power flows, information flows, markets, and regulations (see Figure 1). The integrated Hub approach that brings together a broad, multidisciplinary group of experts covering applied science, technology, economics, and policy serves well to address the barriers and challenges associated with this "pinch point" of grid modernization. The Hub will also facilitate interactions and connect to activities that address the other domains and "seams" of the grid.

Potential research topics include advanced devices, components, software, and systems that will provide the future power grid with the ability to expand its capability, to sense its own conditions, and to reconfigure as necessary to achieve resiliency. Solutions that enable safe two-way power flows, securely integrate information technology with power controls, and optimize operational paradigms will be emphasized. Exploration of utility business models, improved system understanding, and the cultivation of multidisciplinary thought leaders can help establish an electricity services economy. Additionally, policy and market analyses can help reduce barriers to innovation and system transformation.

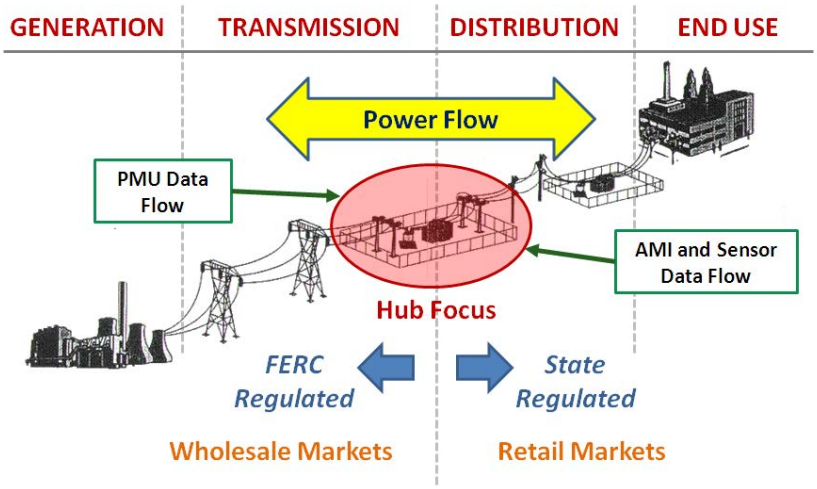


Figure 1 – Schematic portraying the various domains of the grid and the main focus of the Electricity Systems Hub

Sequence

Benefits

Societal Benefits

- Helps reduce greenhouse gas emissions by enabling the increased deployment of renewable energy resources.
- Supports a safe, reliable, and cost-effective transition to a seamless, modernized grid.
- Enables more consumer choice with the optimal integration of electric vehicles, energy management systems, distributed generation, and other technologies with the power system.

Industry Benefits

- Explores new business models and potentially addresses institutional barriers to modernization.
- Serves as an incubator for the leaders of tomorrow by providing an interdisciplinary learning experience.
- Focuses on critical concerns of the industry and develops viable solutions.

Economic Benefits

- Prompts technology innovations that can contribute to economic growth and US leadership in a green energy economy.
- Increased utilization of assets can lower electricity costs, freeing up capital to be spent on other goods and services.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• None	0
FY 2012	• None	0
FY 2013	• Establish a Hub, or several regional Hubs, through competitive solicitation and begin R&D on critical systems integration issues for grid modernization • Begin R&D on critical systems integration issues for grid modernization	19,390

Cyber Security for Energy Delivery Systems
Funding Profile

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Cyber Security for Energy Delivery Systems	29,160	29,007	29,085
SBIR/STTR	0	882	915
Total, Cyber Security for Energy Delivery Systems	29,160	29,889	30,000

Public Law Authorizations:

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 102-486, "Energy Policy of 1992"
Public Law 109-58, "Energy Policy of 1995"
Public Law 110-140, "Energy Independence and Security Act of 2007"

Overview

The Cyber Security for Energy Delivery Systems (CEDS) subprogram directly supports DOE's goal to catalyze the transformation of the nation's energy systems through the development of advanced technologies designed to reduce the risk of energy disruptions due to cyber events in energy control systems.

Reliable and resilient energy infrastructure is vital to our nation's economy, human health and safety, and national security. Cyber security for energy delivery systems has emerged as one of the Nation's most serious grid modernization and infrastructure protection issues. Intelligence reports indicate that cyber adversaries are becoming increasingly targeted, sophisticated, and better financed. The Stuxnet worm—designed to attack a specific type of control system—highlights the emergent capabilities of adversaries to attack infrastructure systems. Research and development activities (coordinated with other federal agencies and the private sector) are needed to develop new cyber security capabilities faster than adversaries can launch new attack tools and techniques.

With so many vital services and critical infrastructures interconnected with energy systems, a large scale cyber attack could disrupt power and cause cascading failures, affecting the economy and public safety of large communities. Operational reliance (and automatic system controls) based on real-time data, such as GPS technology, further reinforces the need to address potential cyber security vulnerabilities—assuring the signal is bona fide and always available when needed. Advanced cyber security solutions designed specifically to meet the unique requirements of high-reliability energy delivery systems are needed to ensure the success of grid modernization and transformation of the nation's energy systems.

The 2011 Roadmap to Energy Delivery Systems Cybersecurity (developed through collaboration with public and private sector stakeholders) identifies a number of challenges to the adoption of effective cyber security solutions for energy infrastructure, including:

- Most cybersecurity solutions are developed for desktop information technology (IT) systems, and cannot be implemented on energy delivery systems that control real-time physical processes without risking a power disruption that rivals that of an intentional cyber attack.
- Real time solutions are needed to keep pace with increasingly sophisticated cyber threats that are unpredictable and evolve faster than the sector's ability to deploy countermeasures.
- The energy sector uses many legacy devices that were designed decades ago when cybersecurity was not a central concern; these devices may not have the computing resources needed to support the cybersecurity upgrades.

Subprogram Accomplishments

This program is founded on collaborations of all energy sector stakeholders to transition innovative ideas from academia, national laboratories and industry to provide cybersecurity for energy delivery systems. Key accomplishments in FY 2011 include:

- Released two new cybersecurity situational awareness tools, including one for the Inter-Control Center Communications Protocol, known as ICCP; a very complex protocol that electric utilities use to exchange information on the state of the grid. Larger utilities use it to exchange information between generation and transmission systems.
- Completed vulnerability assessment of a secure control and data acquisition (SCADA) control system and issued a common vulnerability report that aggregated, without attribution, results from vulnerability assessments from more than 20 products.
- Conducted 5 hands-on training workshops, training 182 energy asset owners in control systems cybersecurity.

Explanation of Changes

The FY 2013 request maintains level funding for the Cyber Security for Energy Delivery Systems.

This recognizes that smart technologies are changing the way that energy information is communicated and controlled, while introducing new vulnerabilities and creating new needs for the protection of grid operations, consumer privacy, and energy market information.

Strategic Management

The Office will implement two key strategies to more efficiently and effectively manage the subprogram:

1. Collaborate with all energy sector stakeholders including national laboratories, academia, technology vendors, and energy asset owners who use energy delivery systems.
2. Foster research in national labs and academia and engage in industry-led projects to transfer promising technologies into the energy sector through competitive solicitations.

Two external factors present the strongest impacts to the overall achievement of the subprogram's strategic goal:

1. The constant evolution of the threat and its increasing sophistication
2. The increasing public availability of exploits targeting energy control systems, making more advanced attacks easier to execute by unskilled adversaries.

Explanation of Funding and Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Cyber Security for Energy Delivery Systems			
The apparent increase reflects the slight reduction in FY 2012 as a result of one-time cost for a freeze in pay to integrated contractors. There is no overall change in funding for the program.	29,007	29,085	+78
SBIR/STTR			
The increase reflects the increase in SBIR/STTR transfer percentages from FY 2012 to FY 2013.	882	915	+33
TOTAL Funding Change, Cyber Security for Energy Delivery Systems	29,889	30,000	+111

Cyber Security for Energy Delivery Systems

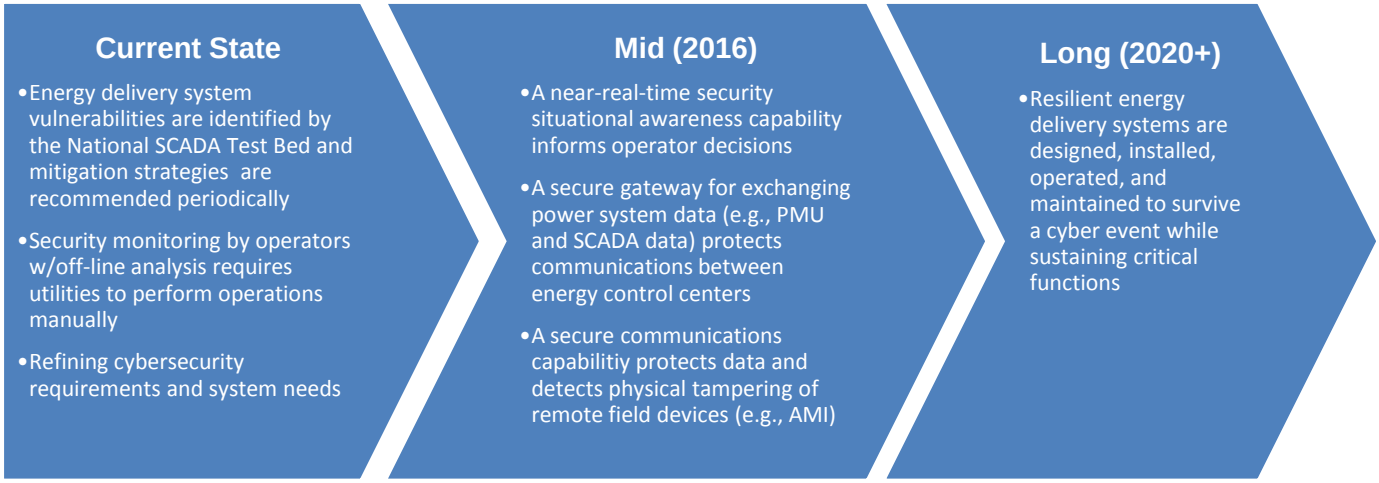
The threat landscape continues to evolve rapidly. The Stuxnet worm, designed to attack a specific control system used in the energy sector, underscores the seriousness of targeted cyber attacks on energy delivery systems. The energy sector must research, develop, and deploy new cybersecurity capabilities faster than adversaries can launch new attack tools and techniques.

The Roadmap for Secure Energy Delivery Systems, developed collaboratively by industry and provides a framework for the program, was updated in 2011 to reflect the changing landscape of technology advances and threats, the evolving needs of the energy sector, the broader focus on energy delivery systems, and the cyber-physical interface.

This program has actively engaged with the Federal Networking Information Technology Research and Development (NITRD) program by providing expertise in cybersecurity for the energy sector. In addition, national laboratories and academia have contributed to NITRD efforts in FY 2011. As the threats become more aggressive and have broader impacts, interagency collaboration and engagement becomes increasingly important to effectively leverage resources.

As part of a layered defense strategy, this work is critical to protect our nation against cyber adversaries with the capability and intent to jeopardize both our national economy and public health and safety by perpetrating a cyberattack on control or SCADA[a] systems and causing a power disruption. During FY 2013, the subprogram will focus on:

- Resilient networks and communications for the smart grid
- National SCADA Test Bed research, vulnerability assessments, and mitigations
- Next-generation technologies to enhance cybersecurity of energy delivery system platforms
- Secure, resilient Smart Grid architectures and components, including developing capability to assist utilities in understanding smart grid cyber risks and secure, real-time communications that protect the privacy of multiple participants in the shared data stream of advanced metering infrastructure
- Developing cybersecurity protective measures for synchrophasors, which are a critical smart grid component that provides engineering data needed for wide-area situational awareness of grid operation



Benefits

- Enabling smooth transition to a fully modernized electric grid by protecting legacy systems and today's energy infrastructure
- Securing consumer confidence by protecting energy sector data from cyber attack
- Protection of evolving technologies through built-in cyber security of developing grid technologies
- Decreased incidence and duration of outages due to malicious intent
- Ability to survive cyber attack while sustaining critical functions

[a] SCADA = Secure Control and Data Acquisition

Other Information

Roadmap to Secure Control Systems in the Energy Sector: http://energy.gov/node/237019

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Continued R&D on industry led projects, and cutting edge research through academia and national laboratories • Continued development of energy-sector cybersecurity technology that prevents unexpected cyber-activity on the control center network and substation computers, which protects against Stuxnet-like cyber-attacks • Continued development of a near-real-time cyber-physical security situational awareness capability, including a training simulator that uses power system engineering to inform operator response decisions, and role-based access control that restricts access to the least privileges needed to do the work at hand • Development of a cryptographic key management capability to secure communications for millions of smart meters, and to secure Smart Grid communication protocols • Supported standards development for secure and resilient Smart Grid architectures, including the Advanced Security Acceleration Project for the Smart Grid (ASAP-SG), a public-private partnership that accelerates the development of Smart Grid security requirements and standards through security profiles used by power grid asset owners, operators, and vendors • Development of cybersecurity protective measures for synchrophasors, which are a critical smart grid component that provides engineering data needed for wide-area situational awareness of grid operation • Supported national laboratory and academic collaborative frontier research in quantum information science; innovative mathematical methods and advanced computer science such as bio-inspired lightweight, mobile agents—digital ants—whose activities can raise early awareness to cyber-attack • Researched independent monitoring and control devices that sit at the lowest levels of a computer, but maintain independence from the system, and so can detect the malicious actions of a cyber-attack • Supported research into building trusted energy delivery control systems from untrusted components • Continued working closely with academic and industry partners through the Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) which is a University led public-private research partnership also supported by the DOE, DHS and Industry for frontier research that supports resilient and secure smart grid systems. • Continued vulnerability research at the National SCADA Test Bed (NSTB) that partners with control system vendors in the electric, oil, and natural gas sectors to identify and mitigate energy delivery control system vulnerabilities in fielded systems • Continued research to identify and mitigate energy-sector communication protocol vulnerabilities, and develop technologies that enforce secure communications	29,160
FY 2012	• Provide final year of funding for industry-led research and development projects awarded in FY 2010 to enhance cyber security of energy delivery systems. • Continue national laboratory integrated risk analysis, research of vulnerability mitigation techniques, and initial proof-of-concept reviews. • Continue the Trustworthy Cyber Infrastructure for the Power Grid (TCIPG), completing development of two control systems cyber security applications	29,007

Fiscal Year	Activity	Funding (Dollars in Thousands)
	• Demonstrate and evaluate bio-inspired technology – digital ants – via hardware implementation and large-scale simulations in energy delivery and information technology systems • Issue competitive solicitation that will foster cutting edge research with the vision to transition this high-risk/high-payoff research into the energy-sector.	
FY 2013	• Complete industry-led projects by transitioning the R&D to the private sector for energy sector cybersecurity, including alpha versions of software, initial network designs, and testing of hardware prototypes. • Continue integrated threat analysis, developing actionable information for sharing with energy stakeholders • Initiate new high-risk, high-payoff cybersecurity research through national laboratories in collaboration with energy sector stakeholders • Complete research developing next-generation technologies to enhance security of energy delivery system platforms including Smart Grid Devices, and initiate a new FOA for the development of secure, resilient Smart Grid architectures and components, including the capability to secure real-time communications • Develop enhanced cybersecurity protective measures for synchrophasors, a critical smart grid component that provides engineering data needed for wide-area situational awareness of grid operation	29,085

Energy Storage
Funding Profile

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Energy Storage	19,440	19,336	14,543
SBIR/STTR	0	588	458
Total, Energy Storage	19,440	19,924	15,000

Public Law Authorizations:

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 102-486, "Energy Policy of 1992"
Public Law 109-58, "Energy Policy of 1995"
Public Law 110-140, "Energy Independence and Security Act of 2007"

Overview

In supporting the Secretary's Goal of *Energy: Build a competitive, low-carbon economy and secure America's Energy Future,* the Energy Storage subprogram is designed to develop and demonstrate new and advanced energy storage technologies that will enhance the stability and reliability of the future electric grid, which includes substantial dispatch of intermittent renewable energy resources such as wind and solar power generation. The OE energy storage program focuses on accelerating the development and deployment of grid-scale energy storage in the electric system. Increasing the affordable use of energy storage in the electric grid will enhance system reliability and enable both greater adoption of renewable energy resources and more effective utilization of the existing electric system.

The subprogram focus areas include:

- Storage System R&D,
- Demonstrations,
- Power Management and Distribution, and
- Analysis

R&D activities focus on improving the economic competitiveness and technical performance of a suite of emerging energy storage technologies. Testing and field demonstration efforts are collaborative with manufacturers, states, and utilities to establish experience and confidence in storage technologies. Analysis, including the development of analytic tools, serves to inform stakeholders and guide R&D investments. Together these efforts will accelerate implementation of emerging storage technologies to advance the modernization of the electrical utility grid.

To maximize the benefits of energy storage, work must be done to address the following challenges:

- **Improving the cost/benefit ratio** of energy storage through advancements in materials engineering and device architectures;
- **Field Validation** of first-of-a-kind systems in life-like simulations in utility environments to optimize storage devices for diverse utility applications;
- **Modeling and Analysis of Storage Systems** to assess the use, costs and benefits of energy storage, identify institutional and policy barriers, and develop tools for utilities and users planning to introduce and use energy storage.

Subprogram Accomplishments

Responding to key challenges for storage deployment, the cost effectiveness of energy storage technologies was significantly improved in FY 2011 through technology advances and through establishment of the capability to assess energy storage performance in utility conditions:

- Developed a new electrolyte chemistry for vanadium redox flow batteries with 70% increased capacity, double the operational temperature range, and increased 90% energy efficiency
- Demonstrated 8,000 deep discharge cycles for a lead-carbon battery showing a 10x improvement of cycle life over traditional lead-acid batteries.
- Commissioned a 1MW Energy Storage test pad for jointly funded performance evaluation of new storage systems under realistic protocols

Explanation of Changes

The reduction of $5M (25%) from FY 2012 levels results from the scaling back of projects on Na-ion batteries and low cost, long life Li-ion batteries for community energy storage, as well as greater leveraging of State funding and collaboration with other DOE offices.

Strategic Management

The Office will implement three key strategies to more efficiently and effectively manage the program:

1. Partner with the private sector, other DOE departments, national laboratories, and universities to accelerate development of advanced energy storage devices
2. Partner with other DOE offices and other Federal and state agencies in leveraged field testing of pioneering storage systems and establishing the regulatory framework for energy storage applications
3. Jointly with industry, develop promising ARPA-E, Recovery Act, and SBIR technologies to enable next generation market ready storage systems

Three external factors present the strongest impacts to the overall achievement of the program's strategic goals:

1. Lack of clear, proven strategies for decision makers to use storage to help manage increasing power demand, more stringent environmental factors, new technologies (renewables, EV, smart grid) and operational uncertainties
2. Absence of regulatory framework and mature market structures create difficulty in cost recovery for utilities and storage providers
3. Lack of tested and proven storage technologies meeting utility needs for cost, cycle life, and energy efficiency

Explanation of Funding and Program Changes

(Dollars in Thousands)

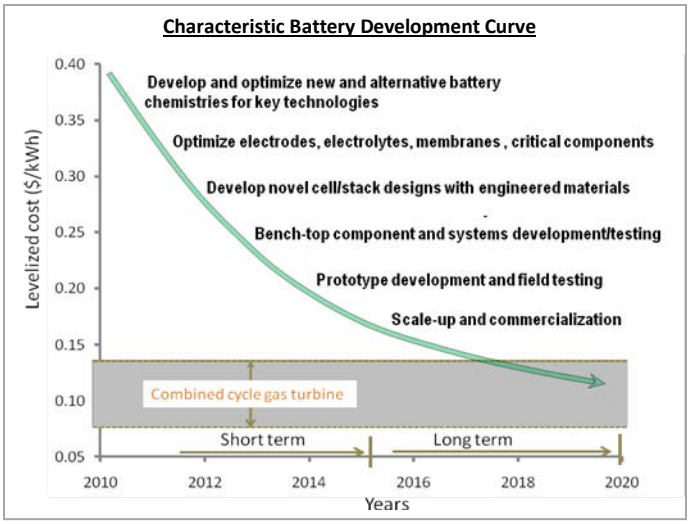
	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Energy Storage			
The reduction of $5M (25%) from FY 2012 levels results from the scaling back of projects on Na-ion batteries and low cost, long life Li-ion batteries for community energy storage, as well as greater leveraging of State funding and collaboration with other DOE offices.	19,336	14,543	-4,794
SBIR/STTR			
The decrease reflects the decrease in overall program funding.	588	458	-130
TOTAL Funding Change, Energy Storage	19,924	15,000	-4,924

Energy Storage

The development of cost-effective energy storage is vital to electric system reliability with high penetration levels of variable generation resources, effective use of existing transmission and distribution systems, electrification of transportation, and broad smart grid deployment. OE is focused on lowering the cost of storage devices, proving their performance in utility applications, facilitating industrial development, and addressing regulatory framework and market maturity for storage adoption. The program involves the development, testing and demonstration of cost effective energy storage technologies as well as development and application of analytic tools. A suite of technologies (e.g. lead-carbon, sodium metal halide, metal air, advanced flow batteries, and flywheel and compressed air storage) are under development that span the range of services associated with grid applications including frequency regulation, wind and solar ramping, and energy management; as well as different scales suitable for central (large) stations, distributed, and end-user deployment.

Sequence

Program efforts typically follow a characteristic development curve. Different technologies are at different stages of development toward cost/performance goals, as shown in the accompanying chart. Technologies exit the development pipeline either through transition to industry, or determination they have a low probability of entering commercialization. Analyses are conducted to address market, system development, grid integration, or regulatory and market questions/issues. Testing is conducted to validate storage performance under utility conditions.



Benefits

For the past decade, industry, utilities, and regional balancing authorities have come to realize that energy storage can have important benefits for the future grid, making cost-effective energy storage an ever more pressing need. Specific benefits include:

Enhancing System Stability

- Frequency and voltage regulation
- Reduction of peak load
- Minimizing grid congestion and defer upgrades

Enabling Large-scale Renewable Integration and Improved Asset Utilization

- Reducing variability of wind and solar
- Mitigation of ramping
- Allow load shifting (ie. Diurnal Wind)

Enabling distributed generation and electric vehicle deployment

- Reducing impact of roof top photovoltaic cells
- Providing electric vehicle fast charging
- Improving local voltage management

Other Information

In 2010 stakeholders from industry and academia helped DOE assess the utility needs for energy storage and develop goals for various technologies to meet power system needs. These were, in turn, used to develop a program plan that addressed the technology development and analysis needs.

OE Energy Storage Program Planning Document (Feb. 2011): http://energy.gov/node/238771

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Completed 8,000 test cycles to verify 10x cycle life of novel Lead-Carbon (PbC) battery technology, • Developed Enhanced Vanadium Flow, and Sodium Metal Halide batteries for ramping and peak management applications • Commissioned MW scale storage system test bed for jointly funded performance evaluation of new storage systems under realistic protocols • Initiated regional market assessments for storage application	19,440
FY 2012	• Perform chemical analysis of Lead-Carbon (PbC) electrodes • Bench test advanced flow and sodium ion batteries to show 70% increased capacity • Develop testing and evaluation standards for storage devices and systems • Develop a guidebook for Public Utility Commission rate review for capital improvements with energy storage	19,336
FY 2013	• Carry out Lead-Carbon (PbC) functional mechanistic studies of performance enhancement to determine chemical mechanism • Develop Mixed-Electrolyte and metallic ionic liquid flow batteries with greater energy density, cycle life, and cost effectiveness • Analyze technical accomplishments of storage projects and share results, • Develop regulatory framework, and market structure impediments assessments for storage applications on the grid.	14,543

Permitting, Siting, and Analysis
Funding Profile

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Permitting, Siting and Analysis	6,000	6,976	6,000
Total, Permitting, Siting and Analysis	6,000	6,976	6,000

P.L. Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 95-617, Public Utilities Regulatory Policy Act, 1978
Public Law 109-58, Energy Policy Act, 2005
Public Law 110-140, Energy Independence and Security Act, 2007

Program Overview and Benefits

In support of the Secretary's goal to *Transform our Energy Systems*, the Permitting, Siting, and Analysis (PSA) program helps states, regional entities, and tribes to develop and improve their programs, policies, and laws to facilitate the development of reliable and affordable electricity infrastructure.

PSA provides expert guidance to state policy makers and the electric power industry to deal with major new planning challenges, such as privacy (smart grid), utility energy efficiency, the effect of cheaper natural gas from increasing shale gas development on utility resource planning, the effect of demand response on future electricity demand, and the effect of EPA regulations on system reliability.

PSA also executes its Federal responsibilities by authorizing the export of electric energy and permitting the construction of transmission infrastructure across international borders, in accordance with the Federal Power Act.

Program Accomplishments and Milestones

In FY 2011 the Permitting, Siting, and Analysis program accomplishments include:

- Provided technical support to approximately 30 states, two federal agencies, regional transmission entities, and the Western Governors Association Committee on Regional Electric Power Cooperation, as well as provided additional analysis and planning not funded under the Recovery Act to the West for its interconnection-wide transmission planning, specifically focused on the wind and solar grid integration requested as part of their planning efforts.
- Continued processing three Presidential permit application Environmental Impact Statements (EISs); the Energia Sierra Juarez transmission Line EIS; the Champlain Hudson Power Express Transmission Line Project EIS; and the Northern Pass Transmission Line EIS.
- Provided co-lead assistance to the State of Hawaii in the development of the Hawaii Interisland Renewable Energy Program: Wind Programmatic EIS.
- Processed 13 new electricity Export Authorizations (EAs), 13 renewals of EAs, and rescinded 8 EAs.

Milestone	Date
• Provide Technical Assistance to 40 States/Governors Offices	May 2012
• Publish 2012 National Congestion Study	Aug 2012
• Finalize regulations for federal permitting of transmission infrastructure pursuant to section 216(h) of the Federal Power Act	Sept 2012

Explanation of Changes

The request decreases funding levels by $1M in FY 2013, a 14% decrease from the FY 2012 appropriation.

The decrease reflects an increase in FY 2012 to support enhanced technical assistance to states, regional entities, and tribes on advanced transmission systems and variable generation grid integration approaches, and a one-time payment in FY 2012 to settle litigation, *California Wilderness Coalition v. DOE*.

Program Planning and Management

OE recognizes that the development of a flexible electricity system begins when states and regions have the necessary expertise to make informed technology and market decisions. Through the PSA program, OE plays a critical role in bridging states' interests for the purpose of realizing national solutions and leveraging lessons learned.

PSA partners with state and regional entities and provides, upon request, technical assistance on electricity-related policies. Through the interconnection planning process, OE facilitates dialogues among regional stakeholders, recognizing that many critical future challenges require regional collaboration.

States, regional entities, and tribes possess limited in-house expertise in these technical areas. We plan for an increased demand for our technical assistance as they consider the effects of evolving policies, new electricity sector technologies(such as demand response and smart grid), cheaper natural gas for electricity generation, oversight of environmental retrofits due to EPA regulations, transmission siting, and renewable standards. PSA provides improved efficiency by sharing technical and policy expertise among these entities.

PSA will implement three key strategies to more efficiently and effectively manage the program.

1. Maintain a team of electricity policy experts – This ensures the availability of expert policy assistance for the requesting state or regional entity.
2. Provide assistance to States: PSA provides technical assistance to states, other federal partners, and tribes on electricity-related topics.
3. Encourage regional thinking among state and local stakeholders, especially regarding transmission, demand-side and generation planning, and analysis.

One external factor presents the most potential impact to the overall achievement of the program's strategic goal:

1. The lack of available highly skilled and experienced state and regional electricity policy analysis experts to provide technical assistance.

Program Goals and Funding

The Permitting, Siting, and Analysis (PSA) program promotes competitive energy markets by supporting the development of informed state policies, laws, and programs that encourage modernization of the nation's electricity grid. To encourage efficient project management and foster teamwork among personnel, PSA focuses its activities in three goal areas:

1. Implementing **Statutory Requirements** - includes the provisions of EPAct 2005, referring to the National Congestion Study and Transmission Tracking and EISA 2007.
2. **International Regulatory Program** – includes authorizing the export of electricity across borders, and permitting the construction of cross-border transmission infrastructure
3. Expert **Technical Assistance** – to states and regional entities, upon request, on electricity topics.

Goal Areas

	Permitting, Siting and Analysis
1. Statutory Requirements	15%
2. International Regulatory Program	25%
3. Technical assistance	60%

Explanation of Funding and Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Permitting, Siting and Analysis			
The decrease reflects the reduction of collaborative efforts with states, regional entities, and tribes on advanced transmission systems and market approaches, and the one-time payment in FY 2012 to settle litigation in *California Wilderness Coalition v. DOE*.	6,976	6,000	-976
TOTAL Funding Change, Permitting, Siting and Analysis	6,976	6,000	-976

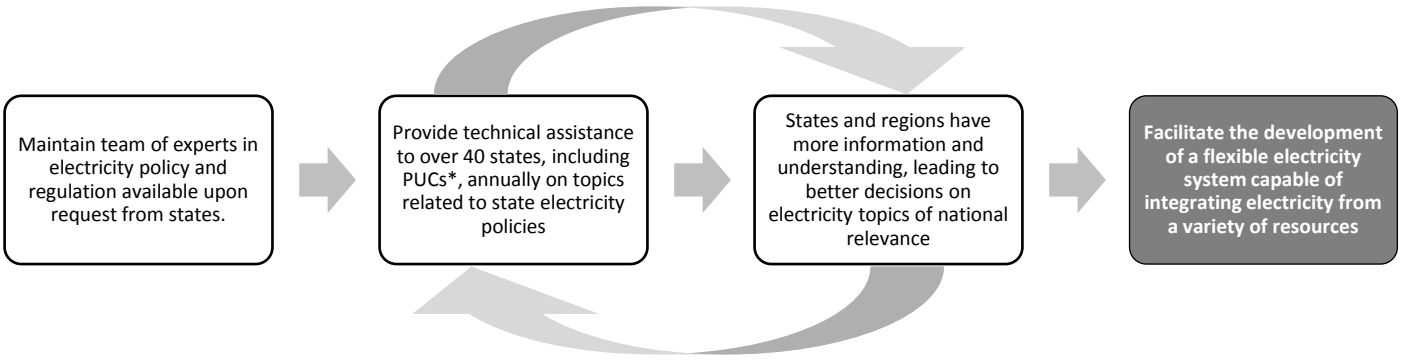
Permitting, Siting and Analysis

PSA helps to develop and improve policies, state laws, and programs that facilitate the development of infrastructure and markets needed to bring electricity from a variety of resources to consumers. Successfully achieving this goal requires close coordination with states, regional entities, and Tribes. PSA assists with their electricity policies by providing objective expert technical assistance, on an as-requested basis, to state public utility commissions, state legislatures, regional state associations, Governors' offices, and Tribes.

Topics requiring assistance or analysis include: electricity resource planning; regional transmission planning; transmission siting; utility energy efficiency; renewable energy policies and portfolio standards; demand-response; and smart grid. The program continues to encourage the development of regional institutions and regional collaboration on these and other topics that help to modernize the grid and meet the needs of a 21st Century economy.

Sequence

PSA maintains a team of experts in electricity policy and regulations, available upon request, to help states, regional entities, and Tribes understand the potential effects, and improve the design, of state and regional policies. The program provides objective technical assistance, leading to informed policy decisions based on the best solutions for each region. The end result is a modern, flexible electricity system, capable of integrating electricity from the resources that best serve its users.



**PUC=Public Utility Commission*

Benefits

- Increase access to a variety of energy resources, improve system reliability
- Provide a backstop to transmission siting authority by recommending National Interest Transmission Corridors (National Corridors)
- Ensure smooth siting for all Federal authorizations as the coordinating agency
- Facilitate regional access to new energy resources and sources of power from Canada and Mexico by authorizing international electricity transmission lines

Other Information

National Electric Transmission Congestion Study: http://energy.gov/oe/downloads/2009-electric-transmission-congestion-study

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Conducted workshops and began analysis of data for the FY 2012 National Transmission Congestion Study. • Provided technical assistance on electricity policies, upon request, to 30 states, two fed-	6,000

Fiscal Year	Activity	Funding (Dollars in Thousands)
	eral agencies, regional transmission entities, and the Western Governors Association Committee on Regional Electric Power Cooperation. • Processed 13 new electricity Export Authorizations (EAs), 13 renewals of EAs, and rescinded 8 EAs. • Conducted four consultations with Tribal leaders to hear electricity issues on Tribal lands. • Provided coordination for siting of transmission facilities. • In conjunction with the Office of Energy Efficiency and Renewable Energy, began the development of voluntary evaluation, measurement and verification (EM&V) protocols for tracking energy efficiency resources. • Provided additional assistance to state officials on other electricity topics, such as renewable energy, transmission and clean coal, which have come to the forefront as a result of Recovery Act initiatives.	
FY 2012	• Publish the 2012 National Transmission Congestion Study. • Finalize regulations for federal permitting of transmission infrastructure pursuant to section 216(h) of the Federal Power Act, as amended. • Implement appropriate parts of FERC's National Action Plan for Demand Response issued under the Energy Independence and Security Act of 2005, as part of a 2011 Implementation Proposal for FERC's Action Plan. • Provide technical assistance on electricity policies, upon request, to approximately 40 public utility commissions and other federal, state and regional entities.	6,976
FY 2013	• Provide technical assistance on electricity policies, upon request, to approximately 40 public utility commissions and other federal state and regional entities. • Respond to any request for DOE emergency orders under the Federal Power Act for reliability issues associated with environmental retrofits or closures of power plants that may occur under various new EPA regulations.	6,000

Infrastructure Security and Energy Restoration
Funding Profile

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Infrastructure Security and Energy Restoration	6,100	5,981	6,000
Total, Infrastructure Security and Energy Restoration	6,100	5,981	6,000

P.L. Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977

Overview

In supporting the Secretary's Goal: *Transform Our Energy Systems*, the Infrastructure Security and Energy Restoration (ISER) division leads national efforts to enhance the reliability, survivability, and resiliency of the U.S. energy infrastructure, while also improving national energy security by addressing energy infrastructure interdependencies based on risk and consequences.

While ISER's primary responsibility is to secure the U.S. energy infrastructure against all hazards, reduce the impact of disruptive events, and assist industry in quickly restoring energy, it also develops tools and technology to enhance the ability of the Department and the energy sector to be resilient, mitigate events, and recover quickly. In addition, ISER's efforts with state and local governments, responding to and recovering from energy disruptions, ensure seamless collaboration at all levels. In an effort to maximize the Department's capabilities within an efficient framework, ISER aligns its activities into focus areas:

- Executing effective **emergency preparedness, response, and restoration** operations;
- Providing reliable energy infrastructure **analysis and situational awareness** to all stakeholders;
- Encouraging a risk-based approach to **physical and cyber system assurance**;

These activities place ISER in a unique role to help define the science and technology needs of the energy sector. ISER uses its years of experience and partnerships to identify potential technical solutions and suppliers of technology, evaluate risk and cost, and drive innovation by facilitating the seamless integration of advanced technologies developed by OE's Research and Development Program into energy infrastructure. ISER contributes to the Department's and the sector's long-term responsibilities to secure the US energy supply by addressing topics like High Impact Low Frequency (HILF) events.

In collaboration with the Department of State, ISER provides initial engineering assessments to key energy-producing allies to assist in securing their own energy infrastructure which may be critical to the US energy supply. Upon request, and on a cost reimbursable basis, ISER provides further advice and assistance to secure these critical energy assets. Also on a cost reimbursable basis, ISER provides strategic energy advice through Energy Advisors to the US Combatant Commands (COCOMs) on a broad range of energy and national security issues.

Program Accomplishments and Milestones

- **Situational Awareness Dashboard** – Developed a near-real time monitoring situational awareness system that ISER uses to collect and analyze performance data on energy infrastructure systems to improve decision makers' capacity to mitigate, and recover from, disruptions.
- **Electricity Sector Cybersecurity Risk Management Guideline** – Began the Risk Management Process (RMP) Guideline initiative, a public-private collaboration to develop a cybersecurity risk management guideline that will provide a consistent, repeatable, and adaptable process to proactively manage cybersecurity risk in the electricity sector.
- **Geomagnetic Disturbance Mitigation Initiative** – Worked with Federal partners and industry to develop a strategy for addressing geomagnetic disturbances (GMD) and the potential impact on grid.
- **Energy Sector Public-Private Partnership Joint Working Group -** The Department collaborates with the Departments of Defense and Homeland Security in engaging sector stakeholders to understand, and where necessary improve, the energy surety (reliability, security, and resiliency) of infrastructure that supports national security missions.

Milestone	Date
Develop, validate, and implement the Energy Sector Criticality Methodology	Dec 2012
Finalize the Risk Management Guidelines for Cybersecurity	Jan 2013
Develop and execute a process to validate the risk of a GMD on system operations and transformers, the impact of the event, and risk mitigation solutions.	Sep 2013

Explanation of Changes

There is no change in funding levels in the FY 2013 request compared to the FY 2012 appropriation.

Program Planning and Management

All activities are facilitated by effective coordination with Federal, State and industry partners to leverage complimentary efforts. Specifically, ISER will implement the following strategies to effectively manage the program:

1. **Use Volunteers**. ISER maintains a cadre of trained energy emergency responders dedicated to the ten regional offices of the Federal Emergency Management Agency (FEMA) to organize and coordinate emergency response activities. Given that natural disasters tend to occur only during certain times of year, ISER supplements full-time staff with trained seasonal volunteers from across DOE. This strategy reduces ISER's costs while ensuring mission accomplishment; responders rapidly deploy to areas where energy infrastructure has been severely damaged.
2. **Build Internal Project Management Capability**. ISER currently has three trained Contracting Officer Representatives (COR) and plans to train more. This allows ISER to lead projects in-house, save money on overhead, and expand its infrastructure reliability activities by applying a robust systems analysis process to identify critical assets and key interdependencies within energy systems. This enhances ISER's monitoring, situational awareness and response capabilities through advancements in outage and restoration visualization and modeling.

Three external factors present the strongest impacts to the overall achievement of ISER's strategic goals:

1. The intensity and frequency of the natural and/or man-made disasters
2. The intensity and frequency of national exercises
3. The dynamic nature of a constantly changing threat – both physical and cyber – to U.S. energy systems

ISER prioritizes its funding of its activities as follows:

1. Activities mandated by statute, regulation, or policy;
2. Activities that are not mandated by statute, regulation, or policy, but participation directly complements mandated activities and ISER's mission; and
3. Activities that strategically guide/execute emergency response and national preparedness in the energy sector.

Program Goals and Funding

ISER's mission, program goals, and focus area activities are aligned with DOE Strategic Plan Goals and US National Security Strategy. In an effort to maximize its capabilities within an efficient framework, ISER aligns its activities into focus areas:

- Executing effective **emergency preparedness, response, and restoration** operations;
- Providing reliable energy infrastructure **analysis and situational awareness** to all stakeholders; and
- Encouraging a risk-based approach to **physical and cyber system assurance**.

Goal Areas

	Emergency Preparedness, Response, and Restoration	Analysis and Situational Awareness	Physical and Cyber System Assurance
Infrastructure Security and Energy Restoration	35%	40%	25%

Explanation of Funding and Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Infrastructure Security and Energy Restoration			
No significant changes.	5,981	6,000	+19
TOTAL Funding Change, Infrastructure Security and Energy Restoration	5,981	6,000	+19

Infrastructure Security and Energy Restoration

ISER's mission, strategic goals, and activities support the Department's objective to "Modernize the Electric Grid" and U.S. National Security Strategy's top security objective: "Strengthen Security and Resilience at Home".

Emergency Preparedness, Response, and Restoration

- Improves mobilization of response teams ahead of storms to ensure rapid and coordinated response with federal partners, affected States, and energy sector leaders. ISER's State Energy Assurance Plan project resulted in the development and implementation of energy assurance and resiliency plans in 50 states and select US territories and cities
- Defines prevention, protection, mitigation, response and recovery options for newly identified and evolving threats.

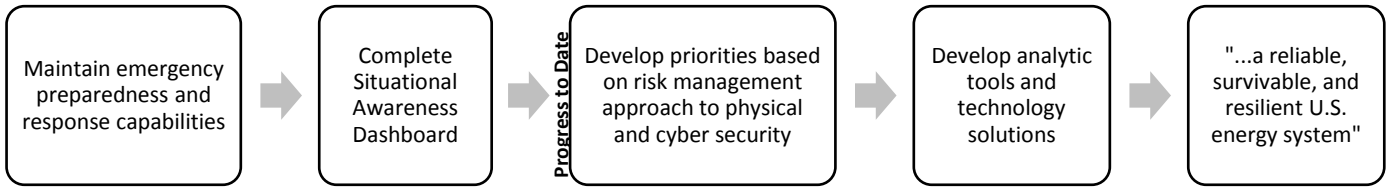
Analysis and Situational Awareness

- Develops state-of-the-art capabilities in real-time situational awareness and visualization, providing information to the public on the status of energy infrastructure, and briefs to senior government officials, the White House and Congress.
- Publishes analytic reports on issues of concern impacting the energy sector; for example, ISER's leadership of a joint public-private effort to determine the impact of geomagnetic disturbances on the North American power grid. ISER provides federal leadership and technical guidance, and will produce a technical mitigation paper in FY 2013.
- Maintains energy system data sets to:
  - support impact projection analysis prior to events;
  - improve awareness of actual system impacts to support response operations; and
  - facilitate the analysis of system conditions and influences in post-event forensics.

Physical and Cyber System Assurance

- Develops risk-based decision-making and resiliency planning, allowing the best return on investment. A good example is ISER's leadership of the interagency effort to develop Risk Management Guidelines for Cybersecurity.
- Facilitates the exchange of actionable information with industry partners on new and evolving threats, vulnerabilities, and mitigation options. These exchanges are vital to the economy and public safety, and key stakeholders have come to rely upon them. ISER's Energy Sector Criticality Methodology will significantly improve asset owners' risk management decisions.
- Manages and Coordinates the Department's activities under the 2010 DOE-DOD Energy Security MOU. The MOU has led to several high-profile collaborations between the Departments that enhance national energy security and provide Federal leadership in transforming the US energy system.

Sequence



Benefits

- Rapid response to natural disasters through improved mobilization of response teams ahead of storms
- Increased availability of information through real-time situational awareness
- Protection against physical and cyber threats through open exchange of threat information and mitigation options
- Reduced impact from disruptive events through close coordination with both the public and private sectors.

Other Information

- National Security Strategy (May 2010) Goal 1 – http://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf
- Presidential Policy Directive (PPD)-8 National *Preparedness* – http://www.dhs.gov/xabout/laws/gc_1215444247124.shtm
- Department of Homeland Security, National Infrastructure Protection Plan – http://www.dhs.gov/nipp
- National Response Framework – http://www.fema.gov/pdf/emergency/nrf/nrf-core.pdf
- Homeland Security Presidential Directive (HSPD) 7 – http://www.ndu.edu/uchs/hspd-7.pdf

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Trained 80% of Regional Coordinators and 20% of Voluntary Responders on regional energy infrastructure to provide the Responders with the skill set necessary to be self-sufficient and apply sub-set of analytical expertise during emergencies. Successfully responded to catastrophic weather events in 2011, including: East Coast Major Winter Storms; Mississippi River Floods; Mid Atlantic/ Southern States Spring Storms and Tornadoes; and Hurricane Irene. • Improved situational awareness capabilities through advancements in power outage and restoration visualization tools; natural gas and petroleum modeling visualization tools; and near-real time reporting capabilities. • Developed internal and external relationships and the appropriate mechanisms (e.g., Memorandum of Understanding) to receive notice of physical/cyber threats from all relevant sources.	6,100
FY 2012	• Train 80% of Regional Coordinators and 20% of Voluntary Responders on regional energy infrastructure to provide the Responders with the skill set necessary to be self-sufficient and apply sub-set of analytical expertise during emergencies. • Building on workshops sponsored by DOE and NERC, support efforts with industry and government stakeholders to analyze the potential impact of a geomagnetic disturbance (GMD) on electric power grid operations. • Improve situational awareness capabilities through the advancement in power outage and restoration visualization tools; natural gas and petroleum modeling visualization tools; and near-real time reporting capabilities. • Develop a framework to address three functions: o Identify assets, systems, networks, and functions o Assess risk based on consequences, threats, and vulnerabilities o Prioritize assets, systems, networks and functions • Complete a draft strategic analytic framework for identifying and modeling foreign energy infrastructure that if disrupted would negatively impact global energy supplies.	5,981
FY 2013	• Train 100% of Regional Coordinators and 50% of Voluntary Responders on regional energy infrastructure; test training by participating in National Level Exercise 2013 (NLE13) • Continue support for efforts with NERC and government and industry stakeholders to analyze the potential impact of GMD on electric power grid operations, producing a technical mitigation paper for use by the energy sector. • Expand infrastructure reliability and analytical capabilities by continuing to apply a robust systems analysis process that incorporates surveys (OE-417, RSR and EIA surveys), field data collection, and modeling results. • Begin development of the cyber-physical threat centralized reporting system, which will have the ability to provide real-time information back to the energy infrastructure community. • Using ISER's criticality framework, conduct a pilot analysis of a country's energy system to identify critical energy infrastructure and characterize the impact on global energy supplies.	6,000

Program Direction
Funding Profile by Category

(Dollars Rounded in Thousands/Whole FTE)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Chicago Operations Office			
Salaries and Benefits	78	0	0
Travel	0	0	0
Support Services	44	0	0
Other Related Expenses	0	0	0
Total, Chicago Operations Office	122	0	0
Full Time Equivalents	1	0	0
National Energy Technology Laboratory			
Salaries and Benefits	6,829	6,019	5,991
Travel	320	361	305
Support Services	1,146	1,188	981
Other Related Expenses	100	405	385
Total, National Energy Technology Laboratory	8,395	7,973	7,662
Full Time Equivalents*	(34)	(33)	(32)
Headquarters			
Salaries and Benefits	10,431	11,924	12,727
Travel	704	700	700
Support Services	5,496	3,769	3,437
Other Related Expenses	2,462	2,644	3,089
Total, Headquarters	19,093	19,037	19,953
Full Time Equivalents	71	75	80
Electricity Delivery and Energy Reliability			
Salaries and Benefits	17,338	17,943	18,718
Travel	1,024	1,061	1,005
Support Services	6,686	4,957	4,418
Other Related Expenses	2,562	3,049	3,474
Total, Electricity Delivery and Energy Reliability	27,610	27,010	27,615
Full Time Equivalents*	72 (34)	75 (33)	80 (32)

*The FTEs reported at NETL are displayed in parenthesis to indicate that they are a non-add in the OE budget because they are counted in the Fossil Energy budget.

Overview

Program Direction provides for the costs associated with the federal workforce, including salaries, benefits, travel, training, building occupancy, IT systems, and other related expenses. It also provides for the costs associated with contractor services that, under the direction of the federal workforce, support OE's mission. It also includes funding for the coordination of the Energy portfolio by the Office of the Under Secretary for Energy.

Salaries and Benefits supports 112 FTEs that provide executive management, programmatic oversight, and analysis for the effective implementation of the OE program. Of these, 80 FTEs are planned for Headquarters and 32 FTEs are planned at NETL. While OE supports 32 FTEs at NETL within its budget, the FTEs are counted in the Fossil Energy Budget. Therefore, the 32 FTEs are non-add in the OE budget.

Travel includes transportation, subsistence, and incidental expenses that allow OE to effectively manage R&D electricity technology programs and projects in the field; provide the Department's electricity-related outreach to regional, State, and Tribes with regard to planning needs and issues, policies, siting protocols and new energy facilities; and assist the Department of Homeland Security, the Department of State and local governments, and the private sector to help protect against and recover from disruptions in the energy infrastructure.

Support Services includes contractor support directed by the federal staff to perform administrative tasks and provide analysis to management. These efforts include issue-oriented support on science, engineering, environment, and economics that benefit strategic planning; technology and market analysis to improve strategic and annual goals; development of management tools and analyses to improve overall Office efficiency; assistance with communications and outreach to enhance the Office's external communication and responsiveness to public needs; and development of program-specific information tools that consolidate corporate knowledge, performance tracking and inventory data, improve accessibility to this information, and facilitate its use by the entire staff. Also may include support for post-doctoral fellows and Intergovernmental Personnel Act (IPA) assignments.

Other Related Expenses includes corporate IT support and working capital expense, such as rent, supplies, copying, graphics, mail, printing, and telephones. It also includes equipment upgrades and replacements, commercial credit card purchases using the simplified acquisition procedures to the maximum extent possible, and other needs.

Major Program Shifts or Changes

There is no significant funding change.

Explanation of Funding Changes

	(Dollars Rounded in Thousands)		
	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012
Salaries and Benefits: Increase reflects four new FTEs, pay raise, and step increases.	17,943	18,718	+775
Travel: No significant change.	1,061	1,005	-56
Support Services: Decrease reflects efforts to increase efficiencies in the use of Support Services.	4,957	4,418	-539
Other Related Expenses: Increase reflects the transfer of additional functions to the Working Capital Fund.	3,049	3,474	+425
Total Funding Change, Program Direction	27,010	27,615	+605

Functional Transfers

DOE is working to achieve economies of scale through an enhanced Working Capital Fund (WCF). Beginning in FY 2013, WCF will include certain shared, enterprise activities such as enhanced cyber security architecture, employee health and testing services, and consolidated training and recruitment initiatives.

Support Services by Category

(Dollars Rounded to Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Technical Support Services			
Feasibility of Design Considerations	50	40	40
Development of Specifications	50	40	40
System Definition	10	10	10
System Review and Reliability Analysis	100	50	45
Trade-Off Analysis	10	10	10
Economic and Environmental Analysis	50	45	45
Test and Environmental Studies	50	40	35
Surveys or Reviews of Technical Operations	280	250	195
Total, Technical Support Services	600	485	420
Management Support Services			
Analysis of Workload and Workflow	25	25	25
Directive Management Studies	10	10	10
Automatic Data Processing	25	25	25
Manpower Systems Analysis	10	10	10
Preparation of Program Plans	100	100	105
Training and Education	5	231	215
Analysis of DOE Management Processes	25	0	0
Reports and Analyses Management and General Administrative Support	5,886	4,071	3,608
Total, Management Support Services	6,086	4,472	3,998
Total, Support Services	6,686	4,957	4,418

Other Related Expenses by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Rent to GSA	0	0	0
Rent to Others	0	0	0
Communication, Utilities, Misc.	439	126	120
Printing and Reproduction	0	0	0
Other Services	10	13	10
Training	95	100	45
Purchases from Gov. Accounts	0	0	0
Operation and Maintenance of Equipment	0	0	0
Supplies and Materials	16	181	175
Equipment	10	35	35
Working Capital Fund	1,992	2,594	3,089
Total, Other Related Expenses	2,562	3,049	3,474

Nuclear Energy

Nuclear Energy

Table of Contents

Nuclear Energy
Proposed Appropriation Language

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for nuclear energy activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, and the purchase of not more than 10 buses and 2 ambulances, all for replacement only, $770,445,000, to remain available until expended, of which $10,000,000 shall be derived from the Nuclear Waste Fund: Provided, That of the amount made available under this heading, $90,015,000 shall be available until September 30, 2014, for program direction.

Nuclear Energy
Office of Nuclear Energy

Overview
Appropriation Summary by Program

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Nuclear Energy Appropriation			
Integrated University Program	0	5,000	0
SMR Licensing Technical Support	0	67,000	65,000
Reactor Concepts Research, Development and Demonstration	164,706	114,871	73,674
Fuel Cycle Research and Development	182,428	186,260	175,438
Nuclear Energy Enabling Technologies	50,891	74,670	65,318
Radiological Facilities Management	51,715	69,510	51,000
Idaho Facilities Management	183,604	154,097	152,000
Idaho Sitewide Safeguards and Security[a]	0	0	95,000
Program Direction	86,279	91,000	90,015
International Nuclear Energy Cooperation	2,994	2,983	3,000
Subtotal, Nuclear Energy Appropriation	722,617	765,391	770,445
Transfer from State Department	1,500	0	0
Recission of Prior Year Balance	-6,300	0	0
Total, Nuclear Energy Appropriation	717,817	765,391[b]	770,445
Other Defense Activities (NE) Appropriation[c]			
Idaho Sitewide Safeguards and Security	88,752[d]	93,350	0
Subtotal Other, Defense Activities Appropriation	88,752	93,350	0
Use of Prior Year Balances	-552	0	0
Rescission of Prior Year Balance	-21	0	0
Subtotal, Other Defense Activities	88,179	93,350	0
Total, Office of Nuclear Energy	805,996	858,741	770,445

[a] Idaho Sitewide Safeguards & Security is being moved from the Other Defense Activities appropriation to the Nuclear Energy Appropriation in FY 2013.
[b] FY 2012 Enacted reflects a rescission of $3,272,000 associated with savings from the contractor pay freeze.
[c] Includes only the NE portion of the Other Defense Activities appropriation.
[d] In FY 2011, the Idaho Sitewide Safeguards and Security program received an Appropriations transfer in the amount of $10,650,000 from the National Nuclear Security Administration's Weapons Activities appropriation. The FY 2011 Current also reflects $522,000 of prior year funds reprogrammed to Idaho Sitewide Safeguards and Security.

Office Overview and Accomplishments

The Office of Nuclear Energy (NE) supports the diverse civilian nuclear energy programs of the U.S. Government, leading Federal efforts to research and develop nuclear energy technologies, including generation, safety, waste storage and management, and security technologies, to help meet energy security, proliferation resistance, and climate goals.

Within the Nuclear Energy Appropriation, NE funds the following major programs: Reactor Concepts Research, Development and Demonstration (RD&D), Nuclear Energy Enabling Technologies (NEET), Fuel Cycle R&D, Radiological Facilities Management (RFM), Idaho Facilities Management (IFM), Idaho Safeguards and Security (S&S), International Nuclear Energy Cooperation and Program Direction. In FY 2013, the Idaho Sitewide S&S program, which has been funded under the Other Defense Activities Appropriation since NE assumed responsibility for the INL in FY 2004, is being requested under the Nuclear Energy Appropriation.

A prerequisite to the expansion of nuclear power is public confidence in the safety of nuclear plants and commercial confidence that the plants can be operated safely, reliably and economically. The Department will explore improvements to light water reactor systems and fuel forms to further enhance safety and reliability under severe accident conditions. Our R&D efforts will be coordinated with reactor vendors, utilities, universities, regulators and the international community to ensure that lessons learned from the events at Fukushima, Japan are appropriately incorporated and that these efforts are integrated and efficient.

Two new line items are initiated in FY 2013. Project 13-D-905, Remote-Handled Low-Level Waste Disposal Project, Idaho National Laboratory, is a jointly funded, compliance driven project with the National Nuclear Security Administration's Office of Naval Reactors to provide ongoing on-site disposal of remote-handled low-level waste generated at INL. Project 13-E-200, Advanced Post-Irradiation Examination Capabilities Project, location TBD, will analyze options for, and design of, a potential future facility to support modern, state-of-the-art advanced post-irradiation examination capabilities on a larger scale.

In FY 2010, the Secretary of Energy chartered a Blue Ribbon Commission (the Commission) on America's Nuclear Future composed of experts from government, academia and industry. The Commission charter charges the Commission to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle, including all alternatives for the storage, processing, and disposal of civilian and defense used nuclear fuel, high-level waste, and materials derived from nuclear activities…[and to] provide advice, evaluate alternatives, and make recommendations for a new plan to address these issues." The Commission issued its final report on January 26, 2012.

Finding a safe, long-term solution to managing the nation's nuclear waste and used nuclear fuel is a challenge that has vexed the nation since the dawn of the nuclear era. Such a solution, however, is necessary to assure the future viability of an important carbon-free energy supply and further strengthen America's standing as a global leader on issues of nuclear safety and nonproliferation.

There are a number of key elements that the Department has recognized as foundational to the nation's used fuel management and high-level waste disposal program, and has been pursuing even prior to the release of its recommendations. The Commission's near-term research and development-related priorities align with how the funding is allocated within the Used Nuclear Fuel Disposition subprogram in FY 2012. Specifically, the Department is undertaking activities to support the development and licensing of standardized transportation, aging, and disposition containers; characterize repository media; conduct non-site specific R&D on geologic disposal; evaluate storage options and their comparative advantages; begin evaluating management alternatives for spent nuclear fuel and high level waste, including possible partnership mechanisms; and expand the Department's capabilities for assessing issues related to the aging and safety of storing used nuclear fuel.

The Department's FY 2013 Congressional budget request builds on these efforts by including $60 million to continue activities initiated in FY 2012 and specifically focus on evaluating consolidated interim storage and transportation issues (focused initially on decommissioned sites); working with industry to develop standardized approaches to used fuel management; conducting material testing to support extended storage of used fuel; revisit and prepare a report on plans to address recommendations identified by the National Academy of Sciences transportation report; and initiating research on geologic disposal alternative environments, e.g. system modeling, engineered barriers, natural barriers, evaluation of design concepts, and experiments.

During FY 2012, the Administration will work with Congress and stakeholders to fully evaluate the Commission's recommendations and assess implementation scenarios for management of used nuclear fuel and other nuclear waste as we develop a path forward. The Department will communicate to Congress the outcome of this assessment within six months of the Commission's report, as requested in the FY 2012 Appropriations Act.

The strategy put forward in the Commission's final report has eight key elements:

1. A new, consent-based approach to siting future nuclear waste management facilities.
2. A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed.
3. Access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management.
4. Prompt efforts to develop one or more geologic disposal facilities.
5. Prompt efforts to develop one or more consolidated interim storage facilities.
6. Prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available.
7. Support for continued U.S. innovation in nuclear energy technology and for workforce development.
8. Active U.S. leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.

As noted above, the Department has already begun activities related to research and further development of storage, transportation, and disposal technologies. In addition, in FY 2012 the Department will also begin evaluating management alternatives for spent nuclear fuel and high level waste, including possible partnership mechanisms such as the Commission's recommendation to shift the responsibility to a government-chartered corporation. The Commission report also examines how Congressional actions since the establishment of the Nuclear Waste Fund have reduced funding flexibility originally envisioned in the Nuclear Waste Policy Act. The Commission recommends changes to address this set of issues. The Administration will thoughtfully and carefully consider this and the other Commission recommendations in FY 2012.

Additionally, in FY 2013 the Department is requesting the appropriation of $10 million from the Nuclear Waste Fund to support BRC recommended activities, consistent with the Nuclear Waste Policy Act.

In FY 2011 NE achieved three significant accomplishments or milestones in program management and program development. Such accomplishments include: 1) performed the first Hydraulic Shuttle Irradiation System experiment at the Advanced Test Reactor, making use of a very significant upgrade for short-duration irradiation testing. 2) completed a major fuel cycle options pilot screening that will enable wise decision making when down-selecting options for our Nation's sustainable fuel cycle. 3) completed the analysis of aging concrete performance and cable degradation in the Ginna nuclear power plant, an important first step in assessing critical components for potential nuclear power plant life extension beyond 60 years.

Crosscuts - Nuclear Energy University Program

The Department strives to engage the U.S. university community to achieve its overall NE research and development mission. As part of this effort the Department allocates up to 20% of its NE research and development appropriations for university-based program and mission-supporting R&D, and related infrastructure improvements.

Within the NEUP framework the Department is investigating options for increasing opportunities for transformative and innovative nuclear energy research that explore "game changing" major breakthrough solutions across the full range of nuclear energy technologies that support and complement the development of new and advanced reactor concepts and fuel cycle technologies; encourage development of transformative, "out-of-the-box" solutions across the full range of nuclear energy technology issues; and focus innovative research relevant to multiple reactor and fuel cycle concepts that offer the promise of dramatically improved performance.

Additionally, Nuclear Energy is committed to participating in the Department's pilot laboratory research internship project for the Science, Technology, Engineering, and Mathematics (STEM) education program authorized by section 101 of the America COMPETES Reauthorization Act of 2010.

(Dollars in Thousands)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Estimate
Nuclear Energy University Program			
Reactor Concepts RD&D	28,008	23,109	14,735
Fuel Cycle R&D	32,110	37,470	35,088
Total, NEUP Funding	60,118	60,579	49.823

Alignment to Strategic Plan

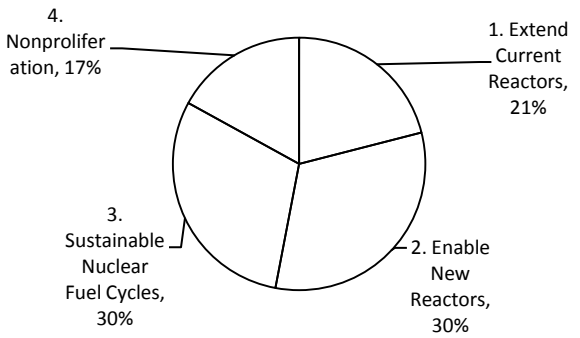
The Department's May 2011 Strategic Plan outlines two primary objectives to which NE aligns its activities: 1) Deploy the Technologies We Have; and 2) Discover the New Solutions We Need. Targeted plans that support these objectives include:

- Accelerate the commercialization of SMR technology through cost-shared technical support.
- Complete a comprehensive assessment—by September 2012—of materials degradation issues for light-water reactor plants operating beyond 60 years.
- Demonstrate advanced inspection techniques for irradiated fuel at the Irradiated Materials Characterization Laboratory (IMCL) by April 2013.

In April 2010 the Department released its Nuclear Energy R&D Roadmap which lays out four main R&D objectives toarget toward addressing key challenges to nuclear power. NE activities are aligned with these goals and the goals guide program planningna nd execution. They provide a concrete framework for NE's activities and link to the Department's strategic priorities.

1. Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
2. Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
3. Develop sustainable nuclear fuel cycles.
4. Understand and minimize the risks of nuclear proliferation and terrorism.

FY 2013 Request Aligned with Goals



Explanation of Changes

The Department requests $770.4 million in Fiscal Year 2013 for NE, including $10 million from the Nuclear Waste Fund. In FY 2013 the Department is requesting funding for Idaho National Laboratory Site Wide Safeguards and Security ($95M) within the NE appropriation. Thus, the NE total request is $88 million, about 10%, below the comparable FY 2012 appropriation (Nuclear Energy + INL Safeguards and Security).

The request maintains support for high priority areas such as Fuel Cycle Research and Development including storage, transportation, and disposal R&D that align with recommendations of the Blue Ribbon Commission on America's Nuclear Future and with R&D on next generation light water reactor fuels with enhanced accident tolerance. The request also maintains support for the Idaho National Laboratory infrastructure. Work in other areas, such as Reactor Concepts Research, Development and Demonstration activities and Nuclear Energy Enabling Technologies, has been refocused to target the most critical issues.

As in prior years, the Integrated University Program is terminated in FY 2013. Congressional action providing an unrequested $15 million for infrastructure support at Oak Ridge National Laboratory within the Space and Defense inftrastructure program is not supported in FY 2013 – no additional infrastructure funding is needed for ORNL in this area, resulting in a $19 million reduction to Radiological Facilities management. This reduction has no impact on program performance.

Program Goal Alignment Summary

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4. Nonprolifer-ation
Nuclear Energy Appropriation				
SMR Licensing Technical Support	0%	100%	0%	0%
Reactor Concepts Research, Development and Demonstration	30%	58%	10%	2%
Fuel Cycle Research and Development	7%	9%	72%	12%
Nuclear Energy Enabling Technologies	58%	21%	19%	2%
Radiological Facilities Management	3%	47%	3%	47%
Idaho Facilities Management	25%	25%	25%	25%
Idaho Sitewide Safeguards/Security	25%	25%	25%	25%
Program Direction	25%	25%	25%	25%
International Nuclear Energy Cooperation	20%	20%	0%	60%
Subtotal, Nuclear Energy Appropriation	18%	30%	29%	23%

Strategic Plan and Performance Measures

STRATEGIC GOAL: Transforming our Energy Systems		
OBJECTIVE: Deploy the Technologies We Have		
TARGETED OUTCOME: Complete a comprehensive assessment—by September 2012—of materials degradation issues for light-water reactor plants operating beyond 60 years. *This targeted outcome is on track for completion in FY 2012.*		
Light Water Reactor Sustainability Annual Measure[5]: Complete 90% of program milestones to support development of scientific knowledge to extend existing plant operating life beyond the 60 year limit.		
	Target	Actual/ Met or Not Met
Budget Year	Complete 90% of program milestones.	N/A
Current Year	Complete 90% of program milestones.	N/A
Prior Year	Complete quarterly milestones.	Met
Analysis	NE-developed tools and assessments will help establish the scientific bases for existing plants to receive license extensions from the NRC in the 2030 timeframe.	
OBJECTIVE: Discover the new solutions we need.		
TARGETED OUTCOME: Complete SMR design certification by 2016.		
Small Modular Reactor Annual Measure: Enable submission of design certification applications (DCAs) to the NRC by partnering with two SMR utilities/vendor teams and supporting design, engineering, certification and licensing efforts for selected SMR projects.		
	Target	Actual/ Met or Not Met
Budget Year	Meet milestones that support completion of annual measure above.	N/A
Current Year	Meet milestones that support completion of annual measure above.	N/A
Prior Year	No measure in FY 2011	N/A
Analysis	NE's cost-shared work with industry supports the target outcome of accelerating commercialization of LWR SMR technologies.	
OBJECTIVE: Discover the new solutions we need.		
TARGETED OUTCOME: Demonstrate advanced inspection techniques for irradiated fuel at the Irradiated Materials Characterization Laboratory (INL).		
Idaho Facilities Management – Project Cost and Schedule Measure: Execute general plant and construction projects within approved cost profiles and schedule, as measured by the total percentages of project with cost performance indexes and schedule performance indexes between 0.9 and 1.15.		
	Target	Actual/ Met or Not Met
Budget Year	80% of projects with cost and schedule indexes between 0.9 and 1.15.	N/A
Current Year	80% of projects with cost and schedule indexes between 0.9 and 1.15.	N/A
Prior Year	80% of projects with cost and schedule indexes between 0.9 and 1.15.	100% / Met
Analysis	Maintain the percentage of projects with indexes between 0.9 and 1.15 at 80% or better.	

[5] For Performance History or Verification and Validation information for this Annual Measure, please follow the hyperlink to the Annual Performance Measure at http://www.cfo.doe.gov.

Facilities Maintenance and Repair

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

Direct-Funded Maintenance and Repair

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Idaho National Laboratory (IFM)	16,009	13,679	16,330
Total, Direct-Funded Maintenance and Repair	16,009	13,679	16,330

Indirect-Funded Maintenance and Repair

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Idaho National Laboratory (IFM)	17,087	17,584	18,338
Total, Indirect-Funded Maintenance and Repair	17,087	17,584	18,338

Direct-Funded Costs for Deferred Maintenance Backlog Reduction

(Dollars in Thousands)

	FY 2011 Costed	FY 2012 Costed	FY 2013 Costed
Idaho National Laboratory (IFM)	2,900	2,800	2,800
Total, Direct-Funded Costs for Deferred Maintenance Backlog Reduction	2,900	2,800	2,800

Indirect-Funded Costs for Deferred Maintenance Backlog Reduction

(Dollars in Thousands)

	FY 2011 Costed	FY 2012 Costed	FY 2013 Costed
Idaho National Laboratory (IFM)	3,300	3,000	3,000
Total, Indirect-Funded Costs for Deferred Maintenance Backlog Reduction	3,300	3,000	3,000

Institutional General Plant Projects

Institutional General Plant Projects (IGPPs) are construction projects that are less than $10 million and cannot be allocated to a specific program. IGPPs fulfill multi-programmatic and/or inter-disciplinary needs and are funded through site overhead. The following table displays total IGPP funding by site.

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Institutional General Plant Projects (IGPP)			
Idaho National Laboratory (IFM)	6,457	12,512	17,366

Institutional General Purpose Capital Equipment

The following table displays total Institutional General Purpose Capital Equipment funding.

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Institutional General Purpose Capital Equipment (IGPCE)			
Idaho National Laboratory (IFM)	4,500	3,500	3,500

Small Business Innovation Research/ Small Business Technology Transfer (SBIR/STTR)

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Reactor Concepts RD&D	3,829	3,389	2,247
Fuel Cycle R&D	5,187	5,495	5,351
Nuclear Energy Enabling Technologies	1,425	2,203	1,992
Total, SBIR/STTR	10,441	11,087	9,590

Nuclear Energy
Office of Nuclear Energy
Funding by Site by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Argonne National Laboratory			
Fuel Cycle Research and Development	12,760	10,664	10,703
International Nuclear Energy Cooperation	448	995	800
Nuclear Energy Enabling Technologies	2,600	1,384	4,350
Reactor Concepts Research, Development and Demonstration	11,795	8,415	5,600
Total, Argonne National Laboratory	27,603	21,458	21,453
Brookhaven National Laboratory			
Fuel Cycle Research and Development	1,855	2,288	1,911
Nuclear Energy Enabling Technologies	100	150	0
Reactor Concepts Research, Development and Demonstration	150	130	60
Total, Brookhaven National Laboratory	2,105	2,568	1,971
Chicago Operations Office			
Radiological Facilities Management	23	22	0
Total, Chicago Operations Office	23	22	0
Idaho National Laboratory			
Fuel Cycle Research and Development	43,323	35,671	30,448
Idaho Facilities Management	176,704	147,997	145,900
International Nuclear Energy Cooperation	532	500	500
Nuclear Energy Enabling Technologies	19,138	18,416	19,880
Radiological Facilities Management	10,060	9,500	10,000
Reactor Concepts Research, Development and Demonstration	123,529	56,701	42,561
Idaho Sitewide Safeguards and Security	0	0	92,272
Total, Idaho National Laboratory	373,286	268,785	341,561
Idaho Operations Office			
Fuel Cycle Research and Development	39,299	37,568	39,586
Idaho Facilities Management	5,300	5,100	5,100
Idaho Sitewide Safeguards and Security	0	0	2,528
Integrated University Program	0	5,000	0

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
International Nuclear Energy Cooperation	15	25	15
Nuclear Energy Enabling Technologies	1,068	8,000	3,800
Program Direction	33,449	33,495	31,136
Radiological Facilities Management	5,203	5,966	4,980
Reactor Concepts Research, Development and Demonstration	747	710	435
SMR Licensing Technical Support	0	60,000	60,000
Total, Idaho Operations Office	85,081	155,864	147,580
Kansas City Site Office			
Idaho Facilities Management	335	88	0
Total, Kansas City Site Office	335	88	0
Lawrence Berkeley National Laboratory			
Fuel Cycle Research and Development	2,707	3,397	3,539
Nuclear Energy Enabling Technologies	200	0	0
Reactor Concepts Research, Development and Demonstration	200	0	0
Total, Lawrence Berkeley National Laboratory	3,107	3,397	3,539
Lawrence Livermore National Laboratory			
Fuel Cycle Research and Development	4,299	3,006	3,154
International Nuclear Energy Cooperation	130	200	200
Nuclear Energy Enabling Technologies	600	775	250
Radiological Facilities Management	500	0	0
Reactor Concepts Research, Development and Demonstration	540	342	170
Total, Lawrence Livermore National Laboratory	6,069	4,323	3,774
Los Alamos National Laboratory			
Fuel Cycle Research and Development	20,648	14,442	12,317
International Nuclear Energy Cooperation	475	560	350
Nuclear Energy Enabling Technologies	350	2,690	800
Radiological Facilities Management	26,965	27,000	27,000
Reactor Concepts Research, Development and Demonstration	1,465	600	820
Total, Los Alamos National Laboratory	49,903	45,292	41,287

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Nevada Site Office			
Idaho Facilities Management	257	0	0
Program Direction	0	4,235	4,279
Total, Nevada Site Office	257	4,235	4,279
Oak Ridge National Laboratory			
Fuel Cycle Research and Development	20,096	18,678	17,919
International Nuclear Energy Cooperation	0	10	200
Nuclear Energy Enabling Technologies	22,792	29,959	26,438
Radiological Facilities Management	4,960	19,426	4,600
Reactor Concepts Research, Development and Demonstration	14,225	8,359	17,930
Total, Oak Ridge National Laboratory	62,073	76,432	67,087
Oak Ridge Operations Office			
International Nuclear Energy Cooperation	90	0	0
Nuclear Energy Enabling Technologies	458	0	0
Program Direction	1,620	1,637	1,654
Radiological Facilities Management	175	150	0
Reactor Concepts Research, Development and Demonstration	1,255	0	0
Total, Oak Ridge Operations Office	3,598	1,787	1,654
Pacific Northwest National Laboratory			
Fuel Cycle Research and Development	9,228	9,330	8,829
International Nuclear Energy Cooperation	210	225	100
Nuclear Energy Enabling Technologies	728	2,585	1,050
Reactor Concepts Research, Development and Demonstration	745	550	290
Total, Pacific Northwest National Laboratory	10,911	12,690	10,269
Radiological and Environmental Sciences Laboratory			
Program Direction	5,498	5,256	5,312
Total, Radiological and Environmental Sciences Laboratory	5,498	5,256	5,312
Sandia National Laboratories			
Fuel Cycle Research and Development	15,664	13,410	13,860

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
International Nuclear Energy Cooperation	0	0	200
Nuclear Energy Enabling Technologies	1,450	2,275	750
Radiological Facilities Management	1,350	1,300	1,300
Reactor Concepts Research, Development and Demonstration	3,667	1,405	1,720
Total, Sandia National Laboratories	22,131	18,390	17,830
Savannah River National Laboratory			
Fuel Cycle Research and Development	5,734	3,988	4,023
International Nuclear Energy Cooperation	0	100	0
Total, Savannah River National Laboratory	5,734	4,088	4,023
Washington Headquarters			
Fuel Cycle Research and Development	6,815	33,818	29,149
Idaho Facilities Management	1,008	912	1,000
Idaho Sitewide Safeguards and Security	0	0	200
International Nuclear Energy Cooperation	1,094	368	635
Nuclear Energy Enabling Technologies	1,407	8,436	8,000
Program Direction	45,712	46,377	47,634
Radiological Facilities Management	2,479	6,146	3,120
Reactor Concepts Research, Development and Demonstration	6,388	37,659	4,088
SMR Licensing Technical Support	0	7,000	5,000
Total, Washington Headquarters	64,903	140,716	98,826
Total, Nuclear Energy	722,617	765,391	770,445

Programs Not Funded in FY 2013

Overview

Integrated University Program

In FY 2011, DOE provided no funding in its Operating Plan for the Integrated University Program (IUP) and no funding is being requested in FY 2013 for the program. IUP has consistently been proposed for termination. This program is a less efficient means to advance the Administration's STEM objectives than other existing programs. In addition, as the nuclear industry expands, it will create the incentives necessary for students to enter nuclear-related programs.

Although no funding was requested in FY 2012, $5 million was congressionally-directed for IUP. Funding was used to support nuclear science and engineering study and research through scholarships and fellowships. It is estimated that these funds will fully fund 30 multi-year student fellowships and 70 single-year scholarships in the nuclear field of study.

All awards under this program are fully funded in the year funding was received. As a result, multi-year student research fellowships do not require support by out-year funds after the appropriation year.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	No FY 2011- funded activities. Continuation of FY 2009 and FY 2010 multi-year activities, including fellowships and investigator initiated research.	0
FY 2012	Provide approximately 70 new scholarships and 30 fellowship grants with FY 2012 funds. Continuation of FY 2009 and FY 2010 multi-year activities, including fellowships and investigator initiated research.	5,000
FY 2013	No FY 2013- funded activities. Continuation of FY 2010 and FY 2012 multi-year activities, i.e., fellowships.	0

SMR Licensing Technical Support
Funding Profile

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
SMR Licensing Technical Support	0	67,000	65,000

Public Law Authorizations

P.L. 112-10, "Department of Defense and Full-Year Continuing Appropriations Act, 2011

P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

The development of clean, affordable nuclear power options is a key element of the Department of Energy's Office of Nuclear Energy (DOE-NE) *Nuclear Energy Research and Development Roadmap.* As a part of this strategy, a high priority of the Department is to help improve the timelines for the commercialization and deployment of small modular reactor (SMR) technologies through the SMR Licensing Technical Support program. The mission of the program is to support first-of-a-kind costs associated with design certification and licensing activities for two SMR designs through cost-shared arrangements with industry partners to promote the deployment of SMRs that can provide safe, clean, affordable power. If industry chooses to deploy these technologies, they could help meet the nation's economic, energy security and climate change goals.

Challenges that the program expects to address in executing its mission include:

- Working with industry partners to assure the public and our Congressional stakeholders that SMRs can meet or exceed the safety standards and profiles of the newest plant technologies.
- Assisting industry in determining whether SMRs can compete economically with existing electricity generating technologies.
- Promoting the timely and efficient execution of SMR licensing to deploy not only the first-mover SMRs, but also a fleet of SMR generation capacity to meet the nation's greenhouse gas emission reduction and affordable energy goals.

Program Accomplishments and Milestones

The program is focused on supporting SMR vendor and utility partnerships for financial cost-shared assistance with a minimum of 50% industry contribution toward the design and licensing of two SMR designs. The funding will support design development, first-of-a-kind engineering, testing, site permitting, and certification and operating license application development, as well as costs associated with the NRC review and approval process. The program will help to demonstrate the potential of the nascent SMR technology and encourage new competition in the marketplace. The cost of the SMR Licensing Technical Support program is $452 million over five years.

In FY2012, the SMR Licensing Technical Support program will achieve a number of significant accomplishments and milestones in program management and implementation. Since the program is focused on accelerating the review and approval of certification and licensing processes that are controlled by the NRC, the thrust of the DOE activities will be in expediting and assuring the completeness, accuracy, and timeliness of vendor and utility technical products.

Program funding will support:

- Two specific reactor technology vendors for the design, engineering, testing, analysis, and NRC approval of a design certification document (DCD) for their reactor system.
- Two specific utilities or consortia for the development of operating license applications specific to the chosen sites.

In the current appropriation year, SMR Licensing Technical Support is working towards the following key milestones:

Milestone	Date
Issue a draft Funding Opportunity Announcement (FOA) for SMR Licensing Technical Support program.	Jan 2012
Issue a final FOA for the SMR Licensing Technical Support program.	Mar 2012

Milestone	Date
Complete award selection process for two SMR deployment projects supported under the SMR Licensing Technical Support program.	Sep 2012

Explanation of Changes

The Department requests $65 million in FY 2013 for SMR Licensing Technical Support, which is a 3% decrease from the current FY 2012 level. This decrease is consistent with the expected project funding plans resulting from competitive awards at the end of FY 2012.

Program Planning and Management

The program will invest in the first-of-a-kind engineering, design development, and licensing and certification of two SMRs to help accelerate the eventual deployment of these technologies. SMRs have the potential to provide clean, affordable power to the nation, improve domestic energy security, and strengthen the economy. The program management staff will establish a set of meaningful performance measures, including discrete milestones as a part of the cooperative agreement, to formally and effectively track project progress. NE will employ an appropriately graded program management system to track cost and schedule performance using these measures.

Strategic Management

In meeting the identified challenges to nuclear power, the Department will implement three key strategies to more efficiently and effectively manage the program, thus putting the taxpayers' dollar to more productive use.

1. Reduce the financial and regulatory risk of design, licensing, and deployment of first-mover SMR nuclear plant technologies.
2. Leverage innovative, crosscutting research and development (R&D), codes and standards, and regulatory activities carried out by the other DOE NE R&D programs to assist in the development, certification and licensing of SMRs.
3. Provide for partnerships, on a limited basis, with national laboratories, universities and international entities to leverage the capabilities and experiences of these organizations in supporting and accelerating project licensing and deployment schedules.

Three external factors that present the strongest potential impacts to the overall achievement of the program's strategic goal:

1. Whether new SMR technology will be deployed depends on power demand and economic and environmental factors beyond the scope of DOE programs. It depends on complex economic decisions made by industry partners;
2. The certification and licensing of plants is the responsibility of the NRC and the timing of review and approval processes is entirely independent of DOE influence;

The outlook for new nuclear deployment projects may be impacted by public reaction to the events at the Fukushima plants in 2011.

Program Goals and Funding

The Department believes that SMRs have the potential to notably contribute to meeting the energy security, economic and environmental goals of the United States. Development and deployment of SMRs domestically may provide an opportunity for the United States to meet clean energy goals, promote U.S. technological leadership in the nuclear field and may help the U.S. industry compete in a potentially lucrative global market. If SMRs are manufactured domestically, it could help reinvigorate the domestic manufacturing sector and could create additional U.S. jobs. Finally, domestic deployment of SMR-based nuclear power would allow the United States to increase greenhouse gas emission avoidance.

The NE R&D Roadmap lays out four goals that programs work toward in support of NE's mission and that guide program planning and execution. These goals provide a concrete framework for NE's activities and link to the Department's strategic priorities:

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable nuclear fuel cycles.
- Understand and minimize the risks of nuclear proliferation and terrorism.

Additionally, the SMR Licensing Technical Support program directly contributes to the following Departmental objective:

- Support design certification and licensing activities for two SMR designs through cost-shared arrangements with industry partners to help accelerate the commercialization of the SMR technologies.

The program activities align with the R&D Roadmap goals as follows:

Goal Areas by Program

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4. Nonprolifer-ation
SMR Licensing Technical Support	0%	100%	0%	0%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
SMR Licensing Technical Support			
This decrease reflects the anticipated progress in FY2012 on the awards as well as progress by the industry partners. The reduction has no affect on the efficacy or progress of the program.	67,000	65,000	-2,000
TOTAL Funding Change, SMR Licensing Technical Support	67,000	65,000	-2,000

SMR Licensing Technical Support
Overview

The mission of the SMR Licensing Technical Support program is to support first-of-a-kind activities for design certification and licensing activities for two SMR designs through cost-shared arrangements with industry partners in order to promote accelerated deployment of these technologies. The acceleration provided by the cost-shared funding is expected to improve U.S. global competitiveness, enhance domestic energy security and contribute to meeting greenhouse gas reduction goals. The program will help demonstrate the potential of the nascent SMR technology and encouraging new competition in the marketplace. The program involves support for two teams consisting of specific reactor technology vendors for the design, engineering, testing, analysis, and NRC approval of a design certification document for their reactor system and specific utilities or consortia for the development of operating license applications specific to the chosen sites.

Sequence

To accomplish its mission, the program will follow a defined path of action for the tasks that are within its scope that includes feedback and focuses on efficiency and cost effectiveness. All activities will be reviewed, revisited, and revised as necessary in the annual budget development and program planning processes.

The submission of the certification and licensing documents are outside of the control of the Department. We are providing incentives to promote the completion of these activities, but it is the industry partner's decision as to whether or when to submit certification and licensing applications. The goal is to provide support for design, engineering, and regulatory processes to help encourage and accelerate those decisions.

Benefits

Potential benefits of SMRs include:

- Provide owners more flexibility in financing, siting, sizing, and end-use applications;
- Reduce initial capital outlay or investment due to the lower plant capital cost;
- Modular components and factory fabrication can reduce construction costs and schedule duration;
- Additional modules can be added incrementally as demand for power increases with revenue provided by existing performing modules;
- Provide power for applications where large plants are not needed, or may be able to replace aging and carbon-emitting fossil plants, or could be located at sites that may not have the necessary infrastructure to support a large unit such as smaller electrical markets, isolated areas, smaller grids, or restricted water or acreage sites.
- Promote domestic job and manufacturing growth as well as regaining nuclear excellence in the United States.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011		0
FY 2012	• Conduct SMR procurement process, including project down-select and cooperative agreement development. • Establish DOE program management processes to oversee project progress and distribute funding to industry partners. • Initiate analysis and studies important to efficient SMR licensing and commercialization.	67,000

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2013	• Selected vendor develop design certification documentation for submittal to NRC. • Selected utility partner begin development of operating license application information, depending on licensing strategy selected. • Conduct periodic program status meetings with industry partners to ensure adequate progress against milestones established in cooperative agreements. • Continue analysis and studies important to efficient SMR licensing and commercialization.	65,000

Reactor Concepts Research, Development and Demonstration
Funding Profile by Subprogram

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Reactor Concepts Research, Development and Demonstration			
Small Modular Reactor Advanced Concepts R&D	3,105	28,001	18,479
Next Generation Nuclear Plant Demonstration Project	94,025	40,000	21,157
Light Water Reactor Sustainability	38,818	25,000	21,661
Advanced Reactor Concepts	28,758	21,870	12,377
SBIR/STTR (non-add)	-	[3,389]	[2,247]
Total, Reactor Concepts Research, Development and Demonstration	164,706	114,871	73,674

Public Law Authorizations

P.L. 112-10, "Department of Defense and Full-Year Continuing Appropriations Act", 2011

P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

The Reactor Concepts Research, Development and Demonstration (RD&D) program is designed to develop new and advanced reactor designs and technologies that advance the state of reactor technology to improve its competitiveness, and help advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs RD&D activities are designed to address technical, cost, safety and security issues associated with reactor concepts including Small Modular Reactors (SMRs), the Next Generation Nuclear Plant Demonstration Project (NGNP) and other advanced reactor concepts. Additionally, RD&D will conduct research and develop advanced technologies to support life extensions of Light Water Reactors (LWRs) and address the impacts of the Fukushima accident with a focus on enhancing the accident tolerant characteristics of reactors.

In maximizing the benefits of nuclear power, work must be done to address the following challenges:

- Improving affordability of nuclear energy;
- Addressing the management of nuclear waste; and
- Minimizing proliferation risks of nuclear materials.

Subprogram Accomplishments and Milestones

In the prior appropriation year, Reactor Concepts RD&D achieved significant accomplishments or milestones in program management and/or program development. Such accomplishments include the following: (1) the NGNP completed its review by the Nuclear Energy Advisory Committee (NEAC) and the Department decided to continue R&D and licensing framework development, as well as continue steps toward developing a public-private partnership; design activities will not be performed; (2) the Light Water Reactor Sustainability (LWRS) program completed an analysis of concrete performance and cable aging degradation from an examination of the Ginna plant during the 2011 refueling outage; (3) the Advanced Reactor Concepts (ARC) program completed a Progress Report on Upgrading the Small Sodium Test Loop for Fundamental Sodium Plugging Data, continued R&D in the Advanced Structural Materials Program, including an update on the evaluation of thermal-aging induced degradation of tensile properties of advanced steels, continued Flouride High Temperature Reactor general design development and continued R&D on the recuperated re-compression Brayton Cycle; (4) the Advanced SMR program management staff worked with industry to identify activities important to SMR development..

In the current appropriation year, Reactor Concepts RD&D is working towards the following key milestones:

Milestone	Date
Prepare an Advanced SMR R&D Program Plan that coordinates industry needs outlines advanced SMR development. (SMR)	Jun 2012
Commence recuperated Re-compression Cycle Brayton Loop operations at Sandia National Laboratory. (ARC)	Sep 2012
Complete irradiation of the second Advanced Graphite Creep (AGC02) test experiment. (NGNP)	Jun 2012
Complete a comprehensive assessment of materials degradation issues for light-water reactor plants operating beyond 60 years. (LWRS)	Sep 2012
Establish the ARC Technical Review Panel and evaluate Generation IV concepts to inform R&D plans and schedule. (ARC)	Jun 2012
Commence the first phase of establishing the Liquid Metals Mechanisms test capability. (ARC)	Sep 2012

Explanation of Changes

The Department requests $73.7 million in FY 2013 for Reactor Concepts RD&D which is a 35.9 percent decrease from the current FY 2012 level. This reduction reflects a refocusing of this program on higher priority, core activities and R&D with expected nearer-term results and broader applicability.

Program Planning and Management

The Reactor Concepts RD&D program pursues projects utilizing program guidance contained in the *Nuclear Energy Research and Development Roadmap Implementation Plan for Objective 2 to* Develop Improvements in the Affordability of New Reactors. Through close coordination between RD&D and the Nuclear Energy Enabling Technologies program, the Nuclear Energy (NE) program will leverage innovative, cross-cutting research and development (R&D) activities.

Strategic Management

In meeting the identified challenges to nuclear power, the department will implement three key strategies to more efficiently and effectively manage the program, thus putting the taxpayers' dollar to more productive use.

1. Partner with the private sector, national laboratories, universities and international partners to develop advanced nuclear technologies.
2. Engage the international community in collaborative reactor projects that will benefit the United States with enhanced safety, improved economics and reduced production of wastes.
3. Participate in domestic and international research cost sharing programs, including the Generation IV International Forum, on specified reactor technologies.

In addition, NE designates up to 20 percent of funds appropriated to its R&D programs for scholarships, fellowships, infrastructure projects, and R&D to be performed at university and research institutions, through open, competitive solicitations.

Three external factors present the strongest challenges to the overall achievement of the program's goal:

- Power demand and economic and environmental factors beyond the scope of DOE R&D programs, as well as complex economic decisions made by industrial partners;
- Industry's inclination to focus on near-term deployment using proven technologies. Industry may not readily support or be supportive of longer-term development of better technologies;
- Data collection for nuclear energy research programs rely in part through collaborations with foreign nations. Should vital data from foreign partners prove unavailable, an increased U.S. effort in technology development would be required.

Subprogram Goals and Funding

This program is guided by the *Nuclear Energy Research and Development Roadmap* (April 2010) in Objectives 1 and 2, which focus on extending the safe operating life of existing nuclear plants and improving the affordability of new reactors to help meet the Administration's energy security and climate change goals. Activities in the Reactor Concepts program are also closely coordinated with Objectives 3 and 4 that focus on developing sustainable nuclear fuel cycles and minimizing the risks of nuclear proliferation and terrorism. By advancing technologies through R&D, NE can help develop the technical basis for keeping existing nuclear plants operating longer than current license periods, support development of advanced concepts for the medium term, and promote design of revolutionary systems for the long term.

The NE R&D Roadmap lays out four goals that programs work toward in support of NE's mission and that guide program planning and execution. These goals provide a concrete framework for NE's activities and link to the Department's strategic priorities:

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable nuclear fuel cycles.
- Understand and minimize the risks of nuclear proliferation and terrorism.

The subprogram within Reactor Concepts RD&D aligns with these goals in the following manner:

Goal Areas by Subprogram

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4. Nonproliferation
Reactor Concepts RD&D				
Small Modular Reactors	0%	70%	20%	10%
Next Generation Nuclear Plant Demonstration Project	0%	90%	10%	0%
Light Water Reactor Sustainability	100%	0%	0%	0%
Advanced Reactor Concepts	0%	90%	10%	0%
Total, Reactor Concepts RD&D	30%	58%	10%	2%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Small Modular Reactors			
The decrease from $28,001,000 to $18,479,000 reflects utilization of limited FY 2012 carryover into FY 2013, and a reduction of advanced SMR licensing related R&D activities.	28,001	18,479	-9,522
Next Generational Nuclear Plant Demonstration Project			
The decrease from $40,000,000 to $21,157,000 reflects decreased scope in fuels, graphite and high temperature metals R&D to the subset of R&D with the highest potential for utility beyond the scope of the program and thereby enabling increased funding to support other near-term reactor issues.	40,000	21,157	-18,843
Light Water Reactor Sustainability			
The decrease from $25,000,000 to $21,661,000 reflects the need to shift funding to higher priority SMR licensing efforts, and efficiencies gained in coordinated efforts with Fuel Cycle R&D (FCR&D) and Nuclear Energy Advanced Modeling and Simulation (NEAMS). Advanced fuel cladding research and the R-7 development of LWRS were adjusted as a result of FCR&D and NEAMS activities.	25,000	21,661	-3,339
Advanced Reactor Concepts			
The decrease from $21,870,000 to $12,377,000 reflects a shift in funding to near-term reactor issues and a focusing of subprogram dollars on higher priority areas. Work in nuclear data cross-section measurements will be significantly reduced from FY 2012 levels.	21,870	12,377	-9,493
TOTAL Funding Change, Reactor Concepts RD&D	114,871	73,674	-41,197

Small Modular Reactor Advanced Concepts R&D
Overview

The SMR Advanced Concepts R&D subprogram will support the development of innovative SMR designs that may offer improved safety, functionality and affordability, incorporating the existing nuclear technology and operating experience base. The program supports laboratory/university and industry projects to conduct nuclear technology R&D, including the development of codes and standards, novel sensors, control systems for multiple units, probabilistic risk assessments, and other technologies that are unique and would be useful to support development of advanced SMR concepts for use in the mid-to long-term. Emphasis is on advanced reactor technologies that offer simplified operation and maintenance for distributed power applications and increased proliferation resistance and security.

R&D activities within the SMR Advanced Concepts subprogram will follow a stepwise process that includes feedbacks and a focus on efficiency and cost-effectiveness. All activities will be reviewed, revisited, and revised as necessary in the annual budget development and program planning processes.

Benefits

- Facilitates the long term development of new non-LWR SMR designs that can offer added functionality and affordability for the production of electricity and high temperature process heat.
- Reduction in capital costs of licensing and constructing multiple-unit SMR plants.
- Improvements in SMR safety, proliferation resistance and security profiles.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Issue Nuclear Energy University Program awards.	3,105
FY 2012	• Pursue R&D on assessment methods, sensors, instrumentation and controls. • Conduct advanced materials development and associated codes and standards. • Conduct advanced heat exchanger testing and computer modeling using various coolants.	28,001
FY 2013	• Continue R&D on assessment methods, sensors, instrumentation and controls. • Continue development advanced materials and associated codes and standards. • Continue advanced heat exchanger testing and computer modeling using various coolants. • Issue interim report documenting assessment of seismic safety risk of generic SMR designs. • Complete SMR economic assessment of advanced SMRs utilizing enhanced manufacturing learning and cost information.	18,479

Next Generation Nuclear Plant Demonstration Project
Overview

The NGNP is designed to demonstrate the technical viability of very high temperature nuclear reactor (VHTR) technology to provide more efficient carbon-free electricity and high-temperature process heat for a variety of industrial uses. The program sponsors collaborative efforts with universities, industry, and the NRC to conduct R&D necessary to license and demonstrate a new generation of gas-cooled, accident-tolerant reactors in the United States. Collaborative efforts are also conducted with international researchers through the Generation IV International Forum Very High Temperature Reactor System Arrangement. In FY 2011 NEAC completed its review of the state of NGNP R&D and licensing activities. The NEAC report concluded that the Project was not ready for a decision to proceed to the complete set of final design and construction activities. However, the report recommended that the Department proceed with the formation of a public-private partnership, begin preliminary design activities and continue R&D as well as interactions with the NRC to develop a licensing framework for VHTRs. In FY 2012, NGNP will focus on R&D activities, interactions with the NRC to develop a licensing framework, and will take steps to inform public-private partnership development.

Execution of the NGNP R&D activities will follow a stepwise process that includes feedbacks and a focus on efficiency and cost-effectiveness to ensure maximum usefulness and applicability of results. All activities will be reviewed, revisited, and revised as necessary in the annual budget development and program planning processes. The Department continues to work with the U.S. private sector to understand industrial end-user requirements, produce trade studies evaluating the integration of NGNP into various industrial applications, and develop cost-sharing strategies to support industry in their efforts to commercialize VHTR technologies. Similarly, the Department's collaboration with the NRC is speeding the development of a framework for licensing VHTRs in the United States.

Benefits

The Department believes that nuclear power from VHTRs has the potential to reduce GHG emissions by displacing fossil fuels in the generation of electricity, and in the production of process heat for certain applications including petroleum refining and the production of fertilizers and other chemical products. This important objective cannot be achieved without the private sector's involvement. The extreme integrity of the fuel in VHTRs under all postulated challenges also provides inherent safety for this class of reactors.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Continued R&D on VHTR fuels, materials, design methods, and user applications. NGNP completed its review by NEAC and decided to move forward with a portion of the NEAC recommendations, including continued R&D and licensing framework development, and establishment of a public-private partnership; design activities will not be performed.	94,025
FY 2012	• Continue R&D on VHTR fuels, materials, design methods, and user applications. • Issue RFP seeking input on business plans and commercial viability of the NGNP project.	40,000
FY 2013	• Continue R&D on VHTR fuels, graphite, and key issues requiring resolution in establishing a licensing framework.	21,157

Light Water Reactor Sustainability
Overview

The existing U.S. nuclear fleet has an excellent safety and performance record and today accounts for about 20% of the U.S. electricity supply and 70% of the low greenhouse-gas-emitting, domestic electricity production. However, with the 60-year operating licenses beginning to expire no later than 2029 and the long planning horizon required to place new generation capabilities in service, utilities are beginning the planning process to obtain a license for operation beyond 60 years or for baseload replacement power with the first relicensing application expected in the 2016 to 2018 time frame. Replacing the current 100-GWe fleet with new nuclear plants would cost hundreds of billions of dollars and replacement with traditional fossil plants would lead to significant increases in carbon dioxide emissions. Extending operating licenses beyond 60 years would enable existing plants to continue to provide safe, clean, and economical electricity without significant greenhouse gas emissions, while reducing the pressure to bring new non-greenhouse-gas-emitting capacity on line. The LWRS program has partnered with industry and the NRC to closely coordinate research needs and share costs. Industry will primarily address the near-term research needs and the LWRS program, along with industry and the NRC, will address the long-term research needs. This research will form the technical basis for age-related material degradation management and to inform major component refurbishment and replacement strategies related to Instrumentation and Control systems, improved fuel, and safety margin characterization. The research will also address post-Fukushima lessons learned, in particular, research to enhance the accident tolerance of light water reactors, accident response analysis capabilities and emerging issues.

Execution of the LWRS subprogram activities will follow a stepwise process that includes feedbacks, critical industry involvement and cost-sharing, and a focus on efficiency and cost-effectiveness to ensure maximum usefulness and applicability of results. All activities will be reviewed, revisited, and revised as necessary in the annual budget development and program planning processes.

Benefits

Results of the R&D conducted by this program could help:

- Reduce risk and uncertainty involved in pursuing additional license extensions.
- Inform decisions for investing in plant refurbishment and modernization.
- Reduce potential for aging related failures causing extended shutdowns or asset loss.
- Maintain safety of aging facilities.
- Overall, extending the life of existing nuclear power plants could provide the following benefits: Assistance in meeting climate change objectives.
- Maintenance of a diverse energy supply.
- Minimized cost impacts to ratepayers.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Materials Aging and Degradation Assessment, Safety Margin Characterization, Instrumentation and Controls, Efficiency Improvements, and Advanced LWR Fuel Cladding accomplishments: o Completed an analysis of concrete performance and cable aging degradation from an examination of the Ginna plant during the 2011 refueling outage. o Completed safety case documentation for irradiation testing of advanced light water reactor silicon carbide clad fuels. o Installed a full-scope simulator for a 4-loop commercial pressurized water reactor in the Human Systems Simulation Laboratory (HSSL for the development and evaluation of control systems and displays. o Developed state-of-the-art data management and graphics user interface (GUI) system for RELAP-7, a state-of-the-art systems analysis code. o Developed a baseline computational model for proactive welding stress management to suppress helium-induced cracking during weld repair. o Developed a physics-based stress corrosion cracking component reliability model for use in risk-informed safety margin characterization.	38,818
FY 2012	• Materials Aging and Degradation Assessment - Investigate mechanisms of irradiation-assisted stress corrosion cracking (IASCC), crack initiation in nickel-based alloys, high-fluence effects on stainless steels, IASCC of alloy X-750, reduction in toughness of reactor pressure vessel steels, and swelling effects and phase transformations in high-fluence core internals. Assess degradation of concrete in unique reactor environments (radiation, high temperature, moisture) and develop nondestructive examination techniques. Continue existing pilot projects at the Ginna and Nine Mile Point plants to obtain information on materials that support development of guidance on inspection of containments and reactor internals, assess degradation of cables, and develop tools and methods to measure degradation and predict failures. • Safety Margin Characterization - Commence validation of the advanced models and computational features in the advanced plant-level safety analysis code (R7), based on a developmental version of R7 and an R7 model of an existing integral-effects thermal-hydraulics test facility. The R7 code uses advanced computational tools and techniques to simulate the behavior of nuclear power plants in a way that develops more comprehensive safety insights and enables a more useful risk-informed analysis of plant safety margin. • Instrumentation and Controls - Continue development of plant control and monitoring systems to improve plant efficiency, facilitate power up-rates, and enable remote monitoring and support. • Systems Analysis and Emerging Issues – Continue development of alternative and new cooling technologies that can be applied in the near term to reactors impacted by insufficient cooling water supplies. Address post-Fukushima lessons learned research needs. • Advanced LWR Fuel Cladding - Continue development of an advanced cladding material with both high performance and greater tolerance of accident conditions. Start the examination of test sample from the HFIR reactor and begin tests at the ATR reactor. Develop a predictive model of fuel cracking and fission gas release.	25,000
FY 2013	• Materials Aging and Degradation Assessment - Conduct mechanistic studies of high fluence irradiation induced degradation, gather high value materials for life extension studies, and assess alternative specimen surveillance techniques. Publish a database of field and operational data on concrete performance. Complete critical analysis of the potential implementation and data needs for using advanced alloys in LWR replacement components. • Safety Margin Characterization - Release a preliminary version of the plant-level safety analysis code (R7) to advanced users. Complete a partial-scope demonstration of R7 capabilities using the PWR Feed and Bleed case study, the industry-recommended case study	

Fiscal Year	Activity	Funding (Dollars in Thousands)
	for steering code development and methodology/ framework development. Initiate additional safety analysis case studies with industry. Engage a broader group of industry stakeholders in code validation and adaptation. • Instrumentation and Controls - Complete three pilot plant projects with industry to demonstrate the use of advanced digital technologies to address obsolescence and improve plant performance. • Advanced LWR Fuel Cladding - Continue development of advanced cladding designs by conducting irradiation tests at the ATR reactor and at the Halden reactor. The work on silicon carbide cladding will also support a research initiative to investigate accident tolerant fuel. • Systems Analysis and Emerging Issues - Demonstrate alternative technologies that reduce water consumption for application to existing reactors. Address post-Fukushima lessons learned research needs.	21,661

Advanced Reactor Concepts
Overview

The Advanced Reactor Concepts (ARC) subprogram performs research to develop and refine future reactor concepts that could dramatically improve nuclear power performance including sustainability, economics, and safety and proliferation resistance. The program supports research to reduce long-term technical barriers for advanced nuclear energy systems focusing on fast reactors, fluoride-cooled advanced high temperature reactors and conversion systems. The program will continue support for international activities in the Generation IV International Forum, and international collaborations on advanced reactor operations and safety. This program will be focused on high value research for long term concepts, R&D needs of promising mid-range concepts, the development of innovative technologies that benefit multiple concepts and stimulation of new ideas for transformational future concepts.

Reactor concepts are being addressed that reside at different maturity levels in this sequence. The key R&D needs are being addressed for two high priority advanced concepts: liquid metal-cooled fast reactors and liquid fluoride salt cooled reactors (FHRs). In addition, R&D that could provide wide benefits (e.g., development of advanced energy conversion technology such as a supercritical CO2 Brayton cycle) is being pursued with a view to application in many different reactor technologies. The ARC program will continue to solicit and evaluate new ideas in order to encourage innovation, incorporation of technology advances, and to enhance the safety, as well as performance, of these systems.

Execution of the ARC subprogram activities will follow a stepwise process that includes feedbacks and a focus on efficiency and cost-effectiveness to ensure maximum usefulness and applicability of results. All activities will be reviewed, revisited, and revised as necessary in the annual budget development and program planning processes.

Benefits

The ARC program activities are focused on supporting the development of advanced concepts with the following key benefits:

- Development of innovative technologies that resolve key feasibility and performance challenges.
- Development and maturation of innovative technologies that reduce fabrication, construction and operating costs.
- Exploration and development of supercritical CO2 Brayton thermal cycle for diverse reactor applications that couple nuclear reactors to power generation with much improved conversion efficiency and reduced plant size.
- Enable additional long-term nuclear energy options that have the potential to provide significant safety, economic improvements and lower fabrication, construction and operations costs.
- Utilize international collaborations to leverage and expand R&D investments.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Continued R&D in the Advanced Structural Materials Program. • Continued Fluoride High Temperature Reactor (FHR) General Design Development. • Continued R&D of the recuperated Re-compression Brayton Cycle. • Completed Progress Report on Small Sodium Test Loop Upgrade for Fundamental Sodium Plugging Data. • Participated in the International code validation and benchmarking project; Phenix end-of-life experiments. • Finalized Report for Zero Power Plutonium Reactor 15A Experiment Database.	28,758
FY 2012	• Commence Under Sodium Viewing ultra-sonic transducer testing to support in service inspection for SFRs. • Commence the first phase of establishing the Liquid Metals Mechanisms test capability. • Develop R&D plan to support general FHR general designs. • Commence recuperated Re-compression Cycle Brayton Loop operations at Sandia National Laboratory.	21,870
FY 2013	• Conduct initial component testing of the Liquid Metal Mechanisms Facility. • Complete Analysis of EBR-II Inherent Safety Tests.	

Fiscal Year	Activity	Funding (Dollars in Thousands)
	• Conduct FHR R&D. • Commence testing of 1 MWe Supercritical CO2 Brayton Cycle facility.	12,377

Fuel Cycle Research and Development
Funding Profile by Subprogram and Activity

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Fuel Cycle Research and Development			
Separations and Waste Forms	37,133	32,224	38,628
Advanced Fuels	50,648	58,656	40,378
Transmutation Research and Development	5,721	0	0
Modeling and Simulation	22,350	0	0
Systems Analysis and Integration	23,775	17,029	22,882
Materials Protection, Accounting, and Control Technology	6,674	5,152	7,203
Used Nuclear Fuel Disposition	32,535	59,650	59,668
Fuel Resources	3,592	3,607	6,679
Spent Nuclear Fuel Analysis	0	9,942	0
SBIR/STTR (non-add)	-	[5,495]	[5,351]
Total, Fuel Cycle Research and Development	182,428	186,260	175,438

Public Law Authorizations

P. L. 112-10, "Department of Defense and Full-Year Continuing Appropriations Act", 2011
P. L. 112-74, Consolidated Appropriations Act, 2012

Overview

The Fuel Cycle Research and Development (FCR&D) program supports the goal in the Department's Strategic Plan to "Enhance nuclear security through defense, nonproliferation, and environmental efforts" by supporting responsible civilian nuclear power development and fuel cycle development. The program is also designed to support Nuclear Energy Research and Development Roadmap Objective 3: "Develop sustainable nuclear fuel cycles." Sustainable fuel cycle options are those that improve uranium resource utilization, maximize energy generation, minimize waste generation, improve safety, and complement institutional measures in limiting proliferation risk.

FCR&D will research and develop a suite of technology options that will enable future decision makers to make informed decisions about how best to manage nuclear waste and used fuel from reactors. The program employs a long-term, science-based approach to foster innovative, transformational technology solutions to achieve this mission.

In addition, the program includes a strong focus on researching and developing storage, transportation, and disposal technologies for spent fuel and nuclear waste. There are a number of key elements that the Department has recognized as foundational to the nation's used fuel management and high-level waste disposal program, and the Used Nuclear Fuel Disposition subprogram encompasses these elements. R&D efforts in these important areas began in NE in FY 2010. Recently, the Blue Ribbon Commission on America's Nuclear Future released its final report, which included research and development-related near-term priorities that align with how the funding within Used Nuclear Fuel Disposition is allocated in FY 2012.

FCR&D supports long-term technology development activities and will:

- Develop technologies for storing, transporting, and disposing of used nuclear fuel and assess the performance of high-level waste forms in the associated storage and disposal environments. This includes addressing the near-term recommendations of the Blue Ribbon Commission on America's Nuclear Future.

- Develop next generation light water reactor fuels with enhanced accident tolerance. To this end, the Office of Nuclear Energy (NE) developed an Accident Tolerant Fuel Initiative in FY 2012. The Initiative is a joint venture between NE's Offices of Fuel Cycle Technologies and Nuclear Reactor Technologies, which manages the Reactor Concepts Research, Development and Demonstration program. It will guide the development of research, development and demonstration (RD&D) activities among the national

laboratories, universities and industry in this important part of NE's portfolio of activities.

- Investigate fuel forms, reactors and fuel/waste management approaches that could dramatically increase utilization, if economically competitive, of fuel resources and reduce the quantity of long-lived radiotoxic elements in the used fuel requiring disposal. Technologies will be considered that require at most limited separations steps and minimize proliferation risks.

- Develop techniques that will enable long-lived actinide elements to be repeatedly recycled (fully closed fuel cycles). The ultimate goal is to develop a cost effective and low-proliferation-risk approach that would significantly decrease the long-term challenges posed by the waste and reduce uncertainties associated with its disposal.

The continued use of nuclear power in the United States faces challenges in achieving the goals of sustainability:

- Nuclear waste management: Sustainable fuel cycle options must include strategies that account for the disposition of all of the nuclear material in use.

As noted in the Blue Ribbon Commission's report: "Advances in nuclear energy technology have the potential to deliver an array of benefits across a wide range of energy policy goals." To that end, the program continues to address two potential long-term challenges:

- Resource utilization: Improving the utilization of fuel resources could reduce the amount of natural material required to produce nuclear energy, preserving more resources for future use.

- Resource availability: For nuclear energy to remain a sustainable energy source there must be assurance that economically viable resources of nuclear fuel are available.

Subprogram Accomplishments and Milestones

In FY 2011, FCR&D achieved three milestones in program development. These accomplishments include: 1) completing a pilot fuel cycle options screening exercise; 2) developing an implementation plan for Objective 3 of the Nuclear Energy Research and Development Roadmap: Develop sustainable fuel cycles; 3) identifying research and development (R&D) needs to develop the technical bases for extended storage of used nuclear fuel. In FY 2012, FCR&D is working towards the following key milestones:

Milestone	Date
Document proliferation and security evaluation criteria for use in the next fuel cycle options screening exercise in FY 2013	Jun 2012
Complete an implementation plan for developing a test and validation complex for extended storage and transportation of used nuclear fuel	Jun 2012
Complete baseline post-irradiation examination report of legacy fuel from Fast Flux Test Reactor and Experimental Breeder Reactor (EBR)-II	Jul 2012
Complete proof of concept testing for four innovative separations processes related to modified open fuel cycles	Sep 2012
Complete preparations for irradiation test for innovative metallic fuel for light water reactors	Sep 2012
Complete the first independent peer reviews of two subprograms: Separations and Waste Forms and Advanced Fuels.	Sep 2012

Explanation of Changes

In FY 2012, FCR&D expanded the scope of the Used Nuclear Fuel Disposition subprogram. The Blue Ribbon Commission's near-term R&D-related priorities align with how the funding was allocated in FY 2012. In FY 2013, the Department requests $175 million for FCR&D, which is a six percent decrease from FY 2012 Enacted. Advanced Fuels and Spent Nuclear Fuel Analysis experience decreases. These decreases are partially offset by increases in each of the other subprograms. Details on those changes are provided later in the Explanation of Funding AND/OR Program Changes.

Program Planning and Management

FCR&D is primarily focused on supporting NE's goal of developing sustainable fuel cycles. All of FCR&D's subprograms contribute to achieving this goal. In addition, most of FCR&D's subprograms also contribute to NE's goal to enable new reactors. This is especially true in Advanced Fuels and Used Nuclear Fuel Disposition Advanced Fuels also supports the NE goal to extend the life of current reactors. Finally, FCR&D's Separations and Waste Forms and Material Protection Accounting, and Control Technology subprograms support NE's goal to minimize proliferation and terrorism risks.

Beginning in FY 2012 and continuing into FY 2013, FCR&D is shifting its priorities to supporting current reactors and enabling new reactors through its work on Light Water Reactor (LWR) fuel with enhanced accident tolerance in Advanced Fuels and the increased scope of Used Nuclear Fuel Disposition.

Strategic Management

In meeting the identified challenges to achieving the goals of a sustainable nuclear fuel cycle, the department will implement three key strategies to more efficiently and effectively manage the program, thus putting the taxpayers' dollar to more productive use.

1. FCR&D will investigate a comprehensive range of potential fuel cycle options classified into three broad fuel cycle strategies (once through, modified open, and full recycle). An objective evaluation and screening assessment will be performed in order to identify the best options to decision makers in the future and to integrate and prioritize needed research and development.
2. The program will employ the following techniques to investigate the range of potential fuel cycle options in a cost-effective manner:
    - A science-based approach that involves small-scale experiments, theory development, and advanced modeling and simulation
    - A dual-path approach simultaneously pursuing both evolutionary advances and revolutionary transformational breakthroughs
    - A systems engineering approach to identify the most promising technology options in an open, objective, and systematic way
3. FCR&D will partner with the private sector, national laboratories, universities and international partners to leverage our resources.

In addition, NE designates up to 20 percent of funds appropriated to its R&D programs for scholarships, fellowships, infrastructure projects, and R&D to be performed at university and research institutions, through open, competitive solicitations.

Three external factors present the strongest impacts to the overall achievement of the program's strategic goal:

1. Industry's inclination to focus on near-term deployment using proven technologies. Industry may not readily support or be supportive of longer-term development of better technologies;
2. Data collection for nuclear energy research programs rely in part through collaborations with foreign nations. Should vital data from foreign partners prove unavailable, an increased U.S. effort in technology development would be required.

Subprogram Goals and Funding

The NE R&D Roadmap lays out four goals that programs work toward in support of NE's mission and that guide program planning and execution. These goals provide a concrete framework for NE's activities and link to the Department's strategic priorities:

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable nuclear fuel cycles.
- Understand and minimize the risks of nuclear proliferation and terrorism.

FCR&D supports all four goals. The third goal to develop sustainable nuclear fuel cycles is the main goal that FCR&D focuses on. FCR&D also supports the first and second goals through advanced fuels development. FCR&D's Used Nuclear Fuel Disposition subprogram also supports the second goal. FCR&D contributes to the fourth goal to minimize proliferation and terrorism risks primarily in developing innovative techniques for monitoring nuclear data in Materials Protection, Accounting, and Control Technology and in the development of advanced Separations and Waste Forms technologies.

Goal Areas by Activities

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4. Minimize Proliferation and Terrorism Risks
Fuel Cycle Research and Development				
Separations and Waste Forms	0%	0%	75%	25%
Advanced Fuels	30%	30%	40%	0%
Systems Analysis and Integration	0%	10%	75%	15%
Materials Protection, Accounting, and Control Technology	0%	0%	50%	50%
Used Nuclear Fuel Disposition	0%	25%	75%	0%
Fuel Resources	0%	0%	100%	0%
Spent Nuclear Fuel Analysis	0%	25%	75%	0%
Total, Fuel Cycle Research and Development	7%	17%	67%	10%

Explanation of Funding AND/OR Program Changes

In FY 2012, FCR&D expanded the scope of the Used Nuclear Fuel Disposition subprogram to include progress toward the development and licensing of standardized containers, the development of models for potential partnerships, and accelerating the characterization of potential geologic repository media. These changes support progress on certain near-term recommendations of the Blue Ribbon Commission on America's Nuclear Future.

In FY 2013, the Department requests $175 million for FCR&D, which is a six percent decrease from FY 2012 Enacted. Program emphasis in FY 2013 will be on supporting current reactors and enabling new reactors through work on Light Water Reactor (LWR) fuel with enhanced accident tolerance and on the storage, transportation, and disposal R&D within Used Nuclear Fuel Disposition. As a result, work on irradiation tests and post-irradiation examinations of fast reactor fuels and advanced transmutation metallic fuel R&D are reduced. Spent Nuclear Fuel Analysis ($10M in FY 2012) is a one-time activity that expands assessment work related to the aging and safety of storing used nuclear fuel. Related activities beyond FY 2012 will be funded within Used Nuclear Fuel Disposition. These decreases are partially offset by increases in each of the other subprograms. Details on those increases are provided below.

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Separations and Waste Forms The increase reflects the initiation of a joint pyrochemical feasibility study with the Republic of Korea (ROK) while continuing advanced pyrochemical studies for domestic applications and transferring into the subprogram limited modeling and simulation activities. These increases are partially offset by decreases in R&D of advanced aqueous technologies and in investigations of innovative modified open cycle technologies. The joint fuel cycle studies with ROK initially involve lab-scale feasibility studies of electrochemical recycling le with irradiated materials. Modeling and simulation activities to be funded within this subprogram are intended to develop an improved understanding of the chemical and physical processes that are key to the success of separations and waste processes and waste form performance. Investigations of certain modified open cycle technologies that lack promise will be discontinued.	32,224	38,628	+6,404
Advanced Fuels The decrease reflects a revised focus on a higher priority spectrum of fuels to support the NE Accident Tolerant Fuel Initiative. R&D on ceramic fuels is reduced, including separate effects testing, advanced characterization, nitride fuel and mixed oxide fuel. Predictive modeling using separative effects testing will continue but lab-scale demonstration of sintering will be delayed. Feasibility studies of advanced metallic fuel alloys at greater than 20 percent burnup will be delayed. Advanced transmutation metallic fuel fabrication method development and characterization will be reduced. Feasibility demonstrations of advanced core materials will focus on LWR fuel only and not fast reactor fuel. Irradiations and post-irradiation examination of fast reactor fuel will be reduced.	58,656	40,378	-18,278
Systems Analysis and Integration The increase reflects the conduct of a second formal screening of fuel cycle options. This second screening activity will add waste forms and disposal technologies and will be conducted with more quantitative formality and more documentation than the initial pilot screening activity in FY 2011.	17,029	22,882	+5,853
Materials Protection, Accounting, and Control Technology The increase reflects expanding the scope of this subprogram to include consolidated storage of used nuclear fuel, enrichment, and fuel fabrication activities.	5,152	7,203	+2,051
Used Nuclear Fuel Disposition There are no significant changes.	59,650	59,668	+18

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Fuel Resources			
The increase reflects additional R&D to achieve "proof of concept" in demonstrating adsorbent technologies for extracting uranium from seawater. This includes developing adsorbent material with high uranium selectivity and sorption capacity, modeling of the functional ligands for uranium adsorption, and establishing the marine testing capabilities.	3,607	6,679	+3,072
Spent Nuclear Fuel Analysis			
The decrease reflects that this is a one-time activity funded in FY 2012 to initiate enhanced assessment work related to the aging and safety of storing used nuclear fuel. Related activities beyond FY 2012 will be funded within Used Nuclear Fuel Disposition.	9,942	0	-9,942
TOTAL Funding Change, Fuel Cycle Research and Development	186,260	175,438	-10,822

Separations and Waste Forms
Overview

Our future ability to sustainably and economically recycle, if deemed appropriate, light water reactor fuels, fast reactor fuels, gas-cooled reactor fuels, molten salt fuels, etc., will depend in part on our ability to separate the various elements of the used nuclear fuel into material for reuse and material for disposal. The ability to engineer, produce, and manage fuel cycle waste forms that are chemically and structurally stable over relevant periods of time from decades to hundreds of thousands of years (depending on the radioisotope) is critical to achieving a sustainable fuel cycle. Since used nuclear fuel will vary by initial composition, burn-up, and cooling time, and recycle fuel composition and physical characteristics will depend on reactor requirements, various combinations of separations and waste forms will be developed to provide science-based options for future policy decisions.

Benefits

The potential benefits of the R&D conducted in this subprogram include:

- Can provide initial experimental verification of advanced separations/waste forms processes for future use.
- Some components of future fuel cycle systems may be added to existing operations for near-term application.
- Through frequent industry interactions, Departmental R&D will progress along mutually advantageous pathways.
- Regular consultations with National Nuclear Security Administration result in minimum system attractiveness using Safeguards-by-Design.
- Research on advanced process control instrumentation combined with advanced modeling has future potential for accurate, real-time detection of diversion.
- International safeguards collaboration can improve the effectiveness of non-proliferation programs world-wide.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Selected four innovative separations processes for initial feasibility studies. • Conducted peer review of glass waste forms alterations over geologic time periods. • Proved the feasibility of recovering zirconium from used nuclear fuel assemblies. • Proved the feasibility of recovering iodine from surrogate used nuclear fuel. • Separated krypton from xenon in cold tests using metal-organic molecular structures. • Completed peer reviews for the Minor Actinide Separations and Off-Gas Capture Sigma Teams and incorporated recommendations. • Hosted a DOE-wide workshop on common areas of research among the various Department offices conducting separations activities.	37,133
FY 2012	• Begin joint Pyrochemical Feasibility Study with Republic of Korea (ROK) while continuing advanced pyrochemical studies for domestic applications. • Continue multi-laboratory study of the simplification of actinide/fission product separations and the capture and immobilization of gaseous radionuclides. • Complete initial hot tests of advanced volatility process for tritium/iodine removal. • Complete formulation of reference alloy waste form.	32,224
FY 2013	• Select reference separations process for use in evaluating the advantages of alternate advanced unit operations and processes. • Continue ROK pyrochemical feasibility study. • Continue to investigate fluoride volatility and use of ionic liquids for used fuel separations. • Investigate alternative waste forms to pressurized gas storage for krypton-85. • Investigate low temperature glass forms for iodine-129 immobilization and disposal.	38,628

Advanced Fuel Research and Development
Overview

The development of improved and advanced nuclear fuels is a major objective for both existing light water reactors and the entire spectrum of advanced nuclear energy systems. The development of advanced fuels is an essential part of achieving a sustainable fuel cycle. Advanced fuels is pursuing two major paths: (1) the development of next generation light water reactor fuels with enhanced accident tolerance, and (2) development over the long term of transmutation fuels with enhanced proliferation resistance and resource utilization. This activity also supports NE's international fuel development cooperation activities and university commitments.

Benefits

The potential benefits of the R&D conducted in this subprogram include:

- R&D targeted toward advanced accident tolerant LWR fuel options may lead to the development of fuel that could better withstand the effects of severe accidents by minimizing cladding failure, reducing hydrogen generation, reducing fission product release, and exhibiting a higher melting temperature.
- Continuation of R&D investment in advanced fuels that can greatly expand the U.S. nuclear resource base while fostering enhanced proliferation and economic benefits available for industrial use in the mid- to long-term.
- Development of advanced fuels that can operate for significantly longer periods of time and require less, or limited, recycling.
- Advanced Fuels program R&D activities are of major interest to several leading nuclear developed countries (China, Republic of Korea, Russia, France, and Japan) thereby permitting the United States to remain a major player in advanced nuclear development while leveraging limited U.S. development funds.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• As a result of Fukushima, the 2010-2011 initiative to develop transformative advanced LWR fuels was expanded to include enhanced accident tolerant fuels. • Continued support of modeling and simulation by initiating separate effects in-pile and out-of-pile test planning. • Continued to meet international obligations for cooperation with France, Russia, China, Japan, Republic of Korea (ROK), and the European Communities (EURATOM), by using international cooperation to leverage program's development activities. • Initiated destructive post irradiation examinations on legacy Fast Flux Test Facility (FFTF) and EBR-2 fast reactor high burn-up irradiated advanced fuels.	50,648
FY 2012	• Develop roadmap for evaluating, developing, and deploying LWR fuels with enhanced accident tolerance. • Initiate R&D on candidate fuels and materials to determine feasibility for accident tolerant LWR application. • Develop a loss of coolant accident testing capability for candidate LWR fuels with enhanced accident tolerance. • Have one innovative LWR fuel irradiation test ready for placement in the Advanced Test Reactor (ATR). • Complete design of an instrumented separate effects test vehicle for ATR plus perform necessary R&D to support the design and use of this new, unique piece of equipment. • Meet international obligations for cooperation with France, Russia, China, Europe, Japan, and ROK, plus enhance cooperation to leverage program's development activities. • Complete destructive post irradiation examinations of legacy FFTF and EBR-2 high burnup fuels. • Identify and obtain nuclear data needed to support advanced LWR fuel concepts.	58,656
FY 2013	• Down select one or two initial LWR accident tolerant fuel candidates.	40,378

Fiscal Year	Activity	Funding (Dollars in Thousands)
	• Initiate feasibility demonstration of novel in-situ instrumented fuel assembly for ATR testing to provide direct support modeling and simulation and thereby accelerate advanced fuel qualification. • Initiate operation on a glove box enclosed casting furnace for advanced transmutation metal fuel development supporting objective for reactor usable qualification within the decade. • Continue international collaboration with China, ROK, France, Japan, and Russia to leverage program activities, and program R&D necessary to actively support the two objectives. • Continue to deliver nuclear data evaluations and covariance production.	

Transmutation Research and Development
Overview

Transmutation R&D's purpose is to provide fundamental cross-cutting support for reactor and fuel cycle development. The program serves to identify, prioritize, pursue, and deliver the required nuclear and covariance data critical in optimization and design, as well as safety and proliferation resistance characteristics. As a fundamental science activity, it encourages innovation to achieve new and high fidelity nuclear data measurements to support all aspects of the fuel cycle.

Benefits

The potential benefits of the R&D conducted in this subprogram include:

- Decreased uncertainty in burnup and transport codes that could lead to operations at higher power levels, decreasing the cost of the electricity being produced.
- Optimization of materials, costs, and safety margins that could lead to decreased construction costs.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Delivered new point-wise covariance data for the major structural isotopes of Cr, Fe, Ni, Mo and Zr to the ENDF library. • Fabricated and bench tested fully populated Time Projection Chamber sectant. • Reported on advanced detector development for the science-based R&D nuclear data effort.	5,721
FY 2012	• The scope of this subprogram was reduced to focus solely on nuclear data necessary to support the development of next generation advanced reactor fuels and light water reactor fuels with enhanced accident tolerance. These activities have been transferred to the Advanced Fuels subprogram. Other aspects of the subprogram have been deferred.	0

Modeling and Simulation
Overview

In FY 2012, modeling and simulation activities were consolidated within the Advanced Modeling and Simulation element of the Crosscutting Technology Development activity under the Nuclear Energy Enabling Technologies program. The mission of Modeling and Simulation within the Office of Nuclear Energy is to create and deploy science-based, verified and validated modeling and simulation capabilities essential for the design, implementation, and operation of all aspects of nuclear energy systems and their nuclear fuel cycles to improve U.S. energy security. Program activities encompass the micro-behavior level of fuels and materials in Fuel Cycle Research and Development to the macro-behavior level of reactor systems, e.g., light water reactors and advanced reactors in Reactor Concepts Research and Development, and their fuel cycles.

Benefits

Refer to the benefits within the Crosscutting Technology Development activity under the Nuclear Energy Enabling Technologies program.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Delivered advancements for the integrated performance and safety codes for nuclear fuel. • Continued projects with universities, industry, and laboratories to deliver fundamental material performance models to the integrated code activities. • Implemented advanced verification, validation, and uncertainty methodologies. • Developed an integrated computational interface and released it to users. • Completed a mesh-to-mesh coupling study and parametric studies to help researchers select the appropriate routines for their work. • Developed a new predictive model for borosilicate glass dissolution rate as a function of temperature and pH. • A three-dimensional model of radionuclide transport in a generic clay repository was formulated and demonstrated for its capability.	22,350
FY 2012	• In FY 2012, modeling and simulation activities were consolidated within the Advanced Modeling and Simulation element of the Crosscutting Technology Development activity under the Nuclear Energy Enabling Technologies program.	0

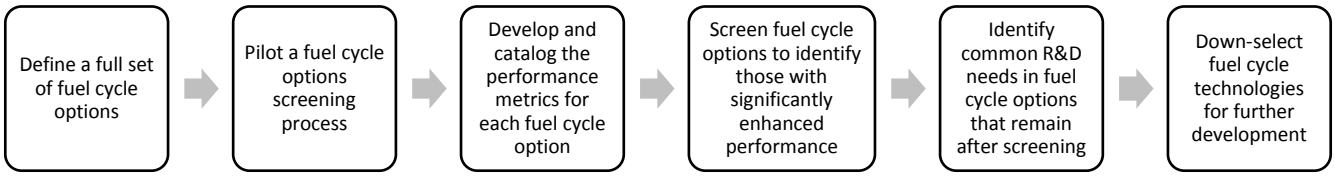
Systems Analysis and Integration
Overview

Systems analysis and integration provides the critical capability needed to analyze complex fuel cycle system options, assess overall performance under various scenarios, and improve understanding of the interdependencies between various subsystems and associated technologies. Systems analysis coupled with the application of the principles of systems engineering will: (1) help the program objectively and openly identify fuel cycles options worthy of further development; (2) aid identification and prioritization of the R&D needed to support their demonstration; (3) help formulate and execute program budgets; (4) enable clearer communication of the rationale for R&D funding decisions; and (5) enhance the ability of the program to rapidly adapt to future policy changes, including any decisions based on recommendations by the Blue Ribbon Commission on America's Nuclear Future.

Hundreds of potential fuel cycle options exist within three broad fuel cycle strategies (once through, modified open, and full recycle). The FY 2013 screening results will be used to identify a relatively small number of those fuel cycle options with attractive characteristics that will determine fuel cycle component technology functions and requirements to enable a focusing of research & development beyond FY 2013 on needed enabling technologies.

Sequence

R&D activities within this subprogram will follow a stepwise process that includes feedbacks and a focus on efficiency and cost-effectiveness. All activities will be reviewed, reevaluated, and revised as necessary in the annual budget development and program planning processes.



Benefits

The benefits of implementing systems analysis and engineering in the context of fuel cycle R&D include:

- Improved ability to inform policy development, strategy development, budget formulation.
- Improved ability to manage definition and prioritization of research and development and definition and justification of infrastructure needs.
- Improved public and stakeholder communication of what we are doing and why we are doing it.
- Systematic, open, objective, repeatable, and verifiable justification of program decisions.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Completed an initial pilot screening of fuel cycle options to determine if the methodology is viable and adds value to the program. • Developed an implementation plan for Objective 3 of the NE R&D Roadmap—Sustainable Fuel Cycles. • Implemented improved program control system that consolidates all NE R&D programs. • Consolidated technical areas to improve efficiency and reduce management costs.	23,775
FY 2012	• Prepare for fuel cycle screening in FY 2013 to include fuel cycle options set, develop improved fuel cycle performance information and metrics, and continue development of the screening process. • Develop knowledge management tools including a fuel cycle catalog.	17,029

Fiscal Year	Activity	Funding (Dollars in Thousands)
	• Complete the first independent peer reviews of two subprograms.	
FY 2013	• Conduct a formal screening of fuel cycle options to define a relatively small set of options for further consideration and use in defining and prioritizing R&D. • Complete independent peer reviews of two additional subprograms.	22,882

Materials Protection, Accounting and Control Technology

Overview

The Materials Protection, Accounting and Control Technology (MPACT) program strives to develop the technologies and analysis tools to support the next generation of nuclear materials management and safeguards for future U.S. nuclear fuel cycles. It also includes assessing vulnerabilities and security of the consolidated storage of used nuclear fuel. Moving forward to address the energy security needs of the country will require innovative approaches to materials control and accounting to ensure that nuclear material is not misused, diverted, or stolen.

NE works closely with the National Nuclear Security Administration (NNSA), Department of State, and the Nuclear Regulatory Commission on issues related to nuclear nonproliferation. NNSA has broad responsibilities in international nonproliferation and security matters for the present and into the future. MPACT is focused on R&D as it relates to potential future fuel cycle facilities here in the United States.

Challenges facing nuclear materials accountancy in general include:

- Regulatory gaps in licensing approach for potential U.S. back-end fuel cycle facilities (storage, disposition, and/or recycling)
- Limitations of accuracy and timeliness of detection (especially in high radiation fields)
- New reactor designs and fuel cycle concepts, which require new nuclear material management approaches (SMRs, Gas-Cooled Reactors, Thorium, etc.)
- Traditional material control and accountability challenges, such as uncertainty in large throughput facilities

Benefits

The potential benefits of the R&D conducted in this subprogram include:

- Better designed fuel cycle facilities that would simplify licensing and operations due to up-front consideration of safeguardability and improved instrumentation.
- Increased confidence of safe and secure nuclear materials management.
- Reduced cost of materials safeguards considerations.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Finalized Objective 4 implementation plan. • Electrochemical actinide sensor initial test. • Microcalorimeter capability demonstration. • AMUSE code validation / Advanced Concepts and Integration Report. • Production of Safeguards and Security by Design Guidelines Document. • Report on lead slowing down spectrometer.	6,674
FY 2012	• Complete and document automatic algorithm for Multi-isotope Process Monitor. • Complete and document baseline electrochemical model and MPACT sensitivity analysis. • Implement and document pattern recognition techniques in MPACT performance model. • Test and document baseline electrochemical process monitoring sensor capability in laboratory conditions. • Develop safeguards and security evaluation criteria for next fuel cycle options screening.	5,152
FY 2013	• Continue R&D on sensors, instrumentation and controls. • Initiate the assessment of vulnerabilities and security of used nuclear fuel consolidated storage in response to the Blue Ribbon Commission's recommendations and in anticipation of upcoming NRC rulemaking regarding long-term challenges.	

Fiscal Year	Activity	Funding (Dollars in Thousands)
	• Extend R&D to assess safeguards and security for enrichment and fuel fabrication. • Support proliferation risk assessment through improvements in "risk-informing" material protection, accounting, and control technology and security.	7,203

Used Nuclear Fuel Disposition Research and Development

Overview

There are a number of key elements that Department has recognized as foundational to the nation's used fuel management and high-level waste disposal program, and has been pursuing even prior to the recommendations recently put forward by the Blue Ribbon Commission on America's Nuclear Future. All radioactive wastes generated by existing and future fuel cycles will need to be safely stored, transported, and disposed. The department recognizes the need to assure the highest level of confidence in the safety and security of all operations associated with each stage of waste management, and pursues research and development activities that will inform decisions regarding fuel cycle options and their impacts on radioactive waste management. This subprogram identifies options for performing these functions, including research into disposal in a variety of geologic environments. The Used Nuclear Fuel Disposition subprogram will identify alternatives and conduct scientific research and technology development to enable long-term storage, transportation, and geologic disposal of used nuclear fuel and waste generated by existing and future nuclear fuel cycles.

Beginning in FY 2012, this subprogram expanded its scope to include: (1) the development and licensing of standardized transportation, storage, and disposition canisters and casks, and (2) the evaluation of management alternatives for spent nuclear fuel and high level waste, including possible partnership mechanisms. It also accelerated the characterization of potential geologic repository media.

The Blue Ribbon Commission's research and development-related near-term priorities align with how the funding is allocated within the Used Nuclear Fuel Disposition subprogram in FY 2012. The Department is undertaking activities to support the development and licensing of standardized transportation, aging, and disposition containers; characterize repository media; conduct non-site specific R&D on geologic disposal; evaluate storage options and their comparative advantages; begin evaluating management alternatives for spent nuclear fuel and high level waste, including possible partnership mechanisms; and expand the Department's capabilities for assessing issues related to the aging and safety of storing used nuclear fuel.

The Department's FY 2013 Congressional budget request builds on these efforts by focusing on evaluating consolidated interim storage and transportation issues (focused initially on decommissioned sites); working with industry to develop standardized approaches to used fuel management; conducting material testing to support extended storage of used fuel; revisiting and preparing a report on plans to address recommendations identified by the National Academy of Sciences transportation report; and initiating research on geologic disposal alternative environments (e.g. system modeling, engineered barriers, natural barriers, evaluation of design concepts, and experiments).

Benefits

The potential benefits of the R&D conducted in this subprogram include:

- Provide a sound technical basis for confidence in the safety and security of long-term storage and transportation of used nuclear fuel and wastes generated from the nuclear energy enterprise.
- Allows the Department of Energy (DOE) to demonstrate the capability for analysis of various used fuel disposal concepts, and to use this capability to analyze the fuel cycle system options.
- By developing experimental and computational capabilities and performing related modeling analyses to support future repository and fuel cycle development, DOE will continue to evaluate key natural system impacts on various waste disposal system concepts and potentially on the upstream processes of fuel cycle.
- By participating with international partners, DOE can leverage their knowledge and experience to establish safe and effective solution for the storage, transportation and disposal of used nuclear fuel.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Produced a gap analysis report defining used fuel evaluations needed to support long term storage and a summary plan for evaluating used fuel storage needs. • Produced a disposal R&D roadmap for prioritizing R&D activities.	

Fiscal Year	Activity	Funding (Dollars in Thousands)
	• Developed a database for transportation readiness for dry-stored used fuel. • Initiated Generic Performance Assessment Model iterations, database and sampling software utilizing generic engineered barrier system (EBS) and natural system information.	32,535
FY 2012	• Initiate system analyses for including initial consolidated interim storage, use of standardized containers, and improving efficiency of transportation. • Conduct R&D on extended storage of used fuel including assessing issues related to the aging and safety of dry and wet storage. • Conduct R&D on transportation of used fuel following extended storage, particularly related to high burn up fuel. • Conduct R&D on geologic disposal alternative environments, e.g., system modeling, engineered barriers, natural barriers, evaluation of design concepts, experiments. • Initiate in situ characterization of potential geologic repository media, including salt.	59,650
FY 2013	• Continue system analyses on consolidated interim storage, standardized containers, and transportation. • Continue R&D on extended storage of used fuel. Include material testing in support of modeling and simulation. • Complete plans for a Test Validation Complex to support the technical basis for extended storage of used fuel. • Expand interactions with potential stakeholders on transportation of used fuel. • Begin to implement actions identified in a review of the National Academy of Sciences report on safe transport of used fuel and high-level waste. • Continue R&D on geologic disposal alternative environments. Complete an RD&D plan and roadmap for the borehole disposal concept.	59,668

Fuel Resources
Overview

For nuclear energy to remain a sustainable energy sources there must be assurance that an economically viable supply of nuclear fuel is available. The availability of fuel resources for each potential fuel cycle and reactor deployment scenario must be understood. Most appropriate for federal involvement in this area is research and development to support investigation of long term, "game-changing" approaches such as the recovery of uranium from seawater.

Benefits

The potential benefits of the R&D conducted in this subprogram include:

- Extended use of nuclear power may drive improvements in defining resource availability. Although currently there is no foreseen shortage of uranium, subprogram R&D will help prove alternate sources of uranium exist, thereby helping to allay concerns of potential issues in the long term.
- Development of alternative long-term, economic supplies of uranium will improve the sustainability of nuclear power
- May ultimately increase the domestic supply of uranium and reduce the reliance on foreign suppliers.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Developed an independent cost and uncertainty analysis based on the reference Japanese seawater uranium extraction technology to identify initial high-return R&D activities. • Conducted a workshop to develop priority R&D focus areas for technology advancement. • Developed adsorbent materials with enhanced uranium adsorption capacity and selectivity.	3,592
FY 2012	• Complete sorption testing capabilities in synthetic seawater. • Select and prepare ligands designed for enhanced sorption capacity for seawater testing. • Complete marine testing laboratory contracts for seawater adsorbent materials evaluation. • Complete initial testing of candidate adsorbent materials at marine facilities.	3,607
FY 2013	• Select and prepare best adsorbent materials from grafting preparation method for marine testing. • Complete independent cost analysis report on the Japanese seawater uranium recovery technology. • Complete adsorbent materials for marine test to achieve initial double capacity recovery goal. • Test the leading candidate adsorbent (ligand and substrate combination) at marine laboratory facility to achieve initial goal to double world's best uranium adsorption capacity.	6,679

Spent Nuclear Fuel Analysis
Overview

This subprogram was initiated at the direction of Congress in FY 2012. The Department has work related to assessing issues related to the aging and safety of storing used fuel in the Used Nuclear Fuel Disposition subprogram. In FY 2012 this work will be expanded, to include experimentation, modeling, and simulation for dry storage casks, as well as for spent fuel pools, as necessary. This was a one-time infusion of funds. Related activities beyond FY 2012 will be funded within Used Nuclear Fuel Disposition.

Benefits

- Provide a sound technical basis for confidence in the safety and security of long-term storage and transportation of used nuclear fuel and wastes generated from the nuclear energy enterprise.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2012	• Expand the Department's capabilities for assessing issues related to the aging and safety of storing used fuel.	9,942

Nuclear Energy Enabling Technologies
Funding Profile by Subprogram and Activities

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Nuclear Energy Enabling Technologies			
Crosscutting Technology Development	28,370	35,899	26,167
Energy Innovation Hub for Modeling and Simulation	22,521	24,232	24,588
National Scientific User Facility	0	14,539	14,563
SBIR/STTR (non-add)	-	[2,203]	[1,992]
Total, Nuclear Energy Enabling Technologies	50,891	74,670	65,318

Public Law Authorizations

Public Law 112-10, "Department of Defense and Full-Year Continuing Appropriations Act, 2011
P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

The Nuclear Energy Enabling Technologies (NEET) program is designed to conduct research and development (R&D) in crosscutting technologies that directly support and enable the development of new and advanced reactor designs and fuel cycle technologies. These technologies will advance the state of nuclear technology, improving its competitiveness, and promoting continued contribution to meeting our Nation's energy and environmental challenges.

The R&D activities will address revolutionary improvements in safety, performance, reliability, economics, and proliferation risk reduction and promote creative solutions to the broad array of nuclear energy challenges related to reactor and fuel cycle development. The activities undertaken in this program complement those within the Reactor Concepts Research Development & Demonstration and Fuel Cycle R&D programs. The knowledge generated through these activities will allow Nuclear Energy (NE) to address key challenges affecting nuclear reactor and fuel cycle deployment (e.g., capital cost, technology risks, and proliferation concerns). Further, these activities will enable nuclear power to continue to be a key component of our energy portfolio and help to achieve energy security and greenhouse gas emission reduction objectives of the United States.

In maximizing the benefits of nuclear power, work must be done to address the broader nuclear energy challenges:

- Improving the affordability and efficiency of nuclear energy;
- Addressing the management of nuclear waste; and
- Minimizing proliferation risks of nuclear materials.

Subprogram Accomplishments and Milestones

In FY 2011 NEET achieved three significant accomplishments or milestones. These accomplishments are: (1) the opening of the Nuclear Energy Innovation Hub for Modeling and Simulation (Hub); (2) the public issuance of the AMP computer code for simulating the performance of nuclear fuel pins, and (3) the initial release of the Virtual Environment for Reactor Analysis.

In the current appropriation year, FY 2012, NEET is working towards the following key milestones:

Milestone	Date
Issue version 2.0 of the Virtual Environment for Reactor Analysis (VERA)	Jul 2012
Award competitive research projects on selected crosscutting nuclear concepts topics	Sep 2012
Issue Crosscutting Research Plans for reactor materials and advanced sensors and instrumentation areas	Sep 2012
Award National Science User Facility projects for irradiation and post-irradiation examination services	Sep 2012

Explanation of Changes

In FY 2013, the research within the crosscutting technologies was focused on the most critical elements as part of the reprioritization of the Department's nuclear research and development activities.

Program Planning and Management

The Program is investing in three areas: Crosscutting Technology Development, Energy Innovation Hub for Modeling and Simulation, and National Scientific User Facility to conduct crosscutting R&D research that will advance the state of nuclear technology improving its

competitiveness, and ensuring lasting contribution to meeting our Nation's energy and environmental challenges.

Crosscutting research will focus in advanced materials for developing fuel and reactor concepts, new instrumentation and sensor technologies, and includes the application of advanced modeling and simulation to support research and development in advanced fuels and advanced reactor systems.

The Hub is an investment in leading-edge modeling and simulation to improve the performance of currently operating Light Water Reactors.

National Scientific User Facility will support strategic partnerships to allow university and other researchers access to unique capabilities to advance cutting edge research in materials and nuclear fuels.

Strategic Management

In meeting the identified challenges to nuclear power, the Department will implement three key strategies to more efficiently and effectively manage the program, thus ensuring the productive use of taxpayers' dollars.

1. NE's R&D programs will partner with the private sector, national laboratories, and universities partners to develop advanced nuclear technologies.
2. Programs will also engage the international community in pursuit of advanced nuclear technologies that will benefit the United States with enhanced safety, improved economics, and reduced production of wastes.
3. Program sub-elements will competitively select research projects and cost share with industry.

In addition, NE designates up to 20 percent of funds appropriated to its R&D programs for Nuclear Energy University Programs (NEUP) scholarships, fellowships, infrastructure projects, and R&D to be performed at university and research institutions, through open, competitive solicitations. Three external factors present the strongest impacts to the overall achievement of the program's goals:

- Power demand and economic and environmental factors beyond the scope of Department of Energy (DOE) R&D programs, as well as complex economic decisions made by industrial partners;
- Industry's inclination to focus on near-term deployment using existing proven technologies. Industry may not readily support or be supportive of longer-term development of better technologies;
- Data collection for nuclear energy research programs relies in part on collaborations with foreign nations. Should vital data from foreign partners prove unavailable, an increased U.S. effort in technology development would be required.

Subprogram Goals and Funding

The NE R&D Roadmap lays out four goals that programs work toward in support of NE's mission and that guide program planning and execution. These goals provide a concrete framework for NE's activities and link to the Department's strategic priorities:

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable nuclear fuel cycles.
- Understand and minimize the risks of nuclear proliferation and terrorism.

The NEET program will invest in research and development that supports the NE Roadmap goals. The application of the Department's world leading expertise in super-computing to create significant advances in modeling and simulation for nuclear energy systems will result in better understanding of nuclear fuel performance, plant system safety margins, and improved reliability at both existing and future nuclear plants (Goals 1, 2, and 3), and the application of the National Laboratories capabilities to understand and improve common materials and instrumentation and controls issues for nuclear power will improve reliability and safety at existing and future plants (Goals 1 and 2).

Goal Areas by Activity

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4. Nonprolif-eration
Nuclear Energy Enabling Technologies				
Crosscutting Technology Development	30%	35%	30%	5%
Energy Innovation Hub for Modeling and Simulation	100%	0%	0%	0%
National Scientific User Facility	30%	35%	35%	0%
Subtotal, Nuclear Energy Enabling Technologies	58%	21%	19%	2%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Crosscutting Technology Development			
The decrease from $35,899,000 to $26,167,000 reflects no new investments in the areas of manufacturing methods and non-proliferation risk assessments due to reprioritization of the Office of Nuclear Energy's research and development activities.	35,899	26,167	-9,732
Energy Innovation Hub for Modeling and Simulation			
Increase reflects normal escalation to help the Hub remain on a path to create transformative capability in the modeling and simulation of operating light water reactors, which is a five year initiative with nominal funding of $25 million per year.	24,232	24,588	+356
National Scientific User Facility			
Increase reflects small escalation to maintain existing NSUF program scope.	14,539	14,563	+24
TOTAL Funding Change, Nuclear Energy Enabling Technologies	74,670	65,318	-9,352

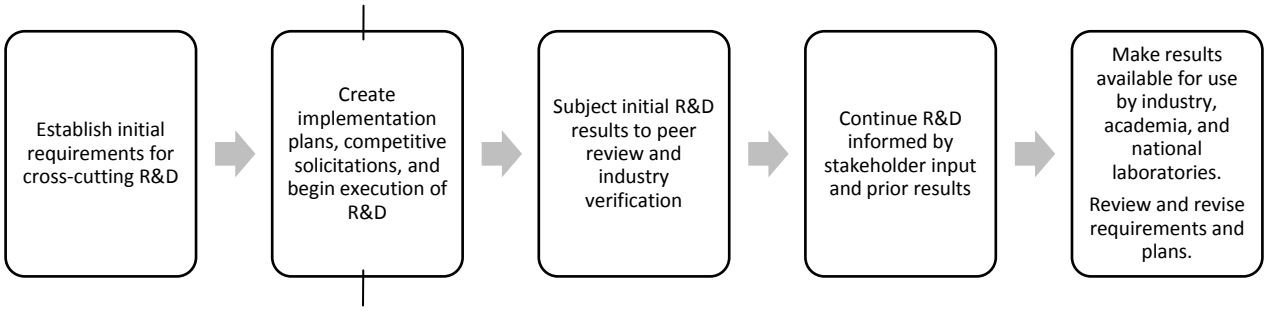
Crosscutting Technology Development
Overview

The Crosscutting Technology Development activity provides support relevant to both reactor and fuel cycle R&D programs. A balanced science-based R&D approach includes both performance enhancement of evolutionary concepts and investigation of novel concepts. The NEET program includes the following elements: (1) Reactor Materials (materials for nuclear applications); (2) Advanced Sensors and Instrumentation; (3) Advanced Modeling and Simulation; (4) Advanced Methods for Manufacturing; and (5) Proliferation and Terrorism Risk Assessment. Incorporating these technologies and capabilities as part of an integrated system offers the promise of revolutionary improvement in safety, performance, reliability, economics, and proliferation risk reduction.

In FY 2013, the funding activities will be in the first three elements: Reactor Materials, Advanced Sensors and Instrumentation, and Advanced Modeling and Simulation. Some of the research in the last two elements, Advanced Methods for Manufacturing and Proliferation Risk Assessment, will be funded through NEUP awards. An on-going National Academy study on Proliferation Risk Assessment is funded in Crosscutting Technology Development.

Sequence

Activities within the Crosscutting Technology Development subprogram will follow a stepwise process that includes feedbacks and a focus on efficiency and cost-effectiveness. All activities will be reviewed, revisited, and revised as necessary in the annual budget development and program planning processes.



Benefits

- Undertake high risk research to overcome current technological limitations.
- Examine new classes of materials not previously considered for nuclear applications.
- Provide models and methods used to predict system and component behaviors with fidelity and resolution well beyond those presently available.
- Orchestrates needed capabilities common across NE R&D programs.
- Delivers enabling technologies beyond individual programs.
- Creates new capabilities needed by the NE R&D enterprise.

Funding and Activity Schedule

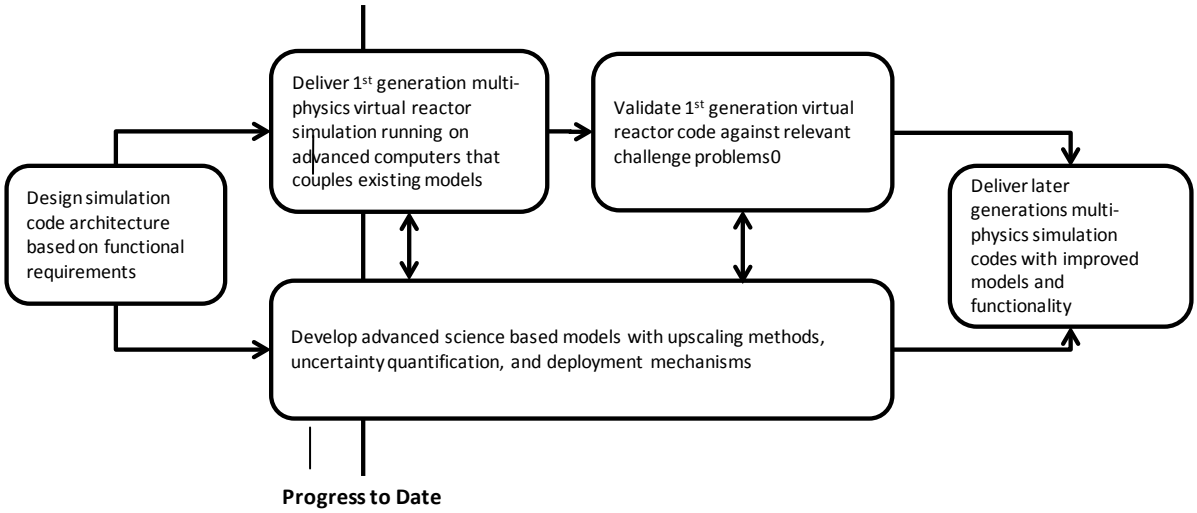
Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Refocused fuel code work to include Moose-Bison-Marmot as the primary fuel pellet-to-pin code and AMP for fuel pin-to-assembly modeling and released AMP 1.0 for internal use and evaluation. • Completed first version of parallel mesh generation tool, iMESH, to greatly speed up the process for setting up analytical models. • Completed the overall Software Quality Assurance Plan (SQAP 1.0) for all Nuclear Energy Modeling and Simulation (NEAMS) products. • Creation of a knowledge database called NE-KAMS. This data repository will be used for	28,370

Fiscal Year	Activity	Funding (Dollars in Thousands)
	rigorous Verification and Validation of the Integrated Performance and Safety Codes (IPSCs) and their physics and chemistry models.	
FY 2012	• Issue Funding Opportunity Announcement in Reactor Materials and Advanced Methods for Manufacturing and initiate selected projects. • Evaluate and prioritize needed modern materials science capabilities and begin procurement of those identified as highest priority. • Provide increases in control system performance and self-calibration capability through research on adaptive digital monitoring and control technology. • Improve and adapt fiber optic and wireless digital instrument communication systems for nuclear plants. • Initiate studies of current proliferation risk assessment methodologies (strengths, key components, scopes, applicability) to include: current methodologies in "prototype scenarios;" and effective coordination with other national security (including counter terrorism and game theory) methodologies and entities (DHS, DARPA, etc.). • Support the National Academy of Sciences study of Proliferation Risk Assessment methods, tools, and applications to develop recommendations for high priority research. • Release to the public advanced fuel pin and assembly computer codes (BISON and AMP 3.0). • Develop and validate different mesoscale modeling tools for predicting fission gas behavior in UO2 nuclear fuel. • Complete and start implementing SHARP-R7 Integration Plan.	35,899
FY 2013	• Issue a solicitation and fund up to six proposals to develop innovative materials in current and/or future reactors. • Coordinate and integrate materials development activities with modeling and simulation and reactor component and system development to optimize the performance with the service requirements. • Continue to acquire highest priority modern materials science capabilities. • Initiate research to identify dominant physical mechanisms limiting materials behavior in current and future nuclear applications. • Conduct research on advanced concepts of operation with special emphasis on advanced automation and information technologies specific to nuclear plant applications. • Continue research on advanced sensors to improve physical measurement accuracy and reduce uncertainty. • Complete a preliminary demonstration of the NEAMS integrated multi-physics reactor simulation capability. • Create improved irradiation performance models for oxide fuel. • Add the ability to simulate anticipated fuel rod transients for UO_2 -fueled LWRs using BISON/MARMOT.	26,167

Energy Innovation Hub for Modeling and Simulation
Overview

The Hub is creating a virtual reactor model of actual Tennessee Valley Authority-owned (TVA), Westinghouse-designed, operating pressurized water reactors (PWRs) that will be able to simulate reactor behavior. Engineers will be able to use this virtual model to improve the safety and economics of reactor operations by simulating proposed solutions to reactor power production increases and reactor life and license extensions. The combination of data gained from the virtual model and the physical reactor will be used to resolve technology issues confronting nuclear energy development. The Hub will also serve to educate today's reactor engineers in the use of advanced modeling and simulation through direct engagement in Hub activities. The Oak Ridge National Laboratory is leading a consortium (CASL – Consortium for Advanced Simulation of Light Water Reactors) of national labs, universities, and industry partners to manage Hub execution. CASL began operations in late June 2010.

Sequence



Benefits

Enable greater understanding of existing light water reactor performance and could:

- Contribute to significant power increases at existing light water reactors.
- Reduce the need for costly experimentation in fuel performance and safety.
- Provide tools with revolutionary resolution to industry, academia, and the national labs for further research into this and succeeding generations of light water reactors.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Apply 3D transport with Thermal Hydraulic (T-H) feedback and Computational Fluid Dynamics (CFD) with neutronics to isolate corrosion-related unidentified deposits (CRUD) vulnerable assembly and pin in pressurized light water reactor (PWR) full-core configuration; generate quantities relevant to CRUD initiation and growth • Apply full-core CFD model to calculate 3D localized flow distributions to identify transverse flow that could result in grid-rod fretting (GTRF). • Established key planning documents: QA, VERA validation plan, and challenge problem specifications.	22,521

Fiscal Year	Activity	Funding (Dollars in Thousands)
	• Released Version 1.0 of the CASL Virtual Reactor (VERA). • Completed design and construction of the CASL one-roof facility at ORNL	
FY 2012	• Issue Version 2.0 of VERA, the Virtual Environment for Reactor Analysis. • Model CRUD deposition and thickness based on best available industry and CASL capabilities. • Model interaction of fluid flow distribution with fuel rods to understand fuel rod vibration. • Initial modeling of peak clad temperature, oxidation, Departure from Nucleate Boiling (DNB), and fuel performance parameters during transients. • Initial modeling of reactor operation; qualify with operational data.	24,232
FY 2013	• Issue Version 3.0 of VERA, the Virtual Environment for Reactor Analysis. • Predict CRUD Induced Power Shift (CIPS) by calculating CRUD formation, boron uptake, and resulting axial power shape. • Calculate fuel rod material wear resulting from grid to rod fretting (GTRF). • Model reactor vessel fluence and material property changes that result in material degradation and limit vessel performance. • Model boron uptake from reactor coolant into CRUD on fuel rods. • Complete initial model of TVA PWR operation (Watts Bar1); qualify against operational data. • Complete initial safety challenge problem modeling: clad oxidation, departure from nucleate boiling, and loss of coolant accident fuel performance.	24,588

National Scientific User Facility
Overview

The National Scientific User Facility (NSUF) activity represents a "prototype laboratory for the future" since it promotes the use of unique nuclear research facilities for science-based experiments to encourage active university, industry, and laboratory collaboration in relevant nuclear scientific research. The NSUF, through competitive solicitations, provides a mechanism for research organizations to collaborate and conduct experiments and post-experiment analysis at facilities not normally accessible to these organizations. On an annual basis, researchers propose projects to be conducted at these unique facilities that may last from a few months to a few years. When projects are awarded, the NSUF program pays for experiment support and laboratory services at the user facilities. In this manner, researchers are introduced to new techniques, equipment, and personnel so that their research benefits from new technologies and experimental capabilities. The Idaho National Laboratory Advanced Test Reactor and post-irradiation examination (PIE) facilities of the Center for Advanced Energy Sciences and Materials and Fuels Complex are available as user facilities. In addition, research reactors at Oak Ridge National Laboratory, the Massachusetts Institute of Technology, and North Carolina State University, the Advanced Photon Source beam line capabilities at the Illinois Institute of Technology, and examination facilities at the Universities of Wisconsin, Michigan, California-Berkeley, and Nevada-Las Vegas are partnered with the NSUF bringing additional user facilities to the research community.

Benefits

The program helps further nuclear science and engineering research by:

- Providing universities and their partners access to world-class, unique research facilities and equipment.
- Supporting DOE-NE research and development mission.
- Training a new generation of nuclear scientists and researchers.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• National Scientific User Facility was funded under the Idaho Facilities Management Program in FY 2011	0
FY 2012	• Continue work on up to 5 previously awarded multi-year irradiation and/or PIE projects; • Award up to 3 new long-term and up to 5 rapid turnaround irradiation and PIE projects. • Conduct NSUF Users Week to provide technical materials-related training and instruct potential users how to design meaningful projects and use equipment. • Increase partnerships to provide user access to UC-Berkeley PIE capabilities and Oak Ridge National Laboratory's (ORNL) High Isotope Flux Reactor's irradiation capabilities.	14,539
FY 2013	• Continue work on up to 5 previously awarded multi-year irradiation and/or PIE projects; • Award up to 3 new long-term and up to 5 rapid turnaround irradiation and PIE projects. • Conduct NSUF Users Week to provide technical materials-related training and instruct potential users how to design meaningful projects and use equipment. • Increase partnerships with other nuclear research facilities to provide unique capabilities to users of the NSUF.	14,563

Radiological Facilities Management
Funding Profile by Subprogram and Activities

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Radiological Facilities Management			
Space and Defense Infrastructure	46,906	64,524	46,000
Research Reactor Infrastructure	4,809	4,986	5,000
Total, Radiological Facilities Management	51,715	69,510	51,000

Public Law Authorizations

P.L. 112-10, Department of Defense and Full-Year Continuing Appropriations Act, 2011

P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

The Radiological Facilities Management (RFM) program maintains Office of Nuclear Energy (NE) managed nuclear facilities at the Idaho National Laboratory (INL), provides support to nuclear and associated support facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), and Sandia National Laboratories (SNL), and provides fresh reactor fuel to and removes used fuel from 26 operating university reactors. The RFM program ensures that the United States' radioisotope power systems (RPS) capabilities are maintained and operated in a safe, environmentally-compliant, and cost-effective manner. Facilities and expertise related to RPS for national security and space exploration missions are maintained through the Space and Defense Infrastructure subprogram. In that subprogram there are four critical functions that the Department of Energy (DOE) maintains; fabrication of safety critical hardware, Pu-238 fuel processing and encapsulation, RPS assembly and testing, and safety analysis. The Research Reactor Infrastructure (RRI) subprogram supports the continued operation of U.S. research reactors by providing research reactor fuel services and maintenance of fuel fabrication equipment.

Subprogram Accomplishments and Milestones

In FY 2011, RFM achieved three significant accomplishments or milestones in program management and/or program development. Such accomplishments include: 1) initiated fuel production at LANL for a NASA Discovery 12 mission, the first planned use of an Advanced Stirling Radioisotope Generator; 2) initiated installation of a multi-purpose glovebox at INL; and 3) Completed shipments of fresh and used nuclear fuel to meet the RRI university program needs.

In the current appropriation year, FY 2012, RFM is working towards the following key milestones:

Milestone	Date
Enable launch of the Mars Science Laboratory mission	Nov 2011
Complete commissioning of a five-ton crane for shipping cask disassembly and training at INL	Jun 2012
Complete the transition of plutonium chemical analysis capabilities at LANL from the Chemistry and Metallurgy Research Building to Pu-238 processing facility at Technical Area-55 (TA-55)	Sep 2012
Complete upgrades to atmospheric control systems in two gloveboxes at INL	Sep 2012
Fabricate and ship fuel elements to the University of Missouri Research Reactor (MURR) and to the Massachusetts Institute of Technology (MIT) Nuclear Research Reactor	Sep 2012
Complete used fuel shipments from MURR and to MIT to the Savannah River Site	Sep 2012

Explanation of Changes

The Department requests $51 million in FY 2013 for RFM, which is a 27% reduction from the current FY 2012 level. The majority of this reduction reflects the completion of Congressionally directed funding for Oak Ridge nuclear infrastructure in FY 2012 in the amount of $15 million. The reduction also reflects cancellation of subprogram elements in Space and Defense Infrastructure related to safety testing and analysis.

Program Planning and Management

NE conducts various internal and external reviews and audits to validate and verify program performance. Periodic RFM program reviews evaluate progress against established plans. NE holds monthly, quarterly, semi-annual, and annual reviews, consistent with program management plans and project baselines, to ensure technical progress, cost, and schedule adherence, and responsiveness to program requirements. Internally, NE provides continual management and oversight of its programs.

For the RFM program, the Department's Office of Health, Safety and Security (HSS) provide an important independent oversight role for DOE through a range of approaches. These approaches include inspections, targeted reviews, collaborative reviews, and assist visits to assess safety related activities. HSS provides the results of their evaluation to Departmental leadership and other stakeholders. The results from these assessments provide a critical evaluation of the adequacy of safety-related policies and the effectiveness of their implementation at DOE facilities.

Strategic Management

The program will use various means and strategies to achieve its strategic goals. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals.

The Department will implement the following strategies:

- Maintain the unique infrastructure and capability to deliver RPS for space science and exploration missions and national security applications as needed.
- Aggressively implement contracting reforms, including fixed price competitive bidding, earned value management, capital planning processes in accordance with DOE Order 413.3B, independent external evaluations, etc., to ensure that the infrastructure program is operating effectively and efficiently to meet the Department's highest priority program needs.

These strategies will contribute to the efficient and effective management of the program, thus putting the taxpayers' dollars to more productive use.

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

- Program infrastructure activities are interrelated with customer-defined, i.e., NASA and national security agencies, requirements for the development of radioisotope power systems. Changes in long-term projected demands for radioisotope power systems would impact NE's provision of infrastructure and development support, including activities associated with restarting domestic Pu-238 production.

Subprogram Goals and Funding

The primary mission of NE is to advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration as appropriate.

The NE R&D Roadmap lays out four goals that programs work toward in support of NE's mission and that guide program planning and execution. These goals provide a concrete framework for NE's activities and link to the Department's strategic priorities:

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable nuclear fuel cycles
- Understand and minimize the risks of nuclear proliferation and terrorism.

In addition to goals associated with NE's primary mission, the Office performs several mission-related functions including providing:

- The capability to develop and furnish nuclear power systems for use in national security and space exploration missions
- Nuclear fuel services to U.S. research reactors.

Goal Areas by Subprogram

	1. Extend Life of Current Reactors	2. Enable New Plants	3. Sustainable Nuclear Fuel Cycles	4. Nonprolif-eration
Radiological Facilities Management				
Space and Defense Infrastructure	0%	50%	0%	50%
Research Reactor Infrastructure	25%	25%	25%	25%
Subtotal, Radiological Facilities Management	3%	47%	3%	47%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2012 Enacted
Space and Defense Infrastructure			
The reduction reflects the completion of Congressionally directed funding for Oak Ridge nuclear infrastructure in FY 2012. The reduction also reflects cancellation of subprogram elements related to safety testing and analysis.	64,524	46,000	-18,524
Research Reactor Infrastructure			
There are no significant changes to the RRI subprogram in FY 2013.	4,986	5,000	+14
TOTAL Funding Change, Radiological Facilities Management	69,510	51,000	-18,510

Space and Defense Infrastructure
Funding Profile by Activity

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Space and Defense Infrastructure			
Idaho National Laboratory	9,960	9,500	10,000
Los Alamos National Laboratory	26,965	27,000	27,000
Oak Ridge National Laboratory	4,960	19,332	4,600
Safety and Program Analysis	5,021	8,692	4,400
Total, Space and Defense Infrastructure	46,906	64,524	46,000

Overview

The Space and Defense Infrastructure program maintains the infrastructure and capabilities to provide radioisotope power systems for space exploration missions and national security applications as needed. The Department maintains capabilities at the Idaho National Laboratory, Oak Ridge National Laboratory, Los Alamos National Laboratory and Sandia National Laboratories needed to produce these systems. Because this program maintains capabilities to support production operations, it is a system that relies on the full range of functions in order to complete its mission.

The Pu-238 based RPS is needed for certain NASA and national security applications where other power sources, such as batteries, fuel cells, and solar technologies, are not economical or technologically viable. They enable NASA space science and exploration missions that lead to major discoveries and open greater possibilities and opportunities to achieve the nation's space exploration goals.

DOE maintains the infrastructure to develop, manufacture and deliver RPS and assess their safety pursuant to a number of laws and directives. The Atomic Energy Act, as amended, assigns to DOE the authority to provide systems that utilize special nuclear material to other Federal agencies. DOE retains title to systems provided to NASA and provides nuclear safety assurance. The National Space Policy directs DOE to maintain the capability and infrastructure to develop and furnish space nuclear power systems for Federal users. Presidential Directive/National Security Council Memorandum 25 (PD/NSC-25) directs DOE to perform the nuclear safety analysis in support of nuclear launch approval.

In addition to the funding requested by the DOE, NASA and national security agencies provide project-specific reimbursable funding for RPS, reactor design and demonstration, material purchases, and launch approval safety activities. The level of reimbursable funding varies from year to year based on build schedules required to support a specific NASA mission or national security application. DOE initiated project planning and technology development activities in FY 2012 on reestablishing a domestic plutonium-238 production supply with reimbursable funding from NASA.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Idaho National Laboratory			
Increase allows upgrade of environmental control system for power system assembly glovebox.	9,500	10,000	+500
Los Alamos National Laboratory			
There are no significant changes.	27,000	27,000	0

Oak Ridge National Laboratory			
The majority of the difference reflects the completion of Congressionally directed funding for Oak Ridge nuclear infrastructure in FY 2012.	19,332	4,600	-14,732
Safety and Program Analysis			
Reflects reduced safety testing and orbit debris analysis.	8,692	4,400	-4,292
TOTAL Funding Change, Space and Defense Infrastructure	64,524	46,000	-18,524

Idaho National Laboratory
Overview

The RPS Program at the INL is responsible for the (1) assembly, (2) testing, (3) storage, and (4) transportation of Radioisotope Thermoelectric Generators (RTGs) of various designs for the NASA space exploration program and National Security.

The facilities are housed in three main buildings. These three buildings house 30 major pieces of equipment and four complex gloveboxes. The facilities occupy approximately 25,000 square feet. The contractor staff is made up of 40 Full Time Equivalents (FTE) with additional resources being provided on a project specific basis as needed.

Space and Security Power Systems Facility (SSPSF). RPS fueling, final assembly, and testing and measurement operations are conducted in the SSPSF which is located on the Material and Fuels Complex campus.

Engineering Development Laboratory (EDL). Facility conducts various non-radiological operations and provides a variety of support functions. The EDL is used to fabricate, assemble, mockup, and test various research, development, and production equipment. The majority of work conducted in EDL is for the RPS Program. The facility includes equipment and glove boxes for welding, including an electron-beam welder, furnaces for bake-out of graphite components, forming equipment for heat source hardware, and various machine tools.

Radioisotope Systems Training and Servicing Facility. Radioisotope Thermo-electric Generator Transportation System which moves the RTGs to user sites and two types of shipping containers are stored in this facility. The facility also provides a training area for these systems.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Maintain capabilities for RPS integration, assembly, testing and delivery and component manufacturing. Store and maintain the flight quality status of the RPS for the NASA Mars Science Laboratory mission. Support capital equipment used in RPS assembly activities, including installation of a multi-purpose glove box for system assembly.	9,960
FY 2012	Support launch of the Mars Science Laboratory mission through the use of NE and NNSA for contingency support and emergency planning expertise, personnel, and equipment. Maintain capabilities for RPS integration, assembly, testing and delivery and component manufacturing. Complete commissioning of a five-ton crane for shipping cask disassembly and training at INL. Upgrade environmental control in two hardware preparation gloveboxes.	9,500
FY 2013	Maintain capabilities for RPS integration, assembly, testing and delivery and component manufacturing. Commission and upgrade environmental controls for multi-purpose glove box and upgrade environmental controls for the inert atmosphere assembly glovebox.	10,000

The Pu-238 processing facility is located within Plutonium Facility-4 (PF-4) within TA-55 at LANL. The facility occupies 12,000 ft^2 within PF-4. Equipment includes 78 glove boxes and 61 pieces of special equipment. A contractor staff of 57 FTEs including supervisors, operators, and technicians is required to maintain the capabilities of the Pu-238 facility in PF-4 in a ready for production status. In addition, approximately 40 FTEs provide infrastructure support services from Los Alamos National Laboratory (LANL). The basic facility staff required for maintaining capability and the associated infrastructure support from LANL are funded by the NE Office of Space and Defense Power Systems. User agencies fund the additional staffing, materials, and equipment required to produce power systems for each mission.

Gloveboxes and Pu-238 Processing: All processing of Pu-238 must be conducted in tightly sealed gloveboxes maintained under negative pressure to ensure no leaks of material into the work spaces. Special precautions and controls are required to ensure operators are not exposed to Pu-238 or radiation in the fuel from radioactive isotopes embedded as impurities in the fuel or activated by Pu-238 decay. Due to the unique invasive properties of Pu-238 in its powdered form, which can cause significant equipment deterioration problems, continuous servicing and maintenance on the gloveboxes and equipment is required, even between production campaigns.

Isotope Fuels Impact Tester (IFIT): The DOE must ensure flight safety for fueled clads and advise the White House on Launch safety issues. In order to test fueled clad integrity under launch or re-entry accident conditions and provide data necessary for safety analyses, a fueled clad impact testing program is maintained at the LANL facility. In order to accomplish a comprehensive safety testing program a complex and highly sophisticated testing capability designated the IFIT is operated and maintained at the LANL facility. Fueled clads are impacted under precisely known conditions replicating a launch/re-entry accident and then subjected to analysis to assess shell and weld integrity and containment of the Pu-238 fuel.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Maintain and operate dedicated Pu-238 processing, encapsulation, and scrap recovery facilities. Initiate transition of chemical analysis capabilities from the Chemistry and Metallurgy Research Building to Pu-238 processing facility at TA-55. Update procedures for major processing operations and initiate a production readiness review. Initiate fuel production campaign for NASA Discovery 12 mission.	26,965
FY 2012	Maintain and operate dedicated Pu-238 processing, encapsulation, and scrap recovery facilities. Continue transition of chemical analysis capabilities from the Chemistry and Metallurgy Research Building to Pu-238 processing facility at TA-55. Upgrade hot press power supply for pellet manufacturing process. Continue fuel production campaign for NASA Discovery 12 mission.	27,000
FY 2013	Maintain and operate dedicated Pu-238 processing, encapsulation, and scrap recovery facilities. Complete transition of chemical analysis capabilities from the Chemistry and Metallurgy Research Building to Pu-238 processing facility at TA-55. Complete fuel production campaign for NASA Discovery 12 mission.	27,000

Oak Ridge National Laboratory
Overview

ORNL is the lead materials development laboratory for the Space and Defense Power Systems program. Unique facilities, equipment, and trained personnel provide:

- Development, testing, welding, and characterization of materials for high temperature heat source applications,
- Expertise in iridium alloys, which is a national asset,
- Refractory and other high temperature metal/materials compatibility and mechanical properties testing (tensile, creep, pressure burst), and
- Expertise in carbon bonded carbon fiber (CBCF) insulator production, which is a unique capability.

ORNL is responsible for the production of two safety critical pieces of hardware for the Space and Defense program:

Iridium Alloy Fueled Clad Vent Set Production. In order to maximize efficiency, the Pu-238 fueled clads must be maintained at a very high temperature. ORNL has developed two alloys of iridium that provide the required safety and performance characteristics. ORNL produces the special iridium alloy metal containment for the Pu-238 fuel pellets that are manufactured at LANL. The containment is used at LANL to make Pu-238 heat sources called fueled clads for the thermoelectric power units assembled at the INL.

Manufacture of Carbon Bonded Carbon Fiber Insulation. The CBCF insulation sleeves are produced at ORNL. The insulators are used in the assembly of heat source modules at INL and are critical to the modules safe operation. The insulator helps protect the fueled clads during potential accidents by reducing temperature spikes that could damage the containment system.

The ORNL production facilities are housed in three Buildings on the ORNL. Within these three buildings, the manufacturing facilities are comprised of 60 pieces of equipment occupying a total of 13,500 square feet. The contractor staff is made up of 11 FTEs directly charged to the program and an additional approximately 10 FTEs charged under indirect charges.

In addition to these activities, Congress provided additional funds for nuclear infrastructure at Oak Ridge National Laboratory in FY 2012. The funds supported maintenance and refurbishment of ORNL nuclear and materials engineering facilities such as the Radiochemical Engineering and Development Center, which plays a role in heavy-element research.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Maintains infrastructure and capabilities to fabricate iridium fuel encapsulation hardware, carbon thermal insulation sleeves used in the re-entry protection system; and materials control, quality control, quality inspection, and documentation. Upgraded vacuum molding system for a carbon component manufacturing process. Modified controller for an electron beam welding furnace.	4,960
FY 2012	Maintain infrastructure and capabilities to fabricate iridium fuel encapsulation hardware, carbon thermal insulation sleeves used in the re-entry protection system; and materials control, quality control, quality inspection, and documentation. Replaced an electrical discharge machine for forming iridium hardware components. Complete procurement for iridium hardware furnace. Also provides Congressional directed funds to maintain and refurbish ORNL nuclear infrastructure for the Department's nuclear research and development missions. Funds support activities such as equipment and building maintenance; end-of-life replacement of nuclear safety and facility support components and systems; and safety/environmental documentation updates.	19,332
FY 2013	Maintain infrastructure and capabilities to fabricate iridium fuel encapsulation hardware, carbon thermal insulation sleeves used in the re-entry protection system; and materials control, quality control, quality inspection, and documentation.	4,600

Safety and Program Analysis
Overview

The Safety and Program Analysis function maintains the capability to prepare nuclear risk assessments and safety analyses, and to conduct testing to assist in evaluating the safety and performance of NASA and national security missions. For NASA missions, the safety analysis supports the Presidential launch approval process. In addition, it maintains access to a cadre of experts to provide independent technical evaluations of system designs and technical and safety performance. Sandia National Laboratories is the laboratory lead for safety analysis capabilities, including: probabilistic risk analysis (PRA), accident scenarios and probabilities, accident environments, nuclear hardware response modeling, mechanical impact environments, solid propellant fire environments, reentry environments, source terms, radiological consequence analysis, atmospheric transport and dispersion modeling, exposure pathway modeling, technical feasibility analysis, materials analysis, thermal analysis. Physical safety testing of hardware and components are conducted to ensure that hardware response models are updated to reflect the most current understanding of potential accident environments.

National Environmental Policy Act support to NASA on Nuclear Systems
Formal process to evaluate the potential environmental impacts of proposed Federal actions, involving the preparation of Environmental Impact Statements by the lead Federal agency, public review and a Record of Decision by the agency

L**aunch Approval Process—Presidential Directive/National Security Council Memorandum 25 (PD/NSC-25)**
Establishes an ad hoc Independent Nuclear Safety Review Panel for each mission tasked to prepare a safety evaluation. Requires sponsoring agency to request President's approval for flight. DOE prepares the detailed safety assessment for the risks associated with an accident involving a nuclear power system.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Continue maintaining the required analytical and testing capabilities that enables the Department to analyze RPS performance and safety for various applications and maintain certification of shipping system. These capabilities are required to meet the presidential launch approval process required under the Presidential Directive/National Security Council-25 (PD/NSC-25).	5,021
FY 2012	Continue maintaining the required analytical and testing capabilities that enables the Department to analyze RPS performance and safety for various applications and maintain certification of shipping system. These capabilities are required to meet the presidential launch approval process required under the Presidential Directive/National Security. Initiate limited activities to increase the understanding of the safety of DOE hardware under the changing and challenging conditions of new launch environments to support the launch approval process. Changes to be evaluated include: new launch vehicles, upper stages, and rocket fuel environments; a new general purpose heat source (GPHS) design; new RPS configurations and temperature regimes; and new spacecraft integration configurations (heat shields). In parallel, plan for reduced safety analysis and independent technical assessment capabilities.	8,692
FY 2013	Maintain safety analysis and independent technical assessment capability. Terminate safety testing activities and orbit debris analysis capability.	4,400

Research Reactor Infrastructure
Funding Profile by Subprogram and Activity

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Research Reactor Infrastructure			
Idaho National Laboratory	4,809	4,986	5,000
Total, Reactor Research Infrastructure	4,809	4,986	5,000

Public Law Authorizations

P.L. 112-10, Department of Defense and Full-Year Continuing Appropriations Act, 2011
P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

The Research Reactor Infrastructure (RRI) program provides fresh reactor fuel to and removes used fuel from 26 operating university reactors thus supporting the continued operation of university research reactors. This in turn provides continued test reactor capability to universities, coupled with research, development, and educational opportunities in support of U.S. nuclear energy initiatives.

The continued operation of university research reactors plays an important role in developing future scientists and engineers in the United States. This program sustains unique capabilities for research and development and educational opportunities supporting U.S. energy initiatives. Used fuel shipments support U.S. and DOE non-proliferation and national security objectives.

Subprogram Accomplishments

In the prior appropriation year, FY 2011, the RRI program achieved three significant accomplishments or milestones in program management and/or program development. Such accomplishments include: 1) fabricated and shipped fresh fuel elements meeting RRI university program needs; 2) completed shipments of used nuclear fuel to meet the RRI university program need, and 3) procured uranium metal and fabricated fuel powder.

In the current appropriation year, the Research Reactor Infrastructure program is working towards the following key milestones:

Milestone	Date
Fabricate and ship fuel elements to MURR and to MIT	Sep 2012
Complete used fuel shipments from MURR and MITR to the Savannah River Site	Sep 2012
Fabricate and ship new TRIGA fuel elements to multiple research reactors	Sep 2012
Procure uranium metal, perform receipt inspection and fabricate two lots of fuel powder	Sep 2012

Explanation of Changes

There are no significant changes for this program in FY 2013.

Strategic Management

The RRI program will use various means and strategies to achieve its goal:

- Fresh reactor fuel will be provided to U.S. Universities at no or low cost to the University.
- The title of the fuel remains with the U.S. government and when the universities are finished with the fuel, the fuel is returned to the U.S. government used fuel storage facilities at INL and the Savannah River Site.
- The highest priority is to fabricate fuel for reactor facilities that have recurring fuel needs on an annual basis.
- These reactor facilities are required to ship used fuel on an annual basis so as to keep inventory levels below limits established by the NRC and associated states.

Factors that could impede performance or achievement of the strategic goal include:

1. Vendor's ability to continue the fabrication of plate type and TRIGA fuel elements..
2. Availability of uranium and aluminum feedstock.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Research Reactor Infrastructure			
There are no significant changes to the RRI subprogram in FY 2013.	4,986	5,000	+14
TOTAL Funding Change, Research Reactor Infrastructure	4,986	5,000	+14

Research Reactor Infrastructure
Overview

This activity provides fresh reactor fuel to and removes used fuel from 26 operating university reactors. It supports the continued operation of U.S. research reactors by providing research reactor fuel services and maintenance of fuel fabrication equipment.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Fabricate and ship 62 fuel elements. Complete 4 used fuel shipments. Procure uranium metal, perform receipt inspection, and fabricate 3 lots of highly enriched uranium fuel powder.	4,809
FY 2012	Fabricate and ship approximately 46 fuel elements. Complete approximately 4 used fuel shipments. Procure uranium metal, perform receipt inspection, and fabricate 2 lots of highly enriched uranium fuel powder and 2 lots of low enriched uranium fuel powder.	4,986
FY 2013	Fabricate and ship approximately 42 fuel elements. Complete approximately 5 used fuel shipments. Procure uranium metal, perform receipt inspection, and fabricate 2 lots of highly enriched uranium fuel powder.	5,000

Idaho Facilities Management
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Idaho Facilities Management			
INL Nuclear Research Reactor Operations and Maintenance	75,248	67,599	67,858
INL Non-Reactor Nuclear Research Facility Operations and Maintenance	59,866	57,879	55,394
INL Engineering and Support Facility Operations and Maintenance	12,448	10,015	10,015
National Scientific User Facility (NSUF)	6,301	0	0
INL Regulatory Compliance	7,490	14,673	10,453
INL Facility Infrastructure Revitalization Program (IFIRP)	22,251	0	0
Advanced Post Irradiation Examination (PIE) Capabilities	0	3,931	500
Construction	0	0	7,780
Total, Idaho Facilities Management	183,604	154,097	152,000

Public Law Authorizations

P.L. 112-10, Department of Defense and Full-Year Continuing Appropriations Act, 2011

P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

The mission of the Idaho Facilities Management (IFM) program is to manage the planning, acquisition, operation, maintenance, and disposition of the Office of Nuclear Energy (NE)-owned facilities and capabilities at the Idaho National Laboratory (INL). The IFM program maintains Department of Energy (DOE) mission-supporting facilities and capabilities at INL in a safe, compliant status to support the Department's nuclear energy research, testing of naval reactor fuels and reactor core components, and range of national security technology programs that support the National Nuclear Security Administration (NNSA) and other Federal agencies such as the Department of Homeland Security in the areas of critical infrastructure protection and nuclear nonproliferation.

The IFM program enables long-term nuclear research and development (R&D) activities by providing the people, facilities, equipment, and nuclear materials necessary to conduct a wide array of experimental activities in a safe and compliant manner. The Advanced Test Reactor (ATR) provides unique irradiation capability to further nuclear fuel and reactor component research in support of advanced nuclear reactor design activities. The Materials and Fuels Complex (MFC) contains a comprehensive range of fuel and experiment fabrication, and pre- and post-irradiation examinations to assess material and fuel characteristics and performance in varying reactor environments. The Un-irradiated Fuel Storage Building (CPP-651) and several of the surrounding buildings, all within the Idaho Nuclear Technology and Engineering Center (INTEC), are used for relocation of Low-Enriched Uranium disposition product from the sodium-bonded spent nuclear fuel campaign. The Research and Education Campus is home to a range of research capabilities and facilities supporting research in nuclear energy as well as National and Homeland Security (N&HS) and energy and the environment.

Benefits

Through the IFM program, NE provides the funding and oversight needed not only to maintain Idaho facilities and infrastructure research assets, but also to ensure their safe and environmentally compliant operation.

- The primary reactor at INL, the ATR, provides a unique irradiation capability to further nuclear fuel and reactor component research in support of advanced nuclear reactor design activities. ATR supports the majority of NE R&D programs as well as NNSA programs, including Naval Reactors Program work in support of the U.S. Navy nuclear fleet and Global Threat Reduction Initiative to support conversion of research and test reactors to low-enriched uranium fuel. The ATR also supports universities and industry users. IFM also maintains and operates the ATR Critical Facility at ATR Complex and the Neutron Radiography Reactor at MFC as well as sustains the Transient Reactor Experiment and Test Facility (TREAT) in a stand-by condition.

- MFC supports important national goals. Its facilities are required for advanced nuclear energy technology R&D and other initiatives and support mission critical R&D capabilities in support of the NE roadmap. Special Nuclear Materials (SNM) management provides support for acquisition strategies and disposition of materials needed to support R&D and other N&HS missions.
- Engineering and support operations enable sound real property management by implementing a life-cycle approach for all facilities at INL. Included in this area are activities to identify and implement energy-saving principles to reduce cost and improve efficiency.
- INL regulatory compliance reduces liabilities and meets waste treatment and disposal obligations with the State of Idaho; avoiding high penalties if agreed upon deadlines are not met. Adequate management of waste will result in steady or reduced life cycle costs and the avoidance of compliance issues in the future. Management, stabilization, and treatment of used nuclear fuel are also conducted in support of agreements with the State of Idaho.

To maximize benefits, the program will work in FY 2013 to address the following challenges:

1. Balancing ATR & MFC maintenance needs with increasing customer utilization requests.
2. Identifying disposition paths for NE-owned nuclear materials
   - Lack of disposition paths for some materials requires additional option studies to determine the most optimum solution, extending storage costs.
   - Large inventories impact long-term operational goals to open up INL for broader research base.
3. Initiating line-item construction project capabilities in FY 2013 for the first time in 7 years requires additional efforts to ensure effective management.

Subprogram Accomplishments & Milestones

In the prior appropriation year (FY 2011), IFM achieved significant accomplishments or milestones in program management and/or program development. Such accomplishments include:

- Obtained Critical Decision (CD)-0, Approve Mission Need, for the Advanced Post Irradiation Examination (PIE) Capabilities Project;
- Obtained CD-0 for the Transient Testing Capability Project;
- Completed first Hydraulic Shuttle Irradiation System experiment at the Advanced Test Reactor (ATR);
- Surpassed 1 metric ton threshold of dispositioned enriched uranium product;
- Obtained CD-1, Approve Alternative Selection and Cost Range, for the RHLLW Disposal Project;
- Completed the Radiological and Environmental Sciences Laboratory Replacement Project, supporting sustainability goals by relocating missions from an antiquated facility to a new, energy efficient location; and
- Completed the INL Facility Infrastructure Revitalization Program (IFIRP) by obtaining an Asset Condition Index of greater than 95%.

In the current appropriation year (FY 2012), IFM is working towards the following key milestones:

Milestone	Date
Issue Environmental Assessment and Finding of No Significant Impact for the RHLLW Disposal Project	Dec 2011
Initiate the Advanced PIE Capabilities Project alternatives assessment	Feb 2012
Develop documentation and conduct independent cost review to support CD-2, Approve Performance Baseline, and CD-3, Approve Start of Construction, for the RHLLW Disposal Project	Aug 2012
Support over 45 irradiation campaigns at the ATR	Sep 2012
Complete transient fuel testing resumption capabilities alternatives analysis	Sep 2012
Complete general plant project construction activities for the Irradiated Materials Characterization Laboratory	Sep 2012
Treat approximately 65kgs of Experimental Breeder Reactor (EBR)-II sodium bonded driver fuel	Sep 2012
Complete MFC Dial Room Replacement project	Sep 2012
Issue Energy Savings Performance Contract (ESPC) for the ATR Complex	Sep 2012

Milestone	Date
Treat approximately two cubic meters of sodium-contaminated low-level waste backlog	Sep 2012
Complete approximately 2-3 off-site shipments of surplus uranium and plutonium	Sep 2012

Explanation of Changes

The Department requests $152 million in FY 2013 for IFM, which is a 1.3 percent decrease from the current FY 2012 level.

Program Planning and Management

NE's R&D Roadmap describes essential research and development programs that require unique nuclear and radiological capabilities. These facilities are difficult and expensive to build and operate, are not commercially available, and are becoming increasingly scarce in the United States and internationally. Although primarily supporting NE activities, other DOE programs, Federal agencies, and commercial entities rely upon these INL capabilities to accomplish their work. By nature, such nuclear facilities have complex regulatory and operating requirements. IFM assures that these capabilities are available and will remain available and relevant to NE mission needs consistent with the NE Roadmap and implementing strategies.

Strategic Management

The program will use various means and strategies to achieve its GRPA Unit Program Goal. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals. The Department will implement the following means:

- Aggressively implement contracting reforms, including fixed price competitive bidding, earned value management, capital planning processes in accordance with DOE Order 413.3B, independent external evaluations, etc., to ensure that the infrastructure program is operating effectively and efficiently to meet the Department's highest priority program needs.
- Ensure that mission essential systems, resources, and services are identified, maintained, and operated in compliance with DOE, Federal, and state safety and environmental requirements in a secure and cost-effective manner.

The Department will implement the following strategies:

1. Identify IFM mission critical facilities and activities through various means, including review of the INL Ten-Year Site Plan and other relevant materials. Develop detailed work planning and funding requests accordingly.
2. Continue maintenance improvement program to clarify priority facilities and reduce deferred maintenance.
3. Continued integration of energy efficiency, petroleum reduction, high performance sustainable building, renewable energy and overall sustainability program planning in all aspects of Idaho facility management.

These strategies will contribute to the efficient and effective management of the program, thus putting the taxpayers' dollars to more productive use.

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

- As the IFM program seeks to improve the responsiveness and support provided to a wide range of R&D and national security programs, changes in nuclear energy R&D progress and priorities could impact priorities within the IFM program, but not necessarily impact its overall cost and long-term liabilities.
- Lack of disposition paths for some SNM and waste may present challenges to certain future R&D.

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

INL carries out a variety of experiment design, fabrication, irradiation, and post-irradiation work in support of the NNSA, Naval Reactors, universities, partnerships with international governments and industry organizations.

Subprogram Goals and Funding

NE R&D programs require certain key infrastructure to support R&D activities. NE successfully employs a solid approach to maintaining such infrastructure. The approach concentrates the high-risk nuclear facilities at the remote Idaho site, maintains unique capabilities at other sites if required, supports vital university infrastructure, negotiates equitable capability exchanges with trusted international partners, refurbishes and re-equips essential facilities if required, addresses maintenance backlogs to ensure safe operation, and makes efficient use of modeling, simulation, and single-effect experiments.

The NE R&D Roadmap states four goals that the R&D programs support to meet NE's mission and that guide program planning and execution. These goals provide a concrete framework for NE's activities and link to the Department's strategic priorities.

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable nuclear fuel cycles.
- Understand and minimize the risks of nuclear proliferation and terrorism.

Those four goals are further supported indirectly by the IFM program through the creation and maintenance of the physical infrastructure necessary for conducting nuclear R&D activities.

Goal Areas by Activities

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4.Non-proliferation
Idaho Facilities Management				
INL Nuclear Research Reactor Ops & Maint.	25%	25%	25%	25%
INL Non-Reactor Nuclear Research Facility Ops & Maint.	25%	25%	25%	25%
INL Engineering and Support Facility Ops & Maint.	25%	25%	25%	25%
National Scientific User Facility	25%	25%	25%	25%
INL Regulatory Compliance	25%	25%	25%	25%
INL Facility Infrastructure Revitalization Program	25%	25%	25%	25%
Advanced PIE Capabilities	25%	25%	25%	25%
Construction	25%	25%	25%	25%
Subtotal, Idaho Facilities Management	25%	25%	25%	25%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
INL Nuclear Research Reactor Operations and Maintenance			
The increase from $67,599,000 to $67,858,000 reflects funds required to support INL reactor activities at planned FY 2013 levels.	67,599	67,858	+259
INL Non-Reactor Nuclear Research Facility Operations and Maintenance			
The decrease from $57,879,000 to $55,394,000 reflects completing design and installation of a glove box to support SNM packaging activities and Congressional directed activities to improve accident response and defense in depth at INL nuclear facilities.	57,879	55,394	-2,485
INL Engineering and Support Facility Operations and Maintenance			
The funding remains flat from FY 2012 to FY 2013.	10,015	10,015	0
INL Regulatory Compliance			
The decrease from $14,673,000 to $10,453,000 reflects a reduction in Other Project Costs (OPCs) activities due to the initiation of construction for the RHLLW Disposal Project.	14,673	10,453	-4,220
Advanced Post Irradiation Examination (PIE) Capabilities			
The decrease from $3,931,000 to $500,000 reflects the completion of alternatives analyses and option studies to support CD-1, Approve Alternative Selection and Cost Range.	3,931	500	-3,431

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Construction			
The increase from $0 to $7,780,000 reflects the start of two line item projects:			
RHLLW Disposal Project (13-D-905): Request includes $6,280,000 of design and construction funds to support replacement of new disposal capability to meet NE and Office of Naval Reactor (NR) long-term program needs. This project is joint-funded with the Office of Naval Reactors.			
Advanced PIE Capabilities Project (13-E-200): Request includes $1,500,000 to perform post CD-1 activities such as preliminary design and engineering work to better understand requirements and costs for a hypothetical future post-irradiation examination facility. The Department has not committed to constructing any such facility and will decide in future years whether to proceed with this project based on a variety of factors, including projected costs, research needs, budgetary constraints, and competing priorities. As such, no funding for activities beyond CD-2 will be requested until after such a decision is made.	0	7,780	+7,780
TOTAL Funding Change, Idaho Facilities Management	154,097	152,000	-2,097

INL Nuclear Research Reactor Operations and Maintenance
Overview

This category supports nuclear research reactor operations and maintenance at the ATR for the INL, including the associated support infrastructure, the ATR Critical Facility (ATRC), and the Neutron Radiography Reactor (NRAD). It also maintains the TREAT facility in an inactive standby mode. NRAD and TREAT are located at MFC.

The primary reactor at INL is the ATR. The ATR supports the majority of NE R&D programs, as well as NNSA programs, including Naval Reactors Program work in support of the U.S. Navy nuclear fleet and Global Threat Reduction Initiatives to support conversion of research and test reactors to low-enriched uranium fuel. The ATR also supports universities and industry users. Programmatic work is funded by the sponsoring programs. The cost to other users depends upon the demands on the reactor and the nature of the user in accordance with DOE regulations.

This category also funds activities related to the potential resumption of a domestic transient fuel testing capability, such as alternative identification and option analysis; environmental studies; facility and equipment evaluations, designs, and refurbishments; and safety evaluations.

Benefits

- Provides unique irradiation capability to further nuclear fuel and reactor component research in support of advanced nuclear reactor design activities.
- Supports U.S. Navy nuclear fleet and Global threat Reduction Initiatives.
- Supports universities and industry users.
- Expansion of nuclear fuel testing capability which will improve the safety and reliability of nuclear fuels in the U. S. and internationally.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Completed installation of the Distributed Control System/Console Display System at ATR to improve reliability. • Initiated the installation of ATR Loop 2A with enhanced instrumentation and fuel ramp capability to support advanced fuel and material testing experiments. • Completed final project execution plan for the Core Internal Change-out (CIC). • Operated ATR at 77% efficiency. • Completed more than 40 irradiation campaigns for universities, the NNSA's Offices of Naval Reactors and Defense Nuclear Nonproliferation. • Produced Cobalt-60 for commercial use in industrial radiography sources. • Initiated ATR modifications to enhance accident response capability and improve defense in depth such as seismic bracing, auxiliary water supply for the ATR canal, and station black-out equipment.	75,248
FY 2012	• Maintain and operate IFM reactor facilities. • Complete ATR Loop 2A installation and begin operation. • Initiate ATR Life Extension Program (LEP) activities such as the heat exchanger seismic supports and the auxiliary canal fill system. • Continue long-lead procurements for ATR CIC activities. • Conduct over 45 irradiation campaigns at ATR as scheduled while maintaining an operating efficiency greater than 80%; Maintain and repair ATR Complex infrastructure and INL Reactors (ATR, ATRC, NRAD, and TREAT). • Complete option studies to resume transient testing. • Complete ATR modifications to enhance accident response capability.	67,599

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2013	• Maintain and operate INL reactors and supporting infrastructure. • Continue planned ATR LEP activities with the goal of completing LEP in FY 2015. • Complete LEP activities such as Reactor Data Acquisition System (RDAS), Lobe Power Calculation and Indicating System (LPCIS) and initiate safety related Plant Protective System, and Surveillance and Testing System replacements. • Initiate final procurements to support ATR CIC-out activities. • Conduct over 45 irradiation campaigns as scheduled while maintaining an operating efficiency greater than 80%. • Operate ATR Loop 2A with enhanced instrumentation and fuel ramp capability to support advanced fuel and material testing experiments. • Initiate detailed analyses to sustain ATR and improve long-term reliability, such as replacement of emergency fire water injection system and transition to commercial power. • Initiate detailed plans and activities to resume transient testing capabilities pending outcome of options studies.	67,858

INL Non-Reactor Nuclear Research Facility Operations and Maintenance
Overview

This category funds operations, maintenance, and support for non-reactor nuclear and radiological research facilities. The non-reactor nuclear research facilities support programmatic activities such as nuclear fuel development, separations development, pre- and post-irradiation fuel examinations, and radiological chemical analysis. This category also funds the management of NE-owned SNM, including the characterization, packaging, storage, and disposition of surplus SNM.

Benefits

- Consolidation and disposition of SNM frees up facility space enabling it to be used for mission–essential activities.
- Enables mission-critical R&D capabilities in support of the NE R&D Roadmap.
- Enables R&D programs by ensuring the nuclear safety bases for MFC nuclear facilities are fully implemented and compliant.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Maintained and operated MFC facilities consistent with Departmental requirements. • Conducted nuclear maintenance and repair of MFC facilities. • Finalized documented safety analyses (DSA) upgrades for key MFC nuclear facilities such as the Fuel Conditioning Facility, the Hot Fuel Examination Facility (HFEF), and the Analytical Laboratory to comply with Departmental requirements. • Initiated DSA-identified facility upgrades to the Fuel Conditioning Facility and Hot Fuel Examination Facility. • Completed off-site shipments of surplus SNM, surpassing 1 metric ton threshold of disposition uranium.	59,866
FY 2012	• Maintain and operate MFC nuclear facilities consistent with Departmental requirements and in support of planned research and development activities. • Conduct nuclear maintenance and repair of MFC facilities, including facility safety system and procedural upgrades as identified through revised DSAs. • Manage NE-owned programmatic and surplus SNM, including characterization, stabilization, and disposal of surplus SNM. • Maintain and operate glove boxes and supporting systems to condition and prepare NE-owned surplus plutonium and uranium for off-site disposition. • Prepare to operate the Irradiated Material Characterization Laboratory (IMCL).	57,879
FY 2013	• Provide trained operators and technicians, qualified criticality safety officers, and material balance custodians to operate MFC nuclear facilities. • Analyze and authorize adjustments to operating parameters and facility operations and coordinate programmatic work activities. • Develop and provide nuclear training, quality assurance, document management; systems and safety engineering; environment, safety and health; nuclear materials management and stewardship. • Perform program integration to support effective execution of projects and programs within the nuclear facilities at the MFC. • Transition IMCL to full operations. • Complete planned facility modifications and upgrades identified in MFC DSAs. • Complete 1-3 shipments to disposition special nuclear materials. • Continue maintenance within the MFC nuclear facilities and infrastructure consistent with the approved safety bases.	55,394

INL Engineering and Support Facility Operations and Maintenance
Overview

This category funds all activities that support the effective management of the buildings, structures, and systems that support the non-nuclear facilities at the INL consistent with Departmental orders and regulations. This category includes activities to support Departmental sustainability goals to improve energy efficiency at the INL.

Additionally, support is provided for Federally-funded program activities and community regulatory support activities to meet obligations defined in crosscutting agreements and contracts such as: Shoshone-Bannock Tribes, Nevada Test Site waste disposal fees, Defense Contract Audit Agency, site environmental monitoring, Payment in Lieu of Taxes, and the National Oceanic and Atmospheric Administration.

Benefits

Maintaining Real Property through recapitalization and life-cycle management activities to keep existing facilities modern and relevant, consistent with DOE Order 430.1B *Real Property and Asset Management* requirements

Reducing out-year costs by dispositioning surplus, non-radiological facilities.

Improving energy efficiency and compliance with Executive Order (EO) 13514 *Federal Leadership in Environmental, Energy, and Economic Performance* to increase efficiency and reduce energy costs.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Conducted non-nuclear facilities maintenance and operation, real property management, sustainment, and community support activities. • Revised the INL 2004 site land-use plan and utility corridor plan. • Installed metering and connectivity infrastructure for thirteen facilities to meet the high performance sustainable building goal. • Installed 15,000 ft^2 of roof replacements utilizing cool roof technology. • Completion and close-out of ESPC for MFC. • Initiated a new Energy Savings Performance Contract (ESPC) for ATR and several other complexes across the site.	12,448
FY 2012	• Management of non-nuclear facilities, real property management, sustainment, and community support activities. • Complete planned decontamination and disposal work. • Install approximately 21,400 ft^2 of roof replacement utilizing cool roof technology. • Oversee implementation of the new ESPC for ATR and several other INL complexes.	10,015
FY 2013	• Manage non-nuclear facilities, real property management, sustainment, and community support activities. • Conduct performance-based real property life-cycle asset management activities. • Recapitalization activities structured to keep existing facilities modern and relevant in an environment of changing standards and missions, consistent with DOE Order 430.1B. • Continue life-cycle planning to identify essential capital alterations and additions; improvements to land, buildings, and utility systems necessary to maintain INL general purpose infrastructure; common/domestic services infrastructure; and multi-program infrastructure. • Continue implementation of a systematic real property asset building inspection program and operation and maintenance of the Department's Facility Information Management System and Condition Assessment Information System. • Complete of planned disposition work for non-nuclear excess buildings. • Continue to implement comprehensive planning activities to support EO 13514 and EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Manage-*	

Fiscal Year	Activity	Funding (Dollars in Thousands)
	ment. • Continue oversight of the new ESPC for several complexes across the site. • Replace and repair approximately 20,000 ft^2 of roofs utilizing cool technology.	10,015

National Scientific User Facility
Overview

While not an actual facility, the National Scientific User Facility (NSUF) activity represents a prototype laboratory for the future since it promotes the use of unique nuclear research facilities for science-based experiments to encourage active university, industry, and laboratory collaboration in relevant nuclear scientific research. The NSUF is actually a program that, through solicitations that encourage university-industry partnerships, provides a mechanism for research organizations to collaborate, and conduct experiments and post-experiment analysis at facilities not normally accessible to these organizations. In this manner, researchers are introduced to new techniques, equipment, and personnel so that their research benefits from new technologies and experimental capabilities. The INL ATR and PIE facilities at the Center for Advanced Energy Sciences and MFC are available as user facilities. In addition, research reactors at Oak Ridge National Laboratory, the Massachusetts Institute of Technology, and North Carolina State University, the Advanced Photon Source beam line capabilities at the Illinois Institute of Technology, and examination facilities at the Universities of Wisconsin, Michigan, California-Berkeley, and Nevada-Las Vegas are partnered with the NSUF bringing additional user facilities to the research community.

Benefits

Further nuclear science and engineering research:

- Help enable access to NE's unique research facilities and equipment
- Support DOE-NE research and development mission
- Train a new generation of nuclear scientists and researchers

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Maintained support for six university partnerships and added two new partnerships to the NSUF. • Performed the first instrumented lead experiment for the ATR NSUF. • Performed the first ATR NSUF Experiment using the ATR Hydraulic Shuttle. • Awarded 5 university experiments using ATR and other INL research facilities and multiple smaller-scale experiments using previously irradiated samples at partnership locations. • Conducted NSUF user's week at the INL to educate new users of INL research facilities.	6,301
FY 2012	In FY 2012, NSUF was transferred to the NEET program. Due to the transfer, no further funding was requested under the IFM program.	0
FY 2013	No funds requested under IFM.	0

INL Regulatory Compliance
Overview

This category supports compliance activities driven by state and Federal environmental and other regulations that are under the purview of NE owner responsibilities. Compliance activities focus on air, soil, and water monitoring and waste disposal consistent with Federal and State permit requirements. Regulatory activities also include work that supports the 1995 Settlement Agreement with the State of Idaho. This category also supports other project costs for the proposed RHLLW Disposal Project to meet long-term waste disposal needs for NE and Office of Naval Reactors, consistent with regulatory requirements.

Benefits

Reduced Liability

- Waste treatment and disposal obligations with the State of Idaho will be met and cost avoidance of high penalties if agreed upon deadlines are not met.
- Adequate management of waste will result in steady or reduced life cycle costs and the avoidance of compliance issues in the future.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Regulatory compliance program management. • Transitioned the processing of Experimental Breeder Reactor (EBR)-II sodium-bonded fuel from blanket fuel to driver fuel, consistent with the 1995 Settlement Agreement. • Treated approximately two cubic meters of sodium-contaminated low-level waste backlog. • Developed documentation to support CD-1, Approve Alternative Selection and Cost Range, for the RHLLW Disposal Project.	7,490
FY 2012	• Processing of 68 kilograms of EBR-II sodium-bonded fuel in support of the 1995 Settlement Agreement with the State of Idaho. • Treatment of approximately two cubic meters of sodium-contaminated low-level waste backlog. • Develop documentation to support CD-2, Approve Performance Baseline, and CD-3, Approve Start of Construction/Execution, for the RHLLW Disposal Project.	14,673
FY 2013	• Continue regulatory compliance program management. • Meet Site Treatment Plan milestones of two cubic meters of Mixed Low-Level Waste (MLLW) that will be treated in the Sodium Components and Maintenance Shop at MFC. • Treat approximately 170 kilograms of EBR-II spent nuclear fuel. • Treat remaining sodium-contaminated low-level waste backlog, approximately two cubic meters. • Retrieve MLLW from Radioactive Scrap and Waste Facility. • Continue Other Project Costs activities for the RHLLW Disposal Project.	10,453

INL Facility Infrastructure Revitalization Program (IFIRP)
Overview

This category restored, rebuilt, and revitalized the physical INL infrastructure by replacing aging facilities and larger equipment to address costly, beyond useful life maintenance. These activities enhanced program execution and satisfied a critical need for improvement to INL infrastructure, and made a significant contribution to the overall reduction of complex-wide deferred maintenance.

In FY 2012, no further funding was requested for IFIRP, having successfully achieved its goal of resolving all urgently needed revitalization projects.

Benefits

Restored, Rebuilt, Revitalized Infrastructure

- Satisfied critical need for improvements to INL infrastructure to support mission needs.
- Provided capabilities that improve safety, reliability, and energy efficiency to meet current and future program research needs.
- Replaced aging facilities and larger equipment to address costly, beyond useful life maintenance.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Site-wide facility revitalization activities ATR, MFC, and Research and Education Center (REC) to reduce maintenance backlogs and improve infrastructure and reliability of capabilities. • Replacement of facilities and/or capabilities such as the 40+ year old MFC Analytical Laboratory Alpha and Sodium Gloveboxes with modern, compartmentalized, multi-functional gloveboxes to support inert and air atmospheric post-irradiation examination work. • Equipment purchases such as uninterrupted power supplies to support dial room communication hub in the Central Facilities Area.	22,251
FY 2012	No funding requested.	0
FY 2013	No funding requested.	0

Advanced Post Irradiation Examination (PIE) Capabilities
Overview

This activity assesses the benefits and options for developing a possible future large-scale advanced post-irradiation examination (A-PIE) facility by funding Other Project Costs for the Advanced PIE Capabilities Project (13-D-200). The Department has not committed to constructing any facility that may be considered in the project. The direction of the project will be decided in future years based on a variety of factors including project costs, research needs, budgetary constraints, and competing priorities. No funding for activities beyond CD-2, Approve Performance Baseline, will be requested until after such a decision is made.

Currently, NE is constructing the Irradiated Materials Characterization Laboratory (IMCL), which will provide modern, flexible nano- and atomic-scale post-irradiation examination capabilities. IMCL is expected to be operational by the spring of 2013. IMCL will provide the ability to meet modern electrical, cleanliness, vibration isolation and radiological control requirements to support current PIE tools and equipment. This facility concept will provide a concept testing ground for A-PIE capabilities, including machine-to-sample and machine-to-building interfaces, and will inform future decisions on the A-PIE Capabilities Project.

If a larger-scale, Advanced PIE Capabilities Project were ever executed, it would require equipment that would allow high hazard materials to be routinely examined in a safe and secure environment. Any such facility could serve as a center for advanced fuels and materials characterization, as well as development of new processes, tools and instruments to further research. The project requirements would specify that alternatives have a flexible footprint with a variety of laboratory capabilities in both fixed and reconfigurable space.

Benefits

Potential benefits of the advanced PIE capabilities include:

- Understanding the irradiation-induced degradation behavior of existing nuclear plant material at a sub-atomic level provide added information for extending the life of the nation's nuclear power reactors;
- Provide added information for developing and qualifying fuels and materials that could improve the operational efficiency of current plants and enable the design and construction of less costly, more efficient future nuclear plants;
- Assist in developing new fuel technologies that enable the development of economical, sustainable, proliferation resistant advanced fuel cycles; and
- Increasing fundamental scientific knowledge of the response of materials to irradiation that leads to development and validation of predictive models of fuel and material behavior.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• None	0
FY 2012	• Initiate initial assessment of alternatives analysis, analysis maturation, environmental studies, and other documentation in support of obtaining Critical Decision 1, Approve Alternative Selection and Cost Range.	3,931
FY 2013	• Complete alternatives analysis, conceptual design, preparation of the National Environmental Policy Act documentation, project execution plan activities and support design activities pending approval of CD-1, Approve Alternative Selection and Cost Range. • Continue project management and other work to support design activities up to CD-2, Approve Performance Baseline.	500

Construction
Overview

The INL, like other national laboratories, requires line-item capital projects to maintain its infrastructure and support mission goals. These projects help achieve NE and DOE strategic objectives by maintaining site services or providing critical information for future decisions. This activity is focused on two primary objectives: (1) identification, planning, and prioritization of projects required to NE programs and objectives, and (2) development and execution of these projects within approved cost and schedule baselines is such projects are deemed necessary. DOE's 413 process does not guarantee that a project will be completed once the initial information gathering and preliminary design phase are complete. It provides an important decision-making framework that, when well executed, allows only the most critically necessary, cost-effective projects to proceed to construction.

Benefits

Advanced PIE Capabilities Project (13-E-200)

- Design funds will support decision making related to a future advanced PIE capabilities needs.

RHLLW Disposal Project (13-D-905)

- Design and construction funds for this replacement capability will provide the continued capability of remote-handled low-level waste storage at INL.
- This jointly funded replacement project will support long-term program needs for the Office of Naval Reactors and the Office of Nuclear Energy.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	None	0
FY 2012	None	0
FY 2013	• **Advanced PIE Capabilities**: Begin preliminary design activities to inform a future decision on whether to enhance NE's PIE capabilities ($1,500,000). • **RHLLW Disposal Project**: Initiate design and construction of the selected alternative to construct a new disposal facility at INL ($6,280,000).	7,780

Capital Equipment, General Plant Projects, and Construction Summary

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Capital Equipment	6,019	6,460	6,000
General Plant Projects	22,216	510	0
Construction	0	0	7,780
Total, Idaho Facilities Management	28,235	6,970	13,780

Major Items of Equipment

(Dollars in Thousands)

	Prior Years	FY 2011 Current	FY 2012 Enacted	FY 2013 Request	Outyears	Total	Comple-tion
	0	0	0	0	0	0	0
Total, Major Items of Equipment	0	0	0	0	0	0	0

Construction Projects

(Dollars in Thousands)

	Prior Years	FY 2011 Current	FY 2012 Enacted	FY 2013 Request	Outyears	Total	Comple-tion
Remote Handled Low-Level Waste Dis-posal Project, 13-D-905							
TEC	0	0	0	6,280	25,487	31,767	31,767
OPC	3,890	4,300	3,800	430	7,350	19,770	19,770
TPC	3,890	4,300	3,800	6,710	32,837	51,537	51,537
Advanced Post Irradiation Examination Capabilities Project , 13-E-200							
TEC	0	0	0	1,500	TBD	TBD	TBD
OPC	0	0	3,931	500	TBD	TBD	TBD
TPC	0	0	3,931	2,000	389,069	395,000	395,000
Total, Construction							
TEC		0	0	7,780			
OPC		4,300	7,731	930			
TPC		4,300	7,731	8,710			

13-E-200, Advanced Post-Irradiation Examination Capabilities Project

Location: TBD

Project Data Sheet (PDS) is for Design and Construction

1. Significant Changes

The most recent DOE O 413.3B approved Critical Decision (CD) is for CD-0, Approve Mission Need, which was issued on January 31, 2011. This is anticipated to be a non-major acquisition project with a preliminary rough order of magnitude (ROM) total project cost (TPC) range between $0 and $395 million. The cost range addresses the uncertainty, given the range of alternatives identified.

A Federal Project Director has not been assigned to this project, but will be selected before or in conjunction with CD-1, Approve Alternative Selection and Cost Range.

This PDS is new and funds are requested in FY 2013 to initiate design activities only. The design funds will not be used until the project receives CD-1 approval. The Department has not committed to constructing any facility that may be considered as part of this project. No funding for activities beyond engineering and design work will be requested until after CD-2, Approve Performance Baseline, is made.

2. Design, Construction, and D&D Schedule[a]

(Fiscal quarter or date)

	CD-0	CD-1	Design Complete	CD-2	CD-3	CD-4	D&D Start	D&D Complete
FY 2013	01/31/2011	4QFY2013	2QFY2016	3QFY2016	TBD	TBD	N/A	N/A

CD-0 – Approve Mission Need
CD-1 – Approve Alternative Selection and Cost Range and Long-lead procurement
CD-2 – Approve Performance Baseline
CD-3 – Approve Start of Construction
CD-4 – Approve Start of Operations or Project Closeout
D&D Start – Start of Demolition & Decontamination (D&D) work
D&D Complete –Completion of D&D work

3. Baseline and Validation Status[b]

(Dollars in Thousands)

	TEC, Design	TEC, Construction	TEC, Total	OPC Except D&D	OPC, D&D	OPC, Total	TPC
FY 2013	$24,000	TBD	TBD	TBD	N/A	TBD	$395,000

[a] The Critical Decision (CDs) dates are design only estimates and are consistent with the high end of the schedule range.
[b] The costs are only estimates and are consistent with the high end of the cost range.

4. Project Description, Justification and Scope

This project is being conducted in accordance with the project management requirements in DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, and all appropriate project management requirements have been met.

Project Description

The project supports pre-CD2 design for a possible future larger-scale advanced post-irradiation examination (PIE) capabilities. Advanced PIE capabilities at a large scale could improve understanding of nuclear fuels and material performance at the micro-, nano-, and atomic scales. Irradiation-driven phenomena can only be understood through conducting a scientific program that includes experimental irradiation testing and post-irradiation examination, materials characterization, and testing coupled with modeling and simulation.

Any potential future facility would require equipment that would allow high hazard materials to be routinely examined in a safe and secure environment. In addition any such facility could serve as a center for advanced fuels and materials characterization, as well as development of new processes, tools and instruments to further research. The project requirements would specify that alternatives have a flexible footprint with a variety of laboratory capabilities in both fixed and reconfigurable space.

Justification

Understanding the behavior of fuels and materials in a nuclear reactor irradiation environment is the limiting factor in nuclear plant safety, longevity, efficiency, and economics. During the last 15 years, nano-scale (10^{-9} meter) characterization of nonnuclear materials has become routine, with capabilities for sub-angstrom (10^{-10}meter) investigation becoming increasingly available to researchers in other fields.

Existing PIE capabilities at U.S. Department of Energy (DOE) laboratories, universities, and in the private sector are widely distributed. Current PIE capabilities, such as those being established at the Irradiated Materials Characterization Laboratory (IMCL) at Idaho National Laboratory, serve basic needs for fuel examination, material handling and waste disposal but are limited in their ability to function on the micro, nano, and atomic scale. A better understanding of nuclear fuels and material performance in the nuclear environment, at the nano-scale and lower, can assist in the development of innovative fuels and materials required for tomorrow's nuclear energy systems. Characterizing radioactive samples at nano-scale to micro-scale length resolutions should also support the development of modern computer codes that could enable order of magnitude improvements in the time and cost of developing new fuels.

This project will effectively harness U.S. intellectual capital by being made available to the nuclear research community as a user facility.

Scope

The project will ensure that any potential future facility would provide a flexible footprint with a variety of laboratories in both fixed and reconfigurable space. Radiological confinement would be provided in the form of fume hoods, glove boxes (i.e., general purpose, alpha, shielded, and combined), and reconfigurable shielded/hot cells (utilizing modular cubicle inserts). Open laboratories would provide the space necessary to accommodate instruments with specific shielding and confinement requirements. A modular design is anticipated to facilitate equipment-specific shielding and flexibility for future equipment development, configuration alteration, and ease of replacement to provide for maximum cost-effective utilization, allowing it to remain relevant over a 40-year projected useful life. The IMCL facility will provide a concept testing ground for advanced PIE capabilities, including machine-to-sample and machine-to-building interfaces, and will inform future decisions on this project.

This project will consider a variety of options; including constructing new and/or modifying existing buildings at a DOE sites and modifying commercial or international facilities. If this project progresses to the construction phase, construction activities would likely include, but not be limited to, installation of shielding, glove boxes, and/or fume hoods to handle nuclear material samples; replacement of climate control systems; room isolation activities to address vibration, electrical and magnetic field, acoustic noise, and temperature fluctuations; installation of communication systems to transmit experimental data; and installation and testing of experimental equipment.

Any potential facility would be a non-reactor nuclear facility that will incorporate requirements to achieve the goals stated in Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management". The facility would accommodate state-of-the-art equipment required for post-irradiation research and development.

Funds appropriated under this data sheet may be used to provide independent assessments related to project planning and execution.

5. Financial Schedule[a]

(Dollars in Thousands)

	Appropriations	Obligations	Costs
Design			
FY 2013	1,500	1,500	1,250
FY 2014	3,500	3,500	3,250
FY 2015	7,500	7,500	7,500
FY 2016	11,500	11,500	12,000
Total, Design	24,000	24,000	24,000
Construction			
FY 2017	TBD	TBD	TBD
Total, Construction	TBD	TBD	TBD
Total Estimated Cost (TEC)			
FY 2013	1,500	1,500	1,250
FY 2014	3,500	3,500	3,250
FY 2015	7,500	7,500	7,500
FY 2016	11,500	11,500	12,000
FY 2017	TBD	TBD	TBD
Total, TEC	TBD	TBD	TBD
Other Project Cost (OPC)			
FY 2012	3,931	3,931	2,431
FY 2013	500	500	2,000
FY 2014	1,000	1,000	1,000
FY 2015	1,000	1,000	1,000
FY 2016	1,000	1,000	1,000
FY 2017	TBD	TBD	TBD
Total, OPC	TBD	TBD	TBD
Total Project Cost (TPC)			
FY 2012	3,931	3,931	2,431
FY 2013	2,000	2,000	3,250
FY 2014	4,500	4,500	4,250
FY 2015	8,500	8,500	8,500

(Dollars in Thousands)

	Appropriations	Obligations	Costs
FY 2016	12,500	12,500	13,000
FY 2017	TBD	TBD	TBD
Total, TPC	TBD	TBD	TBD

a. Budget figures shown for years after FY 2013 are notional. Funding decisions will be made on a year-by-year basis.

6. Details of Cost Estimate[b]

(Dollars in Thousands)

	Current Total Estimate	Previous Total Estimate	Original Baseline
Total Estimated Cost (TEC)			
Design			
Design	20,500	N/A	TBD
Contingency	3,500	N/A	TBD
Total Design	24,000	N/A	TBD
Construction			
Site Preparation	TBD	N/A	TBD
Equipment	TBD	N/A	TBD
Other Construction	TBD	N/A	TBD
Contingency	TBD	N/A	TBD
Total, Construction	TBD	N/A	TBD
Total, TEC	TBD	N/A	TBD
Contingency, TEC	TBD	N/A	TBD
Other Project Cost (OPC)			
OPC except D&D			
Conceptual Planning	1,000	N/A	TBD
Conceptual Design	3,400	N/A	TBD
Start-Up	TBD	N/A	TBD
Contingency	TBD	N/A	TBD
Total, OPC except D&D	TBD	N/A	TBD
D&D			
D&D	TBD	N/A	N/A
Contingency	TBD	N/A	N/A
Total, D&D	TBD	N/A	N/A
Total, OPC	TBD	N/A	TBD
Contingency, OPC	TBD	N/A	TBD
Total, TPC	$395,000	N/A	TBD
Contingency, TPC	TBD	N/A	TBD

[b] The costs are only notional estimates and are based on the high end of the cost range.

7. Schedule of Appropriation Requests

($K)

Request		Prior Years	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Outyears	Total
FY 2013 (initial request)	TEC	0	0	1,500	3,500	7,500	11,500	TBD	TBD	TBD
	OPC	0	3,931	500	1,000	1,000	1,000	TBD	TBD	TBD
	TPC	0	3,931	2,000	4,500	8,500	12,500	TBD	TBD	$395,000

For schedule of project costs, see Section 5, "Financial Schedule."

8. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy (fiscal quarter or date)	N/A
Expected Useful Life (number of years)	N/A
Expected Future Start of D&D of this capital asset (fiscal quarter)	N/A

(Related Funding requirements)

(Dollars in Thousands)

	Annual Costs		Life Cycle Costs	
	Current Total Estimate	Previous Total Estimate	Current Total Estimate	Previous Total Estimate
Operations	N/A	N/A	N/A	N/A
Maintenance	N/A	N/A	N/A	N/A
Total, Operations & Maintenance	N/A	N/A	N/A	N/A

9. Required D&D Information

Area	Square Feet
Area of new construction	N/A
Area of existing facility(s) being replaced	N/A
Area of additional D&D space to meet the "one-for-one" requirement	N/A

Name(s) and site location(s) of existing facility(s) to be replaced: N/A

.

10. Acquisition Approach

An acquisition approach will be developed in FY 2012 and approved as part of CD-1, Approve Alternative Selection and Cost Range.

13-D-905, Remote-Handled Low-Level Waste Disposal Project
Idaho National Laboratory
Project Data Sheet is for Design and Construction

1. Significant Changes

The most recent DOE O 413.3A approved Critical Decision (CD) is for CD-1, Approve Alternative Selection and Cost Range, which was approved on July 13, 2011. CD-2, Approve Performance Baseline, and CD-3, Approve Start of Construction, is anticipated to be approved in the 1st Quarter of FY 2013 in compliance with the DOE O 413.3B. This is a non-major acquisition project with a cost range less than $100M. Based on the conceptual design and estimate, the lower and upper bound of the cost range is between $75 and $95 million respectively.

The project will be jointly funded in accordance with a Memorandum of Agreement between the Department of Energy (DOE) Office of Nuclear Energy (NE) and the Office of Naval Reactors (NR).

A Federal Project Director has been assigned to this project.

This PDS is for new Design and Construction. This project data sheet (PDS) reflects a design-build delivery method. The project will employ a combined CD-2/3 critical milestone approach regarding Approval of the Performance Baseline and Approval to Start Construction, with a readiness hold point established by DOE-Idaho (DOE-ID) prior to actual Start of Construction. The funding figures presented in Sections 5 and 6 represent the upper end of the cost range.

2. Design, Construction, and D&D Schedule

(fiscal quarter or date)

	CD-0	CD-1	CD-2/3[a]	CD-4[b]	D&D Start	D&D Complete
FY 2013	7/1/2009	7/13/11	1Q FY2013	4Q FY2017	4Q FY 2037	4Q FY 2038

a. Based on availability of capital funding
b. The Critical Decision (CDs) dates will be determined when CD-2 is approved by the Acquisition Executive

CD-0 – Approve Mission Need
CD-1 – Approve Alternative Selection and Cost Range
CD-2/3– Approve Performance Baseline/start of Execution

CD-4 – Approve Start of Operations or Project Closeout
D&D Start – Start of Demolition & Decontamination (D&D) work
D&D Complete –Completion of D&D work

3. Baseline and Validation Status

(dollars in thousands)

	TEC[a], Design	TEC[a], Construction	TEC, Total[la]	OPC Except D&D[a]	OPC, D&D[a]	OPC, Total[a]	TPC[a]
FY 2013	3,820	63,440	67,260	27,740	0	27,740	95,000

a. The baseline has been set at the high-end of the TPC range; the project baseline will be approved upon approval of CD-2.

4. Project Description, Justification, and Scope

The project is being conducted in accordance with the project management requirements in DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets, and all appropriate project management requirements have been met.

Project Description

The Project will provide capability for on-site disposal of remote-handled low-level waste (LLW) generated at the Idaho National Laboratory (INL) beyond the end of FY 2017 when the current waste disposal site, which has been in operation since 1952, becomes unavailable for expansion with the closure of the Radioactive Waste Management Complex (RWMC).

The proposed facility will be designed and constructed similar to the remote-handled LLW subsurface concrete disposal vaults currently in use at RWMC's Subsurface Disposal Area (SDA). This approach accommodates, to the maximum extent possible, uninterrupted operations at the generating facilities and capitalizes on the operations experience and cost-efficiencies associated with current remote-handled LLW disposal practices.

The project Key Performance Parameters (KPPs) include:

- Design and construct a vault disposal system to dispose waste generated during the first 10 years of facility life ;
- Design a disposal facility to handle waste volume of approximately 1,600 m^3 that meets the requirements of DOE Order 435.1; and
- Design and construct supporting infrastructure that allows year-round waste emplacement.

Risks

Risk Driver	Risk Description	Handling Strategy
Funding Uncertainties	During potential continuing resolution, project may not receive sufficient funding to award contract to meet construction completion date.	Mitigate. Continue to work with NE and NNSA senior management to ensure funding requirements are met in time to support construction completion date.
Disposal Authorization Statement Delay	A delay in issuance of Disposal Authorization Statement could result in delay to Critical Decision-3, resulting in an overall project delay and increase in costs.	Mitigate. Seek Disposal Authorization Statement early in the project. Coordinate with the Office of Environmental Management to ensure sufficient time for regulatory review.

Justification

INL is a multipurpose national laboratory delivering specialized science and engineering solutions for DOE. Sponsorship of INL was formally transferred to DOE-NE in July 2002. The move to NE and consolidation with Argonne National Laboratory-West supports INL's role as DOE's lead nuclear energy laboratory. In addition, INL hosts the National Nuclear Security Administration's (NNSA) Naval Reactors Facility (NRF). NRF supports the U.S. Navy's nuclear-powered fleet through research and development of materials and equipment and management of naval spent nuclear fuel.

In addition to the nuclear energy mission, Environmental Management (EM) is supporting a large-scale cleanup mission at the INL. These activities include closure of the RWMC under CERCLA (42 USC 9601 et seq. 1980). Remote-handled LLW generated by INL and NRF has been disposed of at RWMC since 1952. EM has notified NE and NR that disposal at RWMC should not be assumed beyond September 30, 2017.

The continuing nuclear energy mission of INL and NRF require continued capability to dispose of remote-handled LLW. Without established, viable remote-handled LLW disposal capability, ongoing and future operations at the INL and NRF would be adversely impacted. In addition to impacting INL operations at the Advanced Test Reactor and Material and Fuels Complex, remote-handled LLW disposal capability also is critical to the NNSA's mission to "provide the United States Navy with safe, militarily effective nuclear propulsion plants and to ensure the safe and reliable operation of those plants." Spent nuclear fuel from the Navy's nuclear-powered fleet is sent to NRF for examination, processing, dry storage, and ultimate disposition. A reliable disposal path for remote-handled LLW is essential to NRF's continued receipt and processing of naval

spent nuclear fuel and, therefore, national security. Based on an evaluation of alternatives and completion of an assessment of the environmental impacts in accordance with the National Environmental Policy Act [NEPA], the highest-ranked alternative for providing continued, uninterrupted remote-handled LLW disposal capability is construction of a new onsite remote-handled LLW disposal facility.

Scope

In the conceptual design, the subsurface vaults are envisioned to be constructed of precast concrete cylinders (pipe sections) stacked on end and placed in a honeycomb-type array. Based on waste projections, approximately 400 vaults will be required in up to five different configurations to support Idaho site operations. The facility is projected to be a Hazard Category 2 nuclear facility, subject to the requirements of DOE-STD-1189, "Integration of Safety into the Design Process." The disposal facility will be located on a suitable site within the INL boundary. Performance of the site/facility will be analyzed in accordance with requirements of DOE Order 435.1. In response to potential public concerns, a wide variety of disposal liner options are being considered for possible inclusion as part of "systems approach" in design and performance of the facility.

Supporting infrastructure to the new facility will include a paved access road; electrical service; firewater and potable water; security fence and systems; a maintenance building; administration building; communications systems; and other operational capabilities. Transportation and handling equipment systems also will be developed for onsite shipments of activated metals and debris waste from the Advanced Test Reactor Complex and the Material and Fuels Complex.

Funds appropriated under this data sheet may be used to provide independent assessments related to project planning and execution.

5. Financial Schedule[a]

(dollars in thousands) (Total Project @ Upper Bound)

	Appropriations			Obligations			Costs
	NE	NR	Total	NE	NR	Total	
Total Estimated Cost (TEC)							
Design[b]							
FY 2013	410	1,300	1,710	410	1,300	1,710	1,010
FY 2014	47	1,463	1,510	47	1,463	1,510	700
FY 2015	530	70	600	530	70	600	1,510
FY 2016	0	0	0	0	0	0	600
FY 2017	0	0	0	0	0	0	0
Total Design	987	2,833	3,820	987	2,833	3,820	3,820
Construction							
FY 2013	5,870	7,590	13,460	5,870	7,590	13,460	2,400
FY 2014	18,370	19,610	37,980	18,370	19,610	37,980	20,870
FY 2015	6,540	5,460	12,000	6,540	5,460	12,000	28,170
FY 2016	0	0	0	0	0	0	12,000
FY 2017	0	0	0	0	0	0	0

(dollars in thousands) (Total Project @ Upper Bound)

	Appropriations			Obligations			Costs
	NE	NR	Total	NE	NR	Total	
Total Construction	30,780	32,660	63,440	30,780	32,660	63,440	63,440
TEC							
FY 2013	6,280	8,890	15,170	6,280	8,890	15,170	3,410
FY 2014	18,417	21,073	39,490	18,417	21,073	39,490	21,570

FY 2015	7,070	5,530	12,600	7,070	5,530	12,600	29,680
FY 2016	0	0	0	$0	0	0	12,600
FY 2017	0	0	0	$0	0	0	0
Total TEC	**31,767**	**35,493**	**$67,260**	**31,767**	**35,493**	**67,260**	**67,260**
OPC, except D&D							
FY 2009	184	0	184	184	0	184	184
FY 2010	3,706	0	3,706	3,706	0	3,706	3,706
FY 2011	4,300	0	4,300	4,300	0	4,300	3,774
FY 2012	3,800	0	3,800	3,800	0	3,800	4,326
FY 2013	430	1,310	1,740	430	1,310	1,740	1,740
FY 2014	415	1,075	1,490	415	1,075	1,490	1,490
FY 2015	1,030	570	1,600	1,030	570	1,600	1,600
FY 2016	4,170	3,640	7,810	4,170	3,640	7,810	7,810
FY 2017	1,735	1,375	3,110	1,735	1,375	3,110	3,110
Total OPC, except D&D	19,770	7,970	27,740	19,770	7,970	27,740	27,740
D&D							
Total D&D	0	0	0	0	0	0	0
OPC							
FY 2009	184	0	184	184	0	184	184
FY 2010	3,706	0	3,706	3,706	0	3,706	3,706
FY 2011	4,300	0	4,300	4,300	0	4,300	3,774
FY 2012	3,800	0	3,800	3,800	0	3,800	4,326
FY 2013	430	1,310	1,740	430	1,310	1,740	1,740
FY 2014	415	1,075	1,490	415	1,075	1,490	1,490
FY 2015	1,030	570	1,600	1,030	570	1,600	1,600
FY 2016	4,170	3,640	7,810	4,170	3,640	7,810	7,810
FY 2017	1,735	1,375	3,110	1,735	1,375	3,110	3,110
Total OPC	**19,770**	**7,970**	**27,740**	**19,770**	**7,970**	**27,740**	**27,740**
Total Project Cost (TPC)							
FY 2009	184	0	184	184	0	184	184
FY 2010	3,706	0	3,706	3,706	0	3,706	3,706
FY 2011	4,300	0	4,300	4,300	0	4,300	3,774
FY 2012	3,800	0	3,800	3,800	0	3,800	4,326
FY 2013	6,710	10,200	16,910	6,710	10,200	16,910	5,150

(dollars in thousands) (Total Project @ Upper Bound)

	Appropriations			Obligations			Costs
	NE	NR	Total	NE	NR	Total	
FY 2014	18,832	22,148	40,980	18,832	22,148	40,980	23,060
FY 2015	8,100	6,100	14,200	8,100	6,100	14,200	31,280
FY 2016	4,170	3,640	7,810	4,170	3,640	7,810	20,410
FY 2017	1,735	1,375	3,110	1,735	1,375	3,110	3,110
Total TPC	**51,537**	**43,463**	**95,000**	**51,537**	**43,463**	**95,000**	**95,000**

a. Budget figures shown for years after FY 2013 are notional. Funding decisions will be made on a year-by-year basis.
b. Design costs are part of the design-build contract, which is funded with construction funds.

6. Details of Project Cost Estimate

(dollars in thousands)

	CD-1 Upper Bound Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design			
Design	3,220	N/A	N/A
Contingency	600	N/A	N/A
Total, Design	3,820	N/A	N/A
Construction			
Site Preparation	NA	N/A	N/A
Equipment	10,000	N/A	N/A
Other Construction	51,520	N/A	N/A
Contingency	1,920	N/A	N/A
Total, Construction	63,440	N/A	N/A
Total, TEC	67,260	N/A	N/A
Contingency, TEC	2,520	N/A	N/A
Other Project Cost (OPC)			
OPC except D&D			
Conceptual Planning	8,030	N/A	N/A
Conceptual Design	3,240	N/A	N/A
Project Support	8,490	N/A	N/A
Start-Up	3,430	N/A	N/A
Contingency	4,550	N/A	N/A
Total, OPC except D&D	27,740	N/A	N/A
D&D			
D&D	0	N/A	N/A
Contingency	0	N/A	N/A
Total, D&D	0	N/A	N/A
Total, OPC	27,740	N/A	N/A
Contingency, OPC	4,550	N/A	N/A
Total, TPC	95,000	N/A	N/A
Total, Contingency	7,070	N/A	N/A

7. Schedule of Appropriation Requests

(dollars in thousands)

Request		Prior Years	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Outyears	Total
FY 2013 (initial request)	TEC	0	0	15,170	39,490	12,600	0	0		67,260
	OPC	8,190	3,800	1,740	1,490	1,600	7,810	3,110		27,740
	TPC	8,190	3,800	16,910	40,980	14,200	7,810	3,110	0	95,000

8. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy (fiscal quarter or date)	1Q FY 2018
Expected Useful Life (number of years)	20 years
Expected Future Start of D&D of this capital asset (fiscal quarter)	3Q FY 2037

(Related Funding requirements)

(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Current Total Estimate	Previous Total Estimate	Current Total Estimate	Previous Total Estimate
Operations	5,130	NA	102,600	NA
Maintenance	490	NA	9,800	NA
Total, Operations & Maintenance	5,620	NA	112,400	NA

9. Required D&D Information

Area	Acres
Area of new construction	2 to 10 acres
Area of existing facility(s) being replaced	97 acres
Area of additional D&D space to meet the “one-for-one” requirement	0

Name(s) and site location(s) of existing facility(s) to be replaced:

- Remote-handled LLW disposal vaults, SDA, RWMC (the cost to close RWMC, including the existing remote-handled LLW disposal vaults, will be funded by DOE EM as part of CERCLA remediation of Waste Area Group 7, Operable Unit 13/14 and is not included in this PDS).

10. Acquisition Approach

The INL Management and Oversight (M&O) contractor will competitively procure the facility design and construction of the proposed onsite remote-handled LLW disposal facility utilizing a negotiated, design-build subcontract. The design-build subcontract will be competitively bid (FY 2012) and awarded in early FY 2013 (depending on availability of capital funding) to qualified general construction subcontractors. Responses to the request for proposal will be evaluated using a "best value" selection process that considers pricing, qualifications, and functionality; conformance with established requirements; safety record; and past performance.

Additional support subcontracts (e.g., monitoring well installation) are envisioned. Services will be solicited only from qualified firms via requests for proposal. Dependent on the action, selection will be based on technical merits and price considerations as provided for in the INL operating contractor's DOE-approved procurement procedures manual.

The types of contracts used for acquisition (e.g., fixed price or fixed labor rate) will vary, dependent on the specific scope of work. Financial incentives may be used, as appropriate, to motivate contractor performance, along with competition to select suppliers. To the extent feasible, procurements will be accomplished by fixed-price contracts awarded based on "best value."

Because this project is based on proven technology and a simplistic design, the design-build delivery method is considered the best acquisition method to complete the project. This method provides continuity between the designer and constructor, reducing project risks, conflicts, schedule, and cost.

The INL M&O contractor will provide project management, construction oversight, and Safety and Quality inspection during construction. In addition, the INL M&O contractor will also perform the following key project activities with subcontractor support and DOE-ID oversight: preparation of documents to support CDs; preparation of engineering design documentation; preparation of NEPA documentation, including a siting study and an environmental assessment; preparation and support to DOE Headquarters approval of a performance assessment and composite analysis; preparation of disposal facility waste acceptance criteria; preparation of nuclear safety documentation; preparation of requests for proposal and performance specifications; subcontractor selection and contract administration; facility design and construction management; and, operational readiness activities.

International Nuclear Energy Cooperation
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
International Nuclear Energy Cooperation	2,994	2,983	3,000
Total, International Nuclear Energy Cooperation	2,994	2,983	3,000

Public Law Authorizations

P.L. 112-10, Department of Defense and Full-Year Continuing Appropriations Act, 2011

P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

International Nuclear Energy Cooperation's (INEC) mission is to serve as the Office of Nuclear Energy's (NE) overall lead for all NE international activities, including analysis, development, and implementation of international civil nuclear energy policy and coordination and integration of NE's international nuclear technical activities. These activities support international bilateral and multilateral engagement and civil nuclear energy Research and Development (R&D) activities with countries with an established or planned civilian nuclear power sector. INEC may also employ workshops to engage industry and foreign governments on international civil nuclear issues such as financing, safety, or comprehensive nuclear fuel services.

INEC provides NE the ability to meet growing demands for engagement with international partners on civil nuclear policy, R&D, and related activities. INEC engages both bilaterally and multilaterally to support broader U.S. policy and commercial goals related to nuclear energy globally and will allow more effective integration of NE international R&D and policy interests. INEC also leverages NE efforts with Department of Energy's (DOE) National Nuclear Security Administration, Office of Environmental Management, and Office of Policy and International Affairs; the National Security Council; Department of State; Department of Commerce; and the Nuclear Regulatory Commission to facilitate U.S. nuclear energy R&D, policy, and commercial interests internationally.

INEC has identified the following challenges for FY 2013:

- Through international engagement, ensure NE R&D decisions are informed of concerns stemming from the events at Japan's Fukushima nuclear power plant.
- Supporting unanticipated international engagement pursuant to new and emerging policy priorities and direction.
- Shaping NE's bilateral and multilateral international engagement to ensure expansion of the use of nuclear power is done safely and securely.

Subprogram Accomplishments and Milestones

In FY 2011, INEC achieved four significant accomplishments or milestones in program management and/or program development: 1) Developed and implemented new bilateral cooperation programs with Argentina, Brazil, the Czech Republic, India, and Kazakhstan; 2) Advanced its nuclear safety probabilistic safety assessment work with China; 3) Initiated analytical studies related to the Comprehensive Nuclear Fuel Services (CFS) approach to limit incentives for individual countries to acquire and/or develop capabilities involving sensitive nuclear technology, and 4) facilitated workshops between the United States and Japan on nuclear safety-related issues concerning the Fukushima nuclear power plants.

In FY 2012, INEC is progressing towards the following key milestones:

Milestone	Date
Conducted, with the Czech Republic, first regional Central Europe Nuclear Safety Workshop	Oct 2011
Initiated R&D collaboration projects with the Czech Republic through a bilateral technical workshop	Jan 2012
Facilitate workshops between the United States and Japan on nuclear safety-related issues concerning the Fukushima nuclear power plants	Feb 2012
Hold United States (U.S.).-Russia workshops on Element 3 of the Civil Nuclear Energy Action Plan	Mar 2012

Milestone	Date
Issue Economic, Policy, and Regulatory Reports supporting international engagement on CFS	Mar 2012
Hold annual review meetings for bilateral R&D Action Plans and International Nuclear Energy Research Initiative (INERI) projects	Sep 2012

Explanation of Changes

Funding request for INEC for FY 2013 is raised $17K over the FY 2012 enacted level.

Program Planning and Management

INEC conducts various internal and external reviews and audits to validate and verify program performance. Periodic program reviews evaluate progress against established plans. INEC holds periodic reviews, consistent with program management plans and project baselines, to ensure progress, cost, and schedule adherence, and responsiveness to program requirements. Internally, INEC provides continual management and oversight of its R&D coordination and other activities.

INEC has engaged its stakeholders to help define the appropriate scope of its program activities to support nuclear energy's role in meeting the nation's energy security and environmental goals. In addition, NE's international engagement activities are conducted in consultation and cooperation with a number of U.S. government organizations, including the National Nuclear Security Administration, National Security Council, and Department of State.

Strategic Management

In meeting the identified challenges to nuclear power, the Department will implement the following key strategies to more efficiently and effectively manage the program, thus putting the taxpayers' dollar to more productive use:

1. NE will leverage international resources and cooperate with other countries bilaterally and multilaterally to boost U.S. technical expertise in civil nuclear energy.
2. NE will partner with the private sector, national laboratories, universities, and international partners to support cooperative international R&D activities to support the safe and secure use of civilian nuclear power.

NE will work with DOE's Office of Policy and International Affairs, as well as other U.S. Government organizations, including the National Nuclear Security Administration, National Security Council, Department of State, and Department of Commerce to support the safe and secure international use of civilian nuclear power.

Subprogram Goals and Funding

INEC contributes to the Department's strategic goal of maintaining a vibrant U.S. science and engineering enterprise by helping NE R&D programs leverage funding and facilities to advance nuclear power as a resource capable of making major contributions to meeting the Administration's energy, environment, security and economic objectives.

NE has developed and published as part of its R&D Roadmap four goals that guide program planning and execution. These goals provide a concrete framework for NE's activities and link NE activities to the Department's strategic priorities:

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable nuclear fuel cycles
- Understand and minimize the risks of nuclear proliferation and terrorism.

Goal Areas by Subprogram

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4. Non-Proliferation
International Nuclear Energy Cooperation				
International Nuclear Energy Cooperation	20%	20%	0%	60%
Subtotal, International Nuclear Energy Cooperation	20%	20%	0%	60%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	2012 Enacted	FY 2013 Request	FY 2013 Request vs. FY 2012 Enacted
International Nuclear Energy Cooperation			
No significant changes reflected.			
	2,983	3,000	+17
TOTAL Funding Change, International Nuclear Energy Cooperation	2,983	3,000	+17

International Nuclear Energy Cooperation
Overview

The requested funding would support INEC's role as overall lead for all NE international activities, including analysis, development, and implementation of international civil nuclear energy policy and coordination and integration of NE's international nuclear technical activities. These activities support international bilateral and multilateral engagement and civil nuclear energy R&D activities with countries with an established or planned civilian nuclear power sector. INEC may also employ workshops to engage industry and foreign governments on international civil nuclear issues such as financing, safety, or comprehensive nuclear fuel services.

Benefits

The potential benefits of INEC include:

Coordination:

- Serves as overall lead for NE in integrating and coordinating international cooperative R&D activities.
- Strategically integrates ongoing bilateral and multilateral engagement in various forums, such as the International Framework for Nuclear Energy Cooperation and the International Atomic Energy Agency, that support NE's and USG overall priorities for civil nuclear energy.
- Supports international discussion of a comprehensive nuclear fuel services approach that could offer economic benefits to countries seeking nuclear power and alternatives to indigenous deployment of sensitive nuclear technologies.
- Supports the President's export, job-creation, energy, and climate objectives through support of U.S. commercial nuclear exports.

Policy:

- Provides policy advice and support to DOE and other federal agencies engaging in international civil nuclear activities both bilaterally and multilaterally, including with the International Atomic Energy Agency.
- Supports Department of Commerce advocacy for U.S. nuclear industry in foreign tenders.
- Advances international dialogue and cooperation on nuclear safety.

Nonproliferation:

- Serves as overall coordinator for NE implementation activities related to understanding and minimizing the risks of nuclear proliferation and terrorism in support of NE R&D Roadmap Objective 4.
- Coordinates NE's international activities with the National Nuclear Security Administration, the Department of State, and the National Security Council to ensure U.S. nonproliferation requirements are met.
- Advances the international dialogue bilaterally and multilaterally on commercially-based comprehensive nuclear fuel services that encourage states to forego the indigenous development of sensitive technologies.

Funding Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	• Developed and implemented new bilateral cooperation programs with Argentina, Brazil, the Czech Republic, India, and Kazakhstan. • Advanced nuclear safety probabilistic safety assessment work with China. • Initiated analytical studies on the CFS approach.	2,994
FY 2012	• Continue to enable bilateral and multilateral collaboration with advanced and developing nuclear energy countries. • Support the development of new collaboration projects with developing nuclear energy countries. • Further engage with international partners on comprehensive nuclear fuel services concepts; continue analytical studies to support this engagement. • Increase attention to international nuclear safety collaboration.	2,983
FY 2013	• Continue existing cooperation efforts with advanced and developing nuclear energy	3,000

Fiscal Year	Activity	Funding (Dollars in Thousands)
	countries. • Implement R&D action plan with Argentina and Brazil. • Potential establishment of Joint Coordinating Committee with South Africa. • Expand expert exchanges and joint work with Kazakhstan. • Continue international collaboration on nuclear safety. • Develop international agreement on comprehensive nuclear fuel services concepts.	

Idaho Sitewide Safeguards & Security
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Idaho Sitewide Safeguards & Security			
Protective Forces	0	0	56,250
Security Systems	0	0	11,289
Information Security	0	0	1,648
Personnel Security	0	0	4,761
Material Control & Accountability	0	0	4,749
Program Management	0	0	5,593
Cyber Security	0	0	10,710
Total, Idaho Sitewide Safeguards & Security	0[a]	0[a]	95,000

[a] Funding for FY 2011 and FY 2012 provided within the Other Defense Activities (ODA) Appropriation.

Public Law Authorizations

P.L. 112-10, Department of Defense and Full-Year Continuing Appropriations Act, 2011

P.L. 112-74, Consolidated Appropriations Act, 2012

Overview

The Idaho Sitewide Safeguards and Security (S&S) program supports the Idaho National Laboratory (INL) complex nuclear facility infrastructure and enables the Office of Nuclear Energy (NE) to conduct research and development in support of multiple program missions. In an effort to better align the S&S funding with INL infrastructure and R&D programs, the S&S program is being requested under the Nuclear Energy appropriation in FY 2013.

The S&S program funds all physical and cyber security activities for the INL, providing protection of the Department of Energy's (DOE) nuclear materials, classified and unclassified matter, Government property, personnel and other vital assets from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts that may cause unacceptable adverse impacts on our national security; program continuity; or the health and safety of employees, the public, or the environment.

The S&S program at the INL benefits the site infrastructure and users by providing the safeguards and security functions required at DOE sites to enable research and development (R&D) utilizing nuclear materials and protected information. In addition to the Office of Nuclear Energy R&D activities, S&S enables a range of national security technology programs that support the National Nuclear Security Administration (NNSA) and other Federal agencies including the Department of Homeland Security in the areas of critical infrastructure protection and nuclear nonproliferation. Safeguards and security functions are also provided through the INL S&S program which enables the Department of the Army, the Department of the Navy and NNSA Naval Reactors missions.

In order to maximize the benefits of nuclear security, the S&S program will work in FY 2013 to address the following challenges:

- Develop Department and program specific long-term nuclear materials management plans that address operational demand, on-site storage/consolidation and disposition.
- Develop implementation strategies for new or evolving Federal and DOE specific physical and cyber security requirements.
- Modernize and maintain physical and cyber security infrastructure, systems and equipment.

Subprogram Accomplishments & Milestones

While under the Other Defense Activities (ODA) appropriation prior to FY 2013, S&S achieved significant accomplishments through risk informed decision making resulting in increased program effectiveness. Accomplishments include: 1) Successful negotiation of a 5-year protective force labor agreement; 2) Installation of advanced technology enhancing capabilities such as the Vehicle Explosives Detection System in lieu of increased manpower; and 3) Successful completion of cyber security system certification and accreditation, risk management, risk planning, policy, procedure, and technical implementation survey.

In FY 2012, Idaho Sitewide S&S, which is funded in the Other Defense Activities appropriation, is working towards the following key milestones:

Milestone	Date
Complete cyber security Certification and Accreditation (C&A) of unclassified moderate enclaves	Jan 2012
Purchase and install Security System/Access Control equipment	Sep 2012
Update Site Specific Security Plan	Sep 2012
Complete implementation of classified cyber risk assessments with improved methodology	Sep 2012

Explanation of Changes

The Department requests $95 million in Fiscal Year 2013 for S&S within the Nuclear Energy Appropriation, which is a 1.76 percent increase over the enacted FY 2012 level of $93.35M for the program within the Other Defense Activities Appropriation.

Subprogram Planning and Management

The goal of the INL Sitewide S&S program is to maintain, with high confidence, a robust, highly-effective, efficient, and cost-effective safeguards and security operational strategy aligned with site-specific characteristics and the DOE and NE missions. The S&S operations strategy is outlined in INL Site-Specific Security Plan to limit adverse effects on INL operations, assets and personnel.

The FY 2013 budget request supports the S&S program by providing funds for investments in infrastructure and cyber security activities while maintaining stable manning levels and labor costs. To ensure a robust and cost effective program NE conducts periodic reviews of the S&S program and supports independent reviews and inspections.

As in the FY 2012 request, the FY 2013 submission provides direct funding for the S&S base program for NE. Base program costs determined to be allocable, i.e., beneficial to Work for Others (WFO) will be paid by WFO via full cost recovery. The costs for WFO-specific security requirements beyond the S&S base program that are specifically requested or driven by the WFO project will be directly charged to those customers as appropriate.

Estimate of Security Cost Recovered by Nuclear Energy, Idaho Sitewide Safeguards and Security

(Dollars in Thousands)

	FY 2011	FY 2012	FY 2013
Idaho National Lab. (INL)	0	2,939	3,000
Total, INL	0	2,939	3,000

Strategic Management

In meeting the identified challenges to nuclear security, the Department will implement three key strategies to more effectively manage the Idaho Sitewide S&S program, thus putting the taxpayers' dollar to more productive use.

1. Conduct peer reviews, self assessments, and benchmark studies to identify cost-effective opportunities to implement comprehensive risk-based approaches that address changing threats and requirements for both physical and cyber security.
2. Utilize the authority requested and granted in the FY 2012 request to charge Work for Other (WFO) customers and other users that drive base S&S costs.
3. NE and INL operational programs have developed and implemented nuclear material consolidation and disposition plans to reduce total material holds and storage locations over the next 5-7 years. S&S will ultimately realize efficiencies from completion of these activities.

Three external factors present the strongest potential impacts on the overall achievement of the program's strategic goal:

- New and/or evolving DOE Orders impacting physical security requirements.
- New and/or evolving DOE Orders and Federal requirements impacting cyber security.
- Ability of external programs/organizations to meet commitments identified in the INL material consolidation and disposition plan.

Subprogram Goals and Funding

U.S. Department of Energy Strategic Plan/ Office of Nuclear Energy Research and Development Roadmap Goal: Energy Security.

The Idaho Sitewide S&S program supports Department's goal of Energy Security by protecting INL facilities and infrastructure, enabling NE to conduct research and development (R&D) in support of multiple program missions.

U.S. Department of Energy Strategic Plan: Nuclear Security

The Idaho Sitewide S&S program supports the Department's Security Goal to "*enhance nuclear security through defense, nonproliferation, and environmental efforts"* by securing the Idaho National Laboratory (INL) complex and enabling a safe and secure environment to conduct NE R&D as well as other Departmental R&D in the areas of defense and nonproliferation.

Goal Areas by Activities

	1. Extend Life of Current Reactors	2. Enable New Reactors	3. Sustainable Nuclear Fuel Cycles	4.Nonproliferation
Idaho Sitewide Safeguards and Security				
Protective Forces	25%	25%	25%	25%
Security Systems	25%	25%	25%	25%
Information Security	25%	25%	25%	25%
Personnel Security	25%	25%	25%	25%
MC&A	25%	25%	25%	25%
Program Management	25%	25%	25%	25%
Cyber Security	25%	25%	25%	25%
Subtotal, Idaho Sitewide Safeguards and Security	25%	25%	25%	25%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Protective Forces			
The increase from $0 to $56,250,000 reflects the transfer of Idaho Sitewide S&S account from Other Defense Activities to the Nuclear Energy Appropriation and a net increase of $1,372,000 from FY 2012. The increase provides funds to maintain protective force levels for key INL facilities consistent with the approved site labor wage agreement and to replace protective force equipment that is at the end of life.	0	56,250	+56,250
Security Systems			
The increase from $0 to $11,289,000 reflects the transfer of Idaho Sitewide S&S account from Other Defense Activities to the Nuclear Energy Appropriation and a net increase of $383,000 from FY 2012. The increase provides funds to maintain security system reliability through critical maintenance and end of life equipment replacement.	0	11,289	+11,289
Information Security			
The increase from $0 to $1,648,000 reflects the transfer of Idaho Sitewide S&S account from Other Defense Activities to the Nuclear Energy Appropriation and a net increase of $32,000 from FY 2012.	0	1,648	+1,648
Personnel Security			
The increase from $0 to $4,761,000 reflects the transfer of Idaho Sitewide S&S account from Other Defense Activities to the Nuclear Energy Appropriation and a net increase of $60,000 from FY 2012.	0	4,761	+4,761
Material Control & Accountability			
The increase from $0 to $4,749,000 reflects the transfer of Idaho Sitewide S&S account from Other Defense Activities to the Nuclear Energy Appropriation and a net decrease of $517,000 from FY 2012. The decrease reflects the completion of one-time equipment replacement activities.	0	4,749	+4,749

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Program Management			
The increase from $0 to $5,593,000 reflects the transfer of Idaho Sitewide S&S account from Other Defense Activities to the Nuclear Energy Appropriation and a net increase of $110,000 from FY 2012. The increase supports performance assurance activities (table top exercise, simulations, self-assessments, limited scope performance tests and force-on-force exercises) required to implement the revised Graded Security Protection policy.	0	5,593	+5,593
Cyber Security			
The increase from $0 to $10,710,000 reflects the transfer of Idaho Sitewide S&S account from Other Defense Activities to the Nuclear Energy Appropriation and a net increase of $210,000 from FY 2012. The increase maintains cyber security systems consistent with the Department's measured risk management and vulnerability management strategies, enabling the ability to respond to continuous changing requirements to protect classified and sensitive information from constant cyber attacks.	0	10,710	+10,710
TOTAL Funding Change, Idaho Sitewide Safeguards and Security Program	0	95,000	+95,000

Protective Forces
Overview

Protective Force provides security police officers (SPO's) and other specialized personnel, equipment, training, and management needed during normal and security emergency conditions for adequate protection of Special Nuclear Material (SNM), classified and sensitive information, Government property and personnel. Protective force personnel are deployed 24 hours a day 7 days a week across the 890 square miles of the INL site to deter, detect, delay and respond to adversarial threats. Funding needs are based on protection strategies designed to ensure adequate protective force staffing levels, equipment, facilities, training, management and administrative support are available to respond to any security incident outlined in Site-Specific Security Plans.

Benefits

Idaho Sitewide S&S enables work with SNM at the INL supporting NE R&D and INL activities.

- Fuel Cycle Development
- Reduced Enrichment Research & Test Reactors (RERTR)
- Space Defense and Power Systems
- Idaho Facilities Management Material Consolidation and Disposition Activities

Idaho Sitewide S&S also enables work with SNM and classified matter at the INL supporting R&D and other activities for a broad national security customer base including the Department of the Navy, Department of the Army, Department of Homeland Security, and the National Nuclear Security Administration.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2012	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2013	Provides funds to maintain a protective force consistent with the Site Specific Security Plan and approved site labor wage agreement, and associated training activities, including facilities, required to maintain protective force weapon qualifications. Funding also provides the purchase replacement protective force equipment such as ammunition, weapons, and protective gear that is at the end of life cycle.	56,250

Security Systems
Overview

Security Systems provides equipment to protect vital security interests and Government property, including performance testing, intrusion detection and assessment, entry and search control, barriers, secure storage, lighting, sensors, entry/access control devices, locks, explosives detection, and tamper-safe monitoring. Security Systems provides maintenance of approximately 4,600 security alarms and 6,100 security locks at multiple INL security areas ensuring 24 hour a day, 7 days a week operation of these systems. Maintaining a reliable physical security infrastructure allows the Idaho Sitewide S&S program to maintain consistent/lower staffing levels and lower labor costs.

Benefits

Idaho Sitewide S&S enables work with SNM at the INL supporting NE R&D and INL activities.

- Fuel Cycle Development
- Reduced Enrichment Research & Test Reactors (RERTR)
- Space Defense and Power Systems
- Idaho Facilities Management Material Consolidation and Disposition Activities

Idaho Sitewide S&S also enables work with SNM and classified matter at the INL supporting R&D and other activities for a broad national security customer base including the Department of the Navy, Department of the Army, Department of Homeland Security, and the National Nuclear Security Administration.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2012	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2013	Provides funds to plan and conduct preventative and corrective maintenance on approximately 4,600 security alarms and 6,100 security locks at multiple INL security areas to ensure 24 hour operation of these systems, including the replacement of badge readers and security screening equipment that have exceeded useful life Funds also support the operation of INL central alarm stations which monitor security area access and development/modification of security alarm systems to maintain compliance with Departmental Requirements.	11,289

Information Security
Overview

Information Security provides for the protection and control of classified and sensitive matter that is generated, received, transmitted, used, stored, reproduced or destroyed at the INL. The Classified Matter Protection and Control Program and Operations Security Program ensure that classified and sensitive unclassified matter is appropriately managed and adequately protected and controlled to prevent access by unauthorized individuals and that those individuals that do have access are trained to handle classified matter. Information Security executes the Technical Security Countermeasures (TSCM) program and conducts TSCM surveys.

Benefits

Idaho Sitewide S&S enables work with SNM at the INL supporting NE R&D and INL activities.

- Fuel Cycle Development
- Reduced Enrichment Research & Test Reactors (RERTR)
- Space Defense and Power Systems
- Idaho Facilities Management Material Consolidation and Disposition Activities

Idaho Sitewide S&S also enables work with SNM and classified matter at the INL supporting R&D and other activities for a broad national security customer base including the Department of the Navy, Department of the Army, Department of Homeland Security, and the National Nuclear Security Administration.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Funding for this activity was requested under the Other Defense Appropriation.	0
FY 2012	Funding for this activity was requested under the Other Defense Appropriation.	0
FY 2013	Provides funds to implement INL information security activities to protect classified and sensitive unclassified matter, including the following programs: Classified Matter and Control, Technical Surveillance Countermeasure, Classification/ Declassification, and Operations Security. Funds also support coordination activities with INL R&D programs to develop project-specific security requirements within the context of the overall INL information security program.	1,648

Personnel Security
Overview

Personnel Security provides for access to classified and sensitive information and assignment of personnel in sensitive positions through the clearance program, adjudication, security awareness and education, U.S. citizen and foreign visitor control, Human Reliability Program, psychological/medical assessments, and administrative review costs. Personnel security also provides for the annual cost to support the database that maintains smart card credentials for INL personnel and badging requirements.

Benefits

Idaho Sitewide S&S enables work with SNM at the INL supporting NE R&D and INL activities.

- Fuel Cycle Development
- Reduced Enrichment Research & Test Reactors (RERTR)
- Space Defense and Power Systems
- Idaho Facilities Management Material Consolidation and Disposition Activities

Idaho Sitewide S&S also enables work with SNM and classified matter at the INL supporting R&D and other activities for a broad national security customer base including the Department of the Navy, Department of the Army, Department of Homeland Security, and the National Nuclear Security Administration.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Funding for this activity was requested under the Other Defense Appropriation.	0
FY 2012	Funding for this activity was requested under the Other Defense Appropriation.	0
FY 2013	Provides funds to conduct INL personnel security programs including security investigations to determine the suitability of INL personnel for classified work, assessing requests for U.S and foreign researchers to work in selected sensitive subject areas, and maintaining databases that hold clearance information. Funds also support federal activities related to processing, tracking, and adjudication of security investigations for federal and non-federal employees, including medical examinations.	4,761

Material Control & Accountability
Overview

Material Control & Accountability (MC&A) provides the personnel, equipment, and services required to account for and control all special nuclear material (SNM) at INL from diversion. MC&A is accomplished through the administration of a robust formal inventory process for all SNM on site that allows INL security personnel to locate and track specific quantities in real time, state of the art measurement equipment, non-destructive analysis and a robust tamper indicating device program.

Benefits

Idaho Sitewide S&S enables work with SNM at the INL supporting NE R&D and INL activities.

- Fuel Cycle Development
- Reduced Enrichment Research & Test Reactors (RERTR)
- Space Defense and Power Systems
- Idaho Facilities Management Material Consolidation and Disposition Activities

Idaho Sitewide S&S also enables work with SNM and classified matter at the INL supporting R&D and other activities for a broad national security customer base including the Department of the Navy, Department of the Army, Department of Homeland Security, and the National Nuclear Security Administration.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2012	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2013	Provides funds to maintain the site's SNM database and tracking systems, coordinate on- and off-site material movements, and to conduct SNM inventories.	4,749

Program Management
Overview

Program Management includes policy oversight, development and update of site security plans; vulnerability assessments and performance testing to ensure adequate protection of SNM; and investigations into incidents of security concern and issuance of security infractions. The activities completed within Program Management allow for risk-informed decision making, support a performance-based S&S program and directly test the efficacy of the INL protection methodology/posture.

Benefits

Idaho Sitewide S&S enables work with SNM at the INL supporting NE R&D and INL activities.

- Fuel Cycle Development
- Reduced Enrichment Research & Test Reactors (RERTR)
- Space Defense and Power Systems
- Idaho Facilities Management Material Consolidation and Disposition Activities

Idaho Sitewide S&S also enables work with SNM and classified matter at the INL supporting R&D and other activities for a broad national security customer base including the Department of the Navy, Department of the Army, Department of Homeland Security, and the National Nuclear Security Administration.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2012	Funding for this activity was requested under the Other Defense Activities Appropriation.	0
FY 2013	Provides funds to maintain and update security program documentation, develop and implement plans to address new security requirements through a combination of table-top simulations and force-on-force exercises to assure program effectiveness and efficiency.	5,593

Cyber Security
Overview

Cyber Security maintains the computing infrastructure and network security configuration necessary to support classified and unclassified information and electronic operations at the INL. The Cyber Security program uses a graduated risk approach based on data sensitivity and impact of loss/ compromise to ensure that electronic or computer information systems, are protected in a manner consistent with upholding key priorities, including importance to national security, support of DOE missions and programs, vulnerability to threats, and the magnitude of harm that would result from an information system compromise.

Benefits

Idaho Sitewide S&S enables work with SNM at the INL supporting NE R&D and INL activities.

- Fuel Cycle Development
- Reduced Enrichment Research & Test Reactors (RERTR)
- Space Defense and Power Systems
- Idaho Facilities Management Material Consolidation and Disposition Activities

Idaho Sitewide S&S also enables work with SNM and classified matter at the INL supporting R&D and other activities for a broad national security customer base including the Department of the Navy, Department of the Army, Department of Homeland Security, and the National Nuclear Security Administration.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Funding for this activity was requested under the Other Defense Appropriation.	0
FY 2012	Funding for this activity was requested under the Other Defense Appropriation.	0
FY 2013	Provides funds to operate, test, and maintain cyber security systems for 8 INL enclaves consistent with the Department's measured risk management and vulnerability management strategies. Funds also support certification and accreditation activities for classified cyber security systems and INL training programs to educate users on cyber security strategies.	10,710

Capital Equipment, General Plant Projects, and Construction Summary

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Capital Equipment	0	0	1,100
General Plant Projects	0	0	250
Construction	0	0	0
Total, Idaho Sitewide Safeguards and Security	0	0	1,350

Program Direction
Funding Profile by Category

(Dollars in Thousands/Whole FTEs)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Idaho Operations Office			
Salaries and Benefits	25,886	26,158	23,799
Travel	1,016	1,027	1,027
Support Services	1,035	1,046	1,046
Other Related Expenses	5,512	5,264	5,264
Total, Idaho	33,449	33,495	31,136
Full Time Equivalents	184	197	187
Radiological and Environmental Sciences Laboratory			
Salaries and Benefits	2,538	2,565	2,592
Travel	66	67	68
Support Services	263	266	269
Other Related Expenses	2,631	2,358	2,383
Total, Idaho	5,498	5,256	5,312
Full Time Equivalents	19	19	19
Oak Ridge			
Salaries and Benefits	1,060	1,071	1,076
Travel	20	20	20
Support Services	252	255	257
Other Related Expenses	288	291	301
Total, Oak Ridge	1,620	1,637	1,654
Full Time Equivalents	8	8	8
Nevada Site Office			
Salaries and Benefits	0	3,098	3,113
Travel	0	100	101
Support Services	0	500	505
Other Related Expenses	0	537	560
Total, Nevada Site Office	0	4,235	4,279
Full Time Equivalents	0	18	18
Headquarters Operations			
Salaries and Benefits	32,749	31,787	30,963
Travel	1,524	1,539	1,555
Support Services	4,768	4,928	4,980
Other Related Expenses	6,671	8,123	10,136
Total, Headquarters Operations	45,712	46,377	47,634
Full Time Equivalents	156	184	184
Grand Total			
Salaries and Benefits	62,233	64,679	61,543
Travel	2,626	2,753	2,771
Support Services	6,318	6,995	7,057
Other Related Expenses	15,102	16,573	18,644
Total, Headquarters Operations	86,279	91,000	90,015
Full Time Equivalents	367	426	416

Overview

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Nuclear Energy (NE). Included is funding for federal personnel from NE; coordination of the Energy portfolio by the Office of the Under Secretary for Energy; and the Office of the General Counsel and Energy Information Administration responsible for administrative and judicial litigation associated with ending of the Yucca Mountain Nuclear Waste Repository project, legal issues related to the standard contract, and the Department's responsibilities regarding spent fuel and high level waste as specified by the Nuclear Waste Policy Act (NWPA).

It also includes travel funding for transportation of HQ and Operations Office personnel, their per diem allowances while in authorized travel status, and other expenses incidental to travel. The use of support services allows the Department to cost-effectively hire the best available industry experts to assist federal staff in managing the nuclear programs and complex activities. In addition to rapidly acquiring this expertise on an as needed basis, using support services provides unlimited flexibility in team composition as the needs of NE evolve. Finally, Other Related Expenses provides NE's contribution to the Department's Working Capital Fund (WCF) for common administrative services at HQ. DOE is working to achieve economies of scale through an enhanced Working Capital Fund (WCF). The WCF increase covers certain shared, enterprise activities including enhanced cyber security architecture, employee health and testing services, and consolidated training and recruitment initiatives

In addition to appropriated funds, NE also manages approximately $91 million dollars annually in work for others and reimbursable funding from the National Aeronautics and Space Administration and the Department of Defense for the development of advanced radioisotope power systems for space exploration and national security missions.

The Program Direction request reflects NE's continued attempts to optimize support for its federal workforce, while continuing to improve efficiency and cost-effectiveness and ensure the expert federal management and oversight of NE mission activities. Currently, 27 percent of the NE workforce will be eligible to retire and an additional five percent will be eligible by the end of FY 2013, presenting a significant challenge to succession planning. Over the past several years, NE has been addressing the issue of an aging workforce through the recruitment of appropriately skilled entry-level engineering, scientific, and administrative positions. The FY 2013 request is flat lined from FY 2012, reflecting efficiencies to be realized in all activity areas.

Major Program Shifts or Changes

None.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs FY 2011
Salaries and Benefits			
The decrease of $3.136 million reflects expected savings from personnel realignments to be executed in FY 2012 and FY 2103.	64,679	61,543	-3,136
Travel			
No significant changes.	2,753	2,771	+18
Support Services			
No significant changes.	6,995	7,057	+62
Other Related Expenses			
The increase of $2.071 million reflects increased HQ working capital fund charges, primarily for the Cyber-One and Overseas Representation Support business lines.	16,573	18,644	+2,071
Total Funding Change, Program Direction	91,000	90,015	-985

Support Services by Category

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Technical Support Services			
Feasibility of Design Considerations	1,214	1,325	1,335
Development of Specifications	445	475	485
System Definition	0	0	0
System Review and Reliability Analysis	0	0	0
Trade-Off Analysis	0	0	0
Economic and Environmental Analysis	407	450	455
Test and Environmental Studies	0	0	0
Surveys or Reviews of Technical Operations	650	750	760
Total, Technical Support Services	2,716	3,000	3,035
Management Support Services			
Analysis of Workload and Workflow	0	0	0
Directive Management Studies	0	0	0
Automatic Data Processing	1,700	1,825	1,830
Manpower Systems Analysis	335	425	430
Preparation of Program Plans	225	295	302
Training and Education	156	200	200
Analysis of DOE Management Processes	0	0	0
Reports and Analyses Management and General Administrative Support	1,186	1,250	1,260
Total, Management Support Services	3,602	3,995	4,022
Total, Support Services	6,318	6,995	7,057

Other Related Expenses by Category

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Rent to GSA	65	66	66
Rent to Others	0	0	0
Communication, Utilities, Misc.	1,331	1,345	1,345
Printing and Reproduction	56	57	57
Other Services	5,805	6,193	6,427
Training	394	398	400
Purchases from Gov. Accounts	0	0	0
Operation and Maintenance of Equipment	2,735	2,764	2,774
Supplies and Materials	1,075	1,086	1,092
Equipment	0	0	0
Working Capital Fund	3,641	4,664	6,483
Total, Other Related Expenses	15,102	16,573	18,644

Fossil Energy Research and Development

Fossil Energy Research and Development

Table of Contents

Fossil Energy Research and Development

Proposed Appropriation Language

For necessary expenses in carrying out fossil energy research and development activities, under the authority of the Department of Energy Organization Act (Public Law 95-91), including the acquisition of interest, including defeasible and equitable interests in any real property or any facility or for plant or facility acquisition or expansion, and for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs (30 U.S.C. 3, 1602, and 1603), $420,575,000, to remain available until expended: Provided, That $115,753,000 shall be available until September 30, 2014 for program direction: Provided further, That for all programs funded under Fossil Energy appropriations in this Act or any other Act, the Secretary may vest fee title or other property interests acquired under projects in any entity, including the United States.

Fossil Energy
Office of Fossil Energy

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted[a]	FY 2013 Request
Fossil Energy Research and Development			
Coal	389,688	368,395	275,869
Natural Gas Technologies	0	14,991	17,000
Unconventional Fossil Energy Technologies	0	4,997	0
Program Direction	164,725	119,929	115,753
Plant & Capital Equipment	19,960	16,794	13,294
FE Environmental Restoration	9,980	7,897	5,897
Special Recruitment Programs	699	700	700
Subtotal, Fossil Energy Research and Development	585,052	533,703	428,513
Rescission of Prior Year Balances	-140,000	-187,000	0
Use of Prior Year Balances	-11,000	0	-7,938
Total, Fossil Energy Research and Development	**434,052**	**346,703**	**420,575**
Clean Coal Technology (CCT)			
Rescission of Prior Year Balances	-16,500	0	0
Total, Clean Coal Technology (CCT)	**-16,500**	**0**	**0**
Strategic Petroleum Reserve	209,441	192,704	195,609
Use of Prior Year Balances	0	0	0
Rescission of Prior Year Balances	-86,300	0	0
Total, Strategic Petroleum Reserve	**123,141**	**192,704**	**195,609**
Northeast Home Heating Oil Reserve	10,978	10,119	10,119
Northeast Home Heating Oil Rescission of Prior Year Balances	0	0	-6,000
Subtotal, Northeast Home Heating Oil Reserve	10,978	10,119	4,119
Northeast Home Heating Oil Reserve Cancellation	0	-100,000	0
Total, Northeast Home Heating Oil Reserve	**10,978**	**-89,881**	**4,119**
Elk Hills School Land Fund	**0**	**0**	**15,580**
Naval Petroleum and Oil Shale Reserves	22,954	14,909	14,909
Rescission of Prior Year Balances	-2,100	0	0
Total, Naval Petroleum and Oil Shale Reserves	**20,854**	**14,909**	**14,909**
Total, Fossil Energy Appropriation	**572,525**	**464,435**	**650,792**

[a] FY 2012 Enacted column reflects a rescission of $297K associated with savings from the contractor pay freeze.

Office Overview and Accomplishments

The Office of Fossil Energy (FE) advances technologies related to the reliable, efficient, affordable, and environmentally sound use of fossil fuels which are essential to our Nation's security and economic prosperity. FE leads Federal research, development, and demonstration efforts on advanced carbon capture and storage (CCS) technologies required to overcome the barriers to widespread, cost-effective deployment of CCS by 2020. FE also leads Federal efforts to ensure prudent development of our domestic oil and natural gas resources through scientific assessment of the risks that exploration and production activities entail and the development of appropriate technologies and processes to mitigate these risks. These Fossil Energy Research and Development (FER&D) programs create public benefits by 1) performing and managing research that reduces market barriers to the environmentally sound use of fossil fuels, 2) partnering with industry and others to advance fossil energy technologies toward commercialization, and 3) supporting the development of information and policy options that benefit the public.

In addition to its Research, Development and Deployment (RD&D) mission, FE also manages the Strategic Petroleum Reserve (SPR), the SPR Petroleum Account, the Northeast Home Heating Oil Reserve (NEHHOR), and the Naval Petroleum and Oil Shale Reserves (NPOSR). The SPR provides strategic and economic security against foreign and domestic disruptions in U.S. oil supplies via an emergency stockpile of crude oil. The program fulfills U.S. obligations under the International Energy Program, which avails the U.S. of International Energy Agency assistance through its coordinated energy emergency response plans, and provides a deterrent against energy supply disruptions. The SPR Petroleum Account funds all SPR petroleum inventory acquisitions, associated transportation costs, U.S. Customs duties, terminal throughput charges and other related miscellaneous costs. During an emergency drawdown and sale, the SPR Petroleum Account is the source of funding for the incremental costs of withdrawing oil from the storage caverns and transporting it to the point where purchasers take title. The NEHHOR provides an emergency supply of home heating oil to protect the Northeast against the high vulnerability of winter-related supply shortages. NPOSR continues to close out legal responsibilities of environmental remediation at Naval Petroleum Reserves No. 1 (NPR-1) and disposition activities, including environmental remediation, at Naval Petroleum Reserves No. 3 (NPR-3).

Within the FER&D Appropriation, FE funds the Office of Clean Coal focused on advancing CCS, and the Office of Oil and Natural Gas focused on unconventional gas onshore and deepwater operations offshore. The NPOSR program will continue Rocky Mountain Oilfield Testing Center testing for 100% participant funded projects and those projects wholly funded by EERE's Geothermal Technology Program.

In 2011 FE achieved significant accomplishments in program management and program development.

Accomplishments include:

COAL: Summit Clean Energy (Texas) project, an Integrated Gasification Combined Cycle (IGCC) power plant that will capture 90% of its carbon dioxide emissions, has signed term sheets/agreements to sell the power and urea. The project is scheduled to break ground in FY 2012.

OIL&GAS: FE continued to study hydrates in the arctic via controlled in-situ depressurization and carbon dioxide injection and drilled a fully instrumented hydrate well in Alaska. In addition, public disclosure of chemicals used in hydraulic fracturing of oil and gas wells was improved and State environmental programs strengthened.

SPR: The SPR maintained an emergency petroleum stockpile to protect the Nation's Energy Security, and completed the replacement of an existing storage cavern at its Bayou Choctaw site that posed a major environmental risk.

Alignment to Strategic Plan

The Department's May 2011 Strategic Plan articulates DOE's first goal to catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies, supported by primary objectives to 1) deploy the technologies we have, 2) discover the new solutions we need, and 3) lead the National conversation on energy.

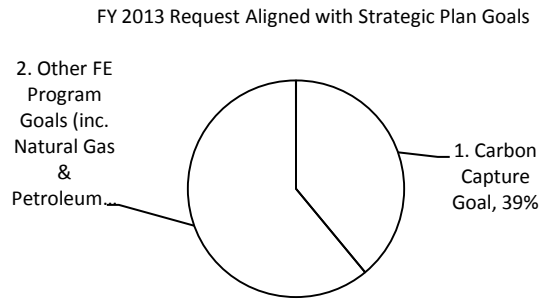
The Office of Fossil Energy's R&D mission supports achievement of this DOE goal, and FE is directly accountable for achieving several targeted outcomes specifically identified in the Strategic Plan, including:

- To bring at least five commercial-scale carbon capture and storage (CCS) demonstrations online by 2016.

- Use research and development results of laboratory through pilot-scale tests to show, through engineering and systems analyses studies, 90% CO_2 capture of advanced post-combustion and pre-combustion capture technologies with potential for no more than a 35% increase in the levelized cost of electricity for post-combustion and no more than a 10% increase in the levelized cost of electricity for pre-combustion when compared to a reference power plant without CO_2 capture and storage.

In addition to targeting these specific outcomes, FER&D efforts are fully aligned with the DOE Strategic Plan to enable prudent development of our natural resources, accelerate energy innovation through precompetitive R&D, leverage domestic and international partnerships, and help to sustain a world-leading technical workforce. In order to achieve these targeted outcomes and support the overall DOE mission and goals, FE has established the following FE Programmatic Goals:

- Enable commercial baseload CCS deployment by 2020 through advanced technology research, development, and demonstration.
- Create a Natural Gas Program to fund recommendations from SEAB Shale Gas Production Subcommittee and DOI Ocean Energy Safety Advisory Committee to ensure prudent development of our oil and gas resources.
- Project American leadership in Fossil Energy technologies through active participation and collaboration with the international community. Continue the momentum for carbon capture and storage (CCS) in multilateral organizations including International Energy Agency (IEA), United Nations, World Energy Council (WEC), and the Carbon Sequestration Leadership Forum and bilaterals with key countries such as China and India.



Explanation of Changes

The Department's Office of Fossil Energy requests $650.792 million in FY 2013, which is a 36% increase over the enacted FY 2012 level. However, the FY 2012 level reflects offsets of $273,000 from rescission of prior year balances and cancellations. Without these offsets in FY 2012, the FY 2013 request would represent a 15% reduction from FY 2012 funding levels.

The Office of Fossil Energy's FY 2013 Budget will:

- Focus on near term critical CCS for clean coal.
- Together in coordination with the Department of the Interior and the Environmental Protection Agency, continue a priority R&D initiative begun in 2012 to understand and minimize the potential environmental, health, and safety impacts of gas development including hydraulic fracturing (fracking).
- Conduct the Gas Hydrates project.
- Maintain an SPR to protect the Nation against potential disruptions in its critical petroleum supplies (foreign or domestic) and fulfill its obligations under the International Energy Program.
- Maintain a NEHHOR with 1 million barrels of Ultra Low Sulfur Diesel to protect the Northeast against high vulnerability of winter-related supply shortages.
- Continue NPOSR legal responsibilities of environmental remediation at NPR-1 (Elk Hills, CA) and NPR-3 (Casper, WY) sites and initiate disposition plans for NPR-3. Environmental remediation of NPR-3 facilities will focus on activities that facilitate the sale/disposition of the property.
- Make the final payment to compensate the State of California for its claim to title to two sections of land within NPR-1.

The program is well balanced between R&D and demonstrations for early deployment of CCS with a robust program in R&D and CCS demos that will help identify the operation and integration challenges. R&D is focused on technologies that can lower the cost of capture and in parallel develop technical foundation for safe and effective long-term geologic storage of CO_2.

The FY 2013 request decreases the levels for Coal (-$92.5M), Unconventional Fossil Energy Technologies (-$5M), Program Direction (-$4.2M), Plant and Capital Equipment (-$3.5M), and Environmental Restoration (-$2M).

Goal Program Alignment Summary

	Focus on near term critical CCS for clean coal.	Conduct natural gas research with USGS and EPA to understand and minimize the potential environmental, health, and safety impacts of gas development including hydraulic fracturing (fracking) and conduct Gas Hydrate activities.	Maintain an SPR with a readiness and capability to respond quickly and effectively to potential disruptions in U.S. petroleum supplies (foreign or domestic).	Maintain a NEHHOR with 1 million barrels of heating oil to protect the Northeast against high vulnerability of winter-related supply shortages.	Continue NPR legal responsibilities of environmental remediation at NPR-1 (Elk Hills, CA) and NPR-3 (Casper, WY) sites and initiate disposition of NPR-3.
Fossil Energy Appropriation					
Coal	100%	0%	0%	0%	0%
Natural Gas Technologies	0%	100%	0%	0%	0%
Strategic Petroleum	0%	0%	100%	0%	0%
Northeast Home Heating Oil Reserve	0%	0%	0%	100%	0%
Naval Petroleum & Oil Shale Reserves	0%	0%	0%	0%	100%
Subtotal, Fossil Energy Appropriation	39%	1%	29%	1%	2%

Strategic Plan and Performance Measures

Subprogram: Carbon Capture

STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.		
OBJECTIVE: Discovering the New Solutions We Need		
TARGETED OUTCOME: CO_2 capture at no more than a 35% increase in levelized cost of electricity when compared to a reference power plant		
FY 2012 Annual Measure[a] #1: Conduct laboratory through pilot-scale tests of advanced post-and oxy-combustion capture technologies that show, through engineering and systems analyses studies, 90% CO_2 capture at no more than a 50% increase in levelized cost of electricity when compared to a reference power plant without CO_2 capture and storage.		
	Target	Actual/ Met or Not Met
Budget Year (FY 2013)	No more than a 45% increase in LCOE	TBD
Current Year (FY 2012)	No more than a 50% increase in LCOE	TBD
Prior Year (FY 2011)	No more than a 55% increase in LCOE	MET
Analysis	Achieving the target shows Coal Program R&D is continuing to make progress in meeting its goal of developing cost-effective, reliable CCS technologies for post-combustion and oxy-combustion capture applications.	
OBJECTIVE: Discovering the New Solutions We Need		

[a] For Performance History or Verification and Validation information for this Annual Measure, please follow the hyperlink to the Annual Performance Measure at http://www.cfo.doe.gov.

TARGETED OUTCOME: CO_2 capture at no more than a 10% increase in levelized cost of electricity when compared to a reference power plant		
FY 2012 Annual Measure #2 : Conduct laboratory through pilot-scale tests of technology components of Advanced Energy Systems with pre-combustion capture that show, through engineering and systems analyses studies, 90% CO_2 capture at no more than a 13% increase in levelized cost of electricity when compared to a reference power plant without CO_2 capture and storage.		
	Target	Actual/ Met or Not Met
Budget Year (FY 2013)	No more than a 12% increase in LCOE	TBD
Current Year (FY 2012)	No more than a 13% increase in LCOE	TBD
Prior Year (FY 2011)	No more than a 14% increase in LCOE	Met
Analysis	Achieving the target shows Coal Program R&D is continuing to make progress in meeting its goal of developing cost-effective, reliable CCS technologies for IGCC and pre-combustion capture applications.	

Subprogram: Carbon Storage

STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.		
OBJECTIVE: Discovering the New Solutions We Need		
TARGETED OUTCOME: Since January 1, 2009, inject and cumulatively store 9.0 million metric tons of CO_2		
FY 2012 Annual Measure[b] #1: Inject 3.0 million (cumulative since 2009) metric tons of CO_2 in large-volume field test sites to demonstrate the formations' capacity to permanently, economically, and safely store carbon dioxide.		
	Target	Actual/ Met or Not Met
Budget Year (FY 2013)	4.0 million metric tons injected	TBD
Current Year (FY 2012)	3.0 million metric tons injected	TBD
Prior Year (FY 2011)	1.5 million metric tons injected	MET
Analysis	The injection of CO_2 in the field tests is critical to meeting the technical goals of the program to validate permanence and efficient use of the storage capacity. The field tests offer an opportunity in different geologic storage formation classes to test and history match a suite of off the shelf and advanced R&D technologies over the life of the facilities.	

Subprogram: Clean Coal Power Initiative

STRATEGIC GOAL: Catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.		
OBJECTIVE: Discovering the New Solutions We Need		
TARGETED OUTCOME: Initiate operations of at least three commercial scale CCS demonstrations by 2016.		
FY 2012 Annual Measure[c] #1: Initiate detailed design on at least one CCS demonstration project.		
	Target	Actual/ Met or Not Met
Budget Year (FY 2013)	Initiate construction of at least one CCS demonstration project	TBD
Current Year (FY 2012)	Initiate detailed design on at least one CCS demonstration project	TBD
Prior Year (FY 2011)	Complete Front End Engineering and Design (FEED) of at least one CCPI Round 3 project.	MET
Analysis	Initiate operations of five commercial scale CCS demonstrations including the Clean Coal Power Initiative (CCPI), FutureGen 2.0, and the Industrial CCS Demonstration projects (includes projects funded by both annual appropriations and the Recovery Act).	

[b] For Performance History or Verification and Validation information for this Annual Measure, please follow the hyperlink to the Annual Performance Measure at http://www.cfo.doe.gov.

[c] For Performance History or Verification and Validation information for this Annual Measure, please follow the hyperlink to the Annual Performance Measure at http://www.cfo.doe.gov.

Facilities Maintenance and Repair

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

Direct-Funded Maintenance and Repair

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
National Energy Technology Laboratory	23,730	21,345	19,397
Strategic Petroleum Reserve	35,206	33,133	35,208
Naval Petroleum and Oil Shale Reserve	930	1,370	900
Total, Direct-Funded Maintenance and Repair	59,866	55,848	55,505

Small Business Innovation Research/ Small Business Technology Transfer (SBIR/STTR)

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Carbon Capture	1,593	1,912	1,734
Carbon Storage	3,298	3,202	2,739
Advanced Energy Systems	3,979	2,771	1,583
Cross-cutting Research	749	1,188	789
Natural Gas	0	416	488
Unconventional Fossil Energy Technologies	0	138	0
Total, SBIR/STTR	9,619	9,627	7,333

Safeguards and Security

Total Office of Fossil Energy contributions in support of the Safeguards and Security program mission is $31.4M in FY 2011, $29.3M in FY 2012 and $28.1M in FY 2013.

Fossil Energy Research and Development
Office of Fossil Energy
Funding by Site by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Ames National Laboratory			
Coal	1,655	1,905	1,915
Total, Ames National Laboratory	1,655	1,905	1,915
Argonne National Laboratory (East)			
Coal	1,625	0	0
Total, Argonne National Laboratory (East)	1,625	0	0
Idaho National Engineering and Environmental Laboratory			
Coal	170	0	0
Total, Idaho National Engineering and Environmental Laboratory	170	0	0
Lawrence Berkeley National Laboratory			
Coal	1,173	4,932	3,427
Total, Lawrence Berkeley National Laboratory	1,173	4,932	3,427
Lawrence Livermore National Laboratory			
Coal	175	2,800	2,000
Total, Lawrence Livermore National Laboratory	175	2,800	2,000
Los Alamos National Laboratory			
Coal	0	5,294	3,637
Total, Los Alamos National Laboratory	0	5,294	3,637
National Energy Technology Laboratory			
Coal	370,061	335,786	254,756
Program Direction	122,180	88,100	83,210
Fossil Energy Environmental Restoration	8,295	6,477	4,477
Total, National Energy Technology Laboratory	500,536	430,363	342,443
Oak Ridge National Laboratory			
Coal	1,675	300	335
Total, Oak Ridge National Laboratory	1,675	300	335
Pacific Northwest Laboratory			
Coal	7,850	3,884	2,750
Total, Pacific Northwest Laboratory	7,850	3,884	2,750
Sandia National Laboratories			
Coal	42	459	568
Total, Sandia National Laboratories	42	459	568
Washington Headquarters			
Coal	5,262	13,035	6,481
Natural Gas	0	14,991	17,000
Program Direction	42,545	31,829	32,543
Fossil Energy Environmental Restoration	1,685	1,420	1,420

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Plant and Capital Equipment	19,960	16,794	13,294
Special Recruitment Programs	699	700	700
Unconventional Fossil Energy Technologies	0	4,997	0
Total, Washington Headquarters	70,151	83,766	71,438
Subtotal Fossil Energy Research and Development	585,052	533,703	428,513
Use of Prior Year Balances	-151,000	-187,000	-7,938
Total, Fossil Energy Research and Development	434,052	346,703	420,575

Site Description

Ames National Laboratory
The Ames National Laboratory is located in Ames, Iowa.

Coal
Ames National laboratory conducts cross-cutting research on virtual simulations and high-temperature materials.

Argonne National Laboratory (East)
The Argonne National Laboratory (ANL), located in Argonne, Illinois, is a major multi-program laboratory managed and operated for the U.S. Department of Energy (DOE) by the University of Chicago under a performance-based contract.

Coal
ANL research supports the following: concepts for various technologies supporting DOE strategies to capture CO_2 from existing and advanced fossil fuel conversion systems in Carbon Capture and Storage; DOE strategies to develop non-destructive testing examination of materials and mineral reaction kinetics in the Cross-cutting Research; and the core technology program in the Solid Oxide Fuel Cells program.

Idaho National Engineering and Environmental Laboratory
The Idaho National Engineering and Environmental Laboratory (INEEL) is located outside of Idaho Falls, Idaho.

Coal
Research conducted at INEEL supports the following: concepts for various technologies for central systems; research on breakthrough concepts to separate and capture CO_2; and research and development on materials development in Cross-cutting Research.

Lawrence Berkeley National Laboratory
The Lawrence Berkeley National Lab (LBNL) is located in Berkeley, California.

Coal
LBNL conducts research in the following areas: concepts for various technologies for central systems and research and development on geologic storage approaches and measurement, monitoring, and verification protocols in geologic carbon storage.

Lawrence Livermore National Laboratory
The Lawrence Livermore National Lab (LLNL) is located in Livermore, California.

Coal
Research will focus on carbon capture and storage approaches.

Los Alamos National Laboratory
The Los Alamos National Laboratory (LANL) is located in Los Alamos, New Mexico.

Coal
Research supports the following: (1) concepts for various technologies for central systems; (2) research and development in the area of Carbon Capture and Storage (CCS) to lower the costs of CO_2 capture, provide fundamental scientific information on engineered geologic storage approaches, and develop advanced instrumentation to measure and validate geologically stored carbon; and (3) research and development in the area of Cross-cutting Research to model mineral storage and develop hydrogen separation membranes.

National Energy Technology Laboratory
The National Energy Technology Laboratory (NETL), located in Morgantown, West Virginia, Pittsburgh, Pennsylvania, Albany, Oregon, Houston, Texas, and Fairbanks, Alaska is a multi-purpose laboratory, owned and operated by the U.S. Department of Energy. NETL conducts and implements science and technology development programs for the Department in energy and energy-related environmental systems. NETL's key functions are to shape, fund, and manage extramural (external) RD&D projects, conduct on-site science and technology research, and support energy policy development and best business practices within the Department.

Coal
Scientists and engineers at NETL conduct basic and applied research and development in to the Coal programs. In-house research in the coal gasification area involves advanced materials testing, gas-stream pollutant removal, sorbents development, and membrane separations. Research in CCS science studies the scientific basis for CCS options for large stationary sources of CO_2. Finally, research in computational energy science is being conducted to utilize advanced simulation techniques to improve and speed the development of cleaner, more efficient energy devices and plants.

Natural Gas Technologies
In the natural gas technology area NETL will conduct natural gas research to understand and minimize the potential enviromental, health, and safety impacts of gas development including hydralic fracturing and gas hydrates activitities.

Program Direction and Management Support
This activity provides funding for salaries, benefits and overhead expenses for management of the Fossil Energy (FE) program at the National Energy Technology Laboratory (NETL), with sites in Morgantown, WV, Pittsburgh, PA, Albany, OR, Houston, TX, and Fairbanks, AK.

Fossil Energy Environmental Restoration
Activities are to ensure protection of workers, the public, and the environment in performing the mission of the National Energy Technology Laboratory (NETL) at the Morgantown, West Virginia, Pittsburgh, Pennsylvania, Houston, Texas, and Albany, Oregon sites.

Oak Ridge National Laboratory
The Oak Ridge National Laboratory (ORNL) is located in Oak Ridge, Tennessee.

Coal
The Oak Ridge National Laboratory conducts research in the following areas: (1) advanced materials that are applicable to advanced coal based power generation systems in CCS and Power Systems; Carbon Capture and Storage to further geologic storage concepts, including measurement, monitoring and verification; and Cross-cutting Research to develop high-temperature materials.

Pacific Northwest Laboratory
The Pacific Northwest Laboratory (PNNL) is located in Richland, Washington.

Coal
The Pacific Northwest Laboratory conducts research and development in the areas of Advanced Research to perform materials research and environmental analyses and Fuel Cells in support of the DOE-Solid State Energy Conversion Alliance (SECA) program.

Sandia National Laboratories
The Sandia National Laboratory (SNL) is located in Albuquerque, New Mexico, and Livermore, California.

Coal
The SNL conducts research and development in the area of CCS on injection of CO_2 into depleted oil and gas formations, and advanced monitoring methodologies based on advanced seismic concepts. SNL also conducts research and development in the area of Cross-cutting Research to conduct fundamental combustion and transformational sensor research.

Washington Headquarters

Coal
This funding provides program support and technical support for each of the programs within the Coal Program.

Natural Gas Technologies
This funding provided program support and technical support for each of the programs within the Natural Gas Technologies Program.

Program Direction
This activity provides funding for salaries, benefits, and overhead expenses for management of the Fossil Energy (FE) program at Headquarters.

Fossil Energy Environmental Restoration
The funding provides program support and technical support.

Coal
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Coal			
Clean Coal Power Initiative, (CCPI)	0	0	0
Carbon Capture and Storage, and Power Systems, (CCS&PS)	389,688	368,395	275,869
Total, Coal	**389,688**	**368,395**	**275,869**

Public Law Authorizations
(Public Law 95-91)

Overview
The Department's May 2011 Strategic Plan outlines two primary objectives to which the Office of Fossil Energy's Coal Program aligns its activities: 1) Deploy the Technologies We Have and 2) Discover the New Solutions We Need. The mission of the Coal Program's CCPI, CCS, and Power Systems Research and Development (R&D) activities is to support secure, affordable, and environmentally acceptable near-zero emissions fossil energy technologies. This will be accomplished via research, development, and demonstration of advanced Carbon Capture, Utilization and Storage (CCUS) technologies that allow industry to derive commercial benefit from the captured carbon dioxide (CO_2) prior to its safe and permanent storage. Commercial availability of CCUS technologies will provide an option to use abundant, secure, fossil fuel resources to provide energy and cost-effectively meet global climate policies.

The Coal Program is focused on the development of CCUS technologies, advanced power generation technologies, and crosscutting efforts such as computational modeling and simulation and plant optimization. The key objectives include:

- By 2016, complete field testing of second generation carbon capture technologies on flue gas slipstreams (1,000 to 12,000 scfm, or 0.5 to 5 MW) at operating power plants and other large-scale facilities.
- By 2016, commence operation of 4 to 6 CCS/CCUS demonstration projects from the suite of coal power plants and other large-scale facilities through the CCPI, FutureGen 2.0, and Industrial Carbon Capture and Storage (ICCS) programs.
- By 2017, develop and validate full-plant suite of computation models and simulate low carbon fossil-fuel based systems.
- By 2020, develop best practices and risk quantification/mitigation approaches to ensure 99% storage permanence.
- By 2025, develop transformational CCS technologies that intrinsically separate CO_2 as part of the energy conversion process thus allowing for capture of the CO_2 at nearly the same cost as coal plants without CCS.
- Project American leadership on CCUS through active participation and collaboration with the international community and provide timely, accurate analysis of the effect of legislative and policy initiatives on the use of coal for the generation of electricity.

Subprogram Accomplishments and Milestones
In FY 2011, the Coal Program achieved the following accomplishments:

Accomplishments

1) The Southern Company Kemper County, MS project broke ground on its integrated gasification combined cycle (IGCC) plant that will demonstrate a novel gasification technology and also capture carbon dioxide for enhanced oil recovery;
2) Two large-scale CCS demonstration projects (Archer Daniels Midland and Air Products) conducted through the ICCS program have progressed to the construction phase (funded under the American Recovery & Reinvestment Act (ARRA));
3) The National Carbon Capture Center (NCCC) commissioned the Post-Combustion Carbon Capture Center (PC4) to test and speed deployment of innovative carbon capture technologies;

4) Two Regional Carbon Sequestration Partnerships (RCSPs) began equipment shakedown testing and site preparation for large-scale carbon dioxide geologic storage projects;
5) DOE launched the World-Class Virtual Energy Simulation Training and Research Center;

6) Three NETL-developed technologies recognized by R&D Magazine as among 100 most significant in past year; and

7) DOE selected 52 grants on University Research Programs, capture and storage technology, advanced turbines, and gasification.

Milestone	Date
Complete 100 hours of testing on a pilot-scale CO2 capture system.	1st Qtr FY 2012
Extend and demonstrate the capability of Multiphase Flow with Interphase eXchange (MFIX) to simulate gas-liquid flow applications.	1st Qtr FY 2012
FutureGen 2.0 Initiate drilling of sequestration site characterization well .	1st Qtr FY 2012
Begin large-scale injection of CO2 at two Regional Carbon Sequestration Partnerships (RCSPs).	2nd Qtr FY 2012
FutureGen 2.0 Complete characterization well drilling.	2nd Qtr FY 2012
Complete CFD modeling to determine furnace gas compositions for an advanced ultrasupercritical (A-USC), oxy-fired pulverized coal boiler.	3rd Qtr FY 2012
FutureGen 2.0 Complete draft characterization analysis.	3rd Qtr FY 2012
Perform site preparation and mobilization on a second IGCC-CCS demonstration project.	4th Qtr FY 2012
FutureGen 2.0 DOE renders decision on authorization of Phase II Preliminary Design and Permitting activities.	4th Qtr FY 2012
Select and award 25 to 35 projects from FOA's solicitation in the following topics: Oxy-combustion, sensors and controls, and University Grant Programs	4th Qtr FY 2012

Explanation of Changes

The Department requests $276 million in FY 2013 for Coal, which is a 25% decrease over the FY 2012 level ($368M).

The FY 2013 request decreases the level of funding for Carbon Capture (-$8.5M). The requested funding level is sufficient to maintain focus on current scope of activities.

The FY 2013 request decreases the funding level for Carbon Storage (-$20M). The request reduces the funding levels for small and large scale field tests in other geologic storage classes.

The FY 2013 request decreases the funding for Advanced Energy Systems (-$45M) and reflects the shift in focus toward technologies that have potential benefits to both existing and new fossil-fueled power plants.

The FY 2013 request decreases the funding for Cross-Cutting Research (-$19M) and reduces development efforts for sensors and control technologies, CCS simulations, and technical outreach.

Program Planning and Management

The Office of Clean Coal performs real-time performance tracking utilizing various systems that rely on data from a single corporate source of record. These systems track progress of multiple programs and projects, including project progress toward ARRA and GPRA (Government Performance & Results Act) quarterly milestones, annual program performance targets, and earned value. Additionally, the Coal Program conducts independent, periodic peer reviews to provide guidance and critical feedback on its programs' direction and plans. Below is a summary of independent peer review panel findings of coal program activities:

- In FY 2011, Advanced Fuels, Oct 18-22, 2010 by ASME
  - ASME Panel noted the following:
    - The project aims to support industry involvement and technology commercialization and has attracted a client base that demonstrated the value of the work
    - The work effectively leverages DOE/NETL resources
    - The synergy of the project tasks could yield significant breakthroughs

- In FY 2011, Fuel Cells, Feb 14-18, 2011 by ASME
  - AMSE Panel noted the following:
    - The project team has achieved impressive fuel cell power densities
    - The project team's work is critical to the successful development of SOFC technology
    - The project produced cost-effective results that will be valuable for directing future NETL technology objectives
- In FY 2011, Carbon Capture, July 18-21, 2011 by AIChE
  - AIChE Panel noted the following:
    - Panel was impressed by the high-quality of the projects reviewed
    - The projects have ambitious goals and significant potential to advance carbon capture technology
    - Panel found the carbon capture R&D projects to be essentially on track and to represent a well-balanced portfolio of fundamental science, national laboratory research, and large-scale industrial projects

Some of the internal tools include:

- FE Dashboard: A comprehensive system that tracks progress toward program quarterly milestones and annual goals, project information, and reporting of information.

- Standard Accounting and Reporting System (STARS): STARS provides the Department with a modern, comprehensive, and responsive financial management system that is the foundation for linking budget formulation, budget execution, financial accounting, financial reporting, cost accounting, and performance measurement. The system processes Departmental accounting information, including General Ledger, Purchasing, Accounts Payable, Accounts Receivable, and Fixed Assets. The system also includes budget execution functionality associated with recording appropriations, apportionments, allotments, allocations, and provides funds control for commitments, obligations, costs, and payments.

- Strategic Integrated Procurement Enterprise System (STRIPES): STRIPES encompasses activities required or directly associated with planning, awarding, and administering various unclassified acquisition and financial assistance instruments. In general terms, the required activities are comprised of the following functions: acquisition/financial assistance planning; pre-solicitation documentation generation; solicitation development; evaluation and award; administration, including approving payment requests; and instrument closeout. Additional functions provided, which are directly associated with the planning, awarding, and administering of the instruments, include: interfacing with internal and external systems, such as STARS, the iManage Data Warehouse, FedBizOpps, and the Central Contractor Registration; workload management; workflow capabilities; and appropriate reporting capabilities for both internal and external purposes.

- Primavera and MS Project: Software tools that track project progress toward goals and milestones.

- iPortal: The iPortal will provide personalized dashboards, messaging (thresholds/alerts), discussion boards, collaboration capabilities, news, reporting, graphing, and data exchange capabilities to DOE executives, managers and staff.

Goal Areas by Subprogram

	1. To bring at least five commercial-scale carbon capture and storage (CCS) demonstrations online by 2016.	2. Use research and development results of laboratory through pilot-scale tests to show, through engineering and systems analyses studies, 90% CO_2 capture of advanced post-combustion and pre-combustion capture technologies with potential for no more than a 35% increase in the levelized cost of electricity for post-combustion and no more than a 10% increase in the levelized cost of electricity for pre-combustion when compared to a reference power plant without CO_2 capture and storage.
Coal		
Clean Coal Power Initiative (CCPI)	100%	0%
Carbon Capture and Storage, and Power Systems, (CCS&PS)	0%	100%
Subtotal, Coal	0%	100%

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Clean Coal Power Initiative	0	0	0
CCS and Power Systems	368,395	275,869	-92,526
Total, Coal	368,395	275,869	-92,526

Carbon Capture and Storage and Power Systems

The Department requests $276 million in FY 2013 for Coal, which is a 25% decrease from the FY 2012 level.

The FY 2013 request decreases the level of funding for Carbon Capture (-$8.5M). The requested funding level is sufficient to maintain focus on current scope of activities.

The FY 2013 request decreases the funding level for Carbon Storage (-$20M). The request reduces the funding levels for small and large scale field tests in other geologic storage classes.

The FY 2013 request decrease the levels for Advanced Energy Systems (-$45M) represents the shift in focus toward technologies that have potential benefits to both existing and new fossil-fueled power plants.

The FY 2013 request decreases the funding for Cross-Cutting Research (-$19M) and reduces development efforts for sensors and control technologies, CCS simulations, and technical outreach.

Clean Coal Power Initiative
Funding Profile by Subprogram and Activities

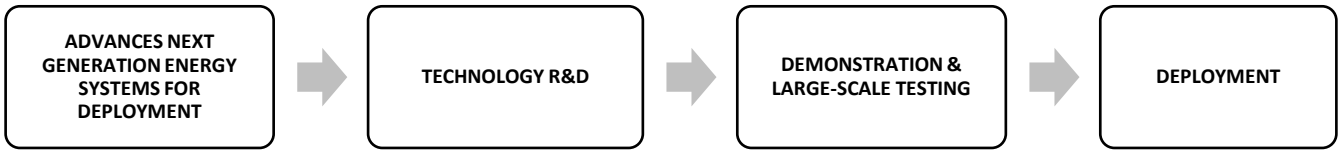
(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Clean Coal Power Initiative (CCPI)			
Total, Clean Coal Power Initiative (CCPI)	0	0	0

Clean Coal Power Initiative
Overview

The Clean Coal Power Initiative program has provided government co-financing for new coal technologies that have helped utilities cut sulfur, nitrogen and mercury pollutants from power plants and reduce greenhouse gas emissions by boosting plant efficiencies and capturing and sequestering carbon dioxide. All projects from Round 1 have been completed. Five projects remain active from the last two rounds of CCPI: two from Round 2 and three from Round 3. Of these, four seek to demonstrate advanced coal gasification technologies while another looks to demonstrate post-combustion carbon capture technology. Round 2 of the CCPI (CCPI-2) was focused on advanced gasification technology and advanced cleanup systems, including mercury control. CCPI Round 3 (CCPI-3) was focused on gaining broader Carbon Capture, and Storage (CCS) commercial-scale experience by expanding technologies, applications, fuels, and geologic formations; seeking projects offering a minimum 300,000 tons per year CO_2 stored per project (all projects selected exceeded this benchmark); demonstrating operation of CO_2 capture technologies that operate at 90 percent efficiency and at reduced cost from conventional baseline technologies; and demonstrating capacity for injecting large volumes of CO_2 into underground formations. The ability to demonstrate advanced technologies at scales that have been developed in the FE Research and Development or other R&D programs is an important benefit of the CCPI program. The CCPI demonstrations are critical to establishing the roadmap for meeting the important environmental and energy security challenges that face us today.

Sequence



Benefits

Industry Benefits

- Enabling advanced technologies to overcome technical risks involved with scale-up and bringing them to the point of commercial readiness, CCPI accelerates the development of advanced coal generation technologies integrated with carbon capture, transport, and eventual geological storage on both new and existing generation technologies. Reduced initial capital outlay or investment due to the lower plant capital cost.
- Facilitates the movement of technologies into the marketplace that are emerging from the core research and development activities.
    - Some of the technologies being demonstrated in CCPI-3, and within CCPI-2 at the Southern Company Services Kemper project, have never before been constructed at commercially-relevant scale and integrated within a power generation facility. As such, key performance benchmarks will be set for these technology based upon the cost and capture efficiencies realized once the current set of projects are complete. Such benchmarks are critical to the Department's commitment to securing the nation's energy future with clean coal technology.

Carbon Capture and Storage and Power Systems
Funding Profile by Subprogram and Activities

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Carbon Capture and Storage (CCS) and Power Systems			
Carbon Capture			
Post-Combustion	41,299	55,495	49,035
Pre-Combustion	17,404	13,403	11,403
Carbon Capture	58,703	68,898	60,438
Carbon Storage			
Regional Carbon Sequestration Partnerships	77,160	83,190	66,980
Geological Storage Technologies	24,946	14,978	11,255
Monitoring, Verification, Accounting and Assessment	8,122	6,738	6,738
Carbon Use and Reuse	967	778	778
Focus Area for Carbon Sequestration Science	9,717	9,726	9,726
Carbon Storage	120,912	115,410	95,477
Advanced Energy Systems			
Advanced Combustion Systems	30,724	15,942	10,699
Gasification Systems	47,614	39,000	31,905
Hydrogen Turbines	30,106	15,000	12,589
Hydrogen from Coal	11,661	0	0
Coal and Coal-Biomass to Liquids	0	5,000	0
Solid Oxide Fuel Cells	48,522	25,000	0
Advanced Energy Systems	168,627	99,942	55,193
Cross-cutting Research			
Plant Optimization Technologies	7,789	13,663	7,000
Coal Utilization Science			
Computational System Dynamics	12,462	11,800	7,800
Computational Energy Science	11,844	13,371	9,400
Energy Analyses			
Environmental Activities	450	450	450
Technical and Economic Analyses	500	500	500
System Analysis/Product Integration	3,887	4,000	0
University Training and Research			
University Coal Research	2,337	3,000	2,400
Historical Black Colleges and Universities & Training	827	1,000	850
International Activities			
Coal Technology Export	650	650	650
International Program Support	700	700	700
Cross-cutting Research	41,446	49,134	29,750
NETL Coal Research and Development	0	35,011	35,011
Total, CCS and Power Systems	389,688[a]	368,395[a]	275,869[a]

[a]This figure does not include the SBIR/STTR funds that were taken from this account.

Public Law Authorizations
Public Law (95-91)

Overview
The CCS and Power Systems program provides research to significantly reduce coal power plant emissions (including carbon dioxide (CO_2)) and substantially improve efficiency to reduce carbon emissions, leading to a viable near-zero atmospheric emissions coal energy system and supporting carbon capture, utilization and storage (CCUS). The Department is developing advanced clean coal technology with a goal of deploying high efficiency coal power plants achieving near-zero atmospheric emissions. The Office of Fossil Energy's CCS and Power Systems program is leading efforts to make possible greater utilization of the Nation's most abundant energy resource (coal) in an environmentally sound and economically competitive way. The core Research and Development (R&D) efforts of the CCS and Power Systems program focuses on a variety of carbon capture, utilization and storage technologies for pulverized coal, oxy-fuel, and gasification plants; post-combustion carbon capture for new and existing plants; improved gasification technologies; improved turbines for future coal-based combined cycle plants; and the creation of a portfolio of technologies that can capture and permanently store greenhouse gases (such as CO_2) or utilize them prior to permanent storage.

The CCS and Power Systems program supports a robust demonstration program, which includes the Clean Coal Power Initiative (CCPI). CCPI seeks to accelerate private sector development of new coal-based power and CCS technologies that can meet increasingly stringent environmental regulations, and develops the technological foundation within the nation's power industry for near-zero emission coal-based energy facilities.

Included in the funding levels in the CCS and Power Section, NETL Coal Research and Development accounts for NETL program specific activities supporting CCS and Power Systems. This funding supports Federal staff directly associated with conducting research activities specific to CCS and Power Systems in Carbon Capture, Carbon Storage, Advanced Energy Systems and Cross-cutting Research.

Program Accomplishments and Milestones
In FY 2011, the Coal Program achieved the following accomplishments:

1. The National Carbon Capture Center (NCCC) commissioned the Post-Combustion Carbon Capture Center (PC4) to test and speed deployment of innovative carbon capture technologies;
2. Two Regional Carbon Sequestration Partnerships (RCSPs) began equipment shakedown testing and site preparation for large-scale carbon dioxide geologic storage projects;
3. DOE launched the World-Class Virtual Energy Simulation Training and Research Center;
4. Three NETL-developed technologies recognized by R&D Magazine as among 100 most significant in past year; and
5. DOE selected 52 grants on University Research Programs, Capture and Storage Technology, Turbines, and Gasification.

Milestone	Date
Complete 100 hours of testing on a pilot-scale CO_2 capture system.	1st Qtr FY 2012
Extend and demonstrate the capability of MFIX to simulate gas-liquid flow applications.	1st Qtr FY 2012
Begin large-scale injection of CO_2 at two RCSPs.	2nd Qtr FY 2012
Select research projects to support student education and advancements in material science from the solicitations issued under the University Coal research Program and the Historically Black Colleges and Universities Program.	3rd Qtr FY 2012
Perform site preparation and mobilization on a second IGCC-CCS demonstration project.	4th Qtr FY 2012
Select and award 25 to 35 projects from FOA's solicitation in the following topics: Oxy-combustion, sensors and controls, and University Grant Programs.	4th Qtr FY 2012

Strategic Management

In meeting the identified challenges to clean fossil energy, the Department will implement four key strategies to more efficiently and effectively manage the program, thus putting the taxpayers' dollar to more productive use:

1. Coal's R&D programs will partner with the private sector, national laboratories, universities and international partners to develop advanced CCS and power systems technologies.
2. Programs will also nurture ties with countries and organizations pursuing state-of-the-art CCS RD&D to leverage resources.
3. Provide analyses of options to incentivize a commercial CCS industry to facilitate technology deployment.
4. Pursue advanced modeling and simulation to accelerate technology deployment by shortening the timeframe and reducing the risk of technology and process development.

Two external factors present the strongest impacts to the overall achievement of the program's strategic goal:

1. Power demand and environmental factors beyond the scope of DOE R&D programs, as well as complex economic decisions made by industrial partners; and
2. Industry's inclination to focus on near-term deployment using proven technologies.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Carbon Capture			
Post-combustion			
The requested funding level is sufficient to maintain focus on current scope of activities.	55,495	49,035	-6,460
Pre-combustion			
The decrease in funding level represents program prioritization on post-combustion capture technology development.	13,403	11,403	-2,000
Subtotal Carbon Capture	68,898	60,438	-8,460
Carbon Storage			
Regional Carbon Sequestration Partnerships			
The decrease maintains funding for the Regional Partnerships and reduces the funding levels for small and large scale field tests in other geologic storage classes.	83,190	66,980	-16,210
Geologic Storage Technologies			
The decrease maintains funding on high priority, near-term research areas to meet goals for safe, permanent storage.	14,978	11,255	-3,723
Monitoring, Verification, Accounting and Assessment			
The requested funding level is sufficient to maintain focus on current scope of activities.	6,738	6,738	0
Carbon Use and Reuse			
The requested funding level is sufficient to maintain focus on current scope of activities.	778	778	0
Focus Area for Carbon Sequestration Science			
The requested funding level is sufficient to maintain focus on current scope of activities.	9,726	9,726	0
Subtotal Carbon Storage	115,410	95,477	-19,933

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Advanced Energy Systems			
Advanced Combustion Systems			
The decrease in funding represents the shift in focus towards technologies that have potential benefits to both existing and new fossil-fueled power plants.	15,942	10,699	-5,243
Gasification Systems			
The decrease in funding represents the shift in focus towards technologies that have potential benefits to both existing and new fossil-fueled power plants.	39,000	31,905	-7,095
Hydrogen Turbines			
The decrease in funding represents the shift in focus towards technologies that have potential benefits to both existing and new fossil-fueled power plants.	15,000	12,589	-2,411
Coal and Coal Biomass to Liquids			
The decrease in funding represent the shift in focus toward technologies that have potential benefits to both existing and new fossil-fueled power plants.	5,000	-	-5,000
Solid Oxide Fuel Cells			
The program has prioritized near-term CCS technologies available for demonstration in the 2015 timeframe. As a result, 2013 funding for longer term Fuel Cell technologies has not been requested. SECA Core Technology R&D will complete existing work – no new Core Technology effort shall be initiated in 2013. Industry team work on fuel cell stack technology to enable low cost, >50% efficiency, 99% carbon capture power generation systems will continue under previously appropriated funds. Work will focus on improving fuel cell stack reliability and endurance and on preparing for manufacturing of a 250+ kW fuel cell system module. Demonstration and testing of this system module, which represents a building block of future multi-MW coal-based power plants, will be delayed from 2013 to 2015. Development and demonstration of commercial-scale fuel cell systems, as a CCS transformational technology, can still remain on schedule for 2020, dependent upon future program funding.	25,000	-	-25,000
Subtotal Advanced Energy Systems	99,942	55,193	-44,749
Cross-cutting Research			
Plant Optimization Technology			
The proposed FY 2013 budget decreases funding to maintain enabling sensors and control technologies and advances in transformational materials that would have potential benefits to both existing and new fossil-fueled power plants and critical EOR and reservoir sensor technology.	13,663	7,000	-6,663

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Coal Utilization Science			
Under the proposed FY 2013 funding, the Carbon Capture and Storage Initiative (CCSI) and the National Risk Assessment Partnership (NRAP) will will be delayed and funding for the current National Lab partnerships will not be funded at prior levels. For CCSI, this will mean that the incorporation of validated simulations in the development and deployment of next-generation carbon capture technologies will be slowed.	25,171	17,200	-7,971
Energy Analyses			
The decrease in funding for *Systems Analysis/Product Integration* reduces technical outreach support for advanced technologies commercialization efforts.	4,950	950	-4,000
University Training and Research			
The decrease in funding for education and training will reduce the number of grants to Historically Black Colleges and Universities and the University Coal Research programs.	4,000	3,250	-750
Subtotal Cross-cutting Research	49,134	29,750	-19,384
NETL Coal Research and Development			
No change in funding.	35,011	35,011	0
Subtotal NETL Coal Research and Development	35,011	35,011	0
TOTAL Funding Change: CCS and Power Systems	368,395	275,869	-92,526

Carbon Capture
Activity

Overview

The Carbon Capture activity is focused on the development of post-combustion and pre-combustion CO_2 capture technology for new and existing power plants as well as industrial sources. Post-combustion CO_2 capture technology is applicable to pulverized coal (PC) power plants, which is the current standard industry technology for coal-fueled electricity generation. Pre-combustion CO_2 capture is applicable to gasification-based systems such as Integrated Gasification Combined Cycle (IGCC), a potential technology for future generation of electricity from coal-fueled plants. In addition to power generation sources, advanced CO_2 capture technologies are being developed for large industrial sources such as petroleum refineries, cement plants and chemical plants.

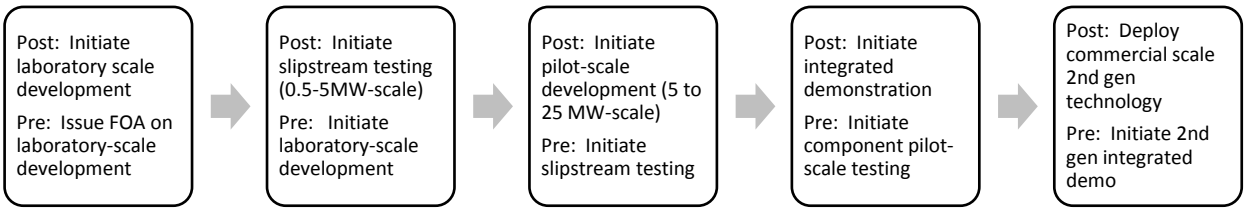
Post-Combustion

This activity focuses specifically on developments related to advanced technologies that achieve 90% CO_2 capture at no more than a 35% increase in levelized cost of electricity (COE) of post-combustion capture for new and existing conventional coal-fired power plants. Given the significant economic penalties associated with currently available CO_2 capture technologies, significant improvements in both cost and energy efficiency will be required to achieve this goal. Laboratory and slipstream tests are being conducted on novel solvents, sorbents, and membranes that have potential to reduce cost and improve efficiency of carbon capture. It is anticipated that successful progression from laboratory- to large-scale demonstration will result in several of these advanced technologies being available for commercial deployment sometime between 2020 and 2030.

Pre-Combustion

This activity focuses on development of advanced technologies that achieve 90% CO_2 capture at no more than a 10% increase in levelized cost of electricity for pre-combustion applications such as IGCC. Significant improvements are required to reduce parasitic energy load and cost, and many technologies that are available in the near-term have not been scaled up or applied to fossil fuel-powered generation systems.

Sequence



Benefits

Industry Benefits

- Lower capital and operating cost compared to current CO_2 capture technologies.
- More energy efficient CO_2 separation, purification and compression compared to current capture technologies.
- Enable more sustainable use of domestic fossil resources.
- Technologies applicable to new and existing coal-fired power plants, natural gas power plants, and industrial plants (such as cement manufacturing, chemical production, natural gas purification).

R&D Benefits

- Leverage industry, university, and national laboratory expertise and resources to develop a suite of cost-effective and energy efficient carbon capture technologies.
- Improve scalability and economies of scale for developing systems at commercial scale.
- Expand operating and performance envelope of advanced solvents, sorbents, and membranes for CO_2 capture.
- Improve integration of capture system components to reduce CO_2 separation energy penalty and overall costs.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Completed parametric testing of laboratory-scale sorbent technologies for post-combustion carbon capture, identified a method that produced stable seals for single hollow fiber membranes to be tested in simulated syngas conditions, performed slipstream testing of an amine solvent at the National Carbon Capture Center on a real flue gas stream, and selected laboratory and small slipstream scale projects that will test solvents, sorbents, membranes, and hybrid post-combustion CO_2 capture systems.	58,703
FY 2012	Continue laboratory through small pilot scale R&D tests of post- and pre-combustion capture technologies such as solvents, sorbents, and membranes that show promise in meeting cost targets, and conduct systems analyses to verify progress toward cost target.	68,898
FY 2013	Continue advanced laboratory scale and small pilot scale slipstream R&D for pre-IGCC and post-combustion (Pulverized Coal) CO_2 capture technologies.	60,438

Carbon Storage
Activity

Overview

The overall goal of the Carbon Storage activity is safe, cost effective, permanent geologic storage and/or use of CO_2. This is conducted by understanding the effectiveness of storage and use across twelve types of storage formations, classified by depositional environment (7 clastic formations; 2 carbonate formations; coal, organic shale, and basalt) which contain fluids such as saline water; oil and gas. The technologies developed through the activity will be used to benefit the existing and future fleet of fossil fuel power generating facilities by reducing the cost-of-electricity impacts and providing protocols for carbon capture, utilization and storage (CCUS) demonstrations as they are designed to capture, transport, utilize or store captured CO_2, and measure, monitor, and validate the CO_2 injected in geologic formations and developing technologies for the beneficial utilization of CO_2.

Regional Carbon Sequestration Partnerships

The Regional Carbon Sequestration Partnerships (RCSP) initiative consists of seven Regional Partnerships and has been implemented in 3 Phases: I) Characterization phase; II) Validation phase and III) Development phase. Phase I focused on characterizing regional opportunities for carbon capture and storage, identified CO_2 sources, and identified priority opportunities for field tests. Phase II has focused on the small scale field tests in a variety of geological storage sites in the US and Canada. Phase III, commenced in FY 2008, will help the development on a large scale of CO_2 capture, transportation, injection, and storage such that it can be achieved safely, permanently, and economically. Regulatory compliance and public outreach and education have been an important component of each of these phases. In addition, this part of the program supports the development of CCS infrastructure through other field projects at small and large scale to test CO_2 injection and utilization in different depositional systems that will provide the understanding of how the CO_2 flows, reacts with the rocks, and impacts the formations. These tests are critical to deployment of the technology broadly across North America. Many of these tests are validating storage and the incremental benefits of using the CO_2 for recovery of different commodities from the sub-surface.

Geologic Storage Technologies

Geologic storage is focused on developing technologies that safely, permanently, and cost effectively store CO_2 in geologic formations and monitor its movement and behavior. This involves developing an improved understanding of CO_2 flow and trapping mechanisms within the geologic formations that can support the development of improved and novel technologies for site construction, reservoir engineering, well construction, and opportunities for beneficial use, across the twelve storage formation classes.

Monitoring, Verification, Accounting and Assessment

Monitoring, Verification, Accounting, and Assessment (MVAA) is an important part of making geologic sequestration a safe, effective, and acceptable method for greenhouse gas control. MVAA of geologic storage sites is expected to serve several purposes, including addressing safety and environmental concerns; inventory verification; project and national accounting of greenhouse gas emissions reductions at geologic storage sites; and evaluating potential regional, national and international greenhouse gas reduction goals. A suite of technologies must be developed and validated across the twelve storage formation classes to meet regulatory requirements and to help improve the operation, efficiency and cost of the storage operations.

Carbon Use and Reuse

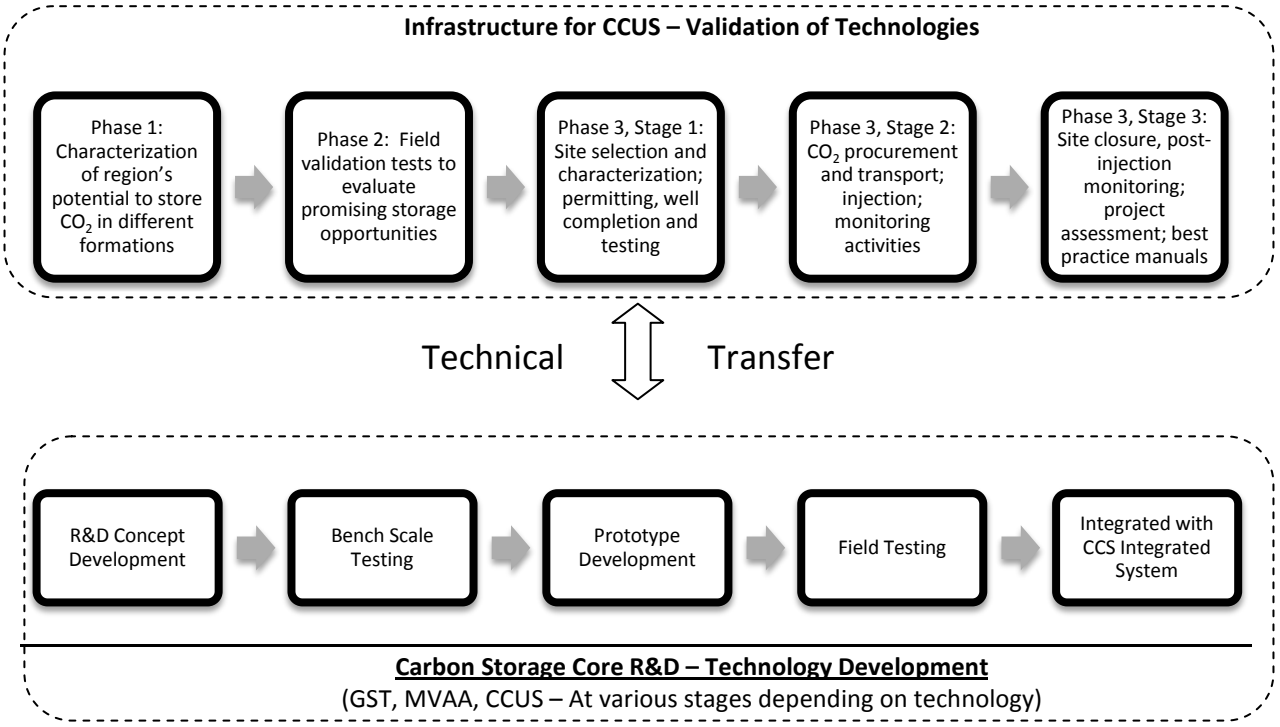
The Carbon Use and Reuse activity focuses on pathways and novel approaches, other than enhanced hydrocarbon recovery, for reducing CO_2 emissions by developing beneficial uses for the CO_2, such as the conversion of CO_2 to useable products and fuels, and other breakthrough concepts that will mitigate CO_2 emissions. The program has focused on the three most valuable products with the largest potential markets (other than EOR) including production of chemicals, building materials, and curing for cement.

Focus Area for Carbon Sequestration Science

The Focus Area for Carbon Sequestration Science supports the Carbon Storage Program through complementary research support for Phase III field efforts from the Regional Carbon Sequestration Partnerships and research addressing needs for 1. Multiphase Flow in Reservoirs and Seals; 2. Fundamental Processes and Properties of geologic storage necessary to optimize simulations and operations; 3. Estimates of Storage Potential in the different geologic storage formation classes;

4. Verifying Storage Performance through integrated MVA with field projects; and 5. Geospatial Data Resources and management of the NATCARB system to archive date from the R&D field projects to ensure access by other researchers. This area continues to support the development of technologies for pre-combustion capture including the simulation, synthesis, and testing of membranes, sorbents, and solvents for IGCC power systems.

Sequence



Benefits

Industry Benefits

- Verify CCS as a safe, effective, and economic option for carbon management throughout the United States.
- Develop best practices for industry and support regulatory development.
- Develop technologies that can monitor, verify, and account for subsurface CO_2 to ensure safe, permanent storage.
- Develop alternatives to commercial manufacturing using CO_2 and offsetting costs and other industry.
- Engage and educate the public and stakeholders on CCS technologies and practices.

R&D Benefits

- Develop improved technologies and protocols which increase injectivity and capacity, and improve storage efficiency, reducing cost for project development, operation, and post closure requirements.
- Determine the geomechanical and geochemical impacts of large-scale injection, and better understand fluid flow, pressure, and brine management in geologic storage operations
- Research and quantify the capabilities of different technologies to monitor and measure CO_2 in the subsurface and near-surface to optimize design of monitoring networks and improve efficiency of storage.
- Validate and improve existing simulation codes to enhance the prediction and accuracy of CO_2 movement in deep geologic formations to +/- 30% accuracy.
- Conduct large-scale injection tests to address practical field and infrastructure issues associated with sustained injectivity, well design integrity, and reservoir integrity throughout the eleven different classes of geologic storage formations.
- Identify technologies which can convert CO_2 into products such as chemicals, plastics, and building products, offsetting other mining and manufacturing processes.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Injected at least 1.5 million metric tons of CO_2 cumulatively at large-volume field tests since 2009, two Regional Carbon Sequestration Partnerships (RCSPs) began equipment shakedown testing and site preparation for large-scale carbon dioxide geologic storage projects, selected three additional projects that will inject and monitor CO_2 to demonstrate the application of various injection and MVA technologies to demonstrate safe, permanent storage of CO_2.	120,912
FY 2012	Inject at least 3.0 million metric tons of CO_2 cumulatively at large-volume field tests since 2009, improve understanding of science behind CO_2 and co-contaminants flow and reactions in formation rocks and seals, evaluate advanced geophysical tools to monitor CO_2 plume, and continue evaluation of CO_2 for beneficial use.	115,410
FY 2013	Continue carbon storage activities through Core R&D and Regional Carbon Sequestration Partnership efforts.	95,477

Advanced Energy Systems
Activity

Overview

The Advanced Energy Systems program is to reduce the cost of coal-based power generation and hydrogen production with CO_2 capture, while increasing plant availability and efficiency, and maintaining the highest environmental standards. The program elements include those required for IGCC power generation (Gasification and Advanced Turbines), Fuel Cells, Advanced Combustion Systems, and Coal and Coal-Biomass to Liquids. The elements related to gasification, oxy-combustion, and turbine systems that produce electricity have a higher priority in budget allocation. Many of these technologies will also reduce the cost of converting other carbon-based materials, such as biomass, petcoke or natural gas, into power and value-added products; however, the primary program mission is to position coal, a dominant U.S. domestic resource, to be a stable platform for a variety of U.S. industries, and for the entire U.S. economy, through the use of coal in an economically-sustainable and environmentally-acceptable manner.

Advanced Combustion Systems

This activity focuses specifically on development of advanced technologies, including oxy-combustion and chemical looping processes, that achieve 90% CO_2 capture at less than a 30% increase in levelized cost of electricity (COE) for new and existing conventional coal-fired power plants. The application of these technologies at current state-of-the-art is associated with significant energy penalties and significant improvements in both cost and energy efficiency will be required to achieve this goal. Critical R&D milestones include the continuation of pilot-scale testing of a broad cross section of advanced oxy-combustion, and chemical looping combustion systems that began in 2008 and initiation of 25 MWe demonstrations of the most promising of these technologies by 2016. It is anticipated that successful progression from pilot- to large-scale demonstration will result in one or more of these advanced technologies being available for commercial deployment sometime between 2020 and 2030.

Oxy Combustion and Chemical Looping

This activity focuses specifically on technology developments related to advanced technologies that achieve 90% CO_2 capture at less than a 30% increase in levelized cost of electricity (COE) of post- and oxy-combustion capture for new and existing conventional coal-fired power plants. Given the significant economic penalties associated with currently available CO_2 capture technologies, significant improvements in both cost and energy efficiency will be required to achieve this goal. Current activities under this program have been focused on technologies that can be retrofitted to existing plants. Activities from FY 2012 on will be focused on new systems to be developed and optimized specifically for the oxy-combustion process, in areas such as chemical looping and pressurized combustion. Technology needs toward development of these new systems will be addressed in a Funding Opportunity Announcement planned for FY 2012. Projects that result from this FOA will contribute the critical R&D milestones under this program.

High Performance Material Component Testing

This activity focuses on research and development activities to validate the technical and economic feasibility of the Advanced-Ultrasupercritical power plant, complete pre-competitive data generation, and lay the ground work for activity to commercialize high performance material component technology. Component testing will include cooperative efforts with hosting utilities, instrumentation and data gathering, metallurgical analysis, assessment of the components and materials, design verification versus the actual data, and performance measured and observed. Continuation of component testing at selected clean coal component demonstration sites will contribute to two key national goals: building highly efficient power plants and developing the U.S. domestic manufacturing base to create new jobs.

Gasification Systems

This activity will advance technology developments to increase gasification efficiency, reduce capital and operations costs, and increase availability to ensure all ranks of domestic coal can be used to support the U.S. economy with reliable power and co-production opportunities. The program will focus on developing the following technologies:

- Ion transport membrane (ITM) technology for oxygen production
- Lower cost, more efficient syngas cleanup to support near zero emissions
- High pressure, solids feed system; technologies to reduce steam use; real time sensors; and other technologies expected to significantly increase gasification efficiency
- More durable refractory materials and sensors, and technologies designed to reduce cooler fouling, and otherwise

improve availability
- Models to improve gasifier performance from reaction kinetics to plant simulations
- Technologies that will reduce the cost of using low rank coal and other opportunity feeds, such as biomass
- Advanced technologies to most economically tailor syngas composition for co-production applications

To drive cost reductions, process improvements, and environmental advances across all gasification sub-systems, the Gasification program also supports crosscutting research, development, analysis, and testing. For example, the National Carbon Capture Center (NCCC) in Wilsonville, Alabama, the preeminent test facility in the United States for the testing and evaluation of advanced oxy-, pre-, and post-combustion carbon capture technologies, provides a large-scale test platform for evaluating components critical to the evolution of gasification technologies.

Hydrogen Turbines

The Turbines activity is designed to enable the cost effective implementation of the Climate Change Technology Program for pre-combustion carbon capture and storage (CCS). The focus is on creating the advanced technology components and subsystems for turbines that will permit the design of IGCC plants that will achieve or surpass goals for carbon capture with less than 10% increase in COE over base-line IGCC without CCS. Key technologies, components and subsystems being developed in this program include:

- Low NOx premixed hydrogen combustors for large frame turbines,
- Material systems and architectures that allow higher temperature operation,
- Stationary and rotating airfoils with superior aerodynamics, strength and cooling technology, and
- Revolutionary gas turbine components and designs.

These technologies and components when integrated together will allow the gas turbine combined cycle power block to deliver the cost, efficiency and power output allowing IGCC to achieve COE goals for CCS. The fungible nature of the technology developed through this activity will be applicable to machines operated on all fossil fuels thereby amplifying the benefits to the nation. Funding priority in FY 2013 will continue to emphasize component and sub system development for the large-frame hydrogen fueled turbine projects for IGCC with CCS.

Hydrogen from Coal

No funding is requested in the FY 2013 appropriation for this activity.

Coal and Coal-Biomass to Liquids

This activity will address the completion of existing projects undertaken in previous fiscal years that focused on development of advanced technologies that have the potential, when incorporated into advanced IGCC systems, to effectively and efficiently co-produce power and fuels from coal or coal/biomass feedstocks.

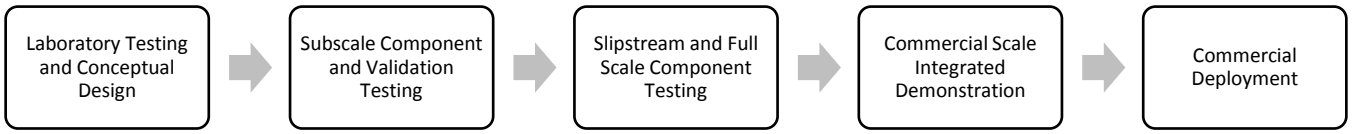
No funding is requested in the FY 2013 appropriation for this activity.

Solid Oxide Fuel Cells

This activity will address the completion of existing projects undertaken in previous fiscal years in the Solid Oxide Fuel Cells (SOFC) program that focused on development of coal-fueled central power generation with carbon capture.

No funding is requested in the FY 2013 appropriation for this activity.

Sequence



Note that the stage of development within the program as seen above, varies among key projects

Benefits

Industry Benefits

- Reduced capital costs, improved efficiency, and improved capacity factors for commercial projects using gasification for power generation, hydrogen production, and fuels production.
- Reduced costs associated with applying CCS to combustion and gasification-based power generation.
- A wider range of fuel and power cycle choices for energy project developers.

R&D Benefits

- Improved understanding of fundamental phenomena affecting technologies in the program, such as hydrogen combustion, oxy-combustion, and gasification kinetics, and high temperature behavior of materials.
- World-Class advances in membrane technologies.
- Improved capabilities to research phenomena associated with both new technology development and optimizing existing technologies.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	The Gasification program completed the design of warm gas cleanup slipstream system that will reduce parasitic load, validating progress towards the COE goal. Completed the installation, shakedown, and construction of the 12 lb/hr hydrogen separation system. Tested the unique novel selective catalytic reduction (SCR) chemical formulation and catalyst procedures suitable for commercial sample preparation. The Turbines program completed the fourth series of high pressure syngas and hydrogen combustion testing with the improved premix design, and the Fuel Cells program completed the design of non-repeat hardware for SOFC stacks to be utilized as the building blocks the module proof-of-concept system.	168,627
FY 2012	Conduct laboratory experiments through pilot-scale tests of technology components of Advanced Energy Systems with pre-combustion capture that show, through engineering and systems analyses studies, 90% CO_2 capture at no more than a 13% increase in levelized cost of electricity when compared to a reference power plant without CO_2 capture and storage.	99,942
FY 2013	Continue Advanced Energy Systems core R&D activities which include the completion of detail design and construction of the Warm Gas Cleanup slipstream system that will reduce parasitic load, start the operation of the 100 T/D ITM pilot plant, continue to create advanced technology and subsystems for turbines that will permit the design of IGCC plants to achieve or surpass goals for carbon capture with less than 10% increase in COE over baseline IGCC without CCS, and implement advanced combustion projects selected in the FY 2012 FOA.	55,193

Cross-cutting Research
Activity

Overview

The Cross-cutting Research activity serves as a bridge between basic and applied research by fostering the development and deployment of innovative systems for improving efficiency and environmental performance. This crosscutting effort is implemented through the research and development of sensors, controls and advanced materials targeted at enhancing the availability of advanced power systems, while reducing costs of Advanced CCS and Power Systems. This program area also develops computation, simulation, and modeling tools focused on optimizing plant design and shortening developmental timelines. Through the new multi-laboratory carbon capture and storage modeling and risk initiative, post-combustion capture, risk assessment, and integrated multi-scale physics-based simulations, designed to leverage existing expertise has been initiated through a joint collaborative effort at several of the National Laboratories. These collaborative efforts will accelerate CCS development and will support the goal enabling commercial deployment of CCS technologies by 2020. In addition, the Cross-cutting Research program area supports science and engineering education in minority colleges and universities and the SBIR/STTR Program.

Plant Optimization Technologies

Sensors, Controls and Other Novel Concepts

The Instrumentation, Sensors & Control element focuses on the development of novel sensors critical to the implementation and optimization of advanced fossil fuel-based power generation systems, including new classes of sensors capable of monitoring key parameters (temperature, pressure, and gases) and operating in harsh environments. This involves development of innovative analytical techniques for on-line industrial use, along with technologies that meet the immediate high-priority measurement need. The controls development work centers around self-organizing information networks and distributed intelligence for process control and decision making. This activity also embeds other novel concepts that possess the potential for eliminating technology barriers in fossil energy systems. These novel concepts include: investigating fundamental combustion and gasification chemistry to discern rates and mechanisms affecting emissions behavior under combustion/gasification conditions; examining the fundamental parameters, kinetics, and thermodynamics involved in CO_2 mineral sequestration; and initiating a broad scope of technology development for advanced power systems.

Cross-cutting Material R&D

The Cross-cutting Materials area focuses on fundamental material research that is applicable to the full range of fossil fuel power generation technologies. Computational techniques to design and develop optimal materials for use in advanced combustion systems are being developed. This includes developing chemistries that will form either protective chromia oxide scales or alumina oxide scales, depending upon application environment and requirements. Work will also continue on the development of alloys based on refractory metal elements such as Nb, Mo, Cr and W to withstand the high temperatures and aggressive environments that are predicted for oxy-fuel turbines, hydrogen turbines and syngas turbines. This computational work will decrease the time to develop the new materials that will enable the next generation of fossil energy power systems. Work will continue the mechanical testing and microstructural analyses that is necessary to prove the performance of the nickel-based alloy Haynes 282 that has not previously been used in pulverized coal-fired power generation plants. This work is not only enabling the AUSC power plant development in the United States by producing the test results that will be used for the ASME code qualification of this material, but is also providing information that will give U.S. suppliers an advantage in the world market.

Coal Utilization Science

Computational Systems Dynamics

Computational system dynamics will develop the capability to utilize immersive, interactive, and distributed visualization technology in the design of next-generation advanced power systems like those under development. These will also implement the use of advanced, distributed computer- aided design tools for virtual design groups, as well as developing system tools that will allow the integrated use of information technology in next-generation advanced fossil power systems design including carbon capture. This program will also initiate a new multi-laboratory carbon capture and storage modeling effort National Risk Assessment Partnership (NRAP). NRAP is a multi-year effort that harnesses the breadth of capabilities across the U.S. Department of Energy (DOE) national lab system into a mission-focused platform in order to develop a defensible, science-based quantitative methodology for determining

risk profiles (and, hence, residual risk) at carbon dioxide (CO_2) storage sites. These three collaborative efforts will accelerate CCS development and will support the goal to enable commercial deployment of CCS technologies by 2020.

Computational Energy Science

Computational Energy Science develops science-based models of the physical phenomenon occurring in fossil fuel conversion processes and develops multi-scale, multi-physics simulation capabilities that couple fluid flow, heat and mass transfer, and complex chemical reactions for optimizing the design and operation of fuel cells, heat engines, combustors, gasifiers, chemical reactors, and other important unit processes in advanced power generation systems. The Carbon Capture Simulation Initiative focuses on post-combustion capture, risk assessment, and integrated multi-scale simulations, designed to leverage existing expertise and funding. The multi-national laboratory collaborative efforts will accelerate CCS development and will support the goal to enable commercial deployment of CCS technologies by 2020.

Energy Analyses

Environmental Activities

Analysis of issues associated with air and water quality, solid waste disposal, and global climate change. These analyses include the potential impact on health and climate change of particulates and linkages to fossil fuel use, barriers to and environmental impacts of large-scale deployment of CCS, and life cycle environmental emissions analysis for existing and advanced fossil fuel technologies.

Technical and Economic Analyses

Analyses that crosscut FE programs and supports multi-year program and strategic planning. It includes critical studies to identify major challenges, technologies, and advanced concepts that have the potential to improve the efficiency, cost, and/or environmental performance of fossil energy systems. These analyses include strategic benefits of fossil fuel technology long-term, integrated modeling analysis of the potential impact of CCS technologies, technical and economic studies carried out through the International Energy Agency Greenhouse Gas Program, and analysis of dispatchability of advanced CCS technology in U.S. regions.

System Analysis/ Product Integration

Work on assessing the technical viability and economics of advanced process concepts to support the development and deployment of near-zero atmospheric emissions plants, including CO_2 capture. Conduct a workshop for state environmental and economic regulators and energy officials to assist in providing state-of-the-art information for use in permitting advanced energy plants and developing state policies and international policies.

University Training and Research

University Coal Research

The University Coal Research (UCR) Program will continue its primary purpose: (1) to improve the Department's understanding of the chemical and physical processes involved in the conversion and utilization of coal in an environmentally acceptable manner; (2) to maintain and upgrade the coal research capabilities and facilities of U.S. colleges and universities; and (3) to support the education of students in the area of coal science through grants at U.S. colleges and universities that emphasize longer-term research for achieving Fossil Energy's strategic objectives. Key research areas that will be supported include, but are not limited to, advanced power systems including near-zero emission power plants; global climate change; development of advanced high performance materials; harsh environment sensors and controls; and the development of advanced fossil based power generation systems. Advanced fossil based power systems include ultra-clean energy plants that could co-produce electric power, fuels, chemicals and other high-value products from coal. Its key goals are the near-zero release of emissions, including greenhouse gases such as carbon dioxide, by the year 2015, along with substantial increases in energy conversion efficiency when utilizing our nation's abundant coal resources. The program will continue to solicit applications submitted from individual universities.

Historical Black Colleges and Univeristies' Education and Training

The Historical Black Colleges and Universities (HBCU) and other minority institutions (OMI) education and training program awards research grants to HBCUs and OMIs which emphasize longer-term research for achieving Fossil Energy's strategic objectives. The research focus of this continued effort has been on sensors and controls in extreme environments; computational energy sciences; and advanced materials for power generation. Funding will be used to

conduct Fossil Energy research activities at these institutions and to support an HBCU/OMI annual technology transfer symposium. Participants are determined by an open financial opportunity announcement on research topics that are of highest priority to Fossil Energy's programs. Grants awarded under this program are intended to maintain and upgrade educational, training and research capabilities of HBCUs/OMIs in the fields of science and technology related to fossil energy resources, with project results being used to further DOE's commitment to Fossil Energy research. The program supports two of DOE's business areas: Science and Technology, and Energy Resources.

International Activities

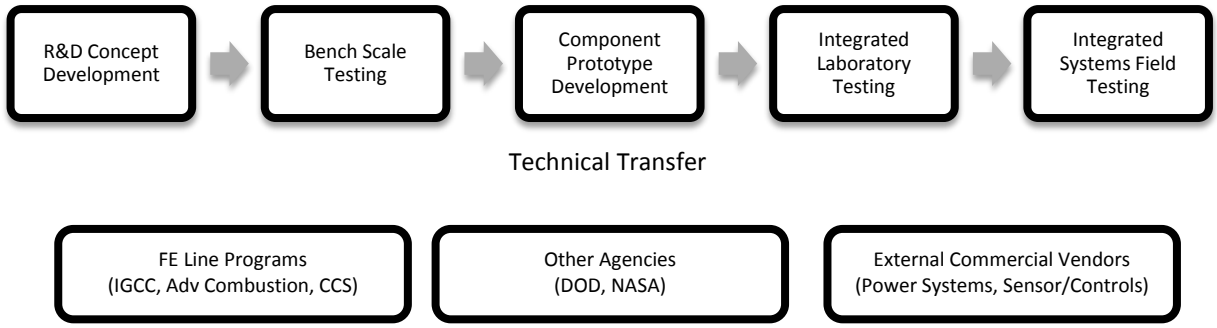
Coal Technology Export

Creating U.S. jobs by working with international organizations to facilitate exporting of U.S. climate technology and energy services to the developing world. Continue the momentum for carbon capture and storage (CCS) in multilateral organizations including International Energy Agency (IEA), United Nations, World Energy Council (WEC), and the Carbon Sequestration Leadership Forum and bilaterals with key countries such as China and India. Generate international support for CCS and work with the WEC to mitigate climate change. Ensure that U.S. policy is reflected in IEA support for G8 initiatives on highly efficient coal-fired power generation and CCS technology. Provide global outreach on advanced clean coal technology and CCS for climate change mitigation and energy security in multilateral forums including: the IEA, United Nations, WEC, and bilaterals with key countries such as China and India.

International Program Support

Continue funding the activity of the International Energy Agency Clean Coal Center (IEACCC). Enhance the competitiveness and adoption of U.S. environmental technology in China and utilize specific initiatives to protect local and global environments through the use of U.S. Clean Coal Technologies in targeted countries. Continue support of Fossil Energy's commitment to the IEA program effort. Preserve and enhance active relationships with national and international organizations. Focus on expanding cleaner energy technology power systems activities globally. Determine opportunities for cleaner power systems and clean fuels from coal in targeted countries.

Sequence



Benefits

Industry Benefits

- Second-generation high performance materials (structural ceramics, new alloys and coatings, and corrosion resistant refractory materials).
- Development of the CCSI Toolset, a comprehensive, integrated suite of validated science-based computational models and methodologies. This initiative will provide simulation tools that will increase confidence in designs, thereby reducing the risk associated with incorporating multiple innovative technologies into new carbon capture solutions.
- Develop and demonstrate a methodology for generating long-term quantitative risk profiles for carbon storage to support widespread commercial deployment.

R&D Benefits

- R&D sensors and controls to improve the efficiency and enhance reliability and plant availability R&D to support a full-scale power plant dynamic model. Computation, simulation, and modeling efforts will be focused on optimizing

plant design and performance, informing R&D investment, and shortening developmental timelines while supporting CCS-focused multi-lab partnerships.

- Computational design and modeling of second generation high-performance materials (structural ceramics, new alloys and coatings, and corrosion resistant refractory materials).

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	Extended and demonstrated the capability of MFIX to simulate gas-liquid flow applications, demonstrated advanced measurement techniques for improved computational model validation, completed CFD modeling to determine furnace gas compositions for an advanced ultrasupercritical (A-USC), oxy-fired pulverized coal boiler and completed the feasibility assessment of passive wireless sensors for harsh environments.	41,446
FY 2012	Continue the development of new classes of sensors that are capable of monitoring key parameters in harsh environment conditions of fossil energy systems and expand the utilization of sensors through the development of artificially intelligent sensor networks and advanced process control for near zero emission power plants, establish a multi-laboratory National Risk Assessment Partnership (NRAP) focused on developing a science-based quantitative methodology for determining risk profiles (i.e., residual risk) at CO_2 storage sites , continue to provide high-performance computational modeling and simulation research into advanced energy plants and CCS technology, and continue to support grants at U.S. colleges and universities by emphasizing longer-term research for achieving Fossil Energy's strategic objectives.	49,134
FY 2013	Continue Cross-cutting Research and Development.	29,750

NETL Coal Research and Development
Activity

Overview

The NETL staff is directly associated with conducting in-house research activities for the Coal Research and Development. This research supports NETL program specific activities in Carbon Capture, Carbon Storage, Advanced Energy Systems, and Cross Cutting Research. The in-house research and development activities are conducted by a staff of scientists, engineers, technicians and administrative personnel.

Benefits

NETL in-house research supports program specific activitiesin Carbon Capture, Carbon Storage, Advanced Energy Systems, and Cross-cutting Research.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011	NETL in-house research activities for Coal Research and Development. For FY 2011, the activity was funded under the Program Direction account at a total amount of $34.265 million.	0
FY 2012	NETL in-house research activities for the Coal Research and Development. This research supports program specific activities in Carbon Capture, Carbon Storage, Advanced Energy Systems, and Cross-cutting Research.	35,011
FY 2013	For FY 2013, continue NETL in-house research activities.	35,011

Natural Gas Technologies
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Natural Gas			
Natural Gas Technologies	0	4,997	12,000
Gas Hydrates	0	9,994	5,000
Total, Natural Gas	0	14,991	17,000[a]

[a]This figure does not include funds that will be taken out for SBIR/STTR.

Public Law Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 109–58, "Energy Policy Act of 2005"

Overview

The mission of the Natural Gas program is to support the DOE missions in energy, environment, and national security.

The Natural Gas Technologies program is being reprioritized to launch a collaborative research and development initiative together with the Environmental Protection Agency and the Department of the Interior's U.S. Geological Survey to understand and minimize the potential environmental, health, and safety impacts of natural gas development through hydraulic fracturing (fracking), consistent with the recommendations of the Secretary of Energy Advisory Board's (SEAB) August 2011 "Shale Gas Production Subcommittee Ninety-Day Report."

Subprogram Accomplishments and Milestones

In the prior appropriation year, the Natural Gas program improved public disclosure of chemicals used in hydraulic fracturing of oil and gas wells and strengthened State environmental programs.

In the current appropriation year, the budget invests in research and development to understand and minimize the potential environmental, health, and safety impacts of shale gas development through hydraulic fracturing (fracking).

The Natural Gas program is studying hydrates in the Arctic via controlled in situ depressurization and carbon dioxide injection. The Program recently drilled a fully instrumented hydrate well in Alaska at a cost of $8 million. Leveraging funding from Japan (up to $7 million) and $5 million from the FY 2011 Basic Energy Science budget, the testing of this well will take place in 2012 and be completed in FY 2013.

Explanation of Changes

The Department requests $17 million in FY 2013 for Natural Gas, which is a $2 million increase from the current FY 2012 level.

The Natural Gas FY 2013 budget request will focus on continued implementation of a priority collaborative research and development initiative together with the Environmental Protection Agency and the Department of the interior's U.S. Geological Survey to understand and minimize the potential environmental, health, and safety impacts of shale gas development through hydraulic fracturing (fracking), consistent with the research recommendations received from the Subcommittee of the Secretary of Energy Advisory Board (SEAB). The SEAB delivered its Shale Gas Production 90-day report to the Secretary on August 18, 2011.

In terms of research, the subcommittee recommended environmental and safety studies, risk assessments, and longer-term R&D such as:

- Assessment of the greenhouse gas footprint for cradle-to-grave use of natural gas.
- Studies to confirm the validity of methane migration (higher concentration of methane originating in shale gas deposits in wells surrounding a producing shale production site).
- Research on methane hydrates.
- Determination of the chemical interactions between fracturing fluids and different shale rocks – both experimental and predictive.
- Understanding induced seismicity triggered by hydraulic fracturing and injection well disposal.
- Development of "green" drilling and fracturing fluids.
- Development of improved cement evaluation and pressure testing wireline tools assuring casing and cementing integrity.
- In 2012, the three agencies will develop and begin implementation of collaborative research plan, in-

cluding goals, objectives, performance measures and milestones in such areas as air, water, ecosystems, and induced seismicity (earthquakes).

The FY 2013 budget request will focus on a high priority subset of these subcommittee recommendations, including the evaluation of gas hydrates as an energy resource for the Nation by initiating a long-term gas hydrate field testing program with industry and international partners. The budget proposes $5 million to fund research in FY 2013 to investigate natural gas hydrates in the Arctic as a potential fossil resource.

Program Planning and Management

The 90-day report submitted by the subcommittee to SEAB stated that natural gas is a cornerstone of the U.S. economy, providing a quarter of the country's total energy. Owing to breakthroughs in technology, production from shale formations has gone from a negligible amount just a few years ago to being almost 30% of total U.S. natural gas production. This has brought lower prices, domestic jobs, and the prospect of enhanced national security due to the potential of substantial production growth. But the growth has also brought questions about whether both current and future production can be done in an environmentally sound fashion that meets the needs of public trust.

The report presents recommendations that if implemented will reduce the environmental impacts from shale gas production.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Natural Gas Technologies			
The FY 2013 request includes funding to understand and reduce the environmental impact of shale gas development.	5,000	12,000	+7,000
Gas Hydrates			
The FY 2013 request includes funding to investigate natural gas hydrates in the Arctic as a potential fossil resource.	10,000	5,000	-5,000
Total, Natural Gas	15,000	17,000	+2,000

Unconventional FE Technologies
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Unconventional FE Technologies	0	4,997	0
Total, Unconventional FE Technologies	0	4,997[a]	0

[a]This figure does not include funds that will be taken out for SBIR/STTR.

Public Law Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 109–58, "Energy Policy Act of 2005"

Overview

The mission of the Unconventional Fossil Energy Resource Program is to provide information and technologies that will assure sustainable, reliable, affordable, and environmentally sound supplies of domestic fossil energy resources.

The Natural Gas program is being reprioritized to launch a collaborative research and development initiative together with the Environmental Protection Agency and the Department of the Interior's U.S. Geological Survey to understand and minimize the potential environmental, health, and safety impacts of natural gas development through hydraulic fracturing (fracking), consistent with the recommendations of the Secretary of Energy Advisory Board's (SEAB) August 2011 "Shale Gas Production Subcommittee Ninety-Day Report."

Subprogram Accomplishments and Milestones

No activity is proposed in FY 2013.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Unconventional FE Technologies			
The Natural Gas program is being reprioritized to launch a collaborative research and development initiative together with the Environmental Protection Agency and the Department of the Interior's U.S. Geological Survey to understand and minimize the potential environmental, health, and safety impacts of natural gas development through hydraulic fracturing (fracking).	4,997	0	-4,997
Total, Unconventional FE Technologies	4,997	0	-4,997

Explanation of Changes

The Natural Gas program is being reprioritized to launch a collaborative research and development initiative together with the Environmental Protection Agency and the Department of the Interior's U.S. Geological Survey to understand and minimize the potential environmental, health, and safety impacts of natural gas development through hydraulic fracturing (fracking), consistent with the recommendations of the Secretary of Energy Advisory Board's (SEAB) August 2011 "Shale Gas Production Subcommittee Ninety-Day Report."

Program Planning and Management

No activity in FY 2013.

Program Direction
Funding Profile by Category

(Dollars in Thousands/Whole FTEs)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Indirect Program Direction – Headquarters			
Salaries and Benefits	17,425	17,084	16,871
Travel	959	1,000	1,000
Support Services	77	85	85
Other Related Expenses	11,244	11,544	12,471
Total, Indirect Program Direction – Headquarters	29,705	29,713	30,427
Full Time Equivalents	100	110	108
NETL Indirect			
Salaries and Benefits	43,112	45,500	46,860
Travel	1,605	1,800	1,900
Support Services	23,078	21,751	18,450
Other Related Expenses	20,121	19,049	16,000
Total, NETL Indirect	87,916	88,100	83,210
Full Time Equivalents	305	360	360
Indirect Program Direction			
Salaries and Benefits	60,537	62,584	63,731
Travel	2,564	2,800	2,900
Support Services	23,155	21,836	18,535
Other Related Expenses	31,365	30,593	28,471
Total, Indirect Program Direction	117,621	117,813	113,637
Full Time Equivalents	405	470	468
NETL Coal Research and Development Direct Program			
Salaries and Benefits	27,241	0	0
Travel	1,075	0	0
Support Services	5,949	0	0
Total, NETL Coal Research and Development Direct Program	34,265	0*	0*
Full Time Equivalents	203	213	199
Import/Export Authorization			
Salaries and Benefits	1,304	1,437	1,437
Travel	20	22	22
Other Related Expenses	515	657	657
Total, Import/Export Authorization	1,839	2,116	2,116
Full Time Equivalents	13	13	13
Program Direction			
Salaries and Benefits	89,082	64,021	65,168
Travel	3,659	2,822	2,922
Support Services	29,104	21,836	18,535
Other Related Expenses	31,880	31,250	29,128
Total, Program Direction	153,725	119,929	115,753
Full Time Equivalents	621	696	680
Reprogrammed Funding for Oil Spill Commission	11,000	0	0

(Dollars in Thousands/Whole FTEs)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Total Fossil R&D Program Direction	164,725	119,929	115,753

* NETL Coal Research & Development Funding has been moved to CCS refrence P.L 112-74

Overview

Program Direction provides for the Headquarters and field Federal workforce responsible for the overall direction and administrative support of the FE program. To carry out FE's mission a federal staff is needed to provide overall guidance, program management, contract administration, budget formulation and execution, etc. FE's primary mission is to ensure that the Nation can continue to rely on traditional resources for clean, affordable energy while enhancing economic, environmental, and energy security. The mission of the program is to also create technology and technology-based policy options for the public benefit. The program is also responsible for project management activities and reporting requirements related to projects selected under the American Recovery and Reinvestment Act (ARRA).

The Office of Import/Export Authorization manages the regulatory review of natural gas imports and exports. This program exercises regulatory oversight of the conversion of existing oil and gas-fired power plants, processes exemptions from the statutory provisions of the Power Plant and Industrial Fuel Use Act of 1978 (FUA), as amended, and processes certifications of alternate fuel capability.

The Program Direction request includes funding for the coordination of the Energy portfolio by the Office of the Under Secretary for Energy.

Major Programmatic Shifts or Changes

Beginning in FY 2012, the NETL Coal Research and Development Direct Program Direction was moved out of Program Direction and is now in a line titled NETL Coal Research and Development under the Carbon Capture and Storage and Power System Program.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Indirect Program Direction – Headquarters			
Salaries and Benefits: The decrease in salaries and benefits reflects a change in FTEs from FY 2012 (110 FTEs) to FY 2013 (108 FTEs).	17,084	16,871	-213
Travel: No funding changes.	1,000	1,000	+0
Support Services: No funding changes.	85	85	+0
Other Related Expenses: DOE is working to achieve economies of scale through an enhanced Working Capital Fund (WCF). The WCF increase covers certain shared, enterprise activities including enhanced cybersecurity architecture, employee health and testing services, and consolidated training and recruitment initiatives.	11,544	12,471	+927
Total, Indirect Program Direction – Headquarters	29,713	30,427	+714

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
NETL Indirect			
Salaries and Benefits: The increase in funding for salaries and benefits is due to the addition of FTEs from ARRA activities that were previously covered with ARRA Bridge funding. The ARRA Bridge funding will be depleted during the middle of FY 2012. The increase will also cover promotions and with-in grade increases.	45,500	46,860	+1360
Travel: The increase in travel is due to the increased FTEs.	1,800	1,900	+100
Support Services: The decrease in support services is due to management optimization efforts in meeting government objectives of reducing costs for support service activity.	21,751	18,450	-3,301
Other Related Expenses: The decrease in other related expenses is due to a reduction in other services for facility operations and infrastructure.	19,049	16,000	-3,049
Total, NETL Indirect	88,100	83,210	-4,890

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Import/Export Authorization			
Salaries and Benefits: No funding changes.	1,437	1,437	0
Travel: No funding changes.	22	22	0
Other Related Expenses: No funding changes.	657	657	0
Total, Import/Export Authorization	2,116	2,116	0

Functional Transfers

The budget request does not include any functional transfers.

Support Services by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Technical Support Services			
Feasibility of Design Considerations	0	0	0
Development of Specifications	0	0	0
System Definition	0	0	0
System Review and Reliability Analysis	365	350	400
Trade-Off Analysis	0	0	0
Economic and Environmental Analysis	900	875	950
Test and Environmental Studies	3,000	2,600	2,225
Surveys or Reviews of Technical Operations	470	400	425
Total, Technical Support Services	4,735	4,225	4,000
Management Support Services			
Analysis of Workload and Workflow	0	0	0
Directive Management Studies	650	650	650
Automatic Data Processing	6,500	6,500	6,500
Manpower Systems Analysis	0	0	0
Preparation of Program Plans	0	0	0

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Training and Education	0	0	0
Analysis of DOE Management Processes	0	0	0
Reports and Analyses Management and General Administrative Support	17,219	10,461	7,385
Total, Management Support Services	24,369	17,611	14,535
Total, Support Services	29,104	21,836	18,535

Other Related Expenses by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Rent to GSA	0	0	0
Rent to Others	1,600	1,700	1,800
Communication, Utilities, Misc.	5,800	5,900	5,500
Printing and Reproduction	30	30	30
Other Services (Facility Operations, Technology Infrastructure Support, etc.)	8,079	5,870	3,000
Training	775	750	750
Purchases from Gov. Accounts	1,800	1,800	1,800
Operation and Maintenance of Equipment	3,100	3,200	2,800
Supplies and Materials	2,119	2,200	1,847
Equipment	2,379	2,400	2,000
Working Capital Fund	6,198	7,400	9,601
Total, Other Related Expenses	31,880	31,250	29,128

Plant and Capital Equipment
Funding Profile by Subprogram and Activities

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Plant and Capital Equipment			
General Plant Projects	19,960	16,794	13,294
Total, Plant and Capital Equipment	19,960	16,794	13,294

Public Law Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 108–153, "21st Century Nanotechnology Research and Development Act 2003"
Public Law 109–58, "Energy Policy Act of 2005"
Public Law 110–69, "America COMPETES Act of 2007"
Public Law 110-140, "Energy Independence and Security Act 2007"
Public Law 111–358, "America COMPETES Act of 2010"

Overview

The Plant and Capital Equipment program creates, improves, and maintains the 119 facilities and infrastructure making up the National Energy Technology Laboratory (NETL). NETL has 119 facilities and related infrastructure located in Morgantown, West Virginia; Pittsburgh, Pennsylvania; and Albany, Oregon. These facilities directly support the development of clean technologies for fossil energy and support the R&D necessary to meet DOE program goals for cost effective and efficient CO_2 capture and sequestration technologies.

Program Accomplishments and Milestones

FY 2013, execution of this program's mission will support the Secretary's climate change technology goals and energy usage reduction goals. Additionally, these funds will contribute to the Secretary's priority for clean energy and GPRA Unit Program Goals by maintaining and improving facilities and related infrastructure supporting performance of research to develop and deploy clean, safe, low-CO_2 emissions energy sources.

In the current appropriation year, Plant and Capital Equipment is working towards the following key milestones:

- FY 2012, Request will be used to conduct projects which will reduce energy, environmental, safety/health risks and liabilities posed by an aging infrastructure, to comply with building standards, and to meet the energy conservation and research requirements of Public Law 110-140, The Energy Independence and Security Act of 2007.
- Meet or exceed the energy conservation milestones for FY 2012 through energy efficiency improvements.
- Department Strategic Goal 5.3 – Infrastructure – Build, modernize, and maintain facilities and infrastructure to achive mission goals and ensure a safe and secure workplace.

Explanation of Changes

The Department requests $13.3 million in FY 2013 for Plant and Capital Equipment, which is a 21% decrease compared to the current FY 2012 level. A comprehensive management improvement strategy will be implemented beginning in FY 2012 to ensure that the highest priority program and other objectives are met, while these savings are realized.

Program Planning and Management

The funding for the Plant and Capital Equipment subprogram in FY 2013 will be used to maintain and improve facilities and related infrastructure supporting performance to develop and deploy clean, safe, low-CO_2 emissions energy sources. In addition to supporting a safe infrastructure, FE sites are working to achieve a reduction in its energy consumption of up to 30% total reduction by the end of FY 2015.

Program Goals and Funding

- Provide an insfracture that is compliant with safety, health and environmetal regulations.
- Meet milestones established to comply with the 2015 energy savings requirements of P.L. 110-140.
- Meet the High Performance Sustainable Buildings goals established by the Secretary.

Specific goals include making substantial progress in the areas of:

- Energy saving
- Demonstrating new technologies
- Efficiency

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
General Plant Projects			
The funding requested and management improvement strategy that will be implemented will enable the program to support an infrastructure compliant with essential safety, health and environmetal regulations.	16,794	13,294	-3,500
TOTAL Funding Change, General Plant Projects	16,794	13,294	-3,500

Environmental Restoration
Funding Profile by Subprogram and Activities

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Environmental Restoration			
CERCLA[a] Remedial Actions	499	200	200
RCRA[b] Remedial Action	3,144	1,697	1,697
Other ES&H[c] Actions	6,337	6,000	4,000
Total, Environmental Restoration	9,980	7,897	5,897

[a] Comprehensive Environmental Response, Compensation, and Liability Act (of 1980)
[b] Resource Conservation and Recovery Act (of 1976)
[c] Environmental Safety and Health

Public Law Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 108–153, "21st Century Nanotechnology Research and Development Act 2003"
Public Law 109–58, "Energy Policy Act of 2005"
Public Law 110–69, "America COMPETES Act of 2007"
Public Law 111–358, "America COMPETES Act of 2010"

Overview

Fossil Energy (FE) Environmental Restoration activities ensure protection of workers, the public, and the environment in performing the FE mission of the National Energy Technology Laboratory (NETL) at the Morgantown (MGN), West Virginia; Pittsburgh (PGH), Pennsylvania; Houston, Texas; Fairbanks, Alaska; and Albany (ALB), Oregon sites.

Program Accomplishments and Milestones

In FY 2011, Fossil Energy's CERCLA subprogram operated and maintained the air sparge remediation system to remove organic contaminants from the Tipton aquifer ground water, as required by the Wyoming Department of Environmental Quality (WDEQ). FE conducted periodic ground water sampling events at Sites 4, 6, 7, 9, and 12 to evaluate contaminant removal and to assess progress toward meeting regulatory requirements set forth by the WDEQ. A project review report as required by the WDEQ was prepared and submitted. *Participants include: U.S. Army Corps of Engineers, HydroGeoLogic Consultants and URS (NETL site support contractor)*. The two-year ground water stability period at the Hoe Creek III Site was completed, and a request to the WDEQ for a determination that the aquifer is restored will be submitted. Quarterly ground water sampling events to verify ground water quality parameters have stabilized and ground water can be considered restored to baseline conditions by the WDEQ were conducted. *Participants include: U.S. Army Corps of Engineers, Cape Environmental Associates*.

In FY 2011, the RCRA subprogram implemented chemical- and pollutant-related environmental management plans under NETL's ISO-14001 program. NETL continued RCRA-related on-site regulatory, corrective, preventive, and improvement activities, such as asbestos and lead abatement and waste minimization and pollution prevention activities. Activities were performed to ensure compliant wastewater treatment plant operations in order to address past notices of violations. RCRA-related risk management and maintenance activities were funded. Retrofits of heating and cooling systems with acceptable refrigerants to meet Federal requirements by 2012 were continued.

Albany RCRA cleanup actions, including abating lead and asbestos exposures were continued. Chemical storage and labeling issues were resolved. Soil and ground water were monitored. Other cleanup actions included upgrading ventilation and air pollution systems, improving air emission management, materials handling, facility equipment disposal, and waste disposal activities. Regulatory ground water monitoring activities in conjunction with the Oregon Department of Environmental Quality were continued. The investigation and risk assessment activities for the specific trichloroethylene (TCE) ground water contamination issue were continued, and the most appropriate path forward for remediation was identified.

The Other ES&S subprogram implemented and improved baseline regulatory compliance, integrated safety management, and the ISO 14001 programs (i.e., emergency management, occupational medicine and health, industrial hygiene, safety, environmental management, ergonomics, training, security, and fire protection). Actions in support of correcting ES&H deficiencies associated with infrastructure (e.g., ventilation systems, waste pads, and gas cylinder storage areas) were implemented. Actions in support of achieving DOE's pollution prevention and energy management goals were conducted. Indoor air quality and ventilations systems, walking/working surfaces, personal protective equipment were maintained, and facility seismic evaluations were conducted. Actions in support of personnel security, operational security, export/import controls, and the foreign national visitor and assignment programs were implemented.

Explanation of Changes

The Department requests $5.9 million in FY 2013 for Environmental Restoration, which is a 25% decrease compared to the FY 2012 level.

The FY 2013 request decreases the levels for Other ES&H (-$2M). The program will continue to provide support and oversight necessary to address its highest priority objectives and to meet federally mandated safety, health, and security requirements.

Program Planning and Management

In FY 2012, NETL plans to continue active operation and maintenance of the air sparge remediation system at Rock Springs Site 4, 6, 7, 9, and 12 to remove organic contaminants from the Tipton aquifer ground water. Upon conclusion of active groundwater water remediation, the groundwater stabilization period will continue. NETL will conduct periodic ground water sampling events to evaluate contaminant removal and to assess progress toward meeting regulatory requirements set forth by the WDEQ. The regulatory agreement, as requested by the WDEQ will be renegotiated. If remediation goals are met and approved by WDEQ, the ground water monitor wells will be plugged and abandoned. NETL will contour and seed disturbed areas with seed mixtures approved by WDEQ. *Participants include: U.S. Army Corps of Engineers, HydroGeoLogic Consultants and URS (NETL site support contractor)*. Plans, following approval from WDEQ, will begin to plug and abandon all remaining ground water monitor wells. NETL will continue the removal of all surface facilities (buildings, air sparge lines, office trailer) and contour and seed all disturbed areas with seed mixtures approved by the WDEQ. The surface reclamation plan with the WDEQ will be negotiated.

The funding for the CERCLA subprogram in FY 2013 will be used to continue active operation and maintenance of the air sparge remediation system at Rock Springs Site 4, 6, 7, 9, and 12 as well as, following approval from WDEQ, to continue ten-year surface revegetation and other required long term monitoring.

In FY 2012 and FY 2013, NETL plans to continue RCRA-related on-site regulatory, corrective, preventive, and improvement activities, such as asbestos and lead abatement and waste minimization and pollution prevention activities. Albany RCRA cleanup actions, including abating lead and asbestos exposures, resolving chemical storage and labeling issues, monitoring soil and ground water, upgrading ventilation and air pollution systems, improving air emission management, materials handling, facility equipment disposal, and waste disposal activities will be continued. The regulatory ground water monitoring activities in conjunction with the Oregon Department of Environmental Quality will continue. NETL will continue the investigation and risk assessment activities for the specific trichloroethylene (TCE) ground water contamination issue and identify the most appropriate path forward for remediation. Priorities under Environmental Restoration will be based on space utilization and consolidation surveys that will allow NETL to focus its attention on facilities and infrastructure that fit within the scope of its five- and ten-year plans. Non-mandatory remediation efforts in underutilized or vacated space will carry a low priority.

In FY 2012 and FY 2013, NETL ESS&H activities will focus on maintaining established regulatory safety and health programs (i.e., emergency management, occupational medicine and health, industrial hygiene, safety, environmental management, ergonomics, training, and fire protection) and mandatory security programs (i.e., personnel security, operational security, export/import controls, and the foreign national visitor and assignment program). Priority will be given to initiatives that protect personnel and the environment. The goals of the Environmental Restoration program will include: maintaining a working environment where OSHA recordable incidents are minimized and are less than the national and standard industry rates; zero notices of violation from local, state, and federal regulatory agencies; and zero violations of DOE security policy. The goals will be measured through mandatory third party audits associated with NETL's ISO 14001 and OHSAS 18001 certifications, mandatory NNSA security self assessments, and various ongoing internal audits and inspections.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
CERCLA			
The Hoe Creek and Hanna remedial actions are scheduled to be completed and released by the Wyoming DEQ after FY 2012. Activities at these sites will be correspondingly reduced over the 2011-2013 timeframe.	200	200	0
RCRA			
Asbestos, lead abatement activities, and pollution prevention work at NETL continues to diminish. The only significant driver of costs in this activity remains the remediation of the groundwater contamination at the Albany site.	1,697	1,697	0
Other ES&H			
This will continueessential support and oversight necessary to meet the program's highest priority safety, health, and security needs.	6,000	4,000	-2,000
TOTAL Funding Change, Environmental Restoration	7,897	5,897	-2,000

Special Recruitment Programs
Funding Profile

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Special Recruitment Programs	699	700	700
Total, Special Recruitment Programs	699	700	700

Public Law Authorizations

Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 108–153, "21st Century Nanotechnology Research and Development Act 2003"
Public Law 109–58, "Energy Policy Act of 2005"
Public Law 110–69, "America COMPETES Act of 2007"
Public Law 111–358, "America COMPETES Act of 2010"

Overview

FE is committed to participating in the Department's pilot laboratory research internship project for the Science Technology, Engineering, and Mathematics (STEM) education program authorized by section 101 of the America COMPETES Reauthorization Act of 2010.

FE also has developed the Mickey Leland Energy Fellowship (MLEF) Program to help engage minority and other highly qualified technical and engineering students in working on Fossil Energy programs and initiatives.

The MLEF program is a ten-week summer internship program that offers women and under-represented minority students majoring in math, science, and engineering an opportunity to learn about FE programs and initiatives. In addition, Fossil Energy works closely with and encourages these MLEF students who are studying academic disciplines related to the Fossil Energy mission to pursue careers in Fossil Energy fuel research ensuring clean, affordable energy.

One of the goals of the MLEF program is to mentor 30-40 students in various programs throughout FE. Students are placed at different sites including the National Energy Technology Lab (NETL), the Strategic Petroleum Reserve, and Fossil Energy Headquarters.

Program Accomplishments and Milestones

The Special Recruitment Programs support the Secretary's priority of developing and nurturing science and engineering talent and provides a succession of scientists and engineers.

In FY 2011, applicants were recruited and selected to participate in the Mickey Leland Energy Fellowship Program.

A survey of the Mickey Leland Energy Fellowship program participants, FE site coordinators, and mentors was conducted at the end of FY 2011. The results of this survey are being used to make improvements to the program in FY 2012.

In FY 2012, applicants will continue to be recruited and selected to participate in the Mickey Leland Energy Fellowship Program.

Explanation of Changes

There were no changes to the Special Recruitment Program.

Program Planning and Management

The funding for the Special Recruitment Programs subprogram in FY 2013 will be used to recruit applicants and select participants in the Mickey Leland Energy Fellowship Program.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Special Recruitment Programs			
There is no significant reduction in funding.	700	700	0
TOTAL Funding Change, Special Recruitment Programs	700	700	0

Naval Petroleum and Oil Shale Reserves

Naval Petroleum and Oil Shale Reserves

Naval Petroleum and Oil Shale Reserves

Proposed Appropriation Language

For expenses necessary to carry out naval petroleum reserve and oil shale reserve activities, $14,909,000, to remain available until expended: Provided, That, notwithstanding any other provision of law, unobligated funds remaining from prior years shall be available for all naval petroleum and oil shale reserve activities.

Explanation of Changes

There are no significant changes.

Naval Petroleum and Oil Shale Reserves
Office of Fossil Energy

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Naval Petroleum and Oil Shale Reserves			
Naval Petroleum and Oil Shale Reserves	22,954	14,909	14,909
Prior Year Rescission	-2,100	0	0
Total, Naval Petroleum and Oil Shale Reserves	20,854	14,909	14,909

Office Overview and Accomplishment

The Naval Petroleum and Oil Shale Reserves (NPOSR) program continues to work towards closing out legal responsibilities of environmental remediation at Naval Petroleum Reserve No. 1 (NPR-1) (Elk Hills, CA) and disposition activities, including environmental remediation, at Naval Petroleum Reserve No. 3 (NPR-3) (Casper, WY). NPR-3 will begin implementing the disposition plan with final disposition of the property estimated to occur in FY 2015. NPR-3 will be utilized for production and testing operations in order to retain asset value during preparation to transfer to potential new ownership. Production facilities will remain operational as long as economically viable. The program will continue Rocky Mountain Oilfield Testing Center (RMOTC) testing for 100% funds-in projects and those projects wholly funded by EERE's Geothermal Technology Program. Environmental remediation of NPR-3 facilities will continue to facilitate the sale/disposition of the property in a manner consistent with an approved property sale/disposition plan.

Explanation of Changes

The Department requests $14.9 million in FY 2013 for NPOSR, which is the same as FY 2012.

Implementation of the disposition plan will be the primary focus of FY 2013. A reduced level of effort in Environmental Remediation at NPR-1 and NPR-3 is planned. NPR-3 will only be able to support minimal maintenance of field facilities. Major breakdowns of wells will not be repaired or replaced. Work included in the disposition plan may need to be prioritized and postponed. Staff reductions will take place in FY 2013 consistent with the reduced level of effort.

Facilities Maintenance and Repair

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

Direct-Funded Maintenance and Repair

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Naval Petroleum and Oil Shale Reserves	930	1,370	900
Total, Direct-Funded Maintenance and Repair	930	1,370	900

Naval Petroleum and Oil Shale Reserves
Fossil Energy

Funding by Site by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Naval Petroleum and Oil Shale Reserves			
NPR Wyoming	15,444	9,179	9,179
Washington Headquarters	7,510	5,730	5,730
Total, Naval Petroleum and Oil Shale Reserves	22,954	14,909	14,909

Naval Petroleum and Oil Shale Reserves
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Naval Petroleum and Oil Shale Reserves			
Production and Operations	14,784	5,480	7,915
Management	8,170	9,429	6,994
Total, Naval Petroleum and Oil Shale Reserves	22,954	14,909	14,909

Public Law Authorizations

Public Law 94–258, "Naval Petroleum Reserves Production Act", 1976
Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 109–58, "Energy Policy Act of 2005"
Public Law 104–106, "The National Defense Authorization Act For Fiscal Year 1996"
Public Law 105–261, "The Strom Thurmond National Defense Authorization Act for Fiscal Year 1999"

Overview

The NPOSR program manages a number of legal agreements that were executed as part of the 1998 sale of NPR-1 in California. These agreements direct post-sale work including environmental restoration and remediation, equity finalization, contract closeout, and records disposition. Legal agreements include payment for post-employment medical and dental benefits to former Management & Operating (M&O) contractor employees. The NPR-1 program continues to work towards closing out the remaining environmental findings, as required by the 2008 agreement between DOE and the California Department of Toxic Substance Control (DTSC).

The Department also operates the NPR-3 and the Rocky Mountain Oilfield Testing Center (RMOTC), co-located near Casper, Wyoming. NPR-3/RMOTC will begin implementing the disposition plan with final disposition of the property estimated to occur in FY 2015. The site facilities will be utilized by production and testing operations in order to maintain asset value during preparation to transfer to potential new ownership. Production facilities will remain operational as long as economically viable. RMOTC will provide opportunities through 100% funds-in agreements for field testing of oilfield technologies and demonstration renewable energy technologies having oilfield application. Any R&D conducted by the Office of Energy Efficiency and Renewable Energy (EERE) should be fully funded through EERE appropriations or non-governmental organization cost-share. Environmental remediation of NPR-3 facilities will continue to facilitate the sale/disposition of the property in a manner consistent with an approved property sale/disposition plan.

RMOTC provides opportunities for field testing and demonstration of low-temperature geothermal technologies and other renewable energy technologies having oilfield application. NPR-3 will implement an approved disposition plan for sale or transfer to new owners while continuing production operations that will deposit revenue into the U.S. Treasury, managing RMOTC testing operations, and maintaining facility assets to attract potential new ownership. Environmental Remediation will continue on facilities that cannot be utilized for production, testing activities, have mechanical issues, or would have no value for potential new owners. Since disposition will relieve RMOTC from the requirement to return the oilfield to its original conditions, the reduction in required environmental remediation will result in significant savings to the Federal government.

Production operations will continue for this stripper field as long as economically viable. Production of 143 barrels of oil per day is forecast generating $4.1M deposited into the U.S. Treasury. Wells will be maintained to continue expected production but major breakdown of equipment will not be repaired or replaced. Infrastructure removal/restoration will not be completed on facilities that could be utilized to attract potential new owners. Transfer of the field to new owners is expected to take place during FY 2015.

Testing operations will operate two geothermal power generation projects being sponsored by the DOE's Geothermal Technology Program. Testing operations will also use 100% funds-in agreements to provide field testing for academia, industry, and small inventors to field test innovations and assist in bringing them to the market place.

Remediation activities will continue for facilities that are not environmentally in compliance with the State of Wyoming Oil and Gas Conservation Commission (WOGCC) regulations or no longer hold value for production operations, testing operations, or to potential new owners.

The disposition plan will be implemented and will focus on maximizing assets to the extent possible and minimizing environmental remediation when applicable. Wells will not be plugged or abandoned unless they have mechanical issues. If it is determined that a well could be produced profitably by a potential new owner, it will not be plugged.

Program Accomplishments and Milestones

On April 22, 2011, the Department settled its Equity Finalization process with Chevron. Under the settlement agreement Chevron has paid $108,000,000 to the Department.

In FY 2012, NPR-3 expects to achieve four significant accomplishments or milestones in program management and/or program development: 1) Provide a site for technology developers to field test inventions, including low-temperature geothermal validation; 2) Environmental remediation; 3) Provide revenue to the U.S. Treasury; and 4) Complete a Disposition Plan.

In FY 2013, NPR-3 will start working towards achieving the following key milestones:

Milestone	Date
Begin to implement Disposition Plan	Oct 1, 2012
Generate $4.1 million in revenues to U.S. Treasury	Sept 30, 2013
Test and validate one new geothermal power generation technology	Sept 30, 2013

Beyond FY 2013, outyear milestones will be dependent upon agreed to options of approved disposition plan. The NEPA process will be completed in FY 2013. Complete and environmental cleanup obligations required from the sale/transfer agreement(s) by the end of FY 2014. Complete the transfer of property in FY 2015. And finally, the closeout of DOE RMOTC office and records disposition will be completed in FY 2016.

Explanation of Changes

The Department requests $14.9 million in FY 2013 for NPOSR, which is the same as FY 2012.

Implementation of the disposition plan will be the primary focus of FY 2013. A reduced level of effort in Environmental Remediation at NPR-1 and NPR-3 is planned. NPR-3 will only be able to support minimal maintenance of field facilities. Major breakdowns of wells will not be repaired or replaced. Work included in the disposition plan may need to be prioritized and postponed. Staff reductions will take place in FY 2013 consistent with the reduced level of effort.

Operating the NPR-3 site will be done in a safe and environmentally required manner; decreased budget levels will decrease the amount of facility maintenance that could lessen interest from potential new ownership. In order to prepare the NPR-3 site for disposition or sale, facilities will need to be operational and functional to attract potential new owners. NPR-3 will focus on implementing the disposition plan while continuing the production operations as long as economically viable, continuing testing operations with 100% funds-in agreements to further innovations in new solutions to energy needs, and continuing to remediate the field site.

Program Planning and Management

NPOSR manages operational measures that are implemented by support service contractors. Action plans are reviewed and analyzed at Program Reviews held at NPR-1 and NPR-3. These reviews provide an opportunity to discuss performance, cost, schedule, and scope to ensure activities are on-track and within budget. Budget formulation/execution assessments are regularly conducted throughout the year to ensure that budget execution is on target.

The program's plans to achieve management goals and put the taxpayer's dollars to best use will be to continue to develop, maintain and operate NPR-3 assets that provide future value to potential owners in an effort to dispose of the site as soon as possible with the least amount of environmental remediation costs to the government.

External factors with strongest impacts to program achievement are having a disposition plan approved to be able to implement; finding potential new ownership for the property and having the required environmental remediation completed for disposition and/or sale that would be in the best interest of the government.

Strategic Management

NPOSR will use various means and strategies to continue its mission and achieve its program goals. The program continues ongoing activities to attain release from remaining environmental findings related to the sale of NPR-1, as is required by the agreement between DOE and the California Department of Toxic Substance Control (DTSC).

Restructuring activities at NPR-3 will include implementing a disposition plan for possible sale of transfer of the site from a government entity.

Notwithstanding funding impacts, two external factors present the strongest impacts to the overall achievement of the program's strategic goals:

1. Transitioning from being able to provide a cost-shared testing to a self sustaining user facility catering to only 100% funds-in agreements without a successful management/operational model from within the Department;
2. Fluctuating oil prices influence the ability to forecast operations requirements to remain profitable.

Program Goals and Funding

If budgets remain constant at the FY 2012 and FY 2013 request levels, remediation work will be delayed at NPR-1 and NPR-3. The work required for disposition will require prioritization, work may be delayed, and some facility maintenance would not be completed.

Explanation of Funding AND/OR Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Production and Operations. The increase is due to realignment of funds from Management with increased efforts on closeout of NPR-1 and disposition of NPR-3. NPR-3 will implement the approved disposition plan that will transfer or sell the site while maintaining and operating assets that provide future value to potential ownership.	5,480	7,915	+2,435
Management. The decrease is due to the completion of Equity Finalization in FY 2011 and focus on disposition of NPR-3.	9,429	6,994	-2,435
TOTAL Funding Change, Naval Petroleum and Oil Shale Reserves	14,909	14,909	0

Naval Petroleum and Oil Shale Reserves
Funding Profile by Activity

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
NPOSR – Operations and Production			
NPR-1 Closeout	3,784	2,480	3,280
NPR-3 Disposition	0	0	4,635
NPR-3 Operations	6,310	0	0
NPR-3 Environmental Remediation	4,690	3,000	0
Total, NPOSR – Operations and Production	14,784	5,480	7,915

Overview

NPR-1 environmental remediation and cultural resource activities are required as a result of the former NPR-1 sales agreement of 1998. The commitments were formalized in legal agreements between DOE, Occidental, Chevron, and the State of California. Current activities encompass execution of the technical baseline, interim measures, environmental sampling and analysis, corrective measures, waste removal and disposal, confirmatory sampling, and request for release from further corrective action.

In supporting the Secretary's Goal of Energy: Build a competitive, low-carbon economy and secure America's Energy Future, the NPR-3 program operates as a stripper field that produces oil and deposits revenue into the U.S. Treasury. It also utilizes the site as a testing facility for RMOTC that allows field testing of oilfield technologies, as well as renewable energy applications as related to oilfield application. RMOTC also supports a Low-Temperature Geothermal Validation Facility which generates power for the field and can be used for future testing partners. The Low-Temperature Geothermal Facility supports the Department's goal of securing America's energy future.

In maximizing the benefits of disposition and remediation of NPR-3, work must be done to address the following challenges:

- Ability to maintain facilities to optimal level of usage and conditioning to attract potential new owners
- Providing a site to assist bringing innovations to market
- Take advantage of higher oil prices to generate revenue for the U.S. Treasury

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
NPR-1 Closeout. The increase is the result of Equity Finalization being completed in FY 2011, and returning the focus to environmental closeout.	2,480	3,280	+800
Environmental Remediation. The decrease is due transitioning to NPR-3 disposition.	3,000	0	-3,000
Disposition. The increase is due to transitioning from production, testing, and environmental remediation to disposition of the field. NPR-3 will implement the approved disposition plan that will transfer or sell the site while maintaining and operating assets that provide value to potential new ownership.	0	4,635	+4,635
TOTAL Funding Change, Production and Operations	5,480	7,915	+2,435

Disposition
Overview

This program element supports activities that focus on disposition by transfer or sale of the NPR-3/RMOTC site from a government entity to allow the testing facility and oil operations to continue under private ownership. In the near term, the Department would fund the NPR-3/RMOTC program to be able to maintain and operate the site at an optimal level to attract potential new ownership. Since disposition will relieve NPR-3/RMOTC from the requirement to return the oilfield to its original conditions, the reduction in required environmental remediation will result in significant savings to the Federal government.

Sequence

Benefits

Industry Benefits

- More flexibility in financing, siting, sizing and end-use applications by private industry.
- Reduced environmental remediation costs to government.

Other Information

Not applicable until plan is approved.

Funding and Activity Schedule

Fiscal Year	Activity	Funding (Dollars in Thousands)
FY 2011		0
FY 2012	Disposition Plan developed	TBD
FY 2013	TBD based on developed and approved plan	TBD
FY 2014 - 2017	TBD based on developed and approved plan	TBD

Program Direction
Funding Profile by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
NPR – Wyoming			
Salaries and Benefits	2,000	2,315	1,700
Travel	50	100	75
Support Services	0	0	0
Other Related Expenses	600	780	539
Business Management & Support	1,794	2,984	2,230
Total, NPR – Wyoming	4,444	6,179	4,544
Full Time Equivalents	14	14	14
Washington, Headquarters			
Salaries and Benefits	1,335	1,080	1,080
Travel	56	50	50
Support Services	135	75	275
Other Related Expenses	200	45	45
Equity	1,000	1,000	0
Bechtel Medical / Dental	1,000	1,000	1,000
Total, Washington, Headquarters	3,726	3,250	2,450
Full Time Equivalents	11	6	6
Program Direction			
Salaries and Benefits	3,335	3,395	2,780
Travel	106	150	125
Support Services	135	75	275
Other Related Expenses	800	825	584
Business Management & Support	1,794	2,984	2,230
Equity	1,000	1,000	0
Bechtel medical/dental	1,000	1,000	1,000
Total, Program Direction	8,170	9,429	6,994
Full Time Equivalents	25	20	20

Public Law Authorizations

Public Law 94–258, "Naval Petroleum Reserves Production Act", 1976
Public Law 95–91, "Department of Energy Organization Act", 1977
Public Law 109–58, "Energy Policy Act of 2005"
Public Law 104–106, "The National Defense Authorization Act For Fiscal Year 1996"
Public Law 105–261, "The Strom Thurmond National Defense Authorization Act for Fiscal Year 1999"

Overview

Provides salaries, travel, contractor support services and other related expenses to support the management and execution of the NPOSR program.

Program Accomplishments and Milestones

On April 22, 2011, the Department settled its Equity Finalization process with Chevron. Under the settlement agreement Chevron has paid $108,000,000 to the Department.

In FY 2012, NPR-3 expects to achieve four significant accomplishments or milestones in program management and/or program development: 1) Provide a site for technology developers to field test inventions, including low-temperature geothermal validation; 2) Environmental remediation; 3) Provide revenue to the U.S. Treasury; and 4) Complete a Disposition Plan.

In FY 2013, NPR-3 will start working towards achieving the following key milestones:

Milestone	Date
Begin to Implement Disposition Plan	Oct 1, 2012
Generate $4.1 million in revenues to U.S. Treasury	Sept 30, 2013
Test and validate one new geothermal power generation unit technology	Sept 30, 2013

Beyond FY 2013, outyear milestones will be dependent upon agreed to options of approved disposition plan. The NEPA process will be completed in FY 2013. Complete and environmental cleanup obligations required from the sale/transfer agreement(s) by the end of FY 2014. Complete the transfer of property in FY 2015. And finally, the closeout of DOE RMOTC office and records disposition will be completed in FY 2016.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Salaries and Benefits			
Decrease associated with the disposition and a reduced level of personnel due to attrition.	3,395	2,780	-615
Travel			
Decrease in travel is associated with the disposition on NPR-3.	150	125	-25
Support Services			
Increase is due to additional funding for NPR-1 remediation support and records management.	75	275	+200
Other Related Expenses			
Decrease is associated primarily with the reduction in rent for office space at NPR-3.	825	584	-241
Business Management and Support			
Decrease is due to reduced activities as a result of disposition of NPR-3	2,984	2,230	-754
Equity			
Decrease due to Equity Finalization being completed in April 2011.	1,000	0	-1,000
Bechtel Medical/Dental	1,000	1,000	0
Total Funding Change, Program Direction	9,429	6,994	-2,435

Other Related Expenses by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Rent to Others	265	450	203
Communication, Utilities, Misc.	79	100	158
Other Services	181	205	117
Operation and Maintenance of Equipment	5	5	15
Supplies and Materials	270	65	91
Total, Other Related Expenses	800	825	584

Strategic Petroleum Reserve

Strategic Petroleum Reserve

Strategic Petroleum Reserve

Proposed Appropriation Language

For necessary expenses for Strategic Petroleum Reserve facility development and operations and program management activities pursuant to the Energy Policy and Conservation Act of 1975, as amended (42 U.S.C. 6201 et seq.), [$192,704,000] $195,609,000, to remain available until expended. (Energy and Water Development and Related Agencies Appropriations Act, 2012.)

Explanation of Changes

The increase is attributable to movement of the degasification plant from the Bryan Mound to West Hackberry site, a capacity maintenance program, and an increased cavern remediation program. The increase is offset by no additional funding required for the Bayou Choctaw cavern replacement project and a reduction in security and power costs.

Strategic Petroleum Reserve
Office of Fossil Energy

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Strategic Petroleum Reserve			
Strategic Petroleum Reserve	209,441	192,704	195,609
Rescission of Prior-Year Balances	-86,300[a]	0	0
Total, Strategic Petroleum Reserve	123,141	192,704	195,609

[a] The FY 2011 Prior Year Rescission included $75.16 million in balances from prior years appropriated for a 1 billion barrel expansion at the Richton, MS site.

Office Overview and Accomplishments

The Strategic Petroleum Reserve (SPR) protects the U.S. from future disruptions in critical petroleum supplies and meets the U.S. obligations under the International Energy Program (Energy Policy and Conservation Act, P.L. 94-163, as amended, Section 151). The mission of the SPR achieves the Secretary's Goal of Security: Protecting the Nation against interruptions in its critical petroleum supplies.

Within the Strategic Petroleum Reserve Appropriation, the SPR funds Facilities Development, Operations (Security, Power, Operations and Maintenance, and Support Services), and Management of the SPR.

In FY 2011, the SPR maintained an emergency petroleum stockpile with the readiness and capability to respond to U.S. oil supply emergencies, continued activity toward completion of the replacement of an existing storage cavern at its Bayou Choctaw site, and completed degas operations at the Bryan Mound site. In 2011, DOE executed an SPR Drawdown of roughly 31 million barrels (MB) under an International Energy Agency (IEA) Collective Action, reducing the current SPR petroleum stockpile to 696 million barrels. The current SPR of 696 MB of oil provides about 82 days of net oil import protection.

In FY 2012, the SPR will complete the replacement of an existing storage cavern at its Bayou Choctaw site that currently poses a major environmental risk.

Explanation of Changes

The Department requests $195.6 million in FY 2013 for the SPR, which is a 1.5% increase over the FY 2012 level.

Due to the FY 2011 Continuing Resolution rescission, the SPR did not have sufficient funding for the required relocation and operation of its crude degasification plant.

The FY 2013 request funds the degasification plant move from the Bryan Mound to the West Hackberry site. The crude inventory stored in the SPR must be periodically processed through a degasification plant in order to maintain a safe crude oil vapor pressure compliant with federal and state regulations.

The FY 2013 request increases the levels for the degasification plant move (+$11.5M), a capacity maintenance program (+$5M), the cavern remediation program (+$300K), and support services (+$27K). The request includes no funding for the cavern replacement project completed in FY 2012 (-$13.2M) and decreases for Security (-$813K) and Power (-$1.8M).

Facilities Maintenance and Repair

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

Direct-Funded Maintenance and Repair

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Strategic Petroleum Reserve	35,206	33,133	35,208
Total, Direct-Funded Maintenance and Repair	35,206	33,133	35,208

Strategic Petroleum Reserve
Office of Fossil Energy

Funding by Site by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Strategic Petroleum Reserve			
Bayou Choctaw Site, LA	32,072	11,425	10,812
Big Hill Site, TX	17,141	20,968	19,333
Bryan Mound Site, TX	20,680	16,925	18,127
National Energy Technology Laboratory	1,255	1,415	1,255
Oak Ridge National Laboratory	375	390	400
Sandia National Laboratory	3,044	3,342	3,186
SPR Program Office, Washington, DC	5,536	5,987	6,765
SPR Project Management Office, New Orleans, LA	97,852	111,183	103,513
West Hackberry Site, LA	31,486	21,069	32,218
Total, Strategic Petroleum Reserve	209,441	192,704	195,609

Strategic Petroleum Reserve
Funding Profile by Subprogram and Activities

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Strategic Petroleum Reserve			
Facilities Development and Operations	186,873	170,914	171,932
Management	22,568	21,790	23,677
Total, Strategic Petroleum Reserve	209,441	192,704	195,609

Public Law Authorizations

Public Law 109–58, "Energy Policy Act of 2005"

Overview

The SPR protects the U.S. from future disruptions in critical petroleum supplies and meets the U.S. obligations under the International Energy Program (Energy Policy and Conservation Act, Section 151). The SPR also includes Defense Department crude oil, stored for national defense purposes.

The mission of the SPR program is in direct support of the Department of Energy's "Energy Security" mission. The SPR benefits the Nation by:

- Ensuring U.S. Energy Security;
- Providing an Emergency Stockpile of petroleum to protect the U.S. against potential foreign or domestic disruptions in its critical oil supplies; and
- Fulfilling U.S. obligations of the International Energy Program (U.S. Treaty).

The SPR benefits the Nation by providing an insurance policy against potential interruptions in U.S. petroleum supplies whether originating from international supply problems, hurricanes, accidents or terrorist activities. In 2011, DOE executed an SPR Drawdown of roughly 31 million barrels under an IEA Collective Action, reducing the current SPR petroleum stockpile to 696 million barrels.

The U.S. imports approximately 49% of its petroleum supplies; the impact of a disruption in these supplies could be significant on the Nation and the national economy without an emergency response capability. The SPR serves as a significant deterrent to hostile threats of cutoffs of petroleum supplies. The SPR, with current crude oil stocks equal to 82 days of imports in underground storage, provides a strong deterrent to hostile efforts.

The SPR protects the economic security of the country. A release of petroleum from the SPR can mitigate the potential economic damage of an actual disruption in international or domestic petroleum supplies and the accompanying severe price increases. The SPR avails the United States of worldwide emergency assistance through its IEA participation. IEA members are required to maintain 90 days of commercial and strategic stocks combined, and participate with other stockholding nations in a coordinated release of stocks in the event of a major supply disruption.

To accomplish its mission and address the challenges outlined above, the SPR program is organized into two subprograms: Facilities Development and Operations and Management. The Facilities Development and Operations subprogram funds all requirements associated with developing and maintaining facilities for the storage and release of petroleum, operations activities associated with placing petroleum into storage, and operational readiness initiatives associated with drawing down and distributing the inventory within 11-15 days notice in the event of an emergency. The Management subprogram funds personnel and administrative expenses related to maintaining the Project Management Office (New Orleans, LA) and the Program Office (Washington, DC), as well as contract services required to support management and the technical analysis of program initiatives and issues.

Program Accomplishments and Milestones

In FY 2011, the SPR maintained an emergency petroleum stockpile with the readiness and capability to respond to U.S. oil supply emergencies, continued activity toward completion of the replacement of an existing storage cavern at its Bayou Choctaw site, and completed degas operations at the Bryan Mound site. In FY 2012, the SPR will maintain an emergency petroleum stockpile to protect the Nation's Energy Security, and will complete the replacement of an existing storage cavern at its Bayou Choctaw site that poses a major environmental risk.

In FY 2013, the SPR is working towards the following key milestones:

Milestone	Date
Relocation of degasification plant to the West Hackberry site	Oct 31, 2013
Begin degasification operations at the West Hackberry site	Nov 1, 2013

Explanation of Changes

The Department requests $195.6 million in FY 2013 for the SPR, which is a 1.5% increase over the FY 2012 level.

Due to the FY 2011 Continuing Resolution rescission, the SPR did not have sufficient funding for the required relocation and operation of its crude degasification plant.

The FY 2013 request funds the degasification plant move from the Bryan Mound to the West Hackberry site. The crude inventory stored in the SPR must be periodically processed through a degasification plant in order to maintain a safe crude oil vapor pressure compliant with federal and state regulations.

No additional funding for the Bayou Choctaw cavern replacement project will be required in FY 2013.

The FY 2013 request increases the levels for the degasification plant move (+$11.5M), a capacity maintenance program (+$5M), the cavern remediation program (+$300K), and support services (+$27K). The request includes no funding for the cavern replacement project completed in FY 2012 (-$13.2M) and decreases for Security (-$813K) and Power (-$1.8M).

Program Planning and Management

There is a hierarchy of performance information for the SPR. The Department collects and tracks the executive-level "corporate" measures. The SPR Program Office monitors the "critical few," specific short- and long-term measures. The SPR Project Management Office manages the detailed, operational measures that are implemented by the contractors. Organizational and action plans are reviewed and analyzed at quarterly Program Reviews. Project Reviews/Assessments, including dashboard updates, are conducted monthly to analyze performance against all milestones and contracts. These reviews provide an opportunity to discuss performance and provide direction to contractors. These same measures are reviewed daily during the site managers' site status meetings.

Budget formulation/execution assessments are regularly conducted throughout the year, including periodic financial performance reviews and annual budget validations. Other evaluations include: semi-annual Management & Operating (M&O) contractor award fee performance assessments against Work Authorization Directives; on-site reviews to verify operational, maintenance and management performance data; and drawdown readiness quarterly reviews.

Strategic Management

The SPR will use various means and strategies to continue its mission and achieve program goals. Assurance of a readiness posture will be accomplished through internal readiness reviews, assessments, exercises, and tests. Effectiveness of the SPR to mitigate severe oil supply disruptions will be influenced by the SPR's size (inventory and capacity) and ability to deliver into the marketplace. In FY 2009, DOE used available balances for the purchase of additional SPR oil, and continued to fill using Federal royalty oil until a 727 million barrel inventory was achieved in December 2009. In 2011, DOE executed an SPR Drawdown of roughly 31 million barrels under an IEA Collective Action, reducing the current SPR petroleum stockpile to 696 million barrels.

The SPR utilizes a transportable degas plant to ensure availability of crude oil inventories at SPR sites within environmental and safety constraints. This process prevents the off-gassing of volatile organic compounds (VOCs) above safe levels during oil movements through commercial distribution points. Inventory processing at Big Hill was completed in FY 2006, and the self-contained degas plant was relocated to Bryan Mound in FY 2007. In anticipation of completion of Bryan Mound degas operations in FY 2011; efforts were initiated to move the plant to the West Hackberry site. In FY 2010, modifications/foundations at the West Hackberry site were made in preparation for relocation of the degas plant to the site. In FY 2012, degas operations were scheduled to begin at the West Hackberry site.

The volume of SPR petroleum stocks available for drawdown and the associated U.S. Energy Security has been reduced by the curtailment of the SPR's crude degasification plant operations. Due to the 2011 appropriation, approximately 60 million barrels in FY 2012, increasing to 70 million barrels in FY 2013, will be temporarily unavailable for use in an SPR drawdown because they are or will be at an unsafe vapor pressure and need to be degasified. The 2013 Request for relocation of the degasification plant supports resumption of degasification operations in FY 2014, which in turn will reduce the unavailability of SPR oil stocks to 30 million barrels by end of FY 2014, and achieve full availability of SPR oil stocks by end of FY 2015.

Due to a damaged internal floating roof on a tank at Bryan Mound, the maximum Bryan Mound site drawdown rate will be reduced by approximately 150,000 barrels per day, which will reduce the drawdown rate from 4.4 million barrels per day to 4.25 million barrels per day in FY 2013.

The FY 2013 budget funds the degasification plant move, with resumption of degasification operations in FY 2014.

Program performance can be affected by several external factors including:

- Changing petroleum consumption and import dependence levels;
- Petroleum market conditions; and
- Developments in the commercial distribution system (e.g., pipelines and terminals).

Program Goals and Funding

The FY 2013 request maintains an SPR with a readiness and capability to respond quickly and effectively to potential disruptions in U.S. petroleum supplies (foreign or domestic). This request provides for the management, operations, maintenance, and security of the Government's four SPR storage sites and maintains SPR readiness and capability to respond to U.S. oil supply emergencies. The SPR is working on a capacity maintenance program to enable the SPR to regain the cavern volume lost to geologically-induced cavern creep.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Facilities Development and Operations. The increase is due to increased operations and maintenance costs, which are offset by reduced security and power costs.	170,914	171,932	+1,018
Management. The increase is due to filling critical positions at HQ while maintaining mission essential support capabilities. The increase is also attributable to escalation.	21,790	23,677	+1,887
TOTAL Funding Change, Strategic Petroleum Reserve	192,704	195,609	+2,905

Facilities Development and Operations
Funding Profile by Activity

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Facilities Development and Operations			
Security	22,356	20,895	20,082
Power	4,890	4,516	2,741
Operations and Maintenance	156,431	142,125	145,704
Support Services	3,196	3,378	3,405
Total, Facilities Development and Operations	186,873	170,914	171,932

Overview

In supporting the Secretary's Goal of Security: Protecting the nation against interruptions in its critical petroleum supplies, the Facilities Development and Operations sub-program provides funding for protection from supply disruptions. The United States' reliance on petroleum, combined with location of significant global reserves in regions of the world subject to political unrest, have made the U.S. vulnerable to supply disruptions.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Security. The decrease from $20,895 to $20,082 is due to a reduction in the cost of the Protective Force subcontract.	20,895	20,082	-813
Power. The decrease from $4,516 to $2,741 is due to rescheduling Degasification Plant Operations to FY 2014, and no funding for the Bryan Mound power contract is required in FY 2013.	4,516	2,741	-1,775
Operations and Maintenance. The increase from $142,125 to $145,704 is due to the following: • Degasification plant move (+$11.5M) • Capacity maintenance program (+$5M) • Cavern remediation program (+$300K) The increase is offset by no additional funding for the Bayou Choctaw cavern replacement project in FY 2013 (-$13.2M).	142,125	145,704	+3,579
Support Services. The increase from $3,378 to $3,405 reflects escalation.	3,378	3,405	+27
TOTAL Funding Change, Facilities Development and Operations	170,914	171,932	+1,018

Program Direction
Funding Profile by Category

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Washington Headquarters			
Salary & Benefits	4,036	3,913	4,254
Travel	184	194	150
Support Services	1,298	1,430	1,900
Other Related Expenses	1,011	840	861
Total, Washington Headquarters	6,529	6,377	7,165
Full Time Equivalents	27	27	28

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Strategic Petroleum Reserve (SPR) Project Management Office			
Salary & Benefits	13,584	13,184	12,862
Travel	608	668	542
Support Services	0	0	0
Other Related Expenses	1,847	1,561	3,108
Total, SPR Project Management Office	16,039	15,413	16,512
Full Time Equivalents	96	96	95

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Program Direction			
Salary & Benefits	17,620	17,097	17,116
Travel	792	862	692
Support Services	1,298	1,430	1,900
Other Related Expenses	2,858	2,401	3,969
Total, Program Direction	22,568	21,790	23,677
Full Time Equivalents	123	123	123

Public Law Authorizations

Public Law 109–58, "Energy Policy Act of 2005"

Overview

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the SPR. The SPR mission of protecting the U.S. from future disruptions in critical petroleum supplies and meeting the U.S. obligations under the International Energy Program is carried out by a workforce composed largely of M&O contractors, although there are a variety of functions that are inherently governmental (e.g., program management, contract administration, budget formulation and execution, and interagency and international coordination) that require a dedicated Federal workforce.

Program Accomplishments and Milestones

In FY 2011, the SPR maintained an emergency petroleum stockpile with the readiness and capability to respond to U.S. oil supply emergencies, continued activity toward completion of the replacement of an existing storage cavern at its Bayou Choctaw site, and completed degas operations at the Bryan Mound site. In FY 2012, the SPR will maintain an emergency petroleum stockpile of 696 million barrels (approximately 82 days of U.S. net imports) to protect the Nation's Energy Security, and will complete the replacement of an existing storage cavern at its Bayou Choctaw site that poses a major environmental risk.

In FY 2013, the SPR is working towards the following key milestones:

Milestone	Date
Relocation of degasification plant to the West Hackberry site	Oct 31, 2013
Begin degasification operations at the West Hackberry site	Nov 1, 2013

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Salaries and Benefits			
No significant change.	17,097	17,116	19
Travel			
Decrease to support DOE initiative to increase teleconferencing.	862	692	-170
Support Services			
Increase attributable to increased project planning efforts, escalation associated with support services contracts, and maintaining mission essential support capabilities.	1,430	1,900	+470
Other Related Expenses			
Increased contingency for DOE employee evacuation expenses in the event of a hurricane, updating of teleconferencing in DOE conference rooms (New Orleans and sites) to support the DOE initiative to increase teleconferencing and decrease travel, and escalation.	2,401	3,969	+1,568
Total Funding Change, Program Direction	21,790	23,677	+1,887

Support Services by Category

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Technical Support Services			
Economic and Environmental Analysis	1,430	1,900	+470
Total, Support Services	1,430	1,900	+470

Other Related Expenses by Category

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Other Related Expenses			
Rent to Others	522	551	+29
Communication, Utilities, Misc.	100	201	+101
Other Services	1,497	1,704	+207
Supplies and Materials	137	140	+3
Equipment	145	1,373	+1,228
Total, Other Related Expenses	2,401	3,969	+1,568

Supporting Information

Operating Expenses, Capital Equipment and Construction Summary

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Capital Equipment	5,273	12,020	10,233
General Plant Projects	17,903	0	0
Total, Strategic Petroleum Reserve	23,176	12,020	10,233

Funding Summary

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Major Items of Equipment	20,315	0	2,088
Construction Projects (includes OPC)	2,833	1,601	1,271
Total, Strategic Petroleum Reserve	23,148	1,601	3,359

Capital Equipment

The following table displays total Capital Equipment funding.

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Heat Exchanger Isolation Valves (BC-MM-618)	1,200	0	0
Upgrade Site Security Detection Systems (NO-MM-718)	661	0	0
Upgrade Communication/Control System to BDWs (BC-MM-575)	447	0	0
ADAS System Upgrade (NO-MM-716)	303	0	0
Anhydrite Pond Liner Replacement (BH-MM-746)	0	1,000	0
Rework 42-Inch CO Pipeline Mainline Valves (WH-MM-659)	0	900	0
Repair Timber Pipe Supports (BC-MM-768)	0	754	0
Repair Erosion Problem at RWIS (BH-MM-373)	0	632	0
Rework 36-Inch CO Pipeline Mainline Valves (WH-MM-809)	0	0	946
Rework CO Pipeline Mainline Valves (BH-MM-658)	0	0	925
Repair And Line Brine Tank BMT-1 (BM-MM-755)	0	0	798
Replace Actuators On Meter Skid Valves (BM-MM-774)	0	0	640
Capital Equipment	2,662	8,734	6,924
Total, Capital Equipment	5,273	12,020	10,233

Major Items of Equipment

(Dollars in Thousands)

	Prior Years	FY 2011 Current	FY 2012 Enacted	FY 2013 Request	Total	Comple-tion
Heat Exchanger Isolation Valves (BM-MM-614)	0	1,800	0	0	1,800	FY 2012
Heat Exchanger Isolation Valves (WH-MM-615)	0	1,500	0	0	1,500	FY 2012
Cavern 102 - Cavern/Well LLE and Construction	0	13,856	0	0	13,856	FY 2012
Cavern 102 - Surface Facilities Construction	0	3,159	0	0	3,159	FY 2012
Rework 42-Inch CO Pipeline Mainline Valves (WH-MM-659)	0	0	0	2,088	2,088	FY 2014
Total, Major Items of Equipment	0	20,315	0	2,088	22,403	

Construction Projects

(Dollars in Thousands)

	Prior Years	FY 2011 Current	FY 2012 Enacted	FY 2013 Request	Total	Comple-tion
Site Building Upgrades (All sites) (BC-MM-669, BM-MM-671, WH-MM-672)						
TEC	0	1,811	0	0	1,811	FY 2012
OPC	0	1,811	0	0	1,811	FY 2012
TPC	0	1,811	0	0	1,811	FY 2012
Expanded Site-Wide Card Access Systems (NO-MM-731)						
TEC	0	272	0	0	272	FY 2012
OPC	0	272	0	0	272	FY 2012
TPC	0	272	0	0	272	FY 2012
HSPD-12 PIV-II Logical Access (all sites) (BC-MM-707, BH-MM-708, BM-MM-709, NO-BM-710, WH-MM-711)						
TEC	0	750	0	0	750	FY 2012
OPC	0	750	0	0	750	FY 2012
TPC	0	750	0	0	750	FY 2012
Site Building Upgrades (BC-MM-673 and BH-MM-670)						
TEC	0	0	1,601	0	1,601	FY 2012
OPC	0	0	1,601	0	1,601	FY 2012
TPC	0	0	1,601	0	1,601	FY 2012
Site Building Upgrades (Phase 2) (BH-MM-670)						
TEC	0	0	0	1,271	1,271	FY 2014
OPC	0	0	0	1,271	1,271	FY 2014
TPC	0	0	0	1,271	1,271	FY 2014
Total, Construction Projects						
TEC		2,833	1,601	1,271		
OPC		2,833	1,601	1,271		
TPC		2,833	1,601	1,271		

SPR Petroleum Account

Proposed Appropriation Language

Of the unobligated balances remaining from the sale of petroleum products in fiscal year 2011 pursuant to section 161(d) of the Energy Policy and Conservation Act (42 U.S.C. 6241(d)), $291,000,000 are hereby permanently cancelled: Provided, That paragraphs (a)(1) and (2) of section 160 of such Act are hereby repealed.

Explanation of Change

Rescission of $291 million in balances from the emergency sale of SPR oil conducted in FY 2011.

SPR Petroleum Account
Office of Fossil Energy

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted[1]	FY 2013 Request
SPR Petroleum Account			
Rescission of Prior-Year Balances	0	0	-291,000
Total, SPR Petroleum Account	0	0	-291,000

[1] FY 2012 enacted rescission of $500,000 has been rebased as mandatory conforming to the change in mandatory program (CHIMP) requirement.

Office Overview and Accomplishments

The SPR Petroleum Account was established in the Treasury pursuant to the provisions of the Omnibus Budget Reconciliation Act of 1981 (P.L. 97-35). This account funds all Strategic Petroleum Reserve petroleum inventory acquisitions, associated transportation costs, U.S. Customs duties, terminal throughput charges and other related miscellaneous costs. During an emergency drawdown and sale, the SPR Petroleum Account is the source of funding for the incremental costs of withdrawing oil from the storage caverns and transporting it to the point where purchasers take title.

The U.S. reliance on oil and U.S. net oil import levels, combined with the location of significant global oil reserves in regions of the world subject to political unrest, have made the U.S. vulnerable to supply disruptions. The presence of the SPR provides protection from supply disruptions.

In 2011, DOE executed an SPR Drawdown of roughly 31 million barrels under an IEA Collective Action, reducing the current SPR petroleum stockpile to 696 million barrels. This provides about 82 days of net oil import protection. The 2013 budget assumes replacement of about 27 MB over the FY 2013-2017 time frame. The sales receipts from the FY 2011 drawdown created mandatory budget authority in the SPR Petroleum Account.

Explanation of Changes

A rescission of $291 million in mandatory balances is proposed in FY 2013. The budget also proposes repeal of authorities related to placement of the Department of the Interior's royalty in-kind oil into the SPR.

Northeast Home Heating Oil Reserve

Northeast Home Heating Oil Reserve

Northeast Home Heating Oil Reserve

Proposed Appropriation Language

For necessary expenses for Northeast Home Heating Oil Reserve storage, operation, and management activities pursuant to the Energy Policy and Conservation Act, $10,119,000 to remain available until expended: Provided, That, of the unobligated balances available under this heading from prior year appropriations, $6,000,000 are hereby permanently cancelled: Provided further, That no amounts may be cancelled from amounts that were designated by the Congress as an emergency requirement pursuant to the Concurrent Resolution on the Budget or the Balanced Budget and Emergency Deficit Control Act of 1985, as amended.

Explanation of Change

There are no significant changes.

Northeast Home Heating Oil Reserve
Office of Fossil Energy

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted [1]	FY 2013 Request
Northeast Home Heating Oil Reserve	10,978	10,119	10,119
Subtotal, Northeast Home Heating Oil Reserve	10,978	10,119	10,119
Northeast Home Heating Oil Reserve Cancellations	0	0	-6,000
Total, Northeast Home Heating Oil Reserve	10,978	10,119	4,119

[1] FY 2012 Enacted has been adjusted to reflect that $100M was rebased as mandatory after enactment.

Office Overview and Accomplishments

The Northeast Home Heating Oil Reserve (NEHHOR) provides a short-term supplement to the Northeast systems' private supply of heating oil in the event of a supply interruption.

Within the Northeast Home Heating Oil Reserve Appropriation, NEHHOR funds Commercial Storage Leases, Information Technology Support, Quality Control, and Analyses.

In FY 2011, NEHHOR completed the sale of all the high sulfur heating oil in commercial storage for $227,419,213. New contracts were awarded in August for new commercial storage leases for 650,000 barrels of Ultra Low Sulfur Diesel (ULSD), and for an additional 350,000 barrels in September. Subsequently, in addition, contracts were awarded in November 2011 for procuring 650,000 barrels of ULSD. The remaining 350,000 barrels of ULSD were solicited in November timeframe with estimated award in February FY 2012. The purchase of ULSD was made to comply with the requirement to convert heating oil to ULSD to meet new Northeast states' emission standards beginning in FY 2011 and FY 2012.

Explanation of Changes

The decrease is due to an FY 2013 discretionary rescission of $6M in prior year balances to continue operation of the Reserve.

Northeast Home Heating Oil Reserve
Fossil Energy
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Northeast Home Heating Oil Reserve			
Hess (Groton, CT)	1,955	2,135	2,315
Global Companies LLC (Revere, MA)	4,170	4,290	4,410
Washington Headquarters	4,853	3,694	3,394
Total, Northeast Home Heating Oil Reserve	10,978	10,119	10,119

Northeast Home Heating Oil Reserve
Funding Profile by Subprogram and Activities

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Northeast Home Heating Oil Reserve			
Northeast Home Heating Oil Reserve	10,978	10,119	10,119
Total, Northeast Home Heating Oil Reserve	10,978	10,119	10,119

Public Law Authorizations

Public Law 107-63, Department of Interior and Related Agencies (2001)

Overview

The Northeast Home Heating Oil Reserve (NEHHOR) provides a short-term supplement to the Northeast systems' private supply of heating oil in the event of a supply interruption.

The heating oil reserve has been designed to augment commercial supplies during an emergency. The Reserve is not designed to displace the private market. It provides a buffer to assist the heating oil industry in mitigating short term supply interruptions. The reserve is a valuable component of America's energy readiness effort, separate from the Strategic Petroleum Reserve.

Program Accomplishments and Milestones

In FY 2011, NEHHOR completed the sale of all the high sulfur heating oil in commercial storage for $227,419,213. New contracts were awarded in August for new commercial storage leases for 650,000 barrels of Ultra Low Sulfur Diesel (ULSD), and for an additional 350,000 barrels in September. In addition, contracts were awarded in November 2011 for procuring 650,000 barrels of ULSD. The remaining 350,000 barrels of ULSD were solicited in November time frame with estimated award in February 2012. The purchase of ULSD was made to comply with the requirement to convert heating oil to ULSD to meet new Northeast states' emission standards beginning in FY 2011 and FY 2012.

NEHHOR benefits the Northeast by providing an insurance policy against potential interruptions in U.S. heating oil supplies whether originating from international supply problems, severe weather, accidents or terrorist activities.

Explanation of Changes

There are no significant changes.

Program Planning and Management

There is a hierarchy of performance information for Petroleum Reserves. The Department collects and tracks the "critical few" measures. The Office of Petroleum Reserves monitors limited, specific, short and long-term measures. Monthly inventory certifications are submitted by storage contractors and Department of Defense quality surveillance personnel make periodic random inspections at each contracted storage site. A comprehensive annual review of each contract is conducted prior to exercise of contract option years. The on-line sales system, always available to the public in a "demo" mode, is also tested annually through a simulated sale with industry participation. Budget formulation/execution assessments are regularly conducted throughout the year, including monthly Dashboard-level Reviews and annual budget validations. Other evaluations include an annual independent inventory audit and the use of a base year contract with one-year options to assure competitive storage service rates.

Strategic Management

The Northeast Home Heating Oil Reserve will use various means and strategies to continue its mission and achieve program goals. Assurance of a readiness posture will be accomplished through internal readiness reviews and assessments, independent audits, quantity and quality surveillance, exercises, and tests. Effectiveness of the Reserve to mitigate the economic damage of severe heating oil supply disruptions will be influenced by the Reserve's ability to quickly deliver into the market.

Program Goals and Funding

Maintain a NEHHOR with 1 million barrels of heating oil to protect the Northeast against high vulnerability of winter-related supply shortages. The FY 2013 request continues operation of the Reserve, including the extension of the lease of commercial storage space.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Northeast Home Heating Oil Reserve	10,119	10,119	0
TOTAL Funding Change, Northeast Home Heating Oil Reserve	10,119	10,119	0

Northeast Home Heating Oil Reserve
Funding Profile by Activity

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Northeast Home Heating Oil Reserve			
Commercial Storage Leases	10,478	9,619	9,619
Information Technology Support	300	300	400
Quality Control and Analysis	200	200	100
Total, Northeast Home Heating Oil Reserve	10,978	10,119	10,119

Overview

In supporting the Secretary's Goal of Security: Protecting the nation against interruptions in its critical heating oil supplies, the NEHHOR provides protection from severe heating oil supply disruptions throughout the Northeast.

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Commercial Storage Leases. No significant changes.	9,619	9,619	0
Information Technology Support. No significant changes.	300	400	+100
Quality Control and Analysis. No significant changes.	200	100	-100
TOTAL Funding Change, Northeast Home Heating Oil Reserve	10,119	10,119	0

Ultra-Deepwater Unconventional Natural Gas

Ultra-Deepwater Unconventional Natural Gas

Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research
Funding Profile by Subprogram

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund	50,000	50,000	50,000
Receipts Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund	-50,000	-50,000	-50,000
Repeal Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund	-50,000	-50,000	-50,000
Repeal Receipts Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund	50,000	50,000	50,000
Total, Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund	0	0	0

Public Law Authorizations
Public Law 109–58, "Energy Policy Act of 2005"

Overview
The Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund was established in Subtitle J of the Energy Policy Act of 2005 (Public Law 109-58) and is funded by royalties paid by industry producers.

Prudent development of domestic oil and natural gas resources will continue to be part of our Nation's overall strategy for energy security for decades to come. These operations have to be conducted responsibly, ensuring that communities are safe and that the environment is protected.

Mandatory R&D funding from EPAct Sec. 999 is too inflexible a mechanism to adequately address environmental and safety concerns in the dynamic and rapidly evolving hydraulic fracturing space, and the FY 2013 budget proposes to repeal this mandatory R&D program. Absent Congressional action on previous requests to repeal the program, the Administration is refocusing this program to support R&D with significant potential public benefits, including activities consistent with the Secretary's Energy Advisory Board (SEAB) recommendations.

Subprogram Accomplishments and Milestones
In the current appropriation year, the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research is being refocused on quantifying potential safety and environmental risks and on developing technologies focused on risk mitigation.

Milestone	Date
Release of unconventional natural gas RFP	Nov 30, 2011
Release of Ultra-Deepwater RFPs	Jan 31, 2012
Federal advisory committees meeting	Apr 1, 2012
Selections of projects	Aug 31, 2012

Explanation of Changes
No changes.

Program Planning and Management
Recommendations, analyses, and ongoing initiatives underpinning this program are:

- The *2011 Draft Annual Plan*, prepared by the Program Consortium, Research Partnership to Secure Energy for America (RPSEA), July 2010
- Final report of findings and recommendations prepared by the Department of Energy Unconventional Resources Technology Advisory Committee (URTAC), October 2010
- *Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling*, Report to the President, National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, January 2011
- *Blueprint for a Secure Energy Future*, The White House, Washington, March 30, 2011
- Final report of findings and recommendations prepared by the Department of Energy Ultra-Deepwater Advisory Committee, April 2011
- Department of the Interior Ocean Energy Safety Committee, Meeting Summary, April 2011
- Department of Energy *Strategic Plan*, May 2011

Elk Hills School Lands Fund

Elk Hills School Lands Fund

Elk Hills School Lands Fund
Proposed Appropriation Language

For necessary expenses in fulfilling the final payment under the Settlement Agreement entered into by the United States and the State of California on October 11, 1996, as authorized by section 3415 of Public Law 104-106, $15,579,815, for payment to the State of California for the State Teachers' Retirement Fund, of which $15,579,815 will be derived from the Elk Hills School Lands Fund.

Explanation of Changes

The most recent installment payment was made to the State of California in FY 2006. It was necessary for DOE to settle NPR-1 final equity with Chevron before the final net proceeds from the sale of DOE's share of NPR-1 could be determined, and that has now been accomplished.

Elk Hills School Lands Fund
Office of Fossil Energy

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Elk Hills – California Teachers' Pension Fund Settlement	0	0	15,580
Total, Elk Hills School Lands Fund	0	0	15,580

Office Overview and Accomplishments

The Elk Hills School Lands Fund, subject to appropriation, provides a source of compensation for the California State Teachers' Retirement System as a result of a settlement with the State of California with respect to its longstanding claim to title of two sections of land within NPR-1.

The Department and the State of California entered into a "Settlement Agreement" on October 11, 1996, in which DOE agreed, subject to appropriation, to compensate the State of California for its claim to title to two sections of land within NPR-1. The "Settlement Agreement" stipulates installments totaling nine percent of the net proceeds from the sale will be paid to the State of California.

Installments totaling $299,520,000 have been paid to date. On April 22, 2011, the Department settled NPR-1 final equity with Chevron. Under the terms of the settlement, Chevron paid $108,000,000 to the United States. That, in turn, increased the net proceeds of the sale. On August 3, 2011, the Department and the State of California agreed on the final payment of $15,579,815 with respect to the longstanding claim on the two sections of land.

Explanation of Changes

The most recent installment payment was made to the State of California in FY 2006. It was necessary for DOE to settle NPR-1 final equity with Chevron before the final net proceeds from the sale of DOE's share of NPR-1 could be determined, and that has now been accomplished.

Advanced Technology Vehicles Manufacturing Program

Advanced Technology Vehicles Manufacturing Program

ATVM Loan Program

Proposed Appropriation Language

For administrative expenses in carrying out the Advanced Technology Vehicles Manufacturing Loan Program, $9,000,000, to remain available until expended. (Energy and Water Development and Related Agencies Appropriations Act, 2013.)

Explanation of Change

$9,000,000 is requested for administrative expenses in FY 2013 versus $6,000,000 appropriated in FY 2012.

Advanced Technology Vehicles Manufacturing Loan Program
Loan Programs Office

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Advanced Technology Vehicles Manufacturing Loan Program			
Direct Loan Subsidy Costs	0	0	0
Administrative Operations, ATVM	9,978	6,000	9,000
Total, ATVM Loan Program	9,978	6,000	9,000

Overview

Section 136 of the Energy Independence and Security Act of 2007 established the Advanced Technology Vehicles Manufacturing (ATVM) Loan Program, consisting of direct loans of up to $25 billion in total loan authority to support the development of advanced technology vehicles and associated components in the United States. The ATVM Loan Program evaluates the technical merit of the proposed advanced technology vehicles or qualifying components. Technical program factors such as economic development and diversity in technology, company, risk, and geographic location are also considered. In making loans to those manufacturers that have existing facilities, priority will be given to those facilities that are oldest or have been in existence for at least 20 years, even if such facilities are idle at the time of application. The program aims to help revitalize the auto industry and encourage the manufacture of environmentally responsible products through providing growth capital in an economic downturn.

Accomplishments and Milestones

The ATVM Loan Program has closed over $8 billion in loans for five projects. These projects are projected to fund over 38,000 jobs in the United States and save approximately 281 million gallons of gasoline annually.

Explanation of Changes

The Department requests $9 million to cover administrative operations for the ATVM program, recognizing the need to meet demand by maintaining existing loan due diligence and monitoring capacity. The Department requests $0 in Fiscal Year 2013 for ATVM Loan Program direct loan credit subsidy costs, which is no change from the FY 2012 enacted budget.

Program Planning and Management

In FY 2012-2013, the ATVM Loan Program will focus on portfolio management and monitoring activities on the existing portfolio as well as originating new loans to utilize remaining loan authority and appropriated credit subsidy.

Strategic Management

In FY2012-FY2013, the ATVM Loan Program will achieve its mission and performance targets by adhering to clear policies, rules, and procedures for the submission, review, and negotiation of loan applications and for follow-on project review. The ATVM Loan Program will undertake a rigorous underwriting process to evaluate the legal, technical, financial, market and environmental attributes of each project. This includes a detailed risk analysis supported by quantitative financial modeling that forecasts project cash flows through the full tenor of the debt instrument. The investigative due diligence process includes technical merit reviews performed by DOE laboratories, market analyses provided by independent marketing consultants, and independent financial advisor services to augment the Federal staff of the ATVM Loan Program. The ATVM Loan Program's underwriting and ongoing credit analysis may identify a number of areas where credit risk may be mitigated. Accordingly, an essential part of the process will be working with applicants/recipients in identifying risk mitigation strategies that will enhance the prospect for timely payment of principal and interest.

The ATVM loan program will actively monitor loans post financial close through the entire life-cycle of the transactions from execution of the loan agreement through the final payment of the debt obligation. The program's overarching goal for its project oversight and credit monitoring approach is to protect the interest of the Federal government by proactively managing risks associated with projects receiving loans. Accordingly, portfolio management policies and procedures have been implemented to monitor and manage construction and operational stage credit risks, compliance risks, and transaction risks.

Alignment to Strategic Plan

The mission of the ATVM Loan Program is to accelerate the domestic commercial deployment of innovative and advanced clean energy technologies at a scale sufficient to meaningfully contribute to the achievement of our national clean energy objectives—including job creation; reduced dependence on oil; mitigation of greenhouse gases; and enhancement of American competitiveness in the global economy of the 21st century.

The Department's May 2011 Strategic Plan outlines one primary objective to which the ATVM Loan Program aligns its activities: Deploy the Technologies We Have. The Strategic Plan also identifies eight targeted outcomes to achieve this objective, of which the ATVM Loan Program supports one:

Support battery manufacturing capacity for 500,000 plug-in hybrid electric vehicles a year by 2015.

.

Strategic Plan and Performance Measures

STRATEGIC GOAL: Transforming our Energy Systems		
OBJECTIVE: Deploy the Technologies We Have		
Advanced Technology Vehicles Manufacturing Loan Program		
Annual Measure #1: Battery production capacity of 120,000 lithium-ion PHEV batteries (1,200,000 kWh) established.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	T:120,000	---- N/A
Current Year (2012)	T:120,000	---- N/A
Prior Year (2011)	---- N/A	---- N/A
Analysis	Supporting battery manufacturing capacity is a key strategy for the Presidential goal of putting 1 million electric vehicles on the road.	
Annual Measure #2: Reduction in petroleum usage (in millions of gallons of fuel per year) achieved through the use of advanced technology vehicles manufactured (at least in part) with funding provided through the ATVM loan program as compared to vehicles available in the base year.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	T: 200 million	---- N/A
Current Year (2012)	T: 150 million	---- N/A
Prior Year (2011)	---- N/A	---- N/A
Analysis	The ATVM Loan Program funds projects that lead to improved fuel economies and reduced petroleum usage.	
Annual Measure #3: Actual loss rate of loans as a percentage of total loan portfolio.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	T: 4%	---- N/A
Current Year (2012)	T: 4%	---- N/A
Prior Year (2011)	T: 4%	R: 0%
Analysis	No losses were incurred in 2011.	

Administrative Operations (Program Direction)
Funding Profile by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Headquarters			
Salary & Benefits	1,250	1,250	1,250
Travel	50	50	50
Support Services	8,378	4,400	7,300
Other Related Expenses	300	300	400
Total, Headquarters	9,978	6,000	9,000
Full Time Equivalents	9	9	9

Overview

Administrative Operations (Program Direction) provides the Federal staffing and contractor resources and associated costs required to provide overall direction and execution of the ATVM Loan Program, including portfolio management, legal, technical, and other operational activities.

Explanation of Changes

The Department requests $9 million, a $3 million increase over FY 2012 enacted levels, to cover administrative operations for the ATVM program, recognizing the need to meet demand by maintaining loan due diligence and monitoring capacity.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs. FY 2012
Salaries and Benefits			
Provides salaries and benefits for 9 full time equivalent employees (FTEs) for loan monitoring activities and portfolio management of closed loans.	1,250	1,250	0
Travel			
Supports the travel of staff members for site visits, training, and attending meetings and presentations.	50	50	0
Support Services			
Provides funding for contractor support for legal, financial, and technical consultants supporting portfolio management activities. The increase in support services will allow the ATVM Loan Program to continue loan monitoring activities through FY 2013.	4,400	7,300	+2,900
Other Related Expenses			
DOE is working to achieve economies of scale through an enhanced Working Capital Fund (WCF). The WCF increase covers certain shared, enterprise activities including enhanced cybersecurity architecture, employee health and testing services, and consolidated training and recruitment initiatives.	300	400	+100
Total Funding Change, Program Direction	6,000	9,000	+3,000

Support Services by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Support Services			
Management/Professional Support Services	8,378	4,400	7,300
Total, Support Services	8,378	4,400	7,300

Other Related Expenses by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Other Services	50	50	50
Working Capital Fund	250	250	350
Total, Other Related Expenses	300	300	400

Title 17 Innovative Technology Loan Guarantee Program

Title 17 Innovative Technology Loan Guarantee Program

Innovative Technology Loan Guarantee Program

Proposed Appropriation Language

Such sums as are derived from amounts received from borrowers pursuant to section 1702(b)(2) of the Energy Policy Act of 2005 under this heading in prior Acts, shall be collected in accordance with section 502(7) of the Congressional Budget Act of 1974: Provided, That for necessary administrative expenses to carry out this Loan Guarantee program, $38,000,000, is appropriated, to remain available until expended: Provided further, That $38,000,000 of the fees collected pursuant to section 1702(h) of the Energy Policy Act of 2005 shall be credited as offsetting collections to this account to cover administrative expenses and shall remain available until expended, so as to result in a final fiscal year 2012 appropriation from the general fund estimated at not more than $0: Provided further, That fees collected under section 1702(h) in excess of the amount appropriated for administrative expenses shall not be available until appropriated. (Energy and Water Development and Related Agencies Appropriations Act, 2013.)

Explanation of Change

$38,000,000 is requested for administrative expenses in FY 2013. These administrative expenses are expected to be offset by an estimated $38,000,000 in collections from borrowers for a net zero appropriation. This represents no change from the FY 2012 enacted budget.

Innovative Technology Loan Guarantee Program
Loan Programs Office

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Title 17 Innovative Technology Loan Guarantee Program			
Section 1703 – Renewables or Efficient End-Use Technology			
Innovative Technology Loan Guarantee Program (LGP)	169,600	0	0
Administrative Operations, LGP	38,000	38,000	38,000
Offsetting Receipts	-38,000	-38,000	-38,000
Section 1705 – Temporary Loan Guarantee Program			
Administrative Operations	20,000	0	0
Offsetting Receipts	-20,000	0	0
Subtotal, Title 17 Innovative Technology Loan Guarantee Program	227,660	0	0
Total, Title 17 Innovative Technology Loan Guarantee Program	169,600	0	0

Overview

The Loan Guarantee Program (LGP), as authorized under Title XVII of the Energy Policy Act of 2005, encourages early commercial use of new or significantly improved technologies in energy projects. Projects supported by DOE loan guarantees must avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases; employ new or significantly improved technologies compared to commercial technologies in service in the United States at the time the guarantee is issued; and offer a reasonable prospect of repayment of the principal and interest on the guaranteed obligation.

Section 1703 of the Act authorizes DOE to provide loan guarantees for innovative clean energy projects in categories including renewable energy systems, advanced nuclear facilities, coal gasification, carbon sequestration, energy efficiency, and various other types of projects. Section 406 of the American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5 (Recovery Act), amended the Loan Guarantee Program's authorizing legislation, by establishing Section 1705 as a temporary program for the rapid deployment of renewable energy and electric power transmission projects, as well as leading edge biofuels projects. The authority to enter into loan guarantees under Section 1705 expired on September 30, 2011.

Accomplishments and Milestones

The Loan Guarantee Program has closed over $16 billion in loan guarantees for 26 renewable energy projects. The portfolio also includes over $10 billion in conditional commitments that have not yet closed, including a loan guarantee for the first nuclear power plant to be built in the U.S. in three decades. Collectively, these projects are projected to fund over 22,000 permanent and construction jobs across the United States, provide enough generation capacity to power 3 million homes, and avoid over 19 million metric tons of carbon dioxide annually.

Explanation of Changes

The FY 2013 Budget request for the LGP represents no change from the FY 2012 enacted levels. The Department requests $38 million for administrative operations for the LGP to cover portfolio management and loan origination activities. The request will be fully offset with fee collections for a net-zero budget request.

Program Planning and Management

In FY 2012-2013, the LGP will focus on portfolio management and monitoring activities on the existing portfolio as well as originating new loan guarantees to utilize remaining loan authority in the nuclear power, front-end nuclear, fossil, and renewable and energy efficiency sectors.

Strategic Management

The LGP undertakes a rigorous underwriting process to evaluate the legal, technical, financial, market and environmental attributes of each project. This includes a detailed risk analysis supported by quantitative financial modeling that forecasts project cash flows through the full tenor of the debt instrument. The investigative due diligence process includes rigorous engineering and technology reviews conducted by major independent engineering firms, market analyses provided by independent marketing consultants, and independent financial advisor services to augment the Federal staff of the LGP. The LGP's loan underwriting and credit analysis may identify a number of areas where credit risk may be mitigated. Accordingly, an essential part of the process involves working with the applicant to identify risk mitigation strategies that will enhance the prospect for timely payment of principal and interest.

Alignment to Strategic Plan

The mission of LGP is to accelerate the domestic commercial deployment of innovative and advanced clean energy technologies at a scale sufficient to meaningfully contribute to the achievement of our national clean energy objectives—including job creation; reduced dependence on oil; mitigation of greenhouse gases; and enhancement of American competitiveness in the global economy of the 21st century.

The Department's May 2011 Strategic Plan outlines one primary objective to which the LGP aligns its activities: Deploy the Technologies We Have. The Strategic Plan also identifies eight targeted outcomes to achieve this objective, of which the LGP supports one:

Double renewable energy generation (excluding conventional hydropower and biopower) by 2012.

Strategic Plan and Performance Measures

STRATEGIC GOAL: Transforming our Energy Systems		
OBJECTIVE: Deploy the Technologies We Have		
Innovative Technology Loan Guarantee Program		
Annual Measure #1: Annual generation capacity from power generation projects receiving DOE loan guarantees that have achieved and maintained commercial operations.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	T: 2.8 GW	---- N/A
Current Year (2012)	T: 1.3 GW	---- N/A
Prior Year (2011)	T: 0.1 GW	R: 0.1 GW
Analysis	The LPO portfolio includes 19 renewable power generation projects that have reached financial close and remain active; two of which have achieved commercial operations.	
Annual Measure #2: Annual production capacity from manufacturing projects receiving DOE loan guarantees that have achieved and maintained commercial operations.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	T: 0.5 GW	---- N/A
Current Year (2012)	T: 0.2 GW	---- N/A
Prior Year (2011)	T: 0.2 GW	R: 0.01 GW
Analysis	The LPO portfolio includes 3 solar manufacturing projects that have reached financial close and remain active. One project began production in 2011	
Annual Measure #3: Estimated annual greenhouse gas emissions (tons of CO_2) reductions from projects receiving loan guarantees that have achieved and maintained commercial operations.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	T: 5,000,000 tons	---- N/A
Current Year (2012)	T: 2,000,000 tons	---- N/A
Prior Year (2011)	T: 200,000 tons	R: 200,000 + tons
Analysis	Avoided greenhouse gas emissions is a Presidential goal and a benefit of supporting a portfolio of renewable and clean energy projects.	

Annual Measure #4: Annual fuel production from biofuel projects receiving DOE loan guarantees that have achieved and maintained commercial operations.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	---- N/A	---- N/A
Current Year (2012)	---- N/A	---- N/A
Prior Year (2011)	---- N/A	---- N/A
Analysis	Biofuel projects supported by LPO loan guarantees are projected to come online after 2013.	
Annual Measure #5: Actual loss rate of guaranteed loans as a percentage of total loan guarantee portfolio.		
	Target	Actual/ Met or Not Met
Budget Year (2013)	T: 4%	---- N/A
Current Year (2012)	T: 4%	---- N/A
Prior Year (2011)	T: 4%	R: N/A
Analysis	Actual losses for projects in bankruptcy will be determined after the conclusion of bankruptcy proceedings.	

Administrative Operations (Program Direction)
Funding Profile by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Headquarters			
Salary & Benefits	19,500	12,500	11,800
Travel	1,000	250	250
Support Services	34,200	23,250	23,250
Other Related Expenses	3,300	2,000	2,700
Total, Headquarters	58,000	38,000	38,000
Full Time Equivalents	138	90	84

Overview

Administrative Operations (Program Direction) provides the Federal staffing and contractor resources and associated costs required to provide overall direction and execution of the Loan Guarantee Program including loan origination, portfolio management, legal, technical, and other operational activities. Administrative Operations are estimated to be fully offset with fee collections for a net-zero budget request.

Major Programmatic Shifts or Changes

Administrative Operations funding in FY 2013 will be held at the FY 2012 funding level. Portfolio management and monitoring activities will increase from prior year levels. However, this will be offset by a corresponding reduction in loan origination activities as the Section 1705 program expired on September 30, 2011.

Explanation of Funding AND/OR Program Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 Request vs FY 2012 Enacted
Salaries and Benefits			
Provides salaries and benefits for 84 full time equivalent employees (FTEs) to administer the following functions of the office: Director, NEPA Compliance, Legal, Credit Policy, Technical and Project Management, Management Operations, Portfolio Management, and Loan Origination. The decrease in salaries and benefits in FY 2013 is due to a projected reduction in loan origination staff.	12,500	11,800	-700
Travel			
Supports the travel of staff members for site visits, training, and attending meetings and presentations.	250	250	0
Support Services			
Funds outside expertise in finance, legal, engineering, technology, credit analysis, and market assessments.	23,250	23,250	0
Other Related Expenses			
DOE is working to achieve economies of scale through an enhanced Working Capital Fund (WCF). The WCF increase covers certain shared, enterprise activities including enhanced cybersecurity architecture, employee health and testing services, and consolidated training and recruitment initiatives.	2,000	2,700	+700
Total Funding Change, Program Direction	38,000	38,000	0

Support Services by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Support Services			
Management/Professional Support Services	34,200	23,250	23,250
Total, Support Services	34,200	23,250	23,250

Other Related Expenses by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Other Services	100	100	100
Working Capital Fund	3,200	1,900	2,600
Total, Other Related Expenses	3,300	2,000	2,700

Energy Information Administration

Energy Information Administration

U.S. Energy Information Administration

Proposed Appropriation Language

For necessary expenses in carrying out the activities of the U.S. Energy Information Administration, $116,365,000, to remain available until expended.

Overview
Appropriation Summary by Program

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Energy Information Administration	95,409	105,000	116,365
Rescission of Prior Year Balances	-400	-	-
Total, Energy Information Administration Appropriation	95,009	105,000	116,365

Overview

The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. EIA is the Nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the U.S. Government.

EIA conducts a wide range of data collection, analysis, and dissemination activities in support of the Secretary's Goal to *Transform our Energy Systems: Catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in clean energy technologies*. Specifically, EIA supports the Departmental objective to *Lead the National Conversation on Energy*. These efforts are especially critical given the central connection between energy, the economy, and the environment, which necessitates that Congress, Federal and State Government, the private sector, the broader public, and the media have ready access to timely, reliable, and relevant energy information. This information is essential to inform a wide range of energy-related decisions, including utilization strategies, availability of energy sources, business and personal investment decisions, policy development, and responses to disruption, emergency, and other shocks affecting the energy sector. As the energy industry becomes increasingly more complex and interrelated, EIA must evolve its program to present a comprehensive picture of the energy marketplace to an ever-expanding customer base.

Within the Energy Information Administration appropriation, EIA has one program: Energy Information Administration, with no subprograms.

Alignment to Strategic Plan

The Department's May 2011 Strategic Plan outlines one primary objective to which EIA aligns its activities: lead the national conversation on energy. The Strategic Plan further identifies three targeted outcomes in support of this objective, one of which has specific relevance to EIA's program: identify the most promising educational opportunities to improve domestic energy literacy.

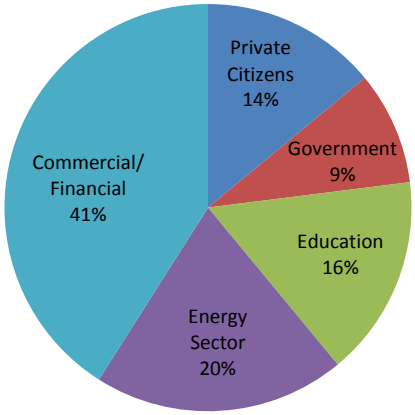
EIA has established two annual performance measures to assist the agency in achieving this targeted outcome:

1. Timeliness of EIA information products – 30% of request
2. Quality of EIA information products – 70% of request

Benefits

EIA serves a broad range of stakeholders who require relevant energy information to bring meaning and context to a rapidly evolving energy landscape. To this end, EIA's priority is to maintain a high-quality core program of energy statistics, analyses, and forecasting capabilities to lead and inform the national conversation on energy, a key component of DOE's overarching strategic vision. While much of EIA's most important work is done directly with policymakers through testimony, presentations, papers, analyses, and responses to questions, EIA ensures broad access to information to all of it stakeholders by disseminating data and analysis products through its website (see Figure 1).

Figure 1: EIA's Web Stakeholders and Customers



Source: 2011 EIA Web Customer Survey

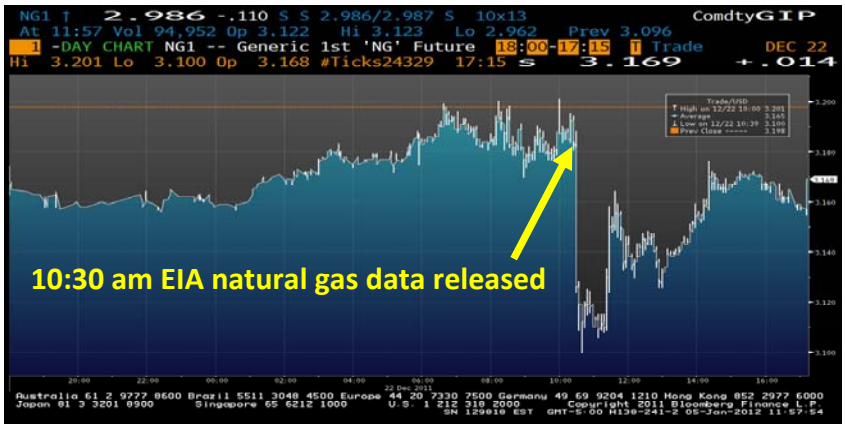
Energy Information Benefits:

- Policymakers at the Federal, State, and local levels have access to statistics and analyses that help inform the public debate in many critical areas such as energy and associated environmental policy, changes in complex and evolving energy markets, and geopolitical dynamics that affect energy supply, demand and, ultimately, prices.

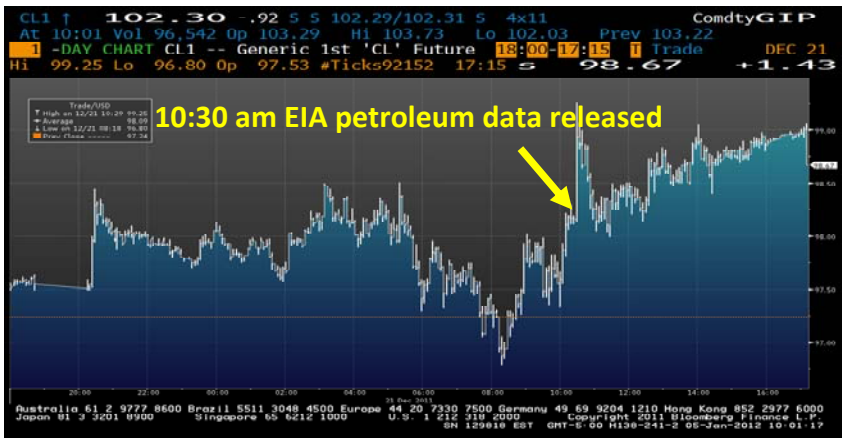
- Producers, investors, traders, and analysts can use a wealth of energy information in their day-to-day activities in the global energy marketplace. For example, Figure 2 shows two typical examples of the immediate effects of EIA's weekly releases of natural gas storage and petroleum product inventory reports on price formation in important energy markets.

- Consumers, researchers, educators, and students have access to a wide range of factual and accurate materials that enables a well-informed citizenry regarding energy and its growing importance in today's world. Figure 2: The energy industry and markets rely heavily on EIA's statistics

Figure 2: The energy industry and markets rely heavily on EIA's statistics



Data Represent NYMEX Henry Hub Natural Gas Near-Month Futures Contract December 22, 2011 - Source: Bloomberg Finance LP (Jan 5, 2012)



Data Represent NYMEX Light, Sweet Crude Oil (WTI) Near-Month Futures Contract December 21, 2011 - Source: Bloomberg Finance LP (Jan 5, 2012)

Strategic Management

EIA has identified three areas of strategic focus that will enable meaningful contributions towards the Department's objective of leading the national conversation on energy while adhering to the principles of exemplary public stewardship:

1. Meet evolving stakeholder needs by providing timely, accurate, and relevant data, analysis and other information that accurately reflect changing energy markets.

2. Enable easy access and convenient navigation of EIA's rich variety of online content by capitalizing on innovative, web-based data management and communication strategies.

3. Optimize organizational efficiency by using innovative tools, methods, and management practices to support the mission.

While significant progress has been made in these areas, formidable challenges remain, including:

1. Integrating new information systems to ensure more intuitive user access to EIA's online statistics and analyses with an emphasis on enabling the public to access desired data in a format and structure usable with minimal additional effort.

2. Deploying best-fit technologies and methods to upgrade EIA's information management architecture in a secure, cost-effective manner.

EIA will address these challenges on multiple fronts by investing in strategic, integrated, and forward-looking solutions.

Program Accomplishments

EIA constantly reviews and modifies its programmatic offerings to meet the evolving needs of its customers. Significant recent accomplishments include:

- Maintained a robust energy statistics program so that critical information streams remained available to our customers within stated deadlines. These statistical offerings cover the full range of the energy industry from production and trade to transformation, distribution, and storage--information that is critical to understanding domestic energy markets.

- Provided key analyses and enhanced forecasting capabilities through the ongoing modernization of the National Energy Modeling System (NEMS), which enabled timely release of the *Annual Energy Outlook* (AEO), a flagship agency publication that provides long-term projections of energy production, consumption, technology, and market trends. This year's AEO also featured a dynamic table browser, enabling users to customize their information queries.

- Launched a redesigned website featuring improved content, navigation, and design to promote public understanding of energy and bring new levels of information accessibility to stakeholders.

- Awarded first recipient of the National Association of Government Communicators "Best in Show," and first-place recipient for "Best Website" and "Shoestring Budget" for *Energy Kids*, which features more than 100 pages of educational content for children, parents, and teachers. EIA also received the ClearMark "Award of Excellence" from the Center for Plain Language and a second-place award for "Best Electronic Publication" from the National Association of Government Communicators for *Energy Explained*, the most comprehensive energy literacy portal on the web.

Explanation of Changes

The Department requests $116.4 million in FY 2013 for EIA, which is an $11.4 million increase over the FY 2012 appropriation. In support of the Secretarial objective of leading the national conversation on energy, the 2013 request restores most EIA data collection and analysis activities, including the 2012 Commercial Buildings Energy Consumption Survey (CBECS), that were suspended in FY 2011 and takes steps to modernize and streamline data collection processes; improves the analysis of energy market behavior and the interrelationship of energy and financial markets; and improves responsiveness to customers' needs.

Program Direction
Funding Profile by Category

(Dollars in Thousands)

	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Headquarters Operations			
Salaries and Benefits	51,673	53,021	53,142
Travel	258	290	290
Support Services	29,577	38,995	48,656
Other Related Expenses	13,901	12,694	14,277
Total, Headquarters Operations	95,409	105,000	116,365
Full Time Equivalents	361	371	370

Public Law (P.L.) Authorizations

P.L. 83-703, Atomic Energy Act (1954)
P.L. 93-275, 15 U.S.C. 761, Federal Energy Administration Act (1974)
P.L. 93-319, Energy Supply and Environmental Coordination Act (1974)
P.L. 94-163, Energy Policy and Conservation Act (1975)
P.L. 94-385, 15 U.S.C. 790, Energy Conservation and Production Act (1976)
P.L. 95-91, 42 U.S.C. 7135, Department of Energy Organization Act, 1977
P.L. 95-621, Natural Gas Policy Act (1978)
P.L. 95-620, 42 U.S.C. 8301, Powerplant and Industrial Fuel Use Act (1978)
P.L. 96-294, Energy Security Act (1980)
P.L. 97-229, 42 U.S.C. 6245, Energy Emergency Preparedness Act (1982)
P.L. 99-58, National Coal Imports Reporting Act (1985)
P.L. 99-58, 42 U.S.C. 6201, Energy Policy and Conservation Act Amendments of 1985
P.L. 100-42, 42 U.S.C. 8312, Powerplant and Industrial Fuel Use Act Amendments of 1987
P.L. 102-486, 42 U.S.C. 13385, Energy Policy Act (1992)
P.L. 104-13, 44 U.S.C. 3501, Paperwork Reduction Act (1995)
P.L. 105-277, 44 U.S.C. 3504, Government Paperwork Elimination Act (1998)
P.L. 107-347: Title V of E-Government Act of 2002, Confidential Information Protection and Statistical Efficiency Act of 2002 (CIPSEA)
P.L. 109-58, 42 U.S.C. 15801, Energy Policy Act of 2005
P.L. 110-140, Energy Independence and Security Act (2007)
P.L. 112-81, National Defense Authorization Act for Fiscal Year 2012

Explanation of Funding Changes

(Dollars in Thousands)

	FY 2012 Enacted	FY 2013 Request	FY 2013 vs. FY 2012
Salaries and Benefits – The net increase in salaries and benefits provides for a small increase in salaries offset by a reduction of one full-time equivalent.	53,021	53,142	+121

(Dollars in Thousands)

FY 2012 Enacted	FY 2013 Request	FY 2013 vs. FY 2012
38,995	48,656	+9,661

Support Services – The increase restores several critical statistics and analyses activities and improves EIA's capabilities to provide comprehensive, relevant energy information to its stakeholders by the most efficient and effective means.

Energy Data Collection, Processing, and Integration (+**$6,457)**

- Upgrades Critical Weekly Statistical Products (+$1,271) – Undertake a comprehensive revitalization and modernization of the *Weekly Petroleum Status Report* (WPSR), an important market indicator frequently referenced by business and trade journalists. This effort will include a complete system redesign to facilitate more efficient data management; implementation of a more robust toolset for evaluating the underlying statistical methods; upgraded security procedures; and enhanced data delivery methods. EIA also will examine the processing and dissemination practices of the *Weekly Natural Gas Storage Report* (WNGSR), a Principal Economic Indicator, to ensure that shared efficiencies and state-of-the-art security protocols are brought to bear on this high-profile publication as well.

- Modernizes Data Collection and Processing (+$825) – Modernize data collection and processing systems and methods, the agency's largest operational area. Current processes are challenged with antiquated, dissimilar, and inefficient collection and processing mechanisms that rely heavily on manual intervention, increasing costs and adversely impacting both quality and timeliness. Building on knowledge gained from previous efforts (including a recent technical architecture assessment and collection pilot program), this effort will leverage appropriate technologies and management controls to yield operational efficiencies, reduce costs, shorten time to publication and improve data quality.

- Restores Electricity Trade Data Collection (+$191) – Resume providing statistics and reporting on electricity imports and exports to provide a more comprehensive view of this energy sector. State energy officials, corporate planners, energy producers, marketers, and consumers use this information widely for decision-making.

- Adds Collection of Monthly Oil Production Data (+$550) – Initiate collection of oil production information directly from operators, providing timely data regarding rapidly changing production trends. This will enable reporting of more accurate production information, increasing market confidence by reducing the need for significant retroactive adjustments.

(Dollars in Thousands)

FY 2012 Enacted	FY 2013 Request	FY 2013 vs. FY 2012

• Conducts the Energy Consumption Data Program (+$3,620) – Conduct the field work for the multi-year CBECS effort, the only statistically reliable source of energy consumption, expenditures, and end uses in U.S. commercial buildings. This energy baseline is critical to understanding building characteristics, performance, and efficiency, as well as user behavior. This data provides U.S. benchmarks which are then used to inform investments in new technologies, performance labeling, and energy management practices. This work is part of the multi-year CBECS cycle and builds upon EIA's significant investment in the planning and preparation efforts underway in 2012. The data collected in the field in 2013 will be published in 2014. Additionally, EIA will begin planning and preparation for the Residential Energy Consumption Survey (RECS), and complete the release of information from the latest Manufacturing Energy Consumption Survey (MECS).

Energy Analysis and Forecasting (+$2,964)

• Restores Energy Modeling and Analysis Capabilities (+$2,193) – Enhance international, short-term, end-use efficiency, and refinery analytic capabilities. International: Assess international crude, liquid fuel, and natural gas markets and produce reports summarizing results on each topic. These analyses will be used to develop models with linkages to NEMS to address the global nature of markets and results will be included in the restored *International Energy Outlook*. As part of this process, restore the International Natural Gas Model. Short-term: Add structured detail to short-term modeling to better incorporate the impact of policies and programs and traditional data-driven forecasts. End Use Efficiency: To better understand the impact of energy efficiency programs, evaluate the programmatic results of state and utility energy efficiency programs, producing an analytic report and incorporating the results in models and short-term and long-term domestic and international energy projections and analyses. Increase research on behavioral economics and state of the art analytical tools to improve analysis of consumer response. Refinery and Refined Products: Restore refinery outage report and perform quantitative assessments of alternative refinery market conditions on product supply.

	(Dollars in Thousands)		
	FY 2012 Enacted	FY 2013 Request	FY 2013 vs. FY 2012
• Resumes and expands the Energy and Financial Markets Initiative (EFMI) (+$1,220) – Resume efforts to increase public understanding of linkages between energy markets and those for other commodities and assets. Specifically, EIA will expand its processing and analysis of non-public data to yield a better understanding of the behaviors, strategies, risks, and profitability of different classes of oil futures market participants. Expand the EFMI program to include providing information to the Congress requested in the National Defense Authorization Act for Fiscal Year 2012 concerning crude and product prices. Results of this work will be used to inform policy makers and will be publicly available on EIA's website.			
• Upgrade NEMS (-$449) – NEMS is the Nation's preeminent tool for developing long-term projections of U.S. energy production, consumption, prices, and technologies so that Federal, State, and local policymakers have access to more reliable forecasts and analyses. These upgrades are part of a multi-year initiative.			
Energy Information Dissemination and Communications (+$515) – Improve customer access and usability of EIA's statistics and analyses through enhanced web-based delivery of energy information. This will provide customers improved, interactive access to EIA's statistical offerings, including custom data tables for State as well as national data, dynamic State energy maps and profiles, and a wide range of other interactive features.			
Resource and Technology Management (-$275) – Reflects completion of projects to improve organization operational efficiency in support of the Department's Management and Excellence goal, as well as completion of cybersecurity, continuity of operations, and disaster recovery requirements.			
Other Related Expenses – This funding level supports increases in DOE Working Capital Fund (WCF) costs. The WCF increase covers regular business line increases due to inflation that are primarily determined by DOE's Office of Management (+$797), as well as certain shared, enterprise activities including cybersecurity architecture, employee health and testing services, and consolidated training and recruitment initiatives (+$365). Other net increases include EIA IT equipment purchases in support of modernizing data collection and updating the critical weekly statistical products (+$615), offset by lower cost of supplies and materials (-$153) and lower rental payments due to consolidating offices (-$41).	12,694	14,277	+1,583
Total, Energy Information Administration	105,000	116,365	+11,365

Program Activities

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Salaries and Benefits	**51, 673**	**53, 021**	**53,142**

Provide salaries and benefits for 370 FTEs. The 370 FTEs support the following functions: Administrator's Office (7 FTEs), energy data collection, processing and integration (165 FTEs), energy analysis and forecasting (120 FTEs), energy information dissemination and communications (30 FTEs), and resource and technology management (48 FTEs).

Travel	**258**	**290**	**290**

Fund travel for EIA personnel to attend training, professional development programs, industry and state conferences; meet with national and international government and energy industry officials; and provide expertise in support of the EIA mission.

Support Services	**29, 577**	**38,995**	**48,656**

Fund contractual support for EIA energy information collection and data management, analysis and forecasting activities, and energy information dissemination. The support services include development, operation, and processing of surveys and the automated tools and equipment required to collect, store, maintain, protect, and disseminate energy information.

- **Energy Data Collection, Processing and Integration Activities** **18, 253** **25,126** **31,583**

  EIA's comprehensive energy data program conducts surveys of energy suppliers and consumers and then processes and integrates survey responses to produce a full range of publicly available data and reports containing relevant, reliable, and timely energy information. Key users of EIA's energy data include the Congress, the Administration, the Secretary of Energy and DOE programs, Federal and State agencies, energy industry analysts, energy producers, marketers and purchasers, academia, the media, and the public. EIA makes data available in a format and structure to minimize additional effort on the part of users. The energy data program also provides the basis for EIA energy analysis and forecasting activities, including key inputs for the Regional Short-Term Energy Model and the National Energy Modeling System.

  - Energy Supply Surveys 15,903 16,977 19,813

    In FY 2013, conduct EIA's core energy supply surveys and resume the data collection on electricity exports and imports that had been suspended in FY 2011. Annual publication of *Emissions of Greenhouse Gases in the U.S.* and the collection of data from manufacturers of geothermal heat pumps and solar thermal systems are not restored.

    As part of its data quality efforts, EIA will modernize the systems and methods it uses in data collection and processing, the agency's largest operational area. Current processes are challenged with antiquated, dissimilar, and inefficient collection and processing mechanisms that rely heavily on manual intervention, increasing costs and adversely impacting both quality and timeliness. EIA will resume improvements in the management of energy data; strengthen quality assurance and update statistical techniques; protect the integrity of data; assure system documentation of data processes; and reduce lifecycle development and operating costs for EIA's statistical programs. There is an increased risk of major failure of existing survey systems and increased system maintenance costs to manage risks and meet requirements, absent these improvements. {FY11 $150; FY12 $350; FY13 $1,175}

    Petroleum and Biofuels Surveys – Operate petroleum and liquid fuel surveys on weekly, monthly, annual, and quadrennial cycles, as well as the monthly biodiesel survey mandated by Section 1508 of the Energy Policy Act of 2005. Collect and disseminate monthly state-level data on wholesale petroleum product prices, including gasoline, diesel, heating oil, propane, residual fuel oil, and kerosene, and prepare and publish the annual petroleum marketing data report and the fuel oil and kerosene sales report. Continue data collection grants to states through the State Heating Oil and Propane Program to collect winter fuels prices at the state level on a weekly basis. EIA will undertake a comprehensive revitalization and modernization of the WPSR, an important market indicator frequently referenced by business and trade journalists. This effort will include a complete system redesign to facilitate more efficient data management; implementation of a more robust toolset for evaluating the underlying statistical methods; upgraded security procedures; and enhanced data delivery methods.

(Dollars in Thousands)

FY 2011 Current	FY 2012 Enacted	FY 2013 Request

Natural Gas and Reserves Surveys – Operate natural gas production, storage, and consumption surveys on weekly, monthly, and annual cycles as well as an annual survey of proved reserves of both oil and natural gas. Collect data from natural gas marketing companies. Examine the processing and dissemination practices of the WNGSR, a Principal Economic Indicator, to ensure that processing efficiencies and state-of-the-art security protocols are brought to bear on this high-profile publication.

In FY 2013, initiate collection of oil production information directly from operators, providing timely data regarding rapidly changing production trends.

Electricity, Coal, Renewables, and Uranium Surveys – Operate weekly, monthly, quarterly, and annual surveys for electric power. Resume collection of data on electricity exports and imports. Operate weekly, monthly, quarterly, and annual surveys on reserves, supply, disposition, and prices for coal. Process selected renewable and alternative fuel surveys including annual surveys of photovoltaic cells and alternate fueled vehicles. Process uranium production and marketing surveys, including annual surveys of the uranium producers, marketers, and nuclear plant operators and a quarterly survey of uranium producers.

- Energy Consumption and Efficiency Surveys 1,200 7,000 10,620

Collect and publish definitive, national end-use consumption data for commercial buildings, residential buildings, and manufacturing. The end-use consumption surveys contribute to EIA's integrated energy statistics and provide critical inputs to short- and longer-term forecasting activities, provide baseline information critical to understanding energy use, and are the basis for benchmarking and performance measurement for energy efficiency programs. EIA will continue implementing methodological improvements across its consumption program based on recommendations by the National Academy of Sciences to improve data reliability and operational efficiency.

In FY 2013, collect commercial building end-use energy data with release of initial data in early FY 2014. The multi-year Commercial Buildings Energy Consumption Survey provides the only national data regarding characteristics of the United States' commercial building stock and its energy use, and provides baseline information critical to understanding energy end-use, establishing equipment standards, and developing performance measurements for energy efficiency programs. This data is important in the context of the efficiency programs focused on commercial buildings--including Energy Star and Leadership in Energy and Environmental Design (LEED) certification program--, as well as state-level initiatives. Funding of approximately $7.0 million in FY 2013 is essential to the completion of CBECS. The field work to be performed in 2013 builds upon the important planning and preparation activities that were funded in 2012, and 2013 funding will ensure completion of the 2012 CBECS on schedule. The most recently published CBECS data is for 2003.

Operate the Manufacturing Energy Consumption Survey on a four-year cycle. MECS provides information on energy throughput and economic and operational characteristics of U.S. manufacturers. Linked with production and employment data from Census Bureau economic surveys, the MECS provides consumption information for policy development, market assessment, computation of gross national product, and public understanding. In FY 2013, complete the release of information from MECS 2010.

Operate the Residential Energy Consumption Survey on a four-year cycle with a sample size sufficient to maintain state-level reporting of energy end-use estimates for 16 States. RECS provides information on structural, equipment, and operational characteristics of housing units, along with household energy consumption and expenditures. RECS also provide baseline information crucial to understanding demand for and use of goods and services in U.S. households. Funding for RECS 2013 will initiate a four year project, with approximately $3.6 million provided in FY 2013.

- Integrated and Financial Data Surveys 1,150 1,150 1,150

Produce the Annual Energy Review, Monthly Energy Review, and State Energy Profiles, each of which provides essential comprehensive national and state-level data that support EIA analysis and forecasting, more efficient

energy markets, and state-level decision making. The audit of data submitted by major oil and natural gas companies and reporting on their financial performance through EIA's Financial Reporting System are not restored.

- **Energy Analysis and Forecasting** **3,825** **5,940** **8,904**

Conduct energy analysis and forecasting activities, including the analysis of energy supply, demand, conversion, and prices. Update, operate, and document EIA's energy models. The models, which are in the public domain, are used by EIA and other DOE program offices, National Laboratories, non-governmental organizations, academic researchers, and others for a variety of energy analysis purposes. Assess the impact of proposed energy policies on projected energy trends. Prepare the *Annual Energy Outlook* (AEO) and the monthly *Short-Term Energy Outlook* (STEO) to provide comprehensive projections of domestic energy markets. Resume analysis and reporting on the market impacts of planned refinery outages. Prepare special modeling analyses requested by the Congress or the Executive Branch.

- Energy Modeling and Analysis 2,107 1,581 3,774

Operate the NEMS, a mid-to-long term energy-economy modeling system. Using the output from NEMS, prepare the AEO, which presents a 25- to 30-year projection and analysis of U.S. energy supply, demand, and prices.

In FY 2013, enhance international, short-term, end-use efficiency, and refinery analytic capabilities. International: Update and operate the World Energy Projections System Plus (WEPS+), which incorporates projections from independently documented models and assumptions about the future energy intensity of economic activity. The updates to WEPS+ are critical to the restoration of the *International Energy Outlook* in 2013.

Assess international crude, liquid fuel, and natural gas markets and produce reports summarizing results. Use these analyses to develop models with linkages to NEMS to address the global nature of these markets and include the results in the restored *International Energy Outlook*. As part of this process, restore the International Natural Gas Model and perform analyses of alternative natural gas market conditions on international supply, consumption, imports and exports.

Short-term: Update and operate the Regional Short-Term Energy Model (RSTEM), an integrated information system that forecasts U.S. supplies, demands, imports, stocks, and prices of energy with a horizon of 12 to 24 months. In FY 2013, add structured detail to its short-term modeling to better incorporate the impact of policies and programs and traditional data-driven forecasts. Using the output from RSTEM, prepare the monthly STEO, a *Summer Motor Gasoline Outlook* (in April), and a *Winter Fuels Outlook* (in October).

End Use Efficiency: To better understand the impact of energy efficiency programs, evaluate the programmatic results of state and utility energy efficiency programs, producing an analytic report on the subject and incorporating results in models and short-term and long-term domestic and international energy projections and analyses.

Refinery and Refined Products: Restore the refinery outage report and perform quantitative assessments of alternative refinery market conditions on product supply. Expand analysis of international crude and product trade and the impact this trade has on domestic fuel markets.

- Energy Model Development 1,468 4,109 3,660

Resume overhauling NEMS, which was developed in 1992. While much of the model has evolved substantially over the years, some fundamental aspects of the NEMS structure have limitations that threaten EIA's ability to provide accurate baseline energy projections, analyze proposed energy policies, and support studies of energy technologies by DOE program offices to comply with the Government Performance and Results Act (GPRA). The new modules will help meet the needs of the Congress, the Administration, and other customers for more

relevant, reliable, and timely assessments and forecasts of emerging policy and technology issues using a modern modeling platform that is more efficient to develop and maintain.

FY 2013 activities include: 1. Enhance treatment of biofuels in the new liquid fuels market module and assess regional markets. 2. Enhance the treatment of enhanced oil recovery opportunities using captured CO2 in the new lower-48 oil and gas supply module. 3. Begin developing the regional transportation module that is critical for vehicle efficiency standards and biofuels demand analysis. 4. Evaluate and revise the decision-making algorithms in the electric power and end-use sector modules to better represent producer and consumer behavior, a multiyear effort. 5. Initiate multiyear technology-specific industrial demand module effort. 6. Initiate multiyear land and water competition effort that is critical for biofuels supply analysis. 7. Design, develop, and deploy ongoing alternative solution methods, simulation evaluation tools, output databases, and software. 8. Analyze expanded Residential Energy Consumption information and incorporate additional regional information where practicable.

- Energy and Financial Markets Initiative 250 250 1,470
  Resume efforts to increase public understanding of linkages between energy markets and those for other commodities and assets. Specifically, EIA will expand its processing and analysis of non-public data to yield a better understanding of the behaviors, strategies, risks, and profitability of different classes of oil futures market participants. EIA will purchase market data and procure analysis of investment flows in over-the-counter financial oil and gas markets to close existing information gaps. Additionally, EIA will collect data on crude oil and petroleum product storage capacity and utilization, and analyze the relationship between inventory behavior and forward curves.

  Results of this work will be used to inform policy makers and will be publicly available on EIA's Energy and Financial Markets website. This effort will yield improved understanding and explanation of the relationships of financial market activity and fundamentals to price formation, stronger theories and analytic techniques to explain market behavior, and a more comprehensive tracking of data regarding key physical and non-physical factors that influence energy prices.

- **Energy Information Dissemination and Communications 1,398 1,349 1,864**
  Conduct EIA's comprehensive communications program for diverse external customer groups and agency employees including EIA's communications policies and standards, the public website (www.eia.gov), press and media relations, marketing and outreach services, energy education and literacy efforts, and employee intranet.

  In FY 2013, support increased energy literacy by maintaining and expanding EIA's energy education product line: *Energy-in-Brief*, *Frequently Asked Energy Questions*, *Energy Explained*, *Energy Kids*, and *Today in Energy*. Improve customer access and usability of EIA's data and analysis by implementing a web-based tool to provide customers access to a much more dynamic and fluid range of statistical offerings, including custom data tables for national and State data, dynamic State energy maps and profiles, and a range of other interactive features. Operate the EIA Information Center, the agency's primary point of contact for customer inquiries and publication fulfillment, and conduct customer engagement activities.

- **Resource and Technology Management 6,102 6,580 6,305**
  Provide overall business management, analysis, and administrative support to the rest of EIA and in response to requests from other components of DOE. Activities include strategic planning and program evaluation, financial and budget management, contracts management, human resource management, resource and workforce analysis, administrative services, and logistical support services.

  Operate and maintain the EIA corporate infrastructure, local area network, communication equipment, and cyber-security requirements. Provide hardware, software, database, network, and other IT support to EIA offices. This support is consistent with EIA's mission requirements as a national statistical agency charged with statutory data confidentiality requirements.

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses	**13,901**	**12,694**	**14,277**

Other related expenses include goods and services provided through the DOE Working Capital Fund (WCF) for operations such as building occupancy, utilities, supplies and materials, phone service, copying, mail supplies, procurement management, and payroll processing. DOE is working to achieve economies of scale through an enhanced WCF. The WCF increase covers certain shared, enterprise activities including enhanced cybersecurity architecture, employee health and testing services, and consolidated training and recruitment initiatives. This activity also covers employee training; other overhead expenses such communications equipment; personal computers; and supplies, materials, and services purchased directly by EIA. Funds also may be used for personnel security investigations.

Total, Program Direction	**95,409**	**105,000**	**116,365**

Support Services by Category

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Technical Support Services			
Data Acquisition	1,119	1,323	1,557
Energy Analysis Support for Fuel Types, Supply, End Use and Energy Conversion Sectors	1,294	1,400	1,600
Survey Development, Methodology, Sampling, & Quality Assurance	25	175	625
Statistical Analysis	362	450	530
Forecasting and Modeling	3,258	5,377	8,188
Survey Management System	150	350	2,446
Survey Operations	15,869	22,073	25,623
System Integration and Maintenance	4,891	5,678	5,423
Developing, Producing, and Marketing Energy Products & Services	1,398	1,349	1,864
Total, Technical Support Services	28,366	38,175	47,856
Management Support Services			
Reports and Analyses Management	1,211	820	800
Total, Management Support Services	1,211	820	800
Total, Support Services	29,577	38,995	48,656

Other Related Expenses by Category

	(Dollars in Thousands)		
	FY 2011 Current	FY 2012 Enacted	FY 2013 Request
Other Related Expenses			
Rent to GSA	166	41	0
Communication, Utilities, Misc.	34	34	34
Training	358	400	400
Working Capital Fund	8,614	8,889	10,051
Supplies and Materials	707	803	650
Equipment	3,822	2,328	2,943
Grants, Subsidies, Contributions	200	199	199
Total, Other Related Expenses	13,901	12,694	14,277

GENERAL PROVISIONS

SEC. 301. The unexpended balances of prior appropriations provided for activities in this Act may be available to the same appropriation accounts for such activities established pursuant to this title. Available balances may be merged with funds in the applicable established accounts and thereafter may be accounted for as one fund for the same time period as originally enacted.

SEC. 302. Funds appropriated by this or any other Act, or made available by the transfer of funds in this Act, for intelligence activities are deemed to be specifically authorized by the Congress for purposes of section 504 of the National Security Act of 1947 (50 U.S.C. 414) during fiscal year 2013 until the enactment of the Intelligence Authorization Act for fiscal year 2013.

SEC. 303. Not to exceed 5 percent, or $100,000,000, of any appropriation, whichever is less, made available for Department of Energy activities funded in this Act or subsequent Energy and Water Development and Related Agencies Appropriations Acts may be transferred between such appropriations, but no such appropriation, except as otherwise provided, shall be increased or decreased by more than 5 percent by any such transfers, and any such proposed transfers shall be submitted promptly to the Committees on Appropriations of the House and Senate.

SEC. 304. None of the funds made available in this title shall be used for the construction of facilities classified as high-hazard nuclear facilities under 10 CFR Part 830 unless independent oversight is conducted by the Office of Health, Safety, and Security to ensure the project is in compliance with nuclear safety requirements.

SEC. 305. None of the funds made available in this title may be used to approve critical decision-2 or critical decision-3 under Department of Energy Order 413.3B, or any successive departmental guidance, for construction projects where the total project cost exceeds $100,000,000, until a separate independent cost estimate has been developed for the project for that critical decision.

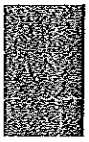
SEC. 306. (a) The set-asides included in Division C of Public Law 111-8 for projects specified in the explanatory statement accompanying that Act in the following accounts shall not apply to such funds: "Defense Environmental Cleanup", "Electricity Delivery and Energy Reliability", "Energy Efficiency and Renewable Energy", "Fossil Energy Research and Development", "Non-Defense Environmental Cleanup", "Nuclear Energy", "Other Defense Activities", and "Science". (b) The set-asides included in Public Law 111-85 for projects specified in the explanatory statement accompanying that Act in the following accounts shall not apply to such funds: "Electricity Delivery and Energy Reliability", "Energy Efficiency and Renewable Energy", "Fossil Energy Research and Development", "Nuclear Energy", and "Science".

SEC. 307. Of the unobligated balances from prior year appropriations available under the heading "Energy Efficiency and Renewable Energy", $69,667,000 are hereby permanently cancelled: Provided, That no amounts may be cancelled from amounts that were designated by the Congress as an emergency requirement pursuant to the Concurrent Resolution on the Budget or the Balanced Budget and Emergency Deficit Control Act of 1985, as amended

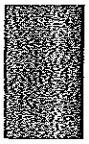
SEC. 501. None of the funds made available by this Act may be used to enter into a contract, memorandum of understanding, or cooperative agreement with, make a grant to, or provide a loan or loan guarantee to any corporation that was convicted (or had an officer or agent of such corporation acting on behalf of the corporation convicted) of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless the agency has considered suspension or debarment of the corporation, or such officer or agent, and made a determination that this further action is not necessary to protect the interests of the Government.

SEC. 502. None of the funds made available by this Act may be used to enter into a contract, memorandum of understanding, or cooperative agreement with, make a grant to, or provide a loan or loan guarantee to, any corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless the agency has considered suspension or debarment of the corporation and made a determination that this further action is not necessary to protect the interests of the Government.

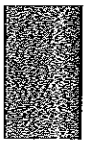
SEC. 503. None of the funds made available by this Act may be used in contravention of Executive Order No. 12898 of February 11, 1994 (``Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations'').



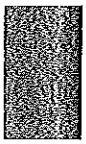
Energy Efficiency and Renewable Energy



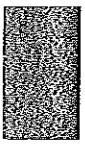
Electricity Delivery and Energy Reliability



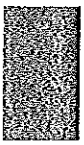
Nuclear Energy



Fossil Energy Research and Development



Naval Petroleum and Oil Shale Reserves

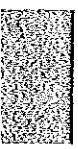


Strategic Petroleum Reserve

Northeast Home Heating Oil Reserve

Ultra-Deepwater Unconventional Natural Gas

Elk Hills Lands Fund



Advanced Tech. Vehicle Manufacturing Loan Porgram

Title 17 Innovative Tech. Loan Guarantee Program

Energy Information Administration