U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HEARING CHARTER

An Overview of the Department of Energy Research and Development Budget for Fiscal Year 2013

Thursday, March 1, 2012
9:30-12:00
2318 Rayburn House Office Building

PURPOSE

On Thursday, March 1, 2012, the Committee on Science, Space, and Technology will hold a hearing entitled "***An Overview of the Department of Energy Research and Development Budget for Fiscal Year 2013."*** The purpose of the hearing is to examine energy policy and budget priorities related to the President's Fiscal Year (FY) 2013 budget request, including activities within the DOE offices of Science, Energy Efficiency and Renewable Energy, Advanced Research Projects Agency–Energy, Fossil Energy, Nuclear Energy, Electricity Delivery and Energy Reliability, and the Loan Guarantee Program Office.

WITNESS

Dr. Steven Chu, *U.S. Secretary of Energy*. Dr. Chu was confirmed as the 12th Secretary of Energy on January 20, 2009. Prior to his appointment Dr. Chu was the Director of DOE's Lawrence Berkeley National Laboratory, and a professor of Physics and Molecular and Cell Biology at the University of California. He is the co-winner of the 1997 Nobel Prize for Physics.

Department of Energy (DOE) Spending

(dollars in millions)

Program	FY11 Actual	FY12 Enacted	FY13 Request	FY13 Request versus FY12 Enacted	
				$	%
Office of Science					
Advanced Scientific Computing Research	*410.3*	*440.9*	*455.6*	*14.7*	*3.3*
Basic Energy Sciences	*1638.5*	*1688.1*	*1799.6*	*111.5*	*6.6*
Biological and Environmental Research	*595.2*	*609.6*	*625.3*	*15.7*	*2.6*
Fusion Energy Sciences	*367.3*	*401.0*	*398.3*	*(2.7)*	*(0.7)*
High Energy Physics	*775.6*	*790.9*	*776.5*	*(14.4)*	*(1.8)*
Nuclear Physics	*527.7*	*547.4*	*526.9*	*(20.5)*	*(3.7)*
Office of Science*	***4897.3***	***4873.6***	***4992.1***	***118.5***	***2.4***
Energy Efficiency and Renewable Energy (EERE)					
Hydrogen and Fuel Cell Technologies	*95.8*	*103.6*	*80.0*	*(23.6)*	*(22.8)*
Biomass and Biorefinery Systems	*180.0*	*199.3*	*270.0*	*70.8*	*35.5*
Solar Energy	*259.6*	*289.0*	*310.0*	*21.0*	*7.3*
Wind Energy	*78.8*	*93.3*	*95.0*	*1.7*	*1.8*
Geothermal Technology	*37.0*	*37.9*	*65.0*	*27.1*	*71.5*
Water Power	*29.2*	*58.8*	*20.0*	*(38.8)*	*(66.0)*
Vehicle Technologies	*293.2*	*328.8*	*420.0*	*91.2*	*27.7*
Building Technologies	*207.3*	*219.2*	*310.0*	*90.8*	*41.4*
*Advanced Manufacturing***	*105.9*	*115.6*	*290.0*	*174.4*	*150.9*
Energy Efficiency and Renewable Energy (EERE)*	**1771.7**	**1809.6**	**2337.0**	**527.4**	**29.1**
Nuclear Energy***	**806.0**	**858.7**	**770.4**	**(88.3)**	**(10.3)**
Electricity Delivery and Energy Reliability R&D	**102.1**	**99.1**	**103.4**	**4.3**	**4.3**
Fossil Energy R&D	**434.1**	**346.7**	**420.6**	**73.9**	**21.3**
ARPA-E	**179.6**	**275.0**	**350.0**	**75.0**	**27.3**
Loan Guarantee Program Office	**179.5**	**6.0**	**9.0**	**3.0**	**50.0**
Totals:	**8370.3**	**8268.7**	**8982.5**	**713.8**	**8.6**

*Total program funding; minor and non-S&T accounts at SC and EERE are not shown.

**Industrial Technologies Preogram renamed as Advanced Manufacturing Office in FY 2013.

*** Total Office of Nuclear Energy; includes Facility Management and Idaho Safeguards and Security

BACKGROUND

The Department of Energy (DOE) funds a wide range of research, development, demonstration, and commercial application activities. DOE's primary mission is to "advance the national economic, and energy security of the United States; to promote scientific and technological innovation in support of that mission; and to ensure the environmental cleanup of the national nuclear weapons complex."[1] In order to fulfill its mission, DOE operations are guided by five strategic themes: energy security, nuclear security, scientific discovery and innovation, environmental responsibility, and management excellence.

The overall FY 2013 budget request for DOE is $27.2 billion, which represents a $855.5 million or 3.2 percent increase over FY 2012 levels. Approximately one third of this amount is dedicated to programs within the Committee on Science, Space, and Technology's jurisdiction. The balance of DOE's funding is allocated to the National Nuclear Security Administration (NNSA), to maintain our stockpile of nuclear weapons, and Defense and Non-Defense Environmental Management (EM) programs, to manage the cleanup of nuclear weapons production and government-sponsored nuclear energy research.

DOE R&D PROGRAMS AND OFFICES

Office of Science

The total FY 2013 budget request for the Office of Science (SC) is $5.0 billion, a $118.4 million or 2.4 percent increase over the FY 2012 levels. The mission of the Office of Science is the delivery of scientific discoveries, capabilities, and major scientific tools to transform the understanding of nature and to advance the energy, economic, and national security of the United States. In support of this mission, SC supports basic research in the following areas: advanced scientific computing, basic energy sciences, biological and environmental research, fusion energy sciences, high energy physics, and nuclear physics. SC's operations take place in three main areas: selection and management of research (47 percent of SC's FY 2013 budget request); operation of world-class, state-of-the-art scientific facilities (38 percent); and design and construction of new facilities (14 percent).

SC also supports several ongoing interagency initiatives such as the Networking and Information Technology Research and Development program; the National Networking Initiative; the United States Global Change Research Program; and the Climate Change Technology Program. SC provides approximately 45 percent of Federal support of basic research in the physical sciences and key components of the Nation's basic research in biology and high-end computing.

Office of Science budget and activities are divided into the following six major program areas:

Basic Energy Sciences (BES) requests $1.8 billion, an increase of $111.5 million (or 6.6 percent) over FY 2012 levels. BES supports basic research into the fundamental building blocks necessary for advancing new energy technologies, and maintains world-class research facilities to develop new knowledge and facilitate advances in areas such as materials science and chemistry. BES requests funding for ongoing operation of two existing Energy Innovation Hubs:

[1] All DOE mission statement quotes come from the cited office's website.

$24.2 million for the fourth fiscal year of the Fuels from Sunlight Hub, administered by the Chemical Sciences, Geosciences, and Biosciences subprogram; and $24.2 million for the second year of the Batteries and Energy Storage Hub, administered by the Materials Sciences, and Engineering subprogram.

In order to realize significant research gains and advance new research methodology, in 2009 BES initiated the creation of Energy Frontier Research Centers (EFRCs.) EFRCs are individually funded between $2-5 million per year to conduct focused research from a small team to solve "grand challenges" associated with disruptive scientific advances. DOE requests continued funding for all 46 existing EFRCs in FY 2013.

Biological and Environmental Research (BER) would receive $625.3 million in the President's budget, which is $15.7 million (2.6 percent) over FY 2012 funding. BER examines fundamental biological systems, climate, and environmental sciences. Specifically, BER researches genomics, drivers of climate change, and deeper environmental issues. The request also includes support for the three DOE Bioenergy Research Centers, the Joint Genome Institute, and Environmental Molecular Sciences Laboratory.

The majority of the requested increase is directed to the Climate and Environmental System Science subprogram, which increases $11.6 million (17.1 percent). This funding will support a "next-generation ecosystem experiment, begun in 2012, focused on the relationship between climate change and Arctic permafrost ecosystems and will initiate a new activity exploring the relationship between climate and tropics ecology."[2]

The budget would provide $455.6 million for **Advanced Scientific Computing Research (ASCR)**, an increase of $14.7 million (3.3 percent) over FY 2012 levels. Within ASCR, the two primary subprograms face different funding profiles for FY 2013. The Mathematical, Computational, and Computer Sciences Research subprogram would receive an increase of $28.1 million (18.1 percent) to focus on the challenge of data-intensive science and develop the computational capacity for future super-computing needs. The High Performance Computing and Network Facilities subprogram request decreases by $13.3 million (4.6 percent) from FY 2012 enacted levels. The budget request includes $68.5 million to continue investigating the potential for an exascale computing system aimed at increasing computational capacity by a thousand-fold.

The request for **Fusion Energy Sciences (FES)** is $398.3 million, a decrease of $2.7 million (0.7 percent) below FY 2012 funding. FES supports research to improve fundamental understanding of matter at very high temperatures and densities needed to develop fusion energy. The contribution to the international ITER project, a partnership to demonstrate the first fusion prototype, is $150 million, an increase of $45 million (42.9 percent) above FY 2012 enacted funding.

The FY 2013 funding request for **High Energy Physics (HEP)** is $776.5 million, a $14.3 million (1.8 percent) decrease from the enacted FY 2012 level. HEP probes the basic relationship between space and time, the elementary constituents of matter and energy, and the interactions

[2] Department of Energy, FY 2013 Congressional Budget Request, Volume 4, p. 148.

between them. This effort is concentrated on three scientific frontiers: the energy frontier, the intensity frontier, and the cosmic frontier.

Nuclear Physics (NP) would receive $526.9 million, a decrease of $20.4 million (3.7 percent) below FY 2012 funding. This program supports research to discover and understand various forms of nuclear matter. It also supports the production and development of techniques to make isotopes that are in short supply for medical, national security, environmental, and other research applications.

Energy Efficiency and Renewable Energy

The mission of the Office of Energy Efficiency and Renewable Energy (EERE) is to "strengthen the United States' energy security, environmental quality, and economic vitality in public-private partnerships." EERE supports this mission statement by: "Enhancing energy efficiency and productivity; bringing clean, reliable and affordable energy technologies to the marketplace; and making a difference in the everyday lives of Americans by enhancing their energy choices and their quality of life." EERE participates in many crosscutting activities with other departments, as well as within DOE offices, including collaborations with the Office of Science, the Advanced Research Projects Agency - Energy, Office of Electricity, Fossil Energy, Federal Energy Management Program, and the Loan Guarantee Program Office.

The Administration's budget request of $2.3 billion for EERE represents a $527.4 million (29.1 percent) increase over FY 2012 levels. This reflects the President's continued emphasis on increasing spending to develop clean energy technologies. Additionally, EERE requests statutory language allowing the Secretary of Energy to transfer up to $100 million to the Defense Production Act Fund.

The proposed funding for the **Solar Energy** program is $310 million, an increase of $21 million (7.3 percent) over FY 2012 levels. This request continues to support the Administration's "SunShot" initiative. A primary component of this initiative is EERE's "Dollar-a-Watt" program to make solar energy cost-competitive with fossil fuels without subsidies. To achieve this goal, solar generation needs to reach a five to six cents/kWh equivalent installed price for solar photovoltaics (PV) energy by 2020, or reduce the installed cost of solar electricity by approximately 75 percent from current costs. In order to achieve the SunShot goals, the budget requests additional emphasis on late-stage technology development activities. Market transformation activities receive an increase of $10.2 million (32 percent) and the manufacturing and SunShot validation subprogram receives a $25.3 million (30 percent) increase above FY 2012 levels.

The FY 2013 funding request for the **Wind Energy** program is $95 million, an increase of $1.7 million (1.9 percent) over FY 2012 enacted levels. The request focuses funding on activities to develop offshore wind technology, and aims to address financial, regulatory, technical, environmental, and social issues associated with offshore wind.

The FY2013 **Biomass and Biorefinery Systems** budget request is $270 million, an increase of $70.7 million (35.5 percent) over the FY 2012 level. This program aims to develop and transform domestic, renewable, and abundant biomass resources into cost-competitive, high performance biofuels, biopower, and bioproducts through targeted planning, research,

development and demonstration. DOE is seeking legislative authority to transfer funds under the Defense Production Act to coordinate EERE biofuel activities with the Navy and U.S. Department of Agriculture. The FY 2013 also includes an increased focus on bio-oil and downstream process technologies to produce final biofuel products.

The proposed funding level for the **Geothermal Technology** program is $65 million, an increase of $27.1 million (71.7 percent) over FY2012. The funding increase is almost exclusively dedicated to the Enhanced Geothermal Systems (EGS) subprogram. The subprogram will focus on EGS reservoir creation and monitoring technologies at EGS field test sites and will evaluate EGS stimulation techniques.

The Administration's budget request provides a total of $20 million for the **Water Power** program, which is a $38.8 million (66 percent) decrease from FY 2012 enacted levels. The program funds incremental hydropower development and demonstrates marine and hydrokinetic (MHK) technologies. According to the budget, the reduction in funding is due to progress in multiyear research projects intended to improve conventional hydropower. The program will focus on MHK technologies and developing open water testing for MHK devices.

The **Hydrogen and Fuel Cell Technologies** (HFCT) program requests $80 million; a $23.6 million or 22.8 percent decrease from FY 2012 levels. The budget states that the decrease reflects previous year progress on fuel cell technologies. FY 2013 efforts will be directed to deploying fuel cells with industry and government partners.

The budget request for the **Buildings Technologies Program** (BTP) is $310 million, a $174.4 million (41.4 percent) increase over FY 2012 levels. BTP supports efforts to improve the energy efficiency of new and existing homes and buildings primarily through advanced building technologies, controls, systems, and whole-building design; demonstration of integrated approaches for construction; bringing transformational tools to the market place; supporting the ENERGY STAR program; supporting the adoption, training, and enforcement of building codes; and promulgating and finalizing efficiency standards as required by law. The Energy Efficient Buildings Systems Design Hub is administered by BTP.

BTP also supports the President's *Better Buildings Initiative*, which aims to achieve a 20 percent improvement in commercial building energy efficiency by 2020. The program will expand demonstration and testing activities associated with retrofitting commercial and residential buildings. In addition to ongoing research, development, and demonstration (RD&D) activities, BTP Equipment and Buildings Standards requests an additional $40 million in part to initiate six new conservation standards rulemaking.

The **Vehicle Technologies Program** (VTP) requests $420 million, an increase of $91.2 million (27.7 percent) over the FY 2012 level. VTP is centered on achieving the President's goal to place one million electric vehicles on the road by 2015. The FY 2013 increase reflects an increased emphasis on advanced battery technology and manufacturing to reduce system cost. VTP will also focus on improving Heating Ventilation Air Conditioning system technologies.

The **Advanced Manufacturing Office** (AMO, formerly the Industrial Technologies Program), request is $290 million, an increase of $174.4 million (150.9 percent) over FY2012 levels. The

mission of 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"[3] for existing manufacturing facilities.

In FY 2013, AMO's Systems Integration activities would increase over $100 million to develop and demonstrate manufacturing processes. DOE requests $20 million for the second year of the Critical Materials Energy Innovation Hub to explore new technologies in order to increase the supply or reduce critical materials demand for energy efficiency and renewable energy technologies. AMO additionally seeks statutory authority to transfer funds under the Defense Production Act to reduce cost and accelerate the availability of certain technologies for both commercial and defense applications.

The Advanced Research Projects Agency –Energy

The Administration requests $350 million in FY 2013 for the Advanced Research Projects Agency – Energy (ARPA-E), an increase of $75 million or 27.3 percent over FY 2012 levels. In FY 2013, ARPA-E will emphasize (1) $184 million for Transportation Systems, including batteries and systems for electric vehicles and development of market competitive fuels using domestic resources such as natural gas; and (2) $130 million for Stationary Power, including challenges associated with "power electronics, solar, wind, osmotic power, smart grid technologies, natural gas, geothermal, and waste heat capture."[4]

Established in 2007 by the America COMPETES Act (P.L.110-69), ARPA-E is statutorily charged with developing energy technologies that result in "(i) reductions of imports of energy from foreign sources; (ii) reductions of energy-related emissions, including greenhouse gases; and (iii) improvement in the energy efficiency of all economic sectors." Initially provided with $400 million in American Recovery and Reinvestment Act (ARRA) (P.L.111-5) funding, ARPA-E did not receive a direct appropriation in FY10, though it did receive a $15 million transfer from the Office of Science.

In FY 2011, ARPA-E was provided $180 million in funding, of which $130 million for 60 projects has thus far been awarded. The six program areas funded in FY 2011 included Plants Engineered to Replace Oil (PETRO), High Energy Advanced Tehrmal Storage (HEATS), Rare Earth Alternatives in Critical Technologies (REACT), Green Electricity Network integration (GENI), and Solar Agile Delivery of Electrical Power Technology (Solar ADEPT). In FY 2012, ARPA-E plans to issue funding opportunity announcements (FOA) for Hybrid Energy Storage Modules (HESM), natural gas for transportation, Small Business Innovation Research (SBIR), and a FOA open to any transformational energy technology.

Fossil Energy R&D

The DOE Office of Fossil Energy (FE) supports R&D focused on coal (including clean coal technologies), gas, and petroleum and also supports the Federal government's Strategic Petroleum Reserve. The President's total budget request for FE is $650.8 million. Of that, FE's R&D budget is $420.6 million, an increase of $73.9 million (21.3 percent) above FY12 enacted

[3] DOE FY 2013 Congressional Budget Request, Volume 3, p. 131.
[4] *Department of Energy, Detailed Budget Request Volume 4*, p. 417.

levels. The FY 2012 level of $533.7 million included a rescission of $187 million resulting from termination of a major carbon capture and sequestration (CCS) demonstration project funded in a previous fiscal year. The base budget request for FE R&D, before accounting for this rescission, represents a decrease of $105.2 million, or 19.7 percent.

Coal R&D is funded at $275.9 million, the bulk of which focuses on advancing carbon capture and sequestration (CCS) efforts. FY 2013 Carbon Capture subprogram efforts are dedicated to achieving FE's goal to accomplish post-combustion carbon dioxide capture at no more than a 35 percent increase in electricity costs. The program is also identifying technologies to acquire commercial value of sequestered carbon through Carbon Capture, Utilization, and Sequestration activities to improve the economic viability of CCS technology. The Carbon Storage subprogram is mostly focused on maintaining funding for regional carbon sequestration partnerships to study the viability of long-term geologic storage in various formations.

The Clean Coal Power Initiative (CCPI) does not request additional funding to support CCS demonstration projects. In FY 2013, CCPI will continue to monitor the progress of the current portfolio of demonstration projects funded through ARRA. The Hydrogen from Coal, Coal to Coal Biomass to Liquids, and Solid Oxide Fuel Cells subprograms are all proposed to be eliminated.

The Natural Gas Technologies R&D program request is $17 million, $12 million of which is proposed for a new interagency R&D initiative by DOE, the Environmental Protection Agency, and the U.S. Geological Survey to "understand and minimize the potential environmental, health, and safety impacts of shale gas development through hydraulic fracturing…including the key research recommendations received from the Subcommittee of the Secretary of Energy Advisory Board."[5]

The FY13 budget request proposes to terminate Unconventional Fossil Energy Technologies programs, including the elimination of $50 million for the Ultra-Deep and Unconventional Natural Gas Other Petroleum Resources Research Program.

Nuclear Energy

The primary mission of the Office of Nuclear Energy (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 FY13 budget request for NE is $770.4 million, a $88.3 million (10.3 percent) decrease below FY 2012 levels. NE's primary R&D programs are Nuclear Energy Enabling Technologies, or NEET, ($65.3 million); Light Water Reactor Small and Modular Reactor Licensing Technical Support ($65 million); Reactor Concepts RD&D ($73.6 million); and Fuel Cycle R&D ($175.4 million). The primary NE research accounts total $382.4 million, a $68.5 million or $15.2 percent decrease from FY 2012. The majority of this decrease is proposed to come out of the Reactor Concepts program (-$41.2 million), specifically activities related to the Next Generation Nuclear Plant (NGNP) (-$19.2 million), advanced small modular reactors (-$9.5 million), and advanced reactor concepts (-$9.5 million).

[5] Department of Energy Budget Highlights, p. 51.

The budget request consolidates funding previously provided in the Energy and Water Development Appropriation "Other Defense Activities" account into the NE funding line. Thus, the budget requests $95 million for security at NE's primary national research facility, Idaho National Laboratory, as part of NE, rather than part of "defense activities."

The Fuel Cycle R&D program includes $59.7 million for the third year of the Used Fuel Disposition Research and Development subprogram, which examines issues associated with managing the back end of the nuclear fuel cycle. The subprogram intends to carry out key recommendations put forth in the *Blue Ribbon Commission on America's Nuclear Future Report to the Secretary of Energy*, such as researching and developing storage, transportation, and disposal technologies for spent fuel and nuclear waste. To assist with this research, NE requests $10 million be appropriated from the Nuclear Waste Fund for activities associated with the disposal of high-level radioactive waste, as required by the Nuclear Waste Policy Act.

In FY 2013, NE requests $24.6 million for the Energy Innovation Hub for Modeling and Simulation known as Consortium for Advanced Simulation of Light Water Reactors (CASL). CASL is creating a "virtual reactor model" of an operating nuclear reactor to "simulate reactor behavior and improve the safety and economics of reactor operations by simulating proposed solutions to reactor power production increases and reactor life and license extensions."[6]

Electricity Delivery and Energy Reliability

The mission of the Office of Electricity Delivery and Energy Reliability (OE) is to "lead national efforts to modernize the electric grid; enhance security and reliability of the energy infrastructure; and facilitate recovery from disruptions to energy supply." Research and Development within OE is funded at $103.4 million in the President's FY13 budget request. This reflects an increase of $4.3 million (4.3 percent) over FY12 levels.

OE's R&D programs focus on clean energy transmission and reliability, smart grid R&D, energy storage, and cyber security for energy delivery systems. OE concentrates on potential strains on the electric system as electric generation shifts towards low-carbon energy sources, specifically associated intermittency problems from wind and solar generation. OE aims to support these objectives through advanced grid modeling and extensive technological breakthroughs in energy storage. The President requests $20 million for the creation of an Electricity Systems Hub to be administered by OE. The new Hub would "address the critical issues and barriers associated [with] modernization of the electric grid."[7]

Loan Guarantee Program Office

Title 17 of the Energy Policy Act of 2005 authorizes DOE to make loan guarantees to encourage early commercial use of new or significantly improved technologies in energy projects. Projects supported must avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases; employ new or significantly improved technologies; and offer a reasonable prospect of repayment of the principal and interest on the guaranteed obligation.

[6] Department of Energy FY 2013 Congressional Budget Request, Volume 3, p. 340.
[7] *DOE Budget Highlights, p. 32.*

According to the budget request, the Loan Guarantee program has awarded over $16 billion in loan guarantees for 26 renewable energy projects, and has made additional commitments that have not yet closed totaling over $10 billion. The FY 2013 budget requests $38 million for administrative operations "to 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."[8] The Administration proposes to offset requested spending with an equivalent amount of fee collections for a net-zero budget request.

[8]Ibid, p. 52.