AN EXAMINATION OF DOE'S CLEAN TECHNOLOGY PROGRAMS

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

FIRST SESSION

WEDNESDAY, JUNE 15, 2011

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Wednesday, June 15, 2011

AN EXAMINATION OF DOE'S CLEAN TECHNOLOGY PROGRAMS

WEDNESDAY, JUNE 15, 2011

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 2:01 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Andy Harris [Chairman of the Subcommittee] presiding.

RALPH M. HALL, TEXAS
CHAIRMAN

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U.S. HOUSE OF REPRESENTATIVES
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Subcommittee on Energy & Environment

An Examination of DOE's Clean Technology Programs

Wednesday, June 15, 2011
2:00 p.m. to 4:00 p.m.
2318 Rayburn House Office Building

Witnesses

Dr. Arun Majumdar, Director, Advanced Research Projects Agency – Energy, U.S. Department of Energy

Dr. Henry Kelly, Acting Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

Mr. David Frantz, Director, Loan Guarantee Program Office, U.S. Department of Energy

HEARING CHARTER

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON ENERGY & ENVIRONMENT
U.S. HOUSE OF REPRESENTATIVES

An Examination of DOE's Clean Technology Programs

WEDNESDAY, JUNE 15, 2011
2:00–4:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Wednesday, June 15, 2011, the Science, Space, and Technology Subcommittee on Energy & Environment will hold a hearing entitled **"An Examination of DOE's Clean Technology Programs."** The purpose of the hearing is to receive testimony from DOE's Office of Energy Efficiency and Renewable Energy (EERE), Advanced Research Projects Agency—Energy (ARPA–E), and Loan Guarantee Program Office (LPO) on DOE's Fiscal Year (FY) 2012 budget request for clean energy technologies and the relative prioritization therein.

Witnesses

- **Dr. Arun Majumdar**, Acting Under Secretary for Energy, and Director, Advanced Research Projects Agency—Energy, U.S. Department of Energy
- **Dr. Henry Kelly**, Acting Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy
- **Mr. David Frantz**, Director, Loan Guarantee Program Office, U.S. Department of Energy

Background

The Department of Energy manages a wide portfolio of activities related to the development of clean energy technologies. DOE's programs span the lifecycle of energy technology development, ranging from long-term basic research supported by the Basic Energy Sciences program at the Office of Science, through later-stage applied research, development, demonstration and commercialization activities supported primarily by EERE, ARPA–E, and LPO. In his 2011 State of the Union address, President Obama made clean energy a centerpiece, calling on Congress to mandate that 80 percent of America's electricity come from clean energy sources by 2035 [1] and committing to placing one million "advanced technology vehicles" on the road by 2015. In addition to several tax and regulatory incentives to support this objective, the President's FY 2012 budget request touts over $8 billion in spending on clean energy technology development programs, representing an approximate increase of 33 percent above current funding. [2]

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." [3] EERE participates in many crosscutting activities with other departments, as

[1] While the Administration has not set forth a specific definition of ″clean energy″ as part of this goal, the President stated it would include ″renewable, nuclear power, efficient natural gas, and coal with carbon capture and sequestration.″

[2] *http://www.whitehouse.gov/blog/2011/01/31/keeping-america-competitive-innovation-and-clean-energy.*

[3] 1AAll mission statements taken from the relevant Department of Energy website.

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.

EERE Budget (dollars in millions)

Energy Efficiency and Renewable Energy (EERE)	FY10 Enacted	FY11 CR[4]	FY12 Request	FY12 House Approps Subcommittee Mark[5]	FY12 Request versus FY11 Appropriated	
					$	%
Hydrogen Technology	*170.3*	*0.0*	*0.0*		*n/a*	*n/a*
Hydrogen and Fuel Cell Technologies	*0.0*	*98.0*	*100.5*		*2.5*	*2.6*
Biomass and Biorefinery Systems	*216.2*	*183.0*	*340.5*		*157.5*	*86.1*
Solar Energy	*243.4*	*264.0*	*457.0*		*193.0*	*73.1*
Wind Energy	*79.0*	*80.0*	*126.9*		*46.9*	*58.6*
Geothermal Technology	*43.1*	*38.0*	*101.6*		*63.5*	*167.1*
Water Power	*48.7*	*30.0*	*38.5*		*8.5*	*28.3*
Vehicle Technologies	*304.2*	*300.0*	*588.0*		*288.0*	*96.0*
Building Technologies	*219.0*	*211.0*	*470.7*		*259.7*	*123.1*
Industrial Technologies	*94.3*	*108.0*	*319.8*		*211.8*	*196.1*
Energy Efficiency and Renewable Energy (EERE)	**2242.5**	**1835.0**	**3200.0**	**1305.0**	**1365.1**	**74.4**

The Administration's budget request of $3.2 billion for EERE represents a $1.365 billion (74.4 percent) increase over FY 2011 levels. In addition to the primary research, development, demonstration, and commercialization activities conducted by EERE's ten program areas, the Office supports cross-cutting activities. EERE's Commercialization Team "works to bridge the gap between research and development, and venture capital funding and marketing," with a goal to "increase the rate and scale of energy efficiency and renewable energy technology market penetration."[6] Education and outreach is also a significant component, with an $11 million budget to engage stakeholders through new media and conduct public service advertising.

EERE also supports a multitude of international activities, both of a multilateral and bilateral nature.[7]For example, EERE partners with the government of Kazakhstan, through the Save Energy Now program, to help improve Kazakh industry energy efficiency. EERE also participates in the Asia-Pacific Economic Cooperation to increase the development and use of renewable energy.

In FY 2010, EERE's $2.2 billion in funding was distributed accordingly: 43 percent to industry, 30 percent to national laboratories, 25 percent to city, state, and Federal (i.e. in-house EERE R&D) governments, and three percent to universities.

EERE Primary Facilities

EERE's primary in-house facility is the National Renewable Energy Laboratory (NREL), located in Golden, Colorado. NREL conducts focused R&D activities aimed to develop renewable electricity, renewable fuels, integrated energy system engineering and testing, and strategic energy analysis.[8] NREL hosts a robust commercialization and technology transfer program to "reduce private sector risk and enable investment in the adoption of renewable energy and energy efficiency technologies"[9] and transfer technologies to the marketplace. The FY 12 budget request includes $301.5 million for NREL, a $13 million (4.4 percent) increase over the FY 10 enacted levels.[10]

Located in conjunction with NREL is DOE's Golden Field Office. The Golden Field Office "builds partnerships to develop, commercialize and encourage the use of [energy efficiency and renewable energy] technologies"[11] in addition to managing

[6] *http://www1.eere.energy.gov/commercialization*
[7] *http://www1.eere.energy.gov/international/*
[8] *http://www.nrel.gov/overview/*
[9] *http://www.nrel.gov/technologytransfer/about.html*
[10] NREL FY 2011 funding was not specified in DOE's Spend Plan.
[11] *http://www.eere.energy.gov/golden/*

NREL. The Administration request for the Golden office is $550.4 million for FY 12, a $64.6 million (13.2 percent) increase from the FY 10 appropriated levels.

Energy Efficiency and Renewable Energy Programs

The proposed funding for the **Solar Energy** program is $457 million, an increase of $193 million (73.1 percent) over FY 2011 levels. This request intends to fund the "SunShot" initiative recently proposed by the Administration. As a part of this initiative, EERE is advancing a "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 four to five 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. Accordingly, an overwhelming percentage of solar energy's increased funding is directed to the PV subprogram. EERE will also continue to fund the Concentrating Solar Power (CSP) subprogram for further research in CSP development and thermal storage activities. As a means to accelerate widespread market adoption of solar energy, the program also seeks to improve applicable local codes, permitting, education and training.

The FY 2012 funding request for the **Wind Energy** program is $126.9 million, an increase of $46.9 million (58.6 percent) over FY 2011 levels. The request continues funding a demonstration project to develop offshore wind technology, and aims to address financial, regulatory, technical, environmental, and social issues associated with offshore wind.

The FY 2012 **Biomass and Biorefinery Systems** budget request is $340.5 million, an increase of $157.5 million (86.1 percent) over the FY 2011 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. In FY 2012, funding for feedstock production trials will be eliminated. The elimination is offset by a major increase of $150 million to expand the Cellulosic Biofuels Reverse Auction with the intention of rapidly injecting money into the emerging cellulosic biofuels industry. Support for integrated biorefinery projects also notably decreases with increased focus on R&D for downstream deployment efforts.

The proposed funding level for the **Geothermal Technology** program is $101.5 million, an increase of $63.5 million (167.1 percent) over FY 2011. This program seeks to broaden its focus to include technologies with a near-term impact by confirming undiscovered hydrothermal resources with innovative exploration technologies. Additionally, the Enhanced Geothermal Systems subprogram is aiming to advance new technologies to use waste carbon dioxide to capture heat and make electricity.

The Administration's budget request provides a total of $38.5 million for the **Water Power** program, which is an $8.5 million (28.3 percent) increase from FY 2011 enacted levels. The program funds incremental hydropower development and demonstrates marine and hydrokinetic (MHK) technologies. The funding will support full-scale MHK open water demonstration projects to establish the baseline cost of MHK generated electricity by 2013.

The **Hydrogen and Fuel Cell Technologies** (HFCT) program requests $100.5 million; a $2.5 million or 2.6 percent increase from FY 2011 levels. The program is refocusing on specific R&D on fuels cells for stationary, transportation and portable power applications.

The budget request for the **Buildings Technologies Program** (BTP) is $470.7 million, a $259.7 million (123.1 percent) increase over FY 2011 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's FY 2012 request includes the President's new *Better Buildings Initiative*, which aims to achieve a 20 percent improvement in commercial building energy efficiency by 2020. In addition to increased R&D funding for building technologies, the initiative includes new tax incentives for commercial building energy efficiency projects and financing opportunities for state and municipal governments through the "Race to the Green" competitive grant program. The initiative would also receive funding from the Loan Guarantee Program Office.

The **Vehicle Technologies Program** (VTP) requests $588 million, an increase of $288 million (96 percent) over the FY 2011 level. The increase reflects an empha-

sis on the development and deployment of plug-in hybrid vehicles (PHEVs). Specifically, in support of the President's goal to place one million electric vehicles on the road by 2015, VTP is requesting $229 million to fund infrastructure development for transportation electrification, including a major new program of grants to communities for upgrading electric vehicle infrastructure.

The **Industrial Technologies Program** (ITP) request is $319.8 million, an increase of $211.8 million (196.1 percent) over FY 2011 levels. ITP seeks to revolutionize industry's energy and carbon intensity by developing manufacturing technologies, materials, and clean energy manufacturing capacity. The Next Generation Materials and Next Generation Manufacturing Processes subprograms are both drastically increased to assist in attaining this goal. Additionally, the request proposes the creation of an Energy Innovation Hub on critical materials. A new $50 million Energy Efficiency Partnership is included to assist industry incorporation of energy efficient technologies into existing facilities.

The Advanced Research Projects Agency—Energy (ARPA–E)

The Administration requests $650 million for the Advanced Research Projects Agency—Energy (ARPA–E) and increase of $470 million (261 percent) over FY 2011 levels.

Advanced Research Projects Agency – Energy Budget (all dollar amounts in millions)

Program	FY10 Enacted	FY11 CR	FY12 Request	FY12 E&W Sub Mark	FY12 Request versus FY11 Appropriated	
					$	%
ARPA-E	*15.0*	*180.0*	*650.0*	*100.0*	*470.0*	*261.1*

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."

Of the $650 million request, $550 million would be provided through discretionary funding for the purpose of sponsoring additional rounds of project funding. Potential funding areas include stationary power, electrical infrastructure, end use efficiency, embedded efficiency, and transportation systems.

ARPA–E would also administer an additional $100 million Wireless Innovation Fund (WIN) aimed at developing clean-energy wireless technologies, paid for through a proposed transfer of wireless spectrum auction revenues. The Administration proposes to establish WIN as a mandatory program.

Current Technology Programs

Upon receiving $180 million in the FY 2011 Continuing Resolution, ARPA–E announced $130 million in funding for five new Funding Opportunity Announcements (FOA), the agency's fourth round of funding opportunities. The round of FOA include:

- **Plants Engineered to Replace Oil (PETRO)** to develop low-cost production of advanced biofuels. ($30 million)
- **High Energy Advanced Thermal Storage (HEATS)** to research advancements in hot and cold thermal energy storage. The energy storage technologies would assist storage necessary to deliver solar electricity, produce fuel from the sun's heat, and improve driving range of electric vehicles due to improvements in air conditioning efficiency. ($30 million)
- **Rare Earth Alternatives in Critical Technologies (REACT)** to study technology alternatives to mitigate demand for rare earth materials. ($30 million)
- **Green Electricity Network Integration (GENI)** to advance grid control technologies necessary to manage issues relating to intermittent sources of electricity generation. ($30 million)

- **Solar Agile Delivery of Electrical Power Technology (Solar ADEPT)** to build on the SunShot Initiative. Solar ADEPT seeks to reduce the total cost of utility-scale solar systems by 75 percent by 2017. ($10 million)

Each program was preceded by an ARPA–E sponsored workshop with specific objectives to identify the technology space in which advancements are necessary.[12] The workshops inform the FOA and resulting technology awards. The latest FOA include all program areas proposed in the FY 2012 budget request.

Recently, ARPA–E hosted workshops on hybrid energy storage modules and small-scale distributed generation. These technology areas are likely the next programs to receive funding. ARPA–E currently does not have any further workshops scheduled.

ARPA–E hosted the 2011 ARPA–E Energy Innovation Summit in March, 2011. The Summit included a Transformational Energy Technology Showcase to highlight award winners, finalists, and other innovative energy technologies which did not receive previous ARPA–E funding.

ARPA–E, Duke Energy, Electric Power Research Institute MOU

In March, DOE announced a partnership between ARPA–E, Duke Energy, and the Electric Power Research Institute to "identify opportunities for testing and deploying ARPA–E funded projects."[13] Duke Energy, in partnership with ARPA–E, will have the opportunity to select specific technologies funded by ARPA–E to deploy at Duke facilities to test the viability of the technology's wide-scale deployment.

Prior funding

First funded the 2009 American Recovery and Reinvestment Act (ARRA), ARPA–E's initial tranche of funding resulted in 85 awards to companies and universities to develop and commercialize technologies in areas such as batteries, carbon capture, biofuels, and building efficiency. A complete list of these awards is included in **Appendix A.**

Loan Guarantee Program Office

The President's FY 12 budget request for DOE's Loan Guarantee Program Office (LPO) is $200 million, equal to the FY 11 funding. Funds would be used as a credit subsidy to guarantee (i.e. agree to repay the borrower's debt obligation in the event of default) loans authorized under Section 1703 of the Energy Policy Act of 2005. This level of requested funding would support an estimated $1 to $2 billion in loan guarantees to support energy efficiency and renewable energy activities.

LPO Budget (all dollar amounts in millions)

Program	FY10 Enacted	FY11 CR	FY12 Request	FY12 E&W Sub Mark	FY12 Request versus FY11 Appropriated	
					$	%
Loan Guarantee Program Office	4.6	200.0	200.0	160.0	0	0

According to DOE, the mission of LPO is to "accelerate the domestic commercial deployment of innovative and advanced clean energy technologies at a scale sufficient to contribute meaningfully to the achievement of our national clean energy objectives-including job creation; reducing dependency on foreign oil; improving our environmental legacy; and enhancing American competitiveness in the global economy of the 21st century."[14]

Specifically, LPO endeavors to encourage commercial- and utility-scale development and adoption of new or significantly improved energy technologies.

Since its creation, the LPO has awarded over $30 billion for 28 projects, financing commercial- and utility-scale development of technologies in the following areas:

- Biomass

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[12] 1A Workshop descriptions can be found at: *http://arpa-e.energy.gov/EventsWorkshops/PastWorkshops.aspx*

[13] *http://arpa-e.energy.gov/media/news/tabid/83/vw/1/itemid/32/Default.aspx*

[14] *https://lpo.energy.gov/?page*__id=17

- Hydrogen
- Solar
- Wind and Hydropower
- Advanced Fossil Energy Coal
- Carbon Sequestration practices and technologies
- Electricity Delivery and Energy Reliability
- Alternative Fuel Vehicles
- Industry Energy Efficiency Projects
- Pollution Control Equipment

In addition to the President's request for Title 17 loan guarantees, the budget asks for $105 million to create a Better Building Pilot Loan Guarantee Initiative for Universities, Schools, and Hospitals. This new program would fund loan guarantees to retrofit commercial buildings and would subsidize up to $2 billion in total loan principal.

On September 30, 2011, the Section 1705 loan guarantees, authorized by the Stimulus, will expire. Due to the expiration of the Section 1705 program, LPO will not have the ability to fund projects in which an application has been submitted. Accordingly, LPO notified companies farthest along in the application process would be processed under the Section 1705 terms, while the remaining companies will have to apply for Section 1703 loan guarantees.A full list of loan guarantees issued can be found in **Appendix B.**

ISSUES FOR COMMITTEE CONSIDERATION

Due to the wide range of clean technology initiatives underway at the Department of Energy and the Administration's renewed push for the development and deployment of those technologies, Committee examination of DOE's clean technology programs warrant continued oversight. Issues to be considered include:

- How does DOE coordinate clean technologies programs through various DOE offices?
- What technology areas merit government funding and what activities should be left to the private market?
- How does DOE prioritize relative programs to gain the most value for taxpayer funding?
- How are programmatic activities being administered by EERE, ARPA–E, and Loan Guarantee Program Office?

Appendix A

ARPA–E Awards Funding:

Funding Opportunity Announcement I—October 26, 2009

The Department of Energy announced major funding for 37 research projects. **$151 million** in funding was awarded through the Department's recently-formed Advanced Research Projects Agency–Energy.

Awardee	Amount	Technology
1366 Technologies Inc.	$4,000,000	Renewable Power (solar)
Agrivida, Inc.	$4,565,800	Biomass Energy
Arizona State University	$5,133,150	Energy Storage
Arizona State University	$5,205,706	Direct Solar Fuels
Ceres, Inc.	$4,989,144	Biomass Energy
Delphi Automotive Systems LLC	$6,733,386	Vehicle Technologies
E.I. du Pont de Nemours and Company	$9,000,000	Biomass Energy
EaglePicher Technologies LLC	$7,200,000	Energy Storage
Envia Systems	$4,000,000	Energy Storage
Exelus, Inc.	$1,000,000	Oil & Gas
FastCAP Systems Corporation	$5,349,932	Energy Storage
FloDesign Wind Turbine Corp.	$8,325,400	Renewable Power (wind)
Foro Energy, Inc.	$9,151,300	Renewable Power (geothermal)
General Motors Company	$2,655,174	Vehicle Technologies
Inorganic Specialists, Inc.	$1,999,447	Energy Storage
Iowa State University	$4,373,488	Direct Solar Fuels
ITN Energy Systems, Inc.	$4,986,249	Building Efficiency
Lehigh University	$566,641	Carbon Capture
Massachusetts Institute of Technology	$6,949,624	Energy Storage
Michigan State University	$2,540,631	Vehicle Technologies
Momentive Performance Materials	$4,519,259	Building Efficiency
Nalco Company	$2,250,487	Carbon Capture
NanOasis Technologies, Inc.	$2,031,252	Water
Ohio State University	$5,000,000	Carbon Capture
PAX Streamline, Inc.	$3,000,000	Carbon Capture
Pennsylvania State University	$1,900,067	Direct Solar Fuels
Phononic Devices, Inc	$3,000,000	Waste Heat Capture

Porifera Inc.	$1,077,992	Carbon Capture
RTI International	$3,111,693	Biomass Energy
Stanford University	$4,992,651	Building Efficiency
Sun Catalytix Corporation	$4,085,350	Direct Solar Fuels / Energy Storage
United Technologies Research Center	$2,251,183	Carbon Capture
Univenture, Inc.	$5,992,697	Biomass Energy / Direct Solar Fuels
University of California, Riverside	$760,705	Vehicle Technologies
University of Delaware	$4,462,162	Vehicle Technologies
University of Illinois	$1,715,752	Waste Heat Capture
University of Minnesota	$2,200,000	Direct Solar Fuels

Funding Opportunity Announcement II—April 29, 2010

The second round of funding from ARPA–E was awarded to 37 research projects and divided into three categories. **$106 million** was awarded to projects that could produce advanced biofuels more efficiently from renewable electricity instead of sunlight; design completely new types of batteries to make electric vehicles more affordable; and remove the carbon pollution from coal-fired power plants in a more cost-effective way.

1. **Electrofuels–Biofuels from electricity (DE–FOA–0000206)**

Electrofuels approaches will use organisms able to extract energy from other sources, such as solar-derived electricity or hydrogen or earth-abundant metal ions. Theoretically, such an approach could be more than 10 times more efficient than current biomass approaches.

Awardee	**Amount**	**Technology**
University of Massachusetts Amherst	$1,000,000	Electron Source – Electric Current
Pennsylvania State University	$1,500,000	Electron Source – Solar Hydrogen
The Ohio State University	$3,977,349	Electron Source – Hydrogen
Massachusetts Institute of Technology	$1,771,404	Electron Source – Hydrogen:
Ginkgo BioWorks	$6,000,000	Electron Source – Electric Current:
Harvard Medical School-Wyss Institute	$4,194,125	Electron Source – Electric Current
Massachusetts Institute of Technology	$3,195,563	Electron Source – Hydrogen and/or Direct Current
North Carolina State University	$2,729,976	Electron Source – Hydrogen:
OPX Biotechnologies Inc.	$6,000,000	Electron Source – Hydrogen:

University of California Los Angeles	$4,000,000	Electron Source – Electric Current:
Medical University of South Carolina	$2,342,602	Electron Source – Electric Current
Columbia University	$543,394	Electron Source – Ammonia:
Lawrence Berkeley National Laboratory	$3,948,493	Electron Source – Hydrogen:

2. **Batteries for Electrical Energy Storage in Transportation (BEEST) (DE–FOA–0000207)**

This ARPA–E program seeks to develop a new generation of ultra-high energy density, low-cost battery technologies for long range plug-in hybrid and all-electric vehicles. If successful, the technologies developed in this program will greatly improve U.S. energy securities, spur economic growth, and reduce greenhouse gas emissions.

Awardee	**Amount**	**Technology**
Sion Power Corporation	$5,000,000	Lithium-Sulfur (Li-S) Battery
ReVolt Technology LLC	$5,000,335	Zinc Flow Air Battery
PolyPlus Battery Company	$4,996,311	Lithium-Air Battery
Pellion Technologies, Inc.	$3,204,080	Magnesium-Ion Battery:
Applied Materials, Inc.	$4,373,990	Advanced Lithium-Ion Battery Manufacturing:
Massachusetts Institute of Technology	$4,973,724	Novel Semi-Solid Rechargeable Flow Battery:
Planar Energy Devices, Inc.	$4,025,373	Solid State Lithium Battery:
Stanford University	$1,000,000	Novel All-Electron Battery:
Recapping, Inc.	$1,000,000	Capacitive Storage:
Missouri University of Science & Technology	$999,997	Lithium-Air Battery:

3. **Innovative Materials & Processes for Advanced Carbon Capture Technologies (IMPACCT) (DE–FOA–0000208)**

This ARPA–E program aims to support revolutionary technologies to capture carbon dioxide from coal-fired power plants using a range of approaches, including solvents, sorbents, catalysts, enzymes, membranes, and gas-liquid-solid phase changes.

Awardee	Amount	Technology
Codexis Inc.	$4,657,045	Solvents / Catalysts:
Texas A&M	$1,019,874	Sorbents:
Massachusetts Institute of Technology	$1,000,000	Sorbents
University of Kentucky-Center for Applied Energy Research	$1,955,078	Membranes / Solvents:
GE Global Research Center	$3,017,511	Phase Change:
Lawrence Livermore National Laboratory	$3,665,000	Solvents / Catalysts:
Lawrence Berkeley National Laboratory	$3,663,696	Sorbents:
Georgia Institute of Technology	$1,000,000	Membranes:
Notre Dame University	$2,559,563	Phase Change:
ATK	$1,000,000	Phase Change:
Columbia University	$1,014,707	Solvents / Catalysts:
University of Colorado at Boulder	$3,144,646	Membranes:
Oak Ridge National Laboratory	$987,547	Sorbents
Research Triangle Institute	$2,000,000	Solvents:

Funding Opportunity Announcement III—July 12, 2010

The third round of funding from ARPA–E was awarded to 43 research projects and divided into three categories. Funded with **$92 million**, the selections focused on accelerating innovation in green technology while increasing America's competitiveness in grid scale energy storage, power electronics and building efficiency.

1. **Agile Delivery of Electrical Power Technology (ADEPT) (DE–FOA–0000288)**

The ADEPT projects explore integrated circuits that incorporate high-voltage transistors and high-performance magnetic materials in applications. ADEPT is also focused on creating record-breaking, high-voltage transistors that can allow the electricity grid to be used like a large controllable circuit.

Awardee	Amount	Technology
Arkansas Power Electronics International, Inc.	$3,914,554	Circuit Topology/Switches - Automobiles:
Case Western Reserve University	$2,254,017	Capacitors - Automobiles:

Cree, Inc.	$3,736,291	Switches - Transmission:
CUNY Energy Institute	$1,568,330	Capacitors - Lighting:
GE Global Research	$949,545	Magnetics - Photovoltaics:
GeneSiC Semiconductor	$2,450,000	Switches - Transmission:
Georgia Tech Research Corporation	$999,017	Magnetics - Consumer Electronics:
Georgia Tech Research Corporation	$981,619	Circuit Topology/Switches - Transmission:
HRL Laboratories, LLC	$5,058,803	Switches – Automobiles
Massachusetts Institute of Technology	$4,414,009	Switches/Magnetics - Lighting:
Teledyne Scientific & Imaging	$3,439,494	Magnetics/Switches – Lighting:
Transphorm Inc	$2,950,000	Switches - Motors:
Virginia Tech	$900,000	Magnetics/Capacitors - Consumer Electronics:
Virginia Tech	$983,000	Magnetics/Switches - Consumer Electronics:

2. **Building Energy Efficiency Through Innovative Thermodevices (BEET–IT) (DE–FOA–0000289)**

The BEET–IT program is focused on developing new approaches and technologies for cooling in buildings to dramatically improve energy efficiency and reduce the use of refrigerants and their impact on climate change.

Awardee	**Amount**	**Technology**
ADMA	$3,269,965	Building Efficiency
Architectural Applications	$458,265	Building Efficiency
Astronautics Corp. of America	$2,889,839	Solid State Cooling
Battelle Memorial Institute, Corporate Operations	$401,654	Vapor Absorption/Adsorption
Counseling & Consulting Associates	$400,000	Gas Cycles: Centrifugal Air Cycle Air Conditioning System

Georgia Tech Research Corp.	$2,399,842	Vapor Absorption/Adsorption
Infinia Corp.	$3,000,617	Gas Cycles: Stirling Air Conditioner (StAC) for Compact Cooling
Material Methods LLC	$399,800	Gas Cycles: Phononic Heat Pump
Pacific Northwest National Laboratory	$2,541,952	Vapor Absorption/Adsorption:
Sheetak Inc.	$563,303	Solid State Cooling: Non-Equilibrium Asymmetric Thermoelectric (NEAT)
The Pennsylvania State University	$2,988,720	Gas Cycles: One-ton (Thermoacoustic Air Conditioner
The Regents of the University of California, Los Angeles	$520,547	Solid State Cooling:
United Technologies Research Center	$2,855,795	Mechanical Vapor Compression: Water-Based HVAC System
United Technologies Research Center	$3,098,765	Vapor Absorption/Adsorption
University of Florida	$1,000,000	Vapor Absorption/Adsorption:
University of Maryland	$500,001	Solid State Cooling: Thermoelastic Cooling
University of Notre Dame	$2,817,926	Mechanical Vapor Compression:

3. **Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS)(DE–FOA–0000290)**

This program seeks to develop revolutionary new storage technologies that exhibit energy, cost, and cycle life comparable to pumped hydropower, but which are modular and can be widely implemented at any location across the power grid.

Awardee	**Amount**	**Technology**
ABB Inc.	$4,200,000	Superconducting Magnetic Energy Storage
Beacon Power Corporation	$2,250,000	Flywheel: Development of a 100 kWh/100 kW Flywheel Energy Storage Module
Boeing	$2,264,136	Flywheel: Low-Cost, High-Energy Density Flywheel Storage Grid Demonstration
CUNY Energy Institute	$3,000,000	Battery: Low-cost Grid-Scale Electrical Storage
Fluidic Energy, Inc.	$3,000,000	Battery: Enhanced Metal-Air Energy Storage System
General Atomics	$1,986,308	Flow Battery: GRIDS Soluble Lead Flow Battery Technology

General Compression	$750,000	Compressed Air Energy Storage
Lawrence Berkeley National Laboratory	$1,592,730	Flow Battery: Hydrogen-Bromine Flow Batteries for Grid-Scale Energy Storage
Primus Power	$2,000,000	Flow Battery: Low-Cost, High Performance 50 Year Electrodes
Proton Energy	$2,148,719	Fuel Cell: Transformative Renewable Energy Storage Devices Based on Neutral
United Technologies Research Center	$3,000,000	Flow Battery: Transformative Electrochemical Flow Storage System (TEFSS)
University of Southern California	$1,459,324	Battery: A Robust and Inexpensive Iron-Air Rechargeable Battery for Grid-Scale Energy Storage

Transformational Energy Research and Development Projects—September 10, 2010

ARPA–E awarded **$9.6 million** to six projects that could improve energy efficiency in buildings by reducing loads on air conditioners; reduce costs associated with generating electricity from solar power; and improve efficiency and power density of electric machines.

Awardee	Amount	Technology
Dais Analytic Corporation	$680,000	Nanotechnology Membrane-Based Dehumidifier
GE Global Research	$2,249,980	Transformational Nanostructured Permanent Magnets
Makani Power, Inc.	$3,000,000	Airborne Wind Turbine
Sustainable Energy Solutions	$750,000	Cryogenic Carbon Capture
Teledyne Scientific & Imaging, LLC	$500,000	Optofluidic Solar Concentrators
University of California Los Angeles (UCLA)	$2,420,802	Thermal Energy Storage with Supercritical Fluids

Funding Opportunity Announcement IV—April 20, 2011

U.S. Department of Energy Secretary Steven Chu announced up to $130 million from ARPA–E will be made available to develop five new program areas.

- **1) Plants Engineered To Replace Oil (PETRO)**—PETRO aims to create plants that capture more energy from sunlight and convert that energy directly into fuels. ARPA–E seeks to fund technologies that optimize the biochemical processes of energy capture and conversion to develop robust, farm-ready crops that deliver more energy per acre with less processing prior to the pump.
- **2) High Energy Advanced Thermal Storage (HEATS)**—ARPA–E seeks to develop revolutionary cost-effective thermal energy storage technologies in three focus areas: 1) high temperature storage systems to deliver solar electricity more efficiently around the clock and allow nuclear and fossil baseload resources the flexibility to meet peak demand, 2) fuel produced from the sun's heat, and 3) HVAC systems that use thermal storage to improve the driving range of electric vehicles by up to 40 percent.
- **3) Rare Earth Alternatives in Critical Technologies (REACT)**—ARPA–E seeks to fund early-stage technology alternatives that reduce or eliminate the dependence on rare earth materials by developing substitutes in two key areas: electric vehicle motors and wind generators.
- **4) Green Electricity Network Integration (GENI)**—ARPA–E seeks to fund innovative control software and high-voltage hardware to reliably control the grid, specifically: 1) controls able to manage 10 times more sporadically available wind and solar electricity than currently on the grid, and 2) resilient power flow control hardware—or the energy equivalent of an internet router—to enable significantly more electricity through the existing network of transmission lines.
- **5) Solar Agile Delivery of Electrical Power Technology (Solar ADEPT)**—the Solar ADEPT program focuses on integrating advanced power electronics into solar panels and solar farms to extract and deliver energy more efficiently. Specifically, ARPA–E aims to invest in key advances in magnetics, semiconductor switches, and charge storage, which could reduce power conversion costs by up to 50 percent for utilities and 80 percent for homeowners.

At this time no awards have been issued for Funding Opportunity Announcement IV

Appendix B

Loan Guarantee Program Awards Funding:

Date	Awardee	Amount	Technology
July 2009	Nordic Windpower USA, Inc.	$16 million	Wind Manufacturing
Sep 2009	Solyndra Inc.	$535 million	Solar Manufacturing
Sep 2009	Ford Motor Company	$5.907 billion	Motor Vehicle Manufacturing
Dec 2009	Red River Environmental Products, LLC	$245 million	Energy Efficiency
Jan 2010	Tesla Motors	$465 million	OEM
Jan 2010	Nissan North America, Inc.	$1.448 billion	OEM
Feb 2010	Georgia Power Company	$8.33 billion	Nuclear Generation
March 2010	SAGE Electrochromics, Inc.	$72 million	Energy Efficiency
April 2010	Fisker Automotive	$529 million	OEM
May 2010	AREVA	$2 billion	Front-end Nuclear
June 2010	Nevada Geothermal Power Company, Inc.	$78.8 million	Geothermal
June, 2010	US Geothermal, Inc.	$97 million	Geothermal
July,2010	Abengoa Solar, Inc.	$1.466 billion	Solar Generation
July 2010	Kahuku Wind Power,	$117 million	Wind Generation
Aug 2010	AES Corporation	$17 million	Battery Storage
Aug 2010	Beacon Power Corporation	$43 million	Energy Storage
Oct 2010	Caithness Shepherds Flat	$1.3 billion	Wind Generation
Oct 2010	LS Power Associated (On Line)	$343 million	Transmission
Dec 2010	Abound Solar	$400 million	Solar Manufacturing
Jan 2011	Diamond Green Diesel	$241 million	Advanced Biofuels
Feb 2011	SoloPower	$197 million	Solar Manufacturing
March 2011	The Vehicle Production Group LLC	$50 million	OEM
March 2011	Solar Trust of America (Solar Millenium)	$2.105 billion	Solar Generation

Chairman HARRIS. The Subcommittee on Energy and Environment will come to order. Good afternoon. Welcome to today's hearing entitled An Examination of DOE's Clean Technology Programs. In front of you are packets containing the written testimony, biographies and truth-in-testimony disclosures for today's witness panel.

I am now going to recognize myself for five minutes for an opening statement.

I first want to thank our witnesses for being here today to testify on the DOE's clean technology programs. I appreciate you taking time from your busy schedules to appear before us this afternoon.

But before discussing the substance of today's hearing, I would like to take a moment to note my displeasure with the DOE's lack of responsiveness to this Committee. Following Secretary Chu's March appearance before the Committee on DOE's 2012 budget request, Members submitted written questions to be answered for the hearing record. The questions were sent to DOE on March 18, three months ago, but the Committee has yet to receive a response.

Similarly, on May 4, I sent a letter to Secretary Chu requesting information on many of the programs we are here today to examine. Once more, DOE has yet to respond to my letter, almost a month past the requested response date.

The Department's inability to answer fundamental and straightforward questions about programs for which it is requesting billions of dollars not only reflects poorly on the Department but it hinders Congressional oversight and informed budget and policy decision-making. The offices represented today are an excellent case in point. The President is requesting almost $2 billion in new spending for them. I would suggest to DOE that if getting this new money is truly a departmental priority, responding to Congress in a timely fashion should be a priority as well.

The budget and policy context in which we consider DOE's clean technology programs today is clear and sobering. The United States is currently facing a budget deficit of $1.6 trillion, with a T, for the current fiscal year and our government is borrowing more than 40 cents for every dollar we spend. Budget projections for the next decade and beyond bleed red ink. Yet, in spite of this dire fiscal reality, President Obama is requesting massive spending, to the tune of $8 billion, for "clean" energy technologies. This request comes on the heels of a 60 percent increase in EERE's base budget over the last six years, over $16 billion worth of stimulus spending provided to EERE alone.

While we have only begun to review this spending in detail, indications of wasteful, duplicative and inappropriate spending may abound and are cause for great concern. At a more fundamental level, I believe the growing attention to and importance of energy policy warrants more careful consideration of the appropriate role of government in energy technology development.

While there is broad agreement that economically feasible alternative energy would be of great benefit to the country, the Federal Government's increasing tendency to involve itself in the energy marketplace is troubling and may even be ultimately counterproductive.

America grows by unleashing its entrepreneurial spirit, motivated by the rewards of success, not through the government picking winners and losers and allocating capital through politically-driven policies and programs. The U.S. economy thrives on innovation and a free market, and I look forward to hearing from witnesses today how DOE can better help unleash this innovation by complementing, not supplanting, private efforts.

In May, the economy experienced another month of anemic growth and the unemployment rate remains above nine percent. It may be counterintuitive to the Washington mindset, but the best way to put American back to work may be to get the government out of the way of the private sector. I believe this applies to energy specifically as well as it does generally to the overall economy.

Thank you again for your time.

[The prepared statement of Mr. Harris follows:]

OPENING STATEMENT
The Honorable Andy Harris (R-MD), Chairman
Subcommittee on Energy and Environment
An Examination of DOE's Clean Technology Programs

June 15, 2011

I thank our witnesses for being here today to testify on the Department of Energy's clean technology programs. I appreciate you taking time from your busy schedules to appear before us this afternoon.

Before discussing the substance of today's hearing, I would like to take a moment to note my displeasure with the Department of Energy's lack of responsiveness to this Committee. Following Secretary Chu's March appearance before the Committee on DOE's 2012 budget request, Members submitted written questions to be answered for the hearing record. The questions were sent to DOE on March 18—three months ago—but the Committee has yet to receive a response. Similarly, on May 4, I sent a letter to Secretary Chu requesting information on many of the programs we are here today to examine. Once more, DOE has yet to respond to my letter, almost a month past the requested response date. The Department's inability to answer fundamental and straightforward questions about programs for which it is requesting billions of dollars not only reflects poorly on the Department; it hinders Congressional oversight and informed budget and policy decision-making. The offices represented today are an excellent case in point—the President is requesting almost $2 billion in *new spending* for them. I would suggest to DOE that if getting this new money is truly a departmental priority, responding to Congress in a timely fashion should be a priority as well.

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America grows by unleashing its entrepreneurial spirit, motivated by the rewards of success, not through the government picking winners and losers and allocating capital through politically-driven policies and programs. The U.S. economy thrives on innovation and a free-market, and I look forward to hearing from witnesses today how DOE can better help unleash this innovation by complementing, not supplanting, private efforts.

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Thank you again for your time and I now recognize Mr. Miller for five minutes for an opening statement.

Chairman HARRIS. And I now recognize Mr. Miller for five minutes for an opening statement.

Mr. MILLER. Thank you. I appreciate Chairman Harris calling today's hearing to examine the Administration's clean technology programs.

Unfortunately, at a time when the United States needs comprehensive energy policies, the Administration and the American people are getting mixed messages from Congress about our visions for energy in the future. There is a growing and unnecessary divide on both the potential for clean energy technologies and the appropriate role of government where winners are supposed to be decided largely by the free market.

I say that winners are decided largely by the marketplace because energy markets are really anything but free. The sector has always been heavily regulated and heavily subsidized by governments, and in many cases, prices are controlled by cartels and manipulated by complex financial mechanisms—I think we will be discussing that this week on the Floor—that have little relation to simple supply and demand.

Classic economic models are insufficient for reflecting the complexities of the energy marketplace. At best, consumer choice is often limited to turning down a thermostat or buying a more fuel efficient car. The sooner we can get beyond the fallacy that free market forces alone can or will determine which technologies are best for the public, the sooner we can have a productive discussion about how to ensure an environmentally and economically sustainable energy future.

That is the ultimate goal of what is expected of us as leaders. We are not expected to block the progress of innovation for the sake of standing guard over outdated economic doctrine. Our global competitors are more than happy to let us quibble over picking winners and losers while we sit back assuming the United States will ultimately prevail in the global free marketplace that we created. They are busy playing an entirely different game. Other governments are very aggressively investing in high technology and clean energy sectors with enough money to ensure that even their weakest players can beat the United States in those new markets. That is reason enough to add a few new plays to our playbook.

The programs that we are discussing today are innovative government approaches to this problem. Despite the usual rhetoric surrounding energy R&D programs, the government actually seldom picks winners or losers. Instead we place bets on groundbreaking science, promising technologies, talented researchers, and pioneering companies, all for the purpose of promoting a more diverse and competitive marketplace where cleaner and more efficient technologies stand a chance. Sometimes they win, sometimes they lose, and often the benefits are unforeseen or simply go unrecognized. But that is what we, the government, are supposed to do in R&D programs. From basic research on nanoscience materials to loan guarantees for deployment of whole systems, the role of government should be to take on technological and financial risk that industry and academia alone are not equipped or inclined to do. We cannot guarantee the success of any project or completely protect

against failure. If we could do either, the private sector should do it.

So we cast a wide net, invest in a range of technologies and projects, manage risk, accept that some disappointment and failures are expected and necessary, hope for breakthroughs and then translate scientific discoveries into practical solutions.

The programs today represent different variations on that model with the end goals the same. It is a shame that increased energy efficiency of the Nation and diversifying our energy supply has become so politicized. Some in Congress would like to paint the complex world of renewable energy with a single brushstroke to make the public believe that it is all a big farce. They want the American people to believe it is a zero-sum game, conventional energy versus clean energy, with the latter paving a path to economic ruin.

We hear them say that renewable energy technologies are a waste of taxpayer money because they are not financially viable without government support while at the same time arguing that those technologies are too mature to warrant government R&D funding and are better left to the private sector. Well, which is it?

Stranger still, as my Republican colleagues lobbied to make massive cuts or shut down DOE clean energy programs altogether, they fail to acknowledge their own longstanding efforts to subsidize through tax incentives, R&D programs, liability indemnification and other means the oil, gas, nuclear and coal sectors, some of the most mature and profitable industries in the world. The subsidies for that industry to develop technologies appears to be an economically and politically powerful industry using their clout to have taxpayers simply pick up some of their ordinary business expenses.

The appropriateness of continued taxpayer support of those sectors may be best left to another conversation, but I am highlighting the inconsistency in my colleagues' concerns over interfering in the free market by picking winners and losers and appealing for some even-handedness when determining which sectors are deserving of increasingly scarce federal resources.

In closing, Mr. Chairman, I thank you for your attention to this project. In contrast just a few years ago there was an unfortunate and growing divide on clean energy with partisan politics clouding our judgment on what is the best way for our future. I believe that in the future we will all see that a diverse and clean energy portfolio is worth the investment, and luckily we have made a down payment through programs like ARPA–E, EERE and the Loan Guarantee program.

Thank you very much.

[The prepared statement of Mr. Miller follows:]

OPENING STATEMENT
RANKING MEMBER BRAD MILLER
June 15, 2011
Hearing
An Examination of DOE's Clean Technology Programs
U.S. House Committee on Science, Space, and Technology
Energy & Environment Subcommittee

I appreciate Chairman Harris calling today's hearing to examine the Administration's Clean Technology programs. Given both the level of public interest and investment in energy, it is important that we provide oversight to the programs trying to push innovation in these fields.

The American Reinvestment and Recovery Act (ARRA) opened the door for a promising clean energy technology sector that was struggling to get a foothold in the marketplace. For many, it was a much needed boon at a time when private sector capital was drying up. But, for some at the Department of Energy, it might have seemed like too much of a good thing. ARRA put enormous pressures on the new leadership of an agency that has never been known for its transparency, speed, and efficiency. Some programs, such as ARPA-E and, to some extent, the Loan Program Office, had to be started from scratch.

It has been anything but easy, and there is still a lot of work to do at DOE. But the hard work shows, and I commend the President, Secretary Chu, and the entire management team for having the vision and stamina to stick with the long process of transforming the Department of Energy into an instrument of innovation in this country.

Unfortunately, at a time when the U.S. needs a comprehensive energy policy most, the Administration and the American public are getting mixed messages from Congress about our visions for energy in the future. There is a growing and unnecessary divide over whether clean energy technologies will ever have a place in the market, and the appropriate role of government when technological winners are assumed to be decided largely by the free market.

I say that winners are decided "largely", and not entirely, by the marketplace because energy markets are really anything but free. The sector has always been heavily regulated and heavily subsidized by governments, and, in many cases, prices are controlled by cartels and manipulated by complex financial mechanisms that have little relation to simple supply and demand. Classic economic models are insufficient for reflecting the complexities of the energy marketplace. At best, consumer choice is often limited to turning down the thermostat or buying a more fuel-efficient car. Rarely does even the most conscientious consumer have a choice about where they get their energy and the associated emissions they may bear.

The sooner we can get beyond the fallacy that free-market forces alone can or will determine which technologies are best for the public, the sooner we can have a productive discussion about how to ensure an environmentally and economically sustainable energy future. This is the

ultimate goal and what is expected of us as leaders. We are not expected to block the progress of innovation for the sake of standing guard over an outdated economic doctrine.

Our global competitors are more than happy to let us quibble over tired ideologies about "picking winners and losers." While we sit back assuming that the U.S. will ultimately prevail in the global free market game that we created, they are busy playing an entirely different game. Other governments are very aggressively investing much more than the U.S. in high-technology and clean energy sectors, and with enough money to ensure that even their weakest players can beat the U.S. in these new markets. Is that not reason enough to try to add few new plays to our playbook? ARPA-E, EERE, and the Loan Guarantee program, along with the Energy Innovation Hubs and the Energy Frontier Research Centers, represent some of the few areas in which we are innovating in how government approaches this problem.

Despite the usual rhetoric surrounding energy R&D programs, the government actually seldom picks winners or losers. Instead, we place bets on groundbreaking science, promising technologies, talented researchers, and pioneering companies, all for the purposes of promoting a more diverse and competitive marketplace where cleaner and more efficient technologies stand a chance. Sometimes they win, sometimes they lose, and often the benefits are unforeseen, or simply go unrecognized. But that is what we, the government, are supposed to do in R&D programs.

From basic research on nano-scale materials to loan guarantees for deployment of whole systems, the role of the government should be to take on technological and financial risks that industry and academia alone are not equipped or inclined to do. We cannot guarantee the success of any project, or completely protect against failure. If we could do either, the private sector should do it. So we cast a wide net, invest in a range of technologies and projects, manage risk, accept that some disappointment and failures are expected and necessary, hope for breakthroughs, and then do whatever it takes to translate scientific discoveries into practical solutions. The programs today represent different variations on that model, but the end-goal is the same.

It is a shame that increasing the energy efficiency of the nation and diversifying our energy supply has become so politicized. Some in Congress would like to paint the complex world of alternative energy with a single brushstroke and make the public believe that, like climate change, it is all a big farce. Worse even, some have gone as far as to cast the movement towards a cleaner, more sustainable economy as a Liberal conspiracy to control people's lives and shut down the fossil industry.

They want the American people to believe it is a zero sum game; conventional energy versus clean energy, with the latter paving the path to economic ruin. We hear them say that renewable energy technologies are a waste of taxpayer money because they are not financially viable without government support, while at the same time arguing that these technologies are too

mature to warrant government R&D funding, and are better left to the private sector. Well, which is it?

Stranger still, as my Republican colleagues lobby to make massive cuts or shutdown DOE clean energy programs altogether, they fail to acknowledge their own longstanding effort to subsidize through tax incentives, R&D programs, liability indemnification, and other means the oil, gas, nuclear and coal sectors – some of the most mature and profitable industries in the world. The appropriateness of continued taxpayer support of these sectors can be left for another conversation. I am merely highlighting the inconsistency in my colleagues' concern over interfering in the free market by picking winners and losers, and appealing for some fairness when determining which sectors are deserving of increasingly scarce federal resources.

In closing, I thank the Chairman for his attention to this subject. As I stated, in contrast to just a few years ago, there is an unfortunate and growing divide on clean energy, with partisan politics clouding our collective judgment on what is best for our future. I believe that, in the future, we will all see that a diverse and clean energy portfolio is worth the investment. Luckily, we have made a down payment with programs such as ARPA-E, EERE and the Loan Guarantee Program. Thank you.

Chairman HARRIS. Thank you very much, Mr. Miller. If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

At this time I would like to introduce our witness panel. Dr. Arun Majumdar is the Director for the DOE's Advanced Research Projects Agency-Energy, ARPA–E Office. Prior to joining to ARPA–E, Dr. Majumdar was the Associate Laboratory Director for Energy and Environment at Lawrence Berkeley National Laboratory and a Professor of Mechanical Engineering and Materials Science and Engineering at the University of California, Berkeley. He received his Bachelor's Degree in Mechanical Engineering at the Indian Institute of Technology, Bombay, in 1985 and his Ph.D. from Berkeley in 1989.

Dr. Henry Kelly is the Acting Assistant Secretary for the Department of Energy's Office for Energy Efficiency and Renewable Energy, EERE. Prior to his arrival at DOE, Dr. Kelly served as the President of the Federation of American Scientists. Dr. Kelly previously worked in the Clinton White House as the Assistant Director for Technology for the Office of Science and Technology Policy. He has a Ph.D. in physics from Harvard University. I am impressed. And a Bachelor of Science in Physics from Cornell University.

Mr. David Frantz serves as the Director of the Department of Energy's Loan Guarantee Program, overseeing application review, due diligence, negotiation, environmental compliance and performance tracking. Prior to working at the DOE, Mr. Frantz worked with Overseas Private Investment Corporation as well as with Advanced Capital Markets, a Washington, D.C., based investment banking firm specializing in international project and corporate finance. Mr. Frantz earned two Master's Degrees in International Economics and International Business respectively from the Fletcher School of Law and Diplomacy at Tufts University. He received a Bachelor of Arts and a commission in the U.S. Navy from VMI. Mr. Frantz also completed post-graduate work at the Harvard Business School.

And as our witnesses should know, spoken testimony is limited to five minutes each, after which the Members of the committee will have five minutes each to ask questions.

I now recognize our first witness, Dr. Arun Majumdar, Director of the Advanced Research Projects Agency–Energy, ARPA–E, at the Department of Energy. Doctor.

STATEMENT OF DR. ARUN MAJUMDAR, DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY–ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. MAJUMDAR. Thank you, Mr. Chairman. First of all, I would like to extend my thanks to the Chairman, the Ranking Member and the esteemed Members of this Subcommittee for inviting me here today to testify on behalf of ARPA–E about our R&D activities.

As I have said before to many of you, I consider you all to be my board of directors, and I am now here to report to you, my board,on

what we have done in the past and what we plan to do in the future.

I want to start today on a historical note. ARPA–E was created by this committee and is modeled after DARPA, which was launched in 1958 in response to the launch of Sputnik when it was felt the United States was losing its technological lead to the Soviets and we needed some quantum leaps in technology. In the next 30 years, DARPA helped catalyze innovations such as the Internet, GPS, stealth-type technology and many others. This has strengthened not only our national security but also our economic prosperity.

We are now in a similar critical Sputnik-like moment. We are falling behind in a global race of clean and sustainable energy solutions. We import more than 50 percent of the oil we use while sending over a billion dollars a day overseas. Our gasoline prices rise because of instabilities around the world. This in the long term is not sustainable. Our children and grandchildren's secure future is at stake, and a secure future is like a stool with three legs: national security, economic security and environmental security. At the foundation of all three securities are innovations and energy technology. ARPA–E's goal is very simple: catalyze energy technology innovations for a secure American future.

In a short existence in just over two years, what have we done so far? We have stood up in organization with a philosophy of excellence in everything we do. I would now like to share with you five core values and some early successes.

Number one, people; Recruit the best talent possible. We have recruited some of the best and the brightest from the technical community. Our program directors stay for a maximum of three years, and then they have to leave. This is not a permanent job. Their future career depends on how they perform at ARPA–E, and they have a three-year clock ticking. This has led to incredible focus and outcomes.

Number two, speed and efficiency. To be globally competitive, speed is of the essence. We have developed a streamlined process where we can execute with a fierce sense of urgency at unprecedented speed and efficiency. We have reduced the contracting time to 2 months and taken other steps that have led us to being called the urgency agency.

Number three, breakthrough technologies through competition. ARPA–E is focused on identifying opportunities for new energy technologies that are too risky for the private sector. Let me give you an example. We created a program to innovate future batteries that would give electric cars longer range and make them cheaper than gasoline-based cars so that electric cars could sell without subsidies. This battery does not exist today. Under this program, we announced ambitious targets for cost and performance, but we're agnostic on the technology. There are now 15 different teams translating science into 15 different competitive technologies. We create the competition, and we let the market pick the winners. If one of these batteries is successful, it will make today's lithium-ion batteries obsolete and ensure U.S. technological lead.

Number four, stewardship and integrity; to be the best possible stewards of the taxpayers' dollars. All projects in ARPA–E are se-

lected purely based on merit and input from a panel of experts. Once selected, our program directors are personally invested in each and every project they manage. That is, they are essentially part of the team trying to help them when they get stuck. But if a technology is not working, we put the project on red alert and give them a finite time to recover. If this does not work, we will terminate the project. We would rather put that money back in the Treasury or fund better ideas than continue down an unsuccessful path.

Number five, create value for secure future. In March we announced a partnership with the Department of Defense to co-develop energy storage systems so that forward operating bases can reduce their fuel consumption by more than 30 percent. As you know, energy is a national security issue, and nowhere is this more vital than in terms of military consumption of energy.

In parallel, we have started a consortium of utilities in order to connect these breakthrough smart and clean energy technologies to the commercial sector as well. Just like the Internet and the GPS, we believe ARPA–E-funded technologies will create whole new industries that do not exist today but could potentially open up large markets as well.

Back in 2009 and early 2010, six of our 120 projects received $24 million in ARPA–E funding which allowed these teams to do their research and reach the milestones ahead of schedule. Because of this derisking of technologies, they then attracted more than $100 million in private-sector investment this year, which is four times leveraging of the taxpayer federal dollars.

Earlier this spring we organized a very successful ARPA–E Energy Innovation Summit which was attended by more than 2,000 innovators, and we showcased not only the technologies that we funded but also the technologies we could not fund.

Where will ARPA–E go in the future? ARPA–E will continue to proactively seek out white space in energy technologies where it can fill vital gaps in energy R&D with coordination with the Department's basic science and applied energy programs. For example, we in the United States have found the largest reserves of natural gas in the world. Can we use that in the transportation sector and reduce our oil use? Can we produce high-efficiency, low-cost engines and fuel cells to maximize the use of natural gas? Can we engineer new plants and crops that are designed to directly produce oil with extremely high yield? Can we store heat at high temperatures so that nuclear and fossil resources have the flexibility to meet peak demand in addition to basic resources? Can we create light materials for high-energy density battery packs for electric vehicles? These are some of the opportunities that we plan to address should Congress provide the funding we are requesting in the fiscal year 2012 budget.

Thank you for the opportunity to testify before you today, and I look forward to answering your questions.

[The prepared statement of Mr. Majumdar follows:]

PREPARED STATEMENT OF DR. ARUN MAJUMDAR, DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY–ENERGY, U.S. DEPARTMENT OF ENERGY

Statement of
Dr. Arun Majumdar
Director, Advanced Research Projects Agency – Energy
U.S. Department of Energy

Before the

Subcommittee on Energy and Environment
Committee on Science, Space and Technology
U.S. House of Representatives

June 15, 2011

ARPA-E: Catalyzing Energy Breakthroughs to Secure America's Future

Chairman Harris, Representative Miller, distinguished members of the subcommittee, thank you for the opportunity to testify today on behalf of the Advanced Research Projects Agency-Energy (ARPA-E) about our clean energy RD&D activities and our Fiscal Year 2012 Budget request.

I want to start on a historical note. On February 12, 1958, President Eisenhower signed Public Law 85-325, authorizing the creation of the Defense Advanced Research Projects Agency (DARPA). This was in response to the launch of Sputnik and to a realization that the U.S. had lost its technological lead and its future security was at stake. DARPA has since been responsible for the development of many transformational technologies, such as the precursors to the internet, stealth and GPS. As the President has said, today the U.S. faces a new Sputnik-like moment. Our future depends on three securities: national security, economic security and environmental security. At the foundation of all these securities are innovations in energy technologies that would reduce our dependence on foreign oil, provide clean and inexpensive electricity, and create a secure, efficient and sustainable infrastructure. As the first Director of ARPA-E, I am grateful for the opportunity to play some role in the creation of a secure American future.

ARPA-E can play a significant role in protecting America's energy security. As a country, we import more than 50 percent of the oil we use and export about $400 billion per year (about $1 billion per day).[1] The recent oil price spikes highlight just how vulnerable we are. This is not sustainable in the long-term. To decrease our reliance on oil, we must create a diverse portfolio of sustainable options for transportation and mobility based on domestic resources to decrease. In order to do so, we need innovations in energy technologies to drive down the cost of electricity from clean and sustainable sources (clean coal, nuclear, natural gas, solar, wind, geothermal etc.) so that energy is affordable to American families and our businesses are enabled to power the economy.

[1] U.S. Energy Information Administration 2011

ARPA-E can also help ensure America's economic security. Income levels are rising in the world, and the world needs more energy. More and more people around the world want to use sustainable and clean energy. Unfortunately, many of the technologies that will be needed do not exist today. If we are to win the future, we need to use our American ingenuity and technological leadership to invent affordable clean energy technologies, make them locally, and sell them globally, just as we did with information technology and biotechnology. This offers an important global business opportunity for the USA. We have a window of opportunity and we need to grab it; speed is of the essence.

ARPA-E focuses exclusively on breakthrough technologies promising genuine transformation in the ways we generate, store, distribute and utilize energy. If just a fraction of the projects funded by ARPA-E are successful, the U.S. could benefit greatly by creating new industries and jobs, making energy technologies substantially more cost-saving, profitable, and cleaner in a sustainable way.

Early Successes in Technology Innovations

How does ARPA-E measure success? ARPA-E enables the Nation's pioneers and entrepreneurs to innovate breakthrough technologies that do not exist today – but if they did, they would make today's technologies obsolete and create large commercial markets. For example, ARPA-E has invested in a portfolio of ideas on rechargeable batteries that would make electric cars have longer range and lower lifecycle cost than gasoline-based cars. This would enable electric vehicles manufacturing to scale without subsidies and significantly reduce our dependence on oil. We need to advance beyond today's lithium ion battery, and no one in the world has this future battery—the global race is on. ARPA-E is focused on identifying the opportunity and creating a competition among innovators.

The portfolio of ideas that ARPA-E funds are high risk projects in which the private sector is unlikely to invest. However, if one of the ARPA-E ideas is shown to be practical, it could indeed change the world. But transformations do not happen overnight – it will take at least 10-15 years to scale these technologies in cost and volume to achieve that global change. In the process, many of these ideas will fail, and ARPA-E will let the market pick the winners.

In the next 3-5 years, we can look for indicators of success: (1) Are we attracting world-class minds to energy R&D? Are we getting world-class ideas? (2) How many small businesses have been created? (3) Do we have the world's best performance? (4) How many patents have been filed and licensed? (5) If ARPA-E's funding has created value, how much follow-on funding has the private sector made?

In FY2010, ARPA-E invested $24 million in six projects. I am happy to report that the initial investments allowed these innovators to do the research and overcome technical barriers ahead of schedule. Only after these successes happened did the private sector invest more than $100M in just one year. In total, ARPA-E projects have received over $285 million in follow-on funding, and we have already seen 17 patents filed.

In April, ARPA-E signed a memorandum of understanding with Duke Energy, one of the largest electric power companies in the United States, and with the Electric Power Research Institute (EPRI), a non-profit research organization that focuses on the electric power utility industry in the U.S. and abroad, to identify opportunities for testing and deploying ARPA-E funded projects that will bolster the electric grid. Through the Memoranda of Understanding (MOUs), ARPA-E, Duke Energy, and EPRI will identify opportunities to expand cutting edge smart grid developments, grid-scale energy storage, power electronics, and energy efficient cooling technologies, among others.

ARPA-E Operational Success – Institutionalizing a Sense of Fierce Urgency

In order to win the future in a globally competitive world, speed is of the utmost importance. Since ARPA-E demands speed from the innovator community, others should demand speed and urgency from ARPA-E. Congress established ARPA-E to have an unusual degree of flexibility. ARPA-E is administered in ways that enable the agency to be lean, effective, and agile. ARPA-E strives to be a model of excellence for a small agency. In its short existence of less than two years, ARPA-E has implemented several key business practices that have earned it recognition as an organization to emulate.

We have streamlined operations to improve speed and efficiency. ARPA-E has created a 5-Es process for program creation and management:

(1) *Envision* a new opportunity for a program and do background in-house research;
(2) *Engage* the experts from the technical community for stakeholder input, an internal debate about reasons for creating a new program, and the announce a new program and receive proposals;
(3) *Evaluate* the proposals based on merit-based technical peer review;
(4) *Establish* the program by selecting awardees and contracting multiple awards;
(5) *Execute* the program with active hands-on project management by ARPA-E program directors for proper stewardship of taxpayer dollars (see later).

This process has not only increased the speed and efficiency but has also improved the quality of its reviews and project management. The total process from conception of a new program to contracting awards (first 4 Es) takes 6-8 months, with contracting in 2-3 months. ARPA-E achieves this by utilizing a program development process that includes extensive up-front technical research and technical workshops co-hosted with other DOE program offices and technical community members. ARPA-E also employs a thorough merit-based peer review process. Further, ARPA-E has embedded dedicated procurement and legal teams, allowing ARPA-E to achieve exceptional speed and efficiency for processing awards from announcement to signing contracts. This speed, efficiency and transparency are critical for meeting ARPA-E's goals. You could call ARPA-E the "urgency agency."

As noted in a report from the President's Council of Advisers in Science and Technology (2010)[2], "Although the ultimate success of the research funded by ARPA-E is unknown... they have been successful in their peer review of proposals, quick negotiation of contracts, and rapid hiring of high-caliber personnel."

The success of these technologies depends not only on the scientists, engineers and entrepreneurs that we fund, but also on the program directors we have hired. By statute, ARPA-E program directors will stay at ARPA-E and serve a maximum term of 3-4 years. But while they are here, our program directors are involved in active project management, engaging directly with the teams they are funding to help them speed up the process of innovation. They have a fierce sense of urgency, and they are demanding speed from our teams.

Technical flexibility, speed, agility and empowerment of Program Directors are key aspects of ARPA-E's programs. For example, the emerging importance of rare earth metals in the energy sector has been highlighted by the mismatch between the rapidly growing demand relative to the limited global supply. ARPA-E was able to respond to this pressing problem and arranged a workshop in December 2010 to bring together thought-leaders from across scientific and engineering disciplines to identify transformational, early-stage applied research and development approaches to address the technical challenges related to the potentially limited availability of rare earth metals and critical materials in the energy sector. This led to a Funding Opportunity focused on rare earth metals in 2011, and we will continue our collaborative efforts on this critical issue both within DOE and with other partner agencies.

ARPA-E and National Security – Partnership with Department of Defense

Rare earth metals are just one of many areas in which ARPA-E is collaborating with key agency partners. The Department of Defense is a prime energy consumer, in the Federal government accounting for 80 percent of the U.S. government's energy consumption. The Department of Defense has a global presence as it operates more than 500 major military installations worldwide. Building on an already strong cooperation between the Department of Energy and the Department of Defense on national security issues ARPA-E and the Department of Defense signed a Memorandum of Understanding in July of 2010 to jointly develop energy technologies.

This partnership has been initiated and co-funding will commence in the 2012 fiscal year. The Department of Defense's Office of the Assistant Secretary of Defense for Research & Engineering (ASDR&E) aims to take advantage of early technology breakthroughs funded through ARPA-E. In particular, using ARPA-E's technical expertise in grid scale energy storage, batteries for electric vehicles, and power electronics, ASDR&E plans to develop hybrid energy storage systems that would provide future electric energy systems with long endurance, rapid charge/discharge platform electrical grids while maintaining a restrictive size and weight form factor, along with assured life and safety under a wide range of application and installation environments. Integrated into advanced military systems, hybrid energy storage modules

[2] President's Council of Advisors on Science and Technology, "Report to the President on Accelerating the Piace of Change in Energy Technologies Through in an Integrated Federal Energy Policy" November 2010 http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-energy-tech-report.pdf

(HESMs) would be key components for extending fuel duration up to 30 percent in forward bases and military platforms while providing robustness and easy maintenance. If successfully developed, HESM technologies will also enable reduced vehicle signatures and ensure continuous operation in casualty situations. For example, in maritime operations, ships will maintain combat and self-protection capabilities longer while absorbing battle-damage. In commercial energy applications, HESM technology would enable an electric grid to effectively match the power and energy requirements of industrial and residential consumers to the intermittent and non-dispatchable generation of renewable resources while maintaining customer power reliability and assurance. ARPA-E recently held a workshop with key participants from the military, academic, and private sectors to explore advanced scientific and technical challenges to the development of HESMs.

Cost effective energy storage is also of interest to DOD's Installations and Environment office, which will work with ARPA-E to assess the technology requirements for storage across military installations. Vulnerability to energy supply disruption is a significant challenge for facilities dependent on the commercial power grid, and backup power is currently limited and expensive. Onsite renewable electricity generation combined with grid scale storage would allow installations to maintain critical functions in the event of grid disruption and enhance installations' efforts to develop micro-grids for energy security.

ARPA-E is continuing its discussions and holding workshops with the DOD to build upon these partnerships and create other ones where innovations in clean energy technologies would make our nation more secure.

ARPA-E Energy Innovation Summit

At the end of February, ARPA-E hosted its second annual Energy Innovation Summit. We attracted world class innovators from industry, academia, and government. The Summit had over 2,000 registered participants spanning all stakeholder communities, including scientists and engineers, entrepreneurs, small and large business CEOs and CTOs, technology investors from the venture community and investment banks, policy researchers and NGOs. A key feature of the Summit is the technology showcase, where ARPA-E showcases not only the technologies that we have funded but also other promising technologies. The goal is to ensure that America wins the future, not just that we promote ARPA-E technologies.

The Summit also brought together as speakers and panelists an incredible lineup of energy thought leaders from around the country. We intend to host another Summit in 2012, and we hope you will join us next year.

Uniqueness of ARPA-E Programs and Projects and Coordination with the rest of DOE

ARPA-E enables the Nation's pioneers and entrepreneurs to innovate technologies that do not exist today – but if they did, would make today's technologies obsolete and create large commercial markets. ARPA-E does not focus on exploratory science, but instead on translating basic science into breakthrough technologies that are too risky and early-stage for private sector investment. The goal is to identify opportunities and develop those energy technologies that

establish entirely new learning curves to make our nation secure and clean energy affordable and sustainable.

ARPA-E programs generally fall into two categories:

- *Translating New Areas of Science into Technology*—for example, ARPA-E's current Electrofuels program. In contrast to today's biofuels (based on algae, sugarcane, corn or cellulose) that use photosynthesis, the goal of the Electrofuels program is to create a biological, non-photosynthetic process to produce liquid fuels. This is an innovative way of creating biofuels that is potentially more than ten times more efficient than today's biofuels, which could potentially mitigate the problems of land and water use. This approach is not being pursued anywhere else.

- *Creating a Quantum Leap in Technology* —for example, ARPA-E's current program called Batteries for Electrical Energy Storage in Transportation, or BEEST. While DOE applied programs and most outside R&D are focused on lithium-ion batteries, ARPA-E is looking for other battery chemistries, such as Zinc and Magnesium, that, if successful, would yield batteries that are less expensive and could enable longer range vehicles than those using today's lithium-ion batteries.

Please note that ARPA-E identifies opportunities and creates a competition. In its solicitations, ARPA-E provides cost and performance metrics for projects to meet or beat, and does not prescribe the method up front, i.e. it is technology agnostic. ARPA-E funds a portfolio of competitive approaches and then seeks to let the scientific competition play out and leave it to the private sector to pick which technologies will be commercialized.

ARPA-E proactively seeks out unexplored "white spaces" where it can fill a vital gap in early stage research and development; coordination between the Department's basic research and applied technology programs is a high priority for the Secretary of Energy. For example, ARPA-E has created a Panel of Senior Technical Advisors (PASTA), a group of technical leaders within DOE spanning the Offices of Science, of Fossil Energy, of Nuclear Energy, of Energy Efficiency and Renewable Energy, of Electricity Delivery and Energy Reliability, and as well as others from senior DOE leadership positions. The intent of the PASTA meetings is to share information, avoid duplication, and engender coordination, cooperation, and collaboration among all of the DOE research programs. In addition, other DOE programs are involved from beginning to end in ARPA-E's program development process—providing technical consultation, co-hosting technical workshops, and serving as reviewers for ARPA-E concept papers and full applications.

The SunShot Initiative represents a significant change to the Department's pursuit of photovoltaic (PV) and other advanced solar technologies and of cost reduction for electricity produced from these technologies. The SunShot Initiative brings a renewed focus on cutting edge R&D across multiple technologies and all parts of the research, development, and demonstration spectrum. Specifically, the goal of the SunShot program is to create a technical program that focuses the effort across the DOE towards a common goal of 5-6 cents/kWhr for solar electricity, broadly across the United States, making it cheaper than electricity from

traditional sources, and enabling it to scale-up without subsidies. If we can reach this goal, it could make the U.S. globally competitive in a very large export market.

The SunShot Initiative leverages strengths from all parts of DOE (EERE, ARPA-E and Science), linking relevant research activities in the Office of Science and ARPA-E with those within the Solar Energies Technology Program to ensure that all the Department's resources are efficiently focused on this common goal to make the U.S. globally competitive. For example, ARPA-E has developed a program in power electronics that will make U.S. globally competitive in this important field of smart grid technology. SunShot will leverage the power electronics effort in ARPA-E and use its technology for integrating solar electricity from photovoltaics to the grid via, for example, low-cost and reliable inverter technologies.

To enable this pan-DOE effort, we have created a joint management structure incorporating a team of members from EERE, ARPA-E and Office of Science that helps coordinate every activity (workshops, funding opportunity announcements, etc) related to SunShot.

Current ARPA-E Programs

ARPA-E's programs and projects to date have included:

- Electrofuels: ARPA-E seeks to use microorganisms to harness energy and convert carbon dioxide into liquid fuels. Theoretically, this could be ten times more efficient than current approaches.

- Batteries for Electrical Energy Storage in Transportation (BEEST): The goal of the BEEST program is simple: Create a new generation of rechargeable battery technologies that will allow a longer range and lower life-cycle cost than gasoline-based cars, so that electric vehicle production can scale without subsidies.

- Building Energy Efficiency Through Innovative Thermodevices (BEETIT): The BEETIT program seeks to develop cost-competitive energy-efficient building cooling technologies that will reduce energy consumption from overall cooling and refrigerants used in vapor compression systems.

- Agile Delivery of Electrical Power Technology (ADEPT): The ADEPT program seeks to create microelectronic circuits that incorporate transistors able to handle high voltages and advanced magnetic materials for much smaller power transformers and inductors. The improved electrical power efficiency from ADEPT could result in smaller personal computers and computer servers, produce lightweight chargers for electric vehicles and allow for the controlled movement of electricity by routing through transmission lines to avoid congestion and overloading.

- Innovative Materials and Processes for Carbon Capture Technologies (IMPACCT): IMPACCT is pushing the boundaries of carbon capture research through technologies such as new liquid chemistries that dissolve carbon dioxide and a capture system inspired by jet engines that transforms carbon dioxide from a gas into pellets of dry ice. If

successful, the IMPACCT program will allow the continued use of America's coal-based power infrastructure without further increases in carbon dioxide emissions.

- Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS): The GRIDS program seeks to develop new technologies that enable widespread use of cost-effective grid-scale energy storage.

ARPA-E Program Directors have been actively managing projects within these programs and evaluating them against their challenging performance benchmarks. ARPA-E anticipates that some of these current projects will have to be terminated for not achieving the goals of the program and in those cases the money will be returned to the Treasury.

2011 Funding Opportunity Announcements

ARPA-E received $180 million in the FY 2011 Continuing Resolution. On April 20th, we issued our 4th round of funding opportunities in five new programs areas that could lead to transformative energy technologies. We are currently reviewing Concept Paper Applications and anticipate making selections in late summer/early fall. Solicitations were issued in the following areas:

- Plants Engineered To Replace Oil (PETRO): PETRO aims to create plants that capture more energy from sunlight and convert that energy directly into fuels.

- High Energy Advanced Thermal Storage (HEATS): HEATS seeks to develop revolutionary cost-effective thermal energy storage technologies in three focus areas: 1) high temperature storage systems to deliver solar electricity more efficiently around the clock and allow nuclear and fossil baseload resources the flexibility to meet peak demand, 2) fuel produced from the sun's heat, and 3) HVAC systems that use thermal storage to dramatically improve the driving range of electric vehicles.

- Rare Earth Alternatives in Critical Technologies (REACT): REACT aims to fund early-stage technology alternatives that reduce or eliminate the dependence on rare earth materials by developing substitutes in two key areas: electric vehicle motors and wind generators.

- Green Electricity Network Integration (GENI): GENI aims to fund innovative control software and high-voltage hardware to reliably control the highly dynamic grid of the future.

- Solar Agile Delivery of Electrical Power Technology (Solar ADEPT): Solar ADEPT aims to invest in key advances in magnets, semiconductor switches, and charge storage, which could reduce power conversion costs and enable broader use of solar power.

2012 Programs –Potential Topics

The following five broad thematic strategic direction areas are areas of technical interest that ARPA-E plans to explore in FY 2012. ARPA-E will coordinate closely with the Department's basic research and applied technology programs, and others throughout the federal government and private sector, during the program development process in all of the following areas.

Transportation Systems: Broadly speaking, reduction in imported petroleum is critical for our national and economic security. ARPA-E will continue to invest in the transportation sector, in both alternative domestic sources of sustainable fuels and electrification of vehicles. Some broad areas of interest include:

- Development of those batteries and systems that would enable electric vehicles to have a range of 300-500 miles and be less expensive than cars having internal combustion engines. This would enable electric vehicles to be market competitive without government subsidies.

- Development of sustainable and market-competitive transportation fuels using domestic resources such as natural gas or a combination of carbon dioxide and hydrogen, that have 5-10 times less land and water use than that of biomass or algae based biofuels. This would be especially attractive for long-haul trucks and air transport where electrification is unlikely to make an impact.

- Development of techniques for using information technology to reduce fuel consumption, avoid traffic congestion, and optimize use of existing transportation resources.

- Development of cost-effective power generation or propulsion systems that have significantly higher efficiency than today's internal combustion engines, and thereby maximize the use of transportation fuels.

Stationary Power: ARPA-E's goal is to create a diverse portfolio of technological options for low-cost clean electricity from traditional and renewable sources. This will make the U.S. the world leader in these technologies and thereby lead to economic prosperity and American jobs. Areas of interest include:

- Electricity generation from solar, wind, natural gas, nuclear, clean coal and other sources to meet base load and peak power at levelized cost of electricity of 5-6 cents/kWh.

- Integrated energy supply systems for distributed supply of heating, cooling, and power in optimal ways.

Given the Nation's increasing reliance on electricity from stationary power sources, ARPA-E is developing specific future focus areas for programs that employ novel approaches, materials, devices, and processes to make revolutionary advances in the way we capture and utilize energy from a portfolio of diverse renewable and other power sources.

Electrical Infrastructure: The U.S. electric grid is undergoing a technical renaissance through the initial deployment of smart-grid technologies. This technical renaissance is motivated by the need to modernize the grid for the 21st century: the U.S. grid is many decades old and often running at maximum capacity, making it vulnerable to outages and security threats.

ARPA-E's goal is to develop next generation technologies that will make today's approaches obsolete, and would truly revolutionize the grid for secure, stable, and reliable transmission and distribution of electrical power and maximize the capacity of today's infrastructure. These technologies could be sold globally, potentially creating American jobs and enhancing economic prosperity. Some areas of interest are as follows:

- Low-cost electrical storage to increase utilization of renewable resources such as wind and solar.

- Advanced, low-cost and smart components for high-efficiency power transmission, conversion and management at ultrahigh voltages for transmission and medium-to-low voltages for distribution networks.

- Technologies for system-level stability, security, high capacity and reliability for the whole U.S. transmission-distribution system.

End Use Efficiency: Energy efficient technologies for buildings, both commercial and residential, offer a tremendous opportunity to reduce energy demand. Buildings consume about 40 percent of energy in the U.S., while the industrial sector consumes about 30 percent. About 72 percent of the Nation's electricity and 55 percent of natural gas is used in buildings. The cooling and heating of buildings consumes 40 percent of the total energy used in buildings. This translates into 12 percent primary energy use in the U.S. To date, activities in ARPA-E in energy efficiency have focused mainly on buildings.

ARPA-E will continue to invest in the buildings sector to develop high-efficiency energy technologies, including an expansion of the current BEETIT program and new technologies for energy measurement systems and integrated building operations, as well as a novel way to light a room. This will be coordinated closely with the new Buildings Energy Innovation Hub as well as all the activities in the Office of Energy Efficiency and Renewable Energy.

ARPA-E's goal is to develop those technologies that do not exist today, but if they did they would lead to substantial life-cycle monetary savings by increasing the efficiency of how energy is used in buildings and industry. Some of the program's areas of interest include those aimed at:

- Reduction of energy consumption by 50% with a pay-back period of less than 5 years by highly efficient and smart use of heating, cooling and electrical power in homes and commercial buildings.

- Advanced and alternative technologies to provide industrial goods and services with substantial reduction in energy consumption and a pay-back period of less than 5 years.

Embedded Efficiency: On the demand side of our energy economy, energy is consumed primarily in three sectors—buildings, transportation and industry. Buildings consume approximately 40 percent of our primary energy, transportation and industry about 30 percent each. Reduction of energy consumption in the industrial sector is essential to ARPA-E's mission and will be achieved through "embedded efficiency" programs.

ARPA-E's goal is to focus on the industrial sector with the aim of developing cost-competitive technologies and industrial processes to significantly reduce energy consumption and emissions. Some of the program's areas of interest include those aimed at:

- Advanced and alternative technologies to provide industrial goods and services with substantial reduction in energy consumption and a pay-back period of less than 5 years.

- Utilization of waste heat from industry and other uses in intelligent ways to reduce primary energy consumption.

Wireless Innovation Fund: The President's Wireless Innovation and Infrastructure Initiative proposes to reallocate a total of 500 megahertz of Federal agency and commercial spectrum bands over the next 10 years in order to increase Americans' access to wireless broadband. As part of this initiative, ARPA-E will participate in the WIN Fund by supporting clean energy activities.

An additional $100 million in mandatory funding is proposed from the Wireless Innovation Fund for ARPA-E to develop cutting-edge wireless technologies. In FY 2012, ARPA-E plans to utilize funds available from the Wireless Innovation Fund on projects related to wireless information technology, particularly in Electrical Infrastructure, End Use Efficiency, and Transportation Systems.

Seedlings/Broad Funding Announcement: The focus of the Seedlings/Broad Funding Announcement is to provide funding for innovative projects that happen to fall outside the boundaries of a specific topic area FOAs. ARPA-E believes it is important to capture any truly innovative projects that may be out there and to foster an inclusive community that demonstrates ARPA-E is open to funding projects that are outside of the specific focus topic areas FOAs. In FY 2012, ARPA-E plans to have at least one Broad Funding Announcement.

Conclusion

ARPA-E's goal is to help catalyze energy breakthroughs with speed and efficiency to secure America's future by attracting the best minds to focus on the major technical challenges in this field and by stimulating technical and the entrepreneurial community to innovate on energy technologies.

Again, I thank you for the opportunity to testify before this Subcommittee, and I am happy to answer any questions you may have at this time.

Chairman HARRIS. Thank you very much, Doctor. And I now recognize our second witness, Dr. Henry Kelly, Acting Assistant Secretary for the Office of Energy Efficiency and Renewable Energy at the Department of Energy. Dr. Kelly.

STATEMENT OF DR. HENRY KELLY, ACTING ASSISTANT SECRETARY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. KELLY. Mr. Chairman, Ranking Member Miller and Members of the Subcommittee, thank you for this opportunity to let me talk about the U.S. Department of Energy's energy efficiency and renewable resources activities.

EERE, as we are commonly known, supports research and development, demonstration and deployment activities on technologies and practices important for meeting national goals to become more energy independent, reduce pollution and spark innovation and entrepreneurship across America to help us win the global competition for new jobs and new industries.

We shouldn't have any illusions that this is going to be an easy job. We face determined and increasingly sophisticated international competition. Nations such as China have carefully crafted plans to acquire the capability to begin low-cost manufacturing of innovative products developed principally by the United States in order to take leadership in the clean energy industry.

We have lost market share in key parts of the clean energy industry including the production of solar devices, compact fluorescent lights and many other areas. In fact, the U.S. producers had a 40 percent market share in photovoltaics a decade ago where now we are below a seven percent world market share.

But even more troubling, losing the U.S. production risks losing the incubators of innovation that begin to surround production of technologies like these. We have seen this happen in key areas like electronics, flat-panel displays, data storage devices and cell phones. We simply can't afford to let this happen in clean energy.

The EERE programs that I will be laying out for you today are designed to ensure that we not only stem the loss in production of these new technologies and reverse the loss in market share but also return clean energy manufacturing to the United States.

There is plenty of reason for optimism on this score. Many observers were, for example, confident that the United States had lost the lithium-ion battery industry overseas. It was declared a complete defeat for the United States a few years ago. But strategic investments made largely in the American Recovery and Reinvestment Act means that we are well on our way to establishing capacity to produce enough batteries for 500,000 plug-in and hybrid vehicles by 2015, hoping for a very large increase in global market share.

The U.S. industry has been clear that in order to compete with determined foreign competitors who receive strong financial support from their governments, they need the U.S. Government to invest in advanced research, promote regulations that encourage innovative solutions and, in some cases, provide early stage financing for first of a kind production. Nearly all the key technologies un-

derlying today's clean energy equipment are the direct result of federal research support over the years, including EERE support. This includes batteries being used in all new electric and hybrid vehicles; low emissivity windows that reduce heat conductivity and solar heat gain by at least 50 percent compared to standard windows and now represent over half the market share in the United States; new processes with the potential to turn cellulose into cost-effective biofuels; and many more. And you will see in my testimony there is a list of some of our other achievements.

Now, the challenges that we face mean that we have to build on those successes of the past and move with unprecedented speed and scale. Well-crafted federal programs are essential to spurring private innovation and investment, and EERE works in close collaboration with other DOE organizations that have the distinct but related mission, including the Loan Programs Office, the Advanced Research Projects Agency for Energy, and the Office of Science. We also work very closely with other federal agencies and state and local governments.

Our principal goal is to find ways to reduce the cost of renewable energy and energy efficiency technologies to the point where they can compete at current energy prices without any subsidy. That would be success for us. But EERE also works to identify barriers to the introduction of new clean technologies, barriers that have blocked the introduction of new energy efficiency and renewable technologies, even when they are cost effective. We work to address these goals in projects that include developing appliance standards; developing model building codes; improving consumer information by test methods that lead to labels like EnergyStar and the Energy Guide labels; supporting the streamlining of regulatory processes as well as streamlining permitting and helping provide the funding for first-of-a-kind high-risk production facilities. EERE has a mandate to help all federal agencies meet these goals.

Because of the importance of EERE's technologies, the President's fiscal year 2012 budget request includes a significant increase for funding in this area, even as the Administration seeks to reduce overall domestic discretionary spending to the lowest levels in a generation. The technologies supported by EERE will be in high demand worldwide in coming years. If we do not move boldly and quickly to seize these opportunities, it will be lost to foreign producers. We can out-invent and out-compete any nation in the world, but only if we are willing to sustain the kinds of private/public partnerships that have driven so much American innovation in the past, innovations that are now central to our economy.

Thank you very much, and I would be happy to answer any questions you may have.

[The prepared statement of Mr. Kelly follows:]

PREPARED STATEMENT OF DR. HENRY KELLY, ACTING ASSISTANT SECRETARY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Introduction

Mr. Chairman, Ranking Member Miller, Members of the Subcommittee, thank you for the opportunity to testify on the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy's (EERE) renewable energy and energy efficiency technology development activities.

EERE supports research, development, demonstration, and deployment (RDD&D) activities on technologies and practices important for meeting national goals to become more energy independent, reduce pollution, and spark innovation and entrepreneurship all across America to help us win the global competition for new jobs and new industries. EERE seeks to achieve these goals through the development of alternate technologies that minimize the cost of energy services and that also minimize the emissions associated with energy production and use. The energy efficiency and renewable energy technologies that are the focus of this research are in high demand worldwide and we work to ensure that clean energy innovation stimulated by EERE funding translates quickly into new business growth and new employment in the U.S.

We shouldn't have any illusions that this task will be easy. We face determined and increasingly sophisticated international competition. Nations such as China have carefully crafted plans to acquire the capability to begin low-cost manufacturing of innovative products developed principally by the U.S. in order to take leadership in the clean energy industry. We have lost market share in key parts of the clean energy industry – including production of solar devices and compact fluorescent lights – as well as in other areas. U.S. producers had a 40 percent market share in photovoltaics a decade ago and we're now below 7 percent. But even more troubling, losing U.S. production risks losing the incubators of innovation that begin to surround production of these technologies. We've seen this happen in key industries like electronics – producing flat panel displays, data storage devices, and cell phones. We can't afford to let this happen in clean energy.

Where China has employed unfair, or discriminatory policy tools the Obama Administration has been pressing China to eliminate those policies. For example, in December, pursuant to a section 301 petition filed by the United Steelworkers, USTR initiated a dispute at the WTO challenging Chinese policies in the wind power equipment sector. In June, the Office of the U.S. Trade Representative announced that as a result of this case, China had agreed to end the Special Fund for Wind Power Equipment Manufacturing, a subsidy program which appeared to be prohibited under WTO rules because it granted subsidies to Chinese companies based on the amount of domestic content used in their products. In addition, strong U.S. government and international pressure resulted this year in China's commitment that its innovation policies will not be tied to the provision of government procurement preferences.

But trade policy is just one aspect of the challenge of restoring our competitiveness in these critical sectors—ensuring that we have the right domestic policies in place is equally critical.

The EERE programs I will be laying out for you today are designed to ensure that we not only stem the loss of production and reverse the loss in market share, but also return clean energy manufacturing to the U.S. There's plenty of reason for optimism on this score. Many observers were confident that the U.S. had lost the Lithium-ion battery industry to overseas producers a few years ago. But strategic investments made by the American Recovery and Reinvestment Act

of 2009 (Recovery Act) mean that we're well on our way to establishing the capacity to produce enough batteries and components to support 500,000 plug-in and hybrid vehicles by 2015.

The key to success is encouraging domestic industries that can continually out-innovate and out-compete any country in the world. We measure our success by whether our work translates into a successful U.S. business opportunity – when a company can take a concept developed with EERE funding and make it a commercial success.

We work hard to ensure that the projects we undertake are in the areas of greatest interest to U.S. businesses and insist that industry participate with increasing levels of cost share as basic concepts approach a point where proprietary products emerge. But the industry has been clear that in order to compete with determined foreign competitors who receive strong financial support from their governments, they need the U.S. government to help them in key areas like advanced research, regulations that encourage innovative solutions, and, in some cases, early stage financing for first-of-a-kind production. The blunt fact is that nearly all the key technologies underlying today's clean energy equipment are the direct result of federal research support – including EERE research – made over the past several decades.

This includes:

- The batteries used in all new electric and hybrid vehicles,
- Compact fluorescent light bulbs that use a quarter of the energy of incandescent bulbs, and solid state lights that can use a tenth as much,
- Low emissivity windows that reduce heat conductivity and solar heat gain by at least 50 percent compared to standard windows and now represent over 50 percent of the windows sold in the U.S., and
- New processes with the potential to turn cellulose into cost effective biofuels.

For more examples of EERE accomplishments see Appendix 1.

The challenges we face mean that we have to build on these successes and move with unprecedented speed and scale. Well-crafted federal programs are essential to spurring private innovation and investment. EERE works in close collaboration with other DOE organizations that have distinct but related missions – including the Loan Guarantee Office, the Advanced Research Projects Agency-Energy (ARPA-E), and the Office of Science (SC). We also work closely with other Federal agencies and State and local governments.

Working together, we can look forward to meeting key goals such as:

- Doubling the share of electricity from clean energy sources by 2035.
- Putting one million electric vehicles on the road by 2015 through improved consumer incentives, new investments in R&D to advance batteries and other innovative technologies, and by encouraging communities to streamline codes and regulations and to invest in advanced vehicle infrastructure.
- Making our buildings more energy efficient, including reducing commercial buildings' energy use by 20 percent by 2020 through a Better Buildings Initiative that will ultimately reduce energy bills for American businesses.
- Rendering solar energy, offshore wind energy, and geothermal plants competitive with conventional sources of electricity without subsidy;

- Advancing biofuels that can be drop-in replacements for gasoline, diesel fuel, or jet fuel, priced competitively with products produced from petroleum;
- Ensuring that 100 percent of federal fleet acquisitions be advanced vehicles by 2015 as called for by President Obama's Executive Order 13514;
- Improving the fuel economy of our cars and trucks through historic fuel economy standards; and
- Continuing to create new jobs in growing industries that support a clean energy economy.

Because of the importance of these technologies to our future, the President's FY 2012 Budget requests an increase in funding for energy efficiency and renewable energy, even as it seeks to reduce overall domestic discretionary spending to the lowest levels in a generation.

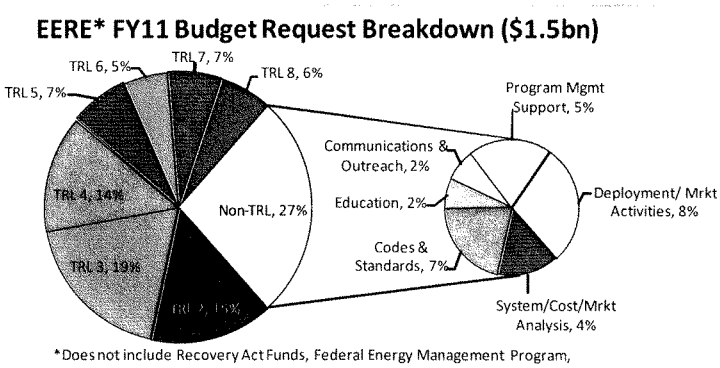
SETTING EERE PRIORITIES

EERE's strategic and research priorities were developed after a careful appraisal of where federal intervention could have the greatest leverage in meeting the Nation's energy security and environmental goals. This means taking a broad look at how the U.S. uses energy, and cost-effective ways we could reduce the energy used to deliver the services that enable transportation and comfortable homes and businesses. It also means finding the most cost effective ways to produce electricity and fuels from renewable resources. We want to be certain that the areas where we're working will have a major impact and we want to be certain that what we're doing fills critical gaps in what U.S. industry can do on its own.

A key theme in setting research priorities is finding ways to reduce the cost of renewable energy and efficiency technologies to the point where they can compete at current energy prices with no subsidies. We carefully consult with stakeholders, including industry groups, in each important technical area, often holding multiple workshops to understand both where research opportunities are greatest and where industry investment is likely to fall short of national needs because the risks are too high or because it is difficult for any single industry to capture the benefits of the research in ways that meet their tests of profitability. We include university and other research specialists in these discussions so that we can clearly understand where our research funds can be most productive. Often these workshops are conducted in collaboration with ARPA-E and SC.

EERE has begun to characterize its research activities using the Technology Readiness Levels (TRLs) that have been used by the Department of Defense and NASA for many years. TRLs assess the maturity of evolving technologies prior to commercialization. TRLs range from Basic Research (TRL 1) to System Proven and Ready for Full Commercial Deployment (TRL 9). EERE funds activities from Applied Research (TRL 2) through System Incorporated in Commercial Design (TRL 8). EERE does not work at all on basic research (TRL 1), which is exclusively an SC and National Nuclear Security Administration function in DOE, or on full commercial deployment (TRL 9) which is the domain of the Loan Guarantee Program. ***(See Appendix 2 for detailed definitions).***

Figure 1:



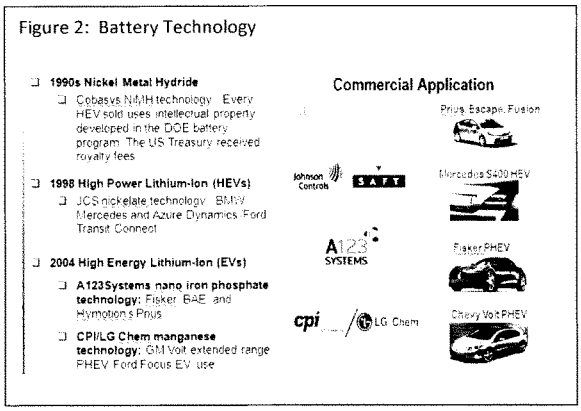
We use TRLs to describe the distribution and balance of applied research, technology development, and demonstration activities in our programs, and to determine the level of private cost sharing that is appropriate for our RD&D projects. As seen in Figure 1, about 55 percent of EERE's work is on research and development (levels 2-5), and 17 percent of our work is on demonstration projects (TRLs 6-8).[1] Twenty-seven percent of EERE's work is on non-TRL activities such as program management, codes, standards, and market analysis. Early stage R&D makes up 34 percent of our work. Each program works with its industry advisors to understand the appropriate TRL balance – a mix that serves one program may not work for another.

Our multi-year roadmaps outline plans for developing technologies and moving research from concepts in a laboratory to systems that can be entirely funded from private equity and loans, with federal funding terminating. For example:

- Our vehicles program has funded a series of battery technologies that have entered the market (see Figure 2). Our programs today focus on technical advances in Lithium-ion batteries that will power the next generation of hybrids and electric vehicles and we have begun exploring the role that EERE can play in advancing a generation of technologies beyond Lithium-ion that are currently under initial development through ARPA-E programs.
- Our wind program played an instrumental role in creating a commercial land-based wind industry and our emphasis today is focused almost entirely on the dramatically new class of technologies needed for cost-effective offshore wind (many of which are also expected to help land-based wind).
- Our biomass program is approaching its program goals for making cellulosic ethanol competitive and is directing increasing amounts of research to the next generation of technologies to permit production of jet fuels, diesel, and direct drop-in gasoline substitutes that do not face blend limits. We are working closely with DOD and USDA on this research.

[1] The TRL breakdown for the 2011 Continuing Resolution has not yet been compiled, and cannot be fully known until all of our Funding Opportunity Announcement selections have been finalized.

Figure 2: Battery Technology



EERE also works to identify barriers to the introduction of new renewable energy and energy efficiency technologies that can be addressed at the federal level. Many of these barriers slow or block the introduction of new energy efficiency and renewable energy technologies even when they are cost effective. Each technology faces its own set of barriers and solutions. For example, the challenges for moving solar technologies into utility markets will be different from those for moving next-generation heat pumps into building markets. While not an easy task, we're estimating the real economic costs of things like permitting delays and setting goals in these areas equivalent to the research goals. Work to address these goals includes developing appliance standards, developing model building codes, improving consumer information by providing test methods that lead to labels like Energy Star and Energy Guide labels, supporting the streamlining of regulatory and permitting processes, and helping provide funding for first-of-a-kind, high-risk production facilities. EERE also has a mandate to help all federal agencies meet the goals for clean energy use established in legislation and in executive orders issued under several presidents.

Collaboration within the DOE and other Federal Organizations

EERE works in close partnership with other DOE programs and offices (see Table 1). SC advances fundamental science underpinning a wide range of energy technologies. EERE's mission is to develop systematic roadmaps for reducing the cost of efficiency and renewable technologies and streamlining their movement into commercial markets. ARPA-E's focus is on high risk technologies that have the potential to transform an energy market with a bold innovation.

The battery example mentioned above offers a good illustration of how the organizations successfully work together and build on each other's work:

- SC developed the underpinning science that governs the mechanisms of ion and charge transport, chemical reactions, and structural changes in the electrodes, electrolytes, and

interfaces of advanced energy storage systems. In addition, SC-supported user facilities were essential for performing these studies and characterizing the materials and physical phenomena associated with these systems. The discoveries made by SC-supported researchers in the science related to Lithium-ion storage devices advanced the technology to the point where its applications in the marketplace could be explored in earnest.

- EERE built on SC's discoveries to design practical Lithium-ion components and devices. Through R&D, EERE is finding ways to meet the cost, safety, and performance standards required for a commercial product. For example, there are three different cathode materials that EERE helped develop and commercialize. EERE research also developed the battery cell technology (cell design, electrolytes and anode materials) for each of these cathode materials. Most new hybrid and electric vehicles use technology that went from SC through EERE, using these cathode materials. A very recent example is a new manganese spinel cathode technology, which is being used in extended-range electric vehicles. It has also been selected for use in hybrid drive heavy vehicles.
- In parallel with these efforts ARPA-E is researching radically distinct approaches to energy storage. For example, it is supporting Envia's System's efforts to develop advanced high capacity silicon-carbon nano-composite anodes to produce the world's highest energy density Lithium-ion batteries. If successful this anode technology would move quickly into commercial production. ARPA-E is also exploring other high risk, breakthrough projects that could create an entirely new generation of ultra-high energy density, low-cost battery technologies for long-range (300 to 500 miles) plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs) from technologies such as metal-air (lithium-air, zinc-air, etc.) battery devices. Projects include using lithium air systems that can deliver as much energy as a tank of gasoline, and systems that may be able to provide cars with energy for up to a 500 mile range.

We are continuing to improve coordination between SC, ARPA-E and EERE in a plan that builds on the strengths of each organization, while ensuring there is no overlap in efforts. The SunShot project, which has a goal to reduce the total cost of installed solar systems by 75 percent by the end of the decade, enabling solar electricity to be broadly competitive with electricity from conventional generation sources without subsidies, is another good example. We developed a joint research and development (R&D) plan that goes from the basic research supported by SC to the integrated demonstrations that will be supported by EERE, while ARPA-E has a major program in power electronics and will take the lead in supporting innovations in that field. One recent outcome of this collaboration was the decision that organic photovoltaic cells were generally not mature enough to be included in EERE's portfolio and that fundamental research into organic photovoltaic materials and processes should be supported by SC.

As another example, the central mechanism for coordination of battery and energy storage-related R&D efforts is the DOE-wide Energy Storage Working Group. Representatives from each program supporting batteries or other energy storage research participate in the group, including EERE, the Office of Electricity Delivery and Energy Reliability, SC, and ARPA-E. The group's primary functions are coordination of current research, strategic planning, and linking existing researchers to facilitate information sharing and coordination across the basic science/technology-deployment continuum. This group meets regularly and supplements the collaboration between the various programs, which has included joint workshops, mutual

participation in peer reviews, cooperation/coordination of Small Business Innovative Research Program solicitations, and joint principal investigator meetings. All of these actions ensure a thorough mutual understanding of the work funded by each office and drive proper delineation and separation of research and goals, minimizing duplication while leveraging resources and expertise among individual programs.

Table 1: Examples of EERE collaboration with other DOE offices

- **Office of Science**: Collaborating to develop synthetic-biology tools to enhance national capabilities in biomanufacturing. Advances in nanotechnology and other new materials developed in the Office of Science are moved to advanced product concepts in areas including photovoltaic devices and solid state lighting. EERE works to ensure that SC is aware of areas where a breakthrough could cut costs or improve efficiency of key devices.
- **Advanced Research Projects Agency- Energy**: Collaborating to achieve SunShot objectives for power electronics and PV, design the buildings hub, and develop advanced biofuels feedstock.
- **Office of Electricity Delivery and Energy Reliability**: Close collaboration on utility policy and regulations for encouraging energy efficiency and on analysis showing how new transmission, smart grid technologies, energy storage, and other advances will facilitate introduction of renewable energy.
- **Fossil Energy**: Collaboration on design of facilities that burn mixtures of coal and biomass, and on analysis of risks of induced seismicity in geothermal energy generation.
- **Loan Guarantee**: Bolsters the development and deployment of renewable sources of energy like wind, biomass, geothermal and solar by supporting innovative renewable energy projects.
- **FERC**: Key partner for analyzing transmission and other needs associated with rapidly expanding use of wind and solar.

Pending new start approval from the Appropriations Committees, the Department is seeking to fund a Batteries and Energy Storage Hub in FY 2011.[2] Funding for the Hub is also proposed under the President's FY 2012 budget. The Hub would provide a nucleus of activity for the entire fundamental energy storage research community. Establishing a focused energy storage research effort with the size, scope, and duration of an Energy Innovation Hub would garner long-term commitment from the most innovative researchers in this field. The Energy Storage Working Group would help facilitate the flow of data and information from the technology programs to the Hub, and to ensure integration within the broader DOE-supported community, the Hub would be a full participant in principal investigator meetings focused on energy storage and related scientific topics.

[2] The Department has established three Energy Innovation Hubs in the areas of energy efficient buildings, modeling and simulation for nuclear reactors and fuels from sunlight. Three new hubs are proposed for establishment under the President's FY 2012 budget, in the areas of batteries and energy storage, smart grid technologies and systems, and critical materials. The Energy Innovation Hubs were modeled after the Department of Energy's BioEnergy Institutes, which have established an outstanding three-year track record for innovation.

To further accelerate the development and adoption of renewable energy and energy efficiency technologies, EERE also works closely with other Federal agencies with relevant resources and authorities (see examples in Table 2). These include federal procurement offices that can provide early markets for innovative technologies, regulatory and loan authorities, regulatory programs, and many others.

The Department is also committed to regularly engaging with other agencies about program activities in order to prevent interagency overlaps. For example, regarding biomass-related activities, DOE regularly coordinates through the Biomass Research and Development Board,[3] which is an interagency collaborative composed of senior decision-makers from federal agencies and the White House – including DOE and USDA (co-chairs); the Departments of the Interior, Transportation, and Defense; the Environmental Protection Agency; the National Science Foundation; and the White House Office of Science and Technology Policy. The Board is charged with maximizing the benefits of federal programs and bringing coherence to federal strategic planning in biomass R&D, including minimizing duplication of activities. Several other interagency formal and informal collaborations function to leverage existing expertise across agencies with similar missions and goals, such as Memoranda of Understanding (MOUs), regular working group meetings, joint solicitations, and other mechanisms. Examples of MOUs signed over the last two years include one on hydropower with the Army Corps of Engineers and the Interior Department; one on off-shore wind, marine and hydrokinetic devices with the Interior Department; and an updated MOU with EPA on Energy Star.

EERE's Federal Energy Management program provides support to all federal agencies to help them meet clean energy goals established by statute and a number of Executive Orders.

In many cases, accelerating the adoption of renewable energy and energy efficiency technologies can best be undertaken through programs that work with entities at the state and local level. One such program is the Energy Efficiency and Conservation Block Grant (EECBG) and State Energy Program's (SEP's) Technical Assistance Program (TAP), the goal of which is to provide EECBG and SEP recipients with resources needed to swiftly implement successful and sustainable clean energy programs. TAP offers direct assistance, aggregated assistance and facilitated peer exchanges that allow groups of grantees to work together on specific issues. Over 230 grantees have identified themselves as willing to mentor another grantee on a particular topic of expertise, and over 75 grantee to grantee technical assistance transactions have already occurred. For example, 10 Rhode Island towns are working together on energy savings performance contracting. This ensures that best practices quickly propagate.

[3] The Board, as well as the Technical Advisory Committee and the annual solicitation, were established by the Biomass Research and Development Act of 2000, as later amended by Section 9001 of the Food Conservation and Energy Act of 2008.

Table 2: Examples of EERE Collaboration with other Federal Agencies

- **EPA:** Collaborating on Energy Star and other issues. DOE testing provides essential data for E15 rule. Collaboration on advanced fuels/engine research and testing. Collaboration on siting of renewables on brownfields. Collaborating on renewable energy and energy efficiency initiatives in Puerto Rico and U.S. Virgin Islands. Collaborating to release the Fuel Economy Guide and keeping www.fueleconomy.gov up to date.
- **HUD:** Under a memorandum of understanding DOE works closely with HUD on energy retrofit efforts. This has included supporting HUD in the crafting of the new PowerSaver home loan program for energy upgrades and collaborating on healthy homes issues.
- **USDA:** Collaboration on biomass feedstock. Collaborating on the Biomass Research & Development Board. Collaboration on the pilot of the Home Energy Score.
- **DOI:** Collaboration on permitting and other regulatory issues associated with siting renewables and transmission lines. Co-funding hydropower, marine-hydrokinetic, offshore wind projects, and wind projects in the Great Lakes. Supporting alternative fuel and advanced technology vehicle use and visitor education in National Parks.
- **DOD:** Key collaborator on demonstrations and procurement. Collaborate on siting renewable energy projects in a manner compatible with military mission. Partner in development, demonstration, and deployment of new energy technologies. Collaborating on working groups with the Department of Navy on biofuels, energy efficiency and others. Co-developer of technology to power DOE's National Training and Education Resource. Implementing DOD Energy Strategies from OSD and each of the armed services.
- **USACE:** MOU on assessing renewable energy generation from Federal hydropower facilities and developing best practices to increase sustainable generation. Collaborating on permitting wind in the Great Lakes.
- **DOC:** The International Trade Administration, Office of Energy and Environmental Industries co-leads with EERE and works with other agencies to implement the Renewable Energy and Energy Efficiency Export Initiative. MOU with NOAA to enhance the accuracy, precision, and completeness of resource information for the effective deployment, the safe, reliable and sustainable operation and maintenance, and the efficient use of weather-dependent and oceanic renewable energy technologies and infrastructure.
- **CEQ**: Collaboration on permitting and siting renewables and transmission lines. Collaborating on the National Ocean Council. Partner in the Recovery Through Retrofit Initiative and on green school efforts.
- **NIST:** Partner on innovation in manufacturing and outreach to upgrade manufacturing enterprises.
- **SBA:** Partner in devoting $500 million per year for five years for energy saving activities through Small Business Investment Companies.
- **DOS:** Partner in planning U.S.-led clean energy initiatives for the Clean Energy Ministerial. Partner on clean Cookstoves Initiative. MOU to transform the way the Department of State practices energy management at diplomatic and consular missions overseas.
- **DOL:** Collaborating on developing Workforce Guidelines for Home Energy Upgrades. Partner on DOE energy efficiency training program accreditation and worker certification.
- **NEC:** Collaborating on Advanced Vehicle Working Group. Collaborating on the Energy Regional Innovation Cluster.
- **FTC:** Collaborating to revise Energy Guide label, and supporting greenhouse gas information inclusion in appliance labeling.

Conclusion

EERE's strategic priorities and R&D portfolio are designed to help put the U.S. on the path to meet its energy, environmental, and national security goals, and to ensure that U.S. businesses and U.S. workers enjoy the benefits of a rapidly growing national and international market for energy efficiency and renewable energy products and services. If we do not move boldly and quickly in these areas, this opportunity will be lost to foreign producers. The recent surge of private investment in domestic manufacturing of wind turbines, batteries, lighting products, and many other renewable energy and energy efficiency products in the U.S. gives us good reason for optimism. We can out-invent and out-compete any nation in the world, but only if we are willing to sustain the kinds of private/public partnerships that have driven so much of American innovation in the past – innovations that are now at the core of our economy.

Thank you very much, and I will be happy to answer any questions Members of the Subcommittee may have.

Chairman HARRIS. Thank you very much, Dr. Kelly. I now recognize our third witness, Mr. David Frantz of the Loan Guarantee Program Office of the Department of Energy.

STATEMENT OF MR. DAVID FRANTZ, DIRECTOR, LOAN GUARANTEE PROGRAM OFFICE, U.S. DEPARTMENT OF ENERGY

Mr. FRANTZ. Thank you, Chairman Harris, Ranking Member Miller and Members of the Subcommittee. I again thank you for the opportunity to testify today. I would note that I was the first federal employee of the Loan Guarantee Program and stood up the program in 2007 and 2008 prior to Jonathan Silver's arrival as the Executive Director of the office. I welcome the opportunity today to review with you the status of the programs, the Department's successes achieved thus far and the future plans to continue providing critical support to the Nation's commercial deployment of clean energy and creating jobs.

As you know, the Energy Policy Act of 2005 (EPACT 05) created Section 1703 to address an urgent gap in financing for clean energy technologies. This circumstance became even more pronounced in the context of the recent economic recession. The resistance of the markets to early financing of innovative technologies has always been a challenge but became even more acute during the recession. The urgent gap is called the valley of death in the clean energy development cycle between laboratory stage development and pilot facility stage operation to ultimate commercial application. The LPO, particularly with the advent of the Recovery Act for appropriated subsidies, has become a crucially important tool to bridge not only the financing gap but to do so on an accelerated basis.

The Loan Programs Office actually administers three separate programs, the 1703 and 1705 programs as well as the Advanced Technology Vehicles Manufacturing Incentive program. The Section 1705 program was created as a part of the Recovery Act to jumpstart the country's clean energy sector by supporting commercially viable projects that had difficulty securing financing given the tight credit markets. The 1705 program has different objectives than 1703's somewhat different programmatic features. Most notable under 1705 is the appropriated credit subsidy costs, which are paid through $2.4 billion in funds appropriated by Congress. Applicants must still pay administrative fees. At this point I would emphasize the fact that the program is required to be self-supporting under the law by covering its administrative costs with earned fees. Therefore, we operate the program at no cost to the U.S. taxpayer.

Additionally, to qualify for 1705 funding, projects must begin construction no later than September 30, 2011. DOE's authority to enter into loan guarantee agreements under Section 1705 expires on that date as well.

I would like to take a minute to highlight some of the successes of the program to date. Since March 2009, the Department has issued conditional commitments for loans or loan guarantees to 30 projects, 16 of which have reached financial close with more to follow. The Department of Energy has provided or conditionally committed nearly $31 billion in financing to these 30 projects which have total project costs of $48 billion. Spread across the country,

they reflect an array of clean energy technologies such as wind, solar, advanced biofuels, nuclear and more including the world's largest wind farm, two of the world's largest concentrated solar power facilities, the first nuclear power plant in the United States in the last 3 decades and the world's first flywheel energy storage plant. Project sponsors estimate to us that these projects will create or save nearly 62,000 jobs, including construction and permanent assignments. To date DOE has committed and closed five ATVM loans over $8.3 billion supporting vehicle and component projects in eight states. We anticipate making many more loans in this category as well.

It is important to remember that the loan program is not a grant program. The Loan Programs Office expects that the loans will be repaid. In fact, the law has as a statutory requirement that each project have a reasonable prospect of repayment. We review these projects under very rigorous evaluation exercise before we grant any of the loans. Moreover, when the loan is fully repaid, the Nation will benefit from the private sector's investment at relatively little cost to the taxpayers. With the passage of the continuing resolution of fiscal year 2011, we have been provided an additional $170 million of appropriated subsidy for 1703. The Department is currently working to develop a process for implementing this new provision. The President's proposed 2012 budget request outlays the policy and priorities of the Administration and would support additional clean energy development projects should Congress fund it to the levels requested.

In just over two years, the Department's loan programs are making a meaningful contribution to our national clean energy goals. Through the extraordinary efforts from arguably one of the most experienced and talented project finance staffs ever assembled, public or private, a prodigious amount of work is being accomplished in the program at an accelerated pace while maintaining the best practices of our industry. We look forward to continuing our progress and to working with Congress to ensure that the programs continue spurring clean energy deployment and job creation while appropriately protecting taxpayer funds.

Thank you very much for inviting me today, and I look forward to responding to your questions.

[The prepared statement of Mr. Frantz follows:]

PREPARED STATEMENT OF MR. DAVID FRANTZ, DIRECTOR, LOAN GUARANTEE PROGRAM OFFICE, U.S. DEPARTMENT OF ENERGY

Statement of
David Frantz
Director of the Loan Programs Office
U.S. Department of Energy

Before the

Subcommittee on Energy and Environment
Committee on Science, Space, and Technology
United States House of Representatives

June 15, 2011

Introduction

Chairman Harris, Ranking Member Miller, and members of the Subcommittee, thank you for the opportunity to testify today. My name is David Frantz, and I am the Director of Origination for the Department of Energy's (DOE) Loan Programs Office (LPO) and previously served as Director of the Loan Programs Office prior to Jonathan Silver's arrival. DOE's loan programs provide critical support for the nation's commercial deployment of clean energy and the jobs and economic growth that come with it. I welcome the opportunity to discuss with you the Department's funding for FY 2011, our FY 2012 budget requests for the programs, and our significant accomplishments to date.

Global and Domestic Context in which the Loan Programs Operate

Clean Energy Opportunities

Clean energy has an important role to play in America's future. The extent to which we can successfully deploy new, innovative clean energy technologies will have enormous implications for our future global competitiveness, energy security, economic recovery, and environment.

America's future prosperity may well depend on our ability to play a leading role in the global transition to a clean energy future. Yet, to date, the United States has not demonstrated the sustained commitment to clean energy investment that is needed to remain competitive.

Global competitiveness is not the only issue we face. The U.S. imports a significant portion of the petroleum it consumes from foreign sources, and this dependence on oil threatens our national security. Investments in domestic clean energy sources can help us regain control of our energy future and reduce oil consumption.

Clean energy not only has long-term, strategic benefits, it is also an important part of our ongoing national economic recovery. Investments in clean energy projects, including

power generating plants, manufacturing facilities, and energy efficiency activities, create new and good jobs – and they create them now.

Deployment: Importance, Obstacles, and Role for Government

Much of the public discussion around clean energy, including the explicit theme of this hearing, focuses on research and development, which is crucial to reaching our long-term national energy goals. But near-term deployment of innovative, commercially-ready technologies is critical as well. Deploying energy technologies at scale immediately creates jobs, drives down unit costs, creates new supply chains, and incentivizes future research and development efforts. Innovation drives commercialization. But commercialization also drives innovation; it is a virtuous circle.

Unfortunately, there are both cyclical and structural impediments to the rapid deployment of innovative technologies in the United States. The recent economic crisis slowed the pace of investment in clean energy projects. Traditional lenders pared back their appetite for risk, resulting in reduced liquidity in the market. The tax equity market – one of the principal sources of equity for renewables projects – shrank, as well.

There also is an ongoing, systemic shortage of debt financing for certain types of innovative clean energy projects, stemming from the relatively high completion risks associated with such projects - principally technology risk and execution risk. Private sector lenders have limited capacity or appetite to underwrite such risks on their own, particularly because commercial-scale clean energy projects are capital-intensive and often require loans with unusually long tenors. Thus, there is a "valley-of-death" in the clean energy technology development cycle, between the pilot-facility stage and commercial maturity, where some companies find it difficult to obtain the financing needed to deploy their technologies at commercial scale – the very point at which they begin to have a meaningful impact on job-creation and the environment.

The Department of Energy's loan programs were designed to address these impediments and fill this financing gap. Loan guarantees lower the cost of capital for projects utilizing innovative technologies, making them more competitive with conventional technologies, and thus more attractive to lenders and equity investors. Moreover, the programs leverage the Department's expertise in technical due diligence, which private sector lenders are often unwilling or unable to conduct themselves.

Achieving our nation's clean energy goals – including global competitiveness and domestic energy security – will require the deployment of innovative technologies at a massive scale, and the DOE loan programs are an important element of federal policy to facilitate that deployment.

Background on the Loan Programs

As you know, the Loan Programs Office actually administers three separate programs: the Title XVII Section 1703 and Section 1705 loan guarantee programs, and the Advanced Technology Vehicles Manufacturing (ATVM) loan program.

The 1703 program, created as part of the Energy Policy Act of 2005, supports the deployment of innovative technologies that avoid, reduce, or sequester greenhouse gas emissions. Following passage of the Fiscal Year 2011 Continuing Resolution (FY11 CR), the program currently has $18.5 billion in loan guarantee authority for nuclear power projects, $1.5 billion in authority for energy efficiency and renewable energy projects, $8 billion for advanced fossil projects, $4 billion for front-end nuclear projects, and $2 billion in mixed authority. In addition, and for the first time, the 1703 program, historically a "self pay" credit subsidy program, now has $170 million in appropriated credit subsidy to support loan guarantees for energy efficiency and renewable energy projects.

The Section 1705 program was created as part of the American Recovery and Reinvestment Act of 2009 (Recovery Act), to jump-start the country's clean energy sector by supporting projects that had difficulty securing financing in a tight credit market. The 1705 program has different statutory objectives than 1703 and somewhat different programmatic features. Most notably, under 1705, the credit subsidy costs associated with the loan guarantees are paid through the $2.4 billion funds appropriated by Congress, though applicants still must pay application and other administrative fees. Additionally, to qualify for 1705 funding, projects must begin construction no later than September 30, 2011. DOE's authority to enter into loan guarantee agreements under 1705 expires on that date as well.

Created under Section 136 of the Energy Independence and Security Act of 2007, the ATVM program issues loans in support of the development of advanced vehicle technologies to help achieve higher fuel efficiency standards and reduce the nation's dependence on oil. Congress funded this program with $7.5 billion in credit subsidy appropriations to support a maximum of $25 billion in loans.

Success of the Loan Programs

The Loan Programs Office has made great strides since this Administration took office two years ago. Between 2007 when the Title XVII Section 1703 program was initially funded, and 2009, DOE did not issue a single loan or loan guarantee. Since March 2009, the Department has issued conditional commitments for loans or loan guarantees to 30 active projects, 16 of which have reached financial close – with more to follow soon under the Section 1703, Section 1705, and ATVM programs.

DOE has provided (or conditionally committed to provide) nearly $31 billion in financing to these 30 projects, which have total project costs of over $48 billion. The projects are spread across the country and reflect an array of clean energy and automotive

technologies, such as wind, solar, geothermal, transmission, battery storage, and nuclear. These projects include the world's largest wind-farm; two of the world's largest concentrated solar power facilities; the first nuclear power plant to begin construction in the United States in the last three decades; and an innovative flywheel energy storage plant.

Project sponsors estimate these 30 projects will create or save over 61,000 jobs, including construction and operating jobs.[1] Cumulatively, they will generate over 30 million MWh of clean energy each year – enough to power over two million households, or nearly all the households in Maryland.[2] And they will avoid over 17 million tons of CO2 annually – more than is produced by all of the approximately three million registered vehicles in Oregon.[3]

Under the Section 1703 program, DOE has offered conditional commitments for four projects so far, including one nuclear power, one front end nuclear, and two energy efficiency projects, which amount to just over $10.6 billion in total government supported financing, including capitalized interest. Under 1705, DOE has issued conditional commitments to 21 projects representing approximately just under $11.8 billion in financing, including capitalized interest. In addition, a significant number of projects are in the final stages of pre-conditional commitment due diligence. LPO estimates that these projects, if they ultimately reach financial close, will utilize our remaining credit subsidy appropriations.

While there has been significant interest in the 1705 program, there has been little demand for loan guarantees for renewable energy projects under the 1703 program. This may, in part, reflect the ability of certain renewable projects to qualify under both programs. But it may also reflect the fact that innovative clean energy companies – which tend to be smaller and have less capital – consider the 1703 program's self-pay credit subsidy cost requirement to be prohibitive. The new credit subsidy provided by the 2011 CR will allow the 1703 program to invest in a limited number of projects that may not have had the means to pay a fee to cover the subsidy cost up front.

To date, DOE has committed and closed five ATVM loans, totaling over $8.3 billion, which will support advanced vehicle projects in eight states. We anticipate making a number of significant additional ATVM loan commitments in the coming months.

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[1] Breakdown by program is as follows (based on Sponsor estimates): **1703:** 5,210 construction, 1,340 permanent; **1705**: 13,273 construction, 3,534 permanent; **ATVM**: 4,940 created, 33,000 saved.

[2] Sources: EIA 2005 Residential Energy Consumption Survey, Table US8; U.S. Census Bureau, American FactFinder, 2010.

[3] Sources: U.S. Environmental Protection Agency, Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle; U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 2008, Table MV-1 (December 2009).

Value of DOE Loan Programs

It is important to remember that the loan programs are not grant programs; LPO expects that the loans it provides or guarantees will be repaid. We review projects on a competitive basis, and we do not fund every eligible project. We ensure that the loans we support meet our statutory requirement of having a "reasonable prospect of repayment." Every project that receives financing support first goes through a rigorous financial, legal and technical review process – similar to, and in some ways more comprehensive than, what a private sector lender would conduct – before a single dollar of taxpayer money is put to work.

Not surprisingly, this type of sophisticated review requires thousands of man-hours, which is costly. However, administrative costs associated with the Title XII programs, including personnel expenses, are required by Title XVII to be covered by fees paid by applicants.

Moreover, the programs can efficiently and effectively leverage government resources to spur private-sector investment. It is intended to finance projects that might otherwise not get built – because they would have difficulty accessing conventional debt markets. A relatively small amount of appropriated credit subsidy can support a large amount of new private sector investment. Moreover, when a loan is fully repaid, the nation will have benefited from the incentivized private sector investment at relatively little cost to taxpayers.

The potential benefits are great. The projects supported by the loan programs promote economic growth and job creation. Clean energy and automotive technology projects can create construction and permanent operating jobs. In addition, these projects help lower the delivered cost of renewable energy and contribute to the build-out of the domestic supply chain and manufacturing base that we will need to "win" the clean energy future.

FY 2011 and FY 2012 DOE Loan Programs Budget Highlights

The FY 2011 Continuing Resolution, rescinded $17 billion in self-pay loan authority and provided $170 million of appropriated credit subsidy to support energy efficiency and renewable energy projects. These funds will support a small number of projects which the Department likely would have been unable to support previously. The Department is currently working to develop a process for implementing this new provision.

The President's FY 2012 Budget lays out the policy priorities of the Administration and remains a good starting point for developing funding levels. Specifically, the Budget requests (1) up to $36 billion in additional authority for nuclear power loan guarantees under the 1703 program; (2) $200 million in appropriated credit subsidy for renewable energy systems and efficient end-use energy technologies under the 1703 program; (3) $6 million in appropriations for loan monitoring administration under the ATVM program; and (4) $105 million for a proposed Better Buildings Pilot Loan Guarantee Initiative for Universities, Schools, and Hospitals.

Title XVII: 1703 Innovative Loan Guarantee Program

Nuclear Power: The Department requests up to $36 billion in loan guarantee authority to help deploy a new generation of American nuclear reactors. The additional loan guarantee authority for nuclear power projects, which would bring the 1703 program's cumulative authority for nuclear power projects to $54.5 billion, will promote deployment of new plants and support an increasing role for private sector financing. The new authority, combined with our existing authority, is expected to be sufficient to support six to eight nuclear power projects, including the Vogtle project, which has already received a conditional commitment.

Renewable Energy Systems and Efficient End-Use Energy Technologies: The Department requests $200 million in appropriated credit subsidy, under the 1703 Program, to support an estimated $1 to $2 billion in loan guarantees for renewable energy system and efficient end-use energy technology projects.

Administrative Costs: The FY 2012 budget also requests $38 million to evaluate applications, monitor outstanding loan guarantees, and ensure efficient and effective management of the loan guarantee program. This request is expected to be offset by collections from borrowers authorized under Title XVII of the Energy Policy Act of 2005 (P.L. 109-8).

ATVM Program

The Department requests $6 million to support ongoing loan monitoring activities associated with the program mission of making loans to automobile and automobile part manufacturers for the cost of re-equipping, expanding, or establishing manufacturing facilities in the United States to produce advanced technology vehicles or qualified components, and for associated engineering integration costs.

Better Buildings Loan Guarantee Initiative for Universities, Schools, and Hospitals

To spur investment in energy efficiency retrofits for buildings which serve as assets to our communities, the Department requests $100 million for loan guarantee subsidy costs to support up to $2 billion in loan guarantees for universities, schools, and hospitals. This pilot program is one component of the President's Better Buildings Initiative and would fund cost-effective technologies and measures to assist universities, schools, and hospitals save on energy usage and associated energy costs. The Department also requests $5 million for administrative expenses to carry out the program. I look forward to working with Congress to develop the authorizing statute for the program.

Conclusion

In just two years, the Department's loan programs have begun to meet the expectations Congress had in creating and funding them and we are making a meaningful contribution to our national clean energy goals. We look forward to continuing our progress as we continue to administer these loan programs in the most effective and efficient way possible – while appropriately protecting taxpayer funds.

Thank you again for inviting me here today. I look forward to responding to your questions.

Chairman HARRIS. Thank you very much, Mr. Frantz. I want to remind Members of the committee rules limiting questions to five minutes, and the Chair is first going to recognize the Ranking Member for questions, Mr. Miller.

Mr. MILLER. All right. That is an unusual procedure, but that is fine. We often hear the phrase "crowding out." What the Federal Government is doing in this area is "crowding out" private investment, but Mr. Frantz just spoke of the valley of death, a phrase that I have frequently heard from tech entrepreneurs in my district, the research triangle area of North Carolina and also the triad as well where there are a couple of research universities, A&T and UNCG. Dr. Majumdar.

Mr. MAJUMDAR. Majumdar.

Mr. MILLER. I am doing the best I can. Is the space for funding for energy research really that small and how does the research that is funded by ARPA–E fit in with private funding?

Mr. MAJUMDAR. Well, thank you, Congressman. I think this is a question that, you know, has been asked, and it is a very important question that really ought to be addressed.

Actually, there are multiple valleys of death, and what ARPA–E is trying to do is to fill the first valley. And what is that valley? How to translate science into breakthrough technologies that do not exist today, but if they did, they would make today's technologies obsolete. And that is the valley of death that we are trying to address.

One example that I gave in my oral testimony is about the next generation battery technology that does not exist today, and there is frankly a global race going on to develop that battery that will make electric cars cheaper than gasoline-based cars and have a longer range. That battery does not exist. China is investing, Japan is investing and you know, there is a global race. And I think we need to sort of go back to one of the core competencies of our Nation, which is the best science and engineering infrastructure in the world, and empower them to innovate these new technologies.

Another example I would give is new ways of making oil, and we had a conversation, Chairman Harris, about this in your office, that all the technologies that are there to create fuels in terms of using biology is using plants. And that is a route that a lot of people in the industry and R&D infrastructure are taking. We decided to take a completely different route and call it electrofuels, and this is not using plants. This is using electricity that is generated locally and using non-photosynthetic microbes, and the biology is different, to make fuels. And this turns out that it could be potentially 10 times more efficient than creating biofuels. Now, there is no industry creating electrofuels today. If this is successful, we will create the industry. In fact, this is too risky for the private sector investment. So I don't think they are crowding out private-sector funding at all. There is no field like that to start with.

And that is the kind of thing that we are trying to do which is exactly what, if you were to go to 1968, when DARPA started investing in Internet and what is now called TCP/IP which is the routing and the protocols, et cetera, and at that time, there was no Internet industry. In fact, the ARPANET did not even exist. They created it. And that is the kind of investment they made, and that,

you know, led to huge industries that were created. And ARPA–E is trying to fill that first valley of death, and I don't think it is crowding out investment.

What we do invest in are technologies that are too risky, but if they are successful, they will be attractive to the private sector, which is where we are seeing now, at least in some of the cases, where we have invested let us say $24 million in six technologies, which has then with the R&D that has been done, reduced the risk, shown the results ahead of schedule, and that has led to more than $100 million in private-sector investment. That is not crowding out. That is actually unleashing the private-sector investment after the federal dollars have gone in and allowed them to reduce the risk.

Mr. MILLER. Okay. We hear about disrupting market mechanisms by government involvement, but it certainly doesn't look like there are pure market forces at work in energy pricing. We don't reflect what we are doing in very unstable parts of the world with our military. That may be driven in part by a concern about the stability of our energy supply. That is not reflected in oil and gas prices. Obviously, environmental damage is not really reflected in oil and gas prices or other energy prices. The disruption, the 2003 blackout in the Northeast, was billions of dollars of economic disruption. The cost of that, a stable grid isn't really reflected either. How much of a lead time for innovations before they get to the market is really the point at which the government should invest versus when the private sector might come in?

Mr. MAJUMDAR. Well, I would say this is exactly the right time to invest because we are not only looking at—you mentioned the grid—about the acid wall that the utilities and the grid industry, the ISOs and RTOs are going to face because many of the things that are there, components on the grid, are more than 40 years old. They are beyond their lifetime right now. And once they start failing, as you mentioned in the Northeast, more might happen. And so there is a security aspect of the grid as well. So this is exactly the right time to invest to modernize our grid.

In terms of our transportation sector, as I mentioned, we are importing oil. We all know that, and it is a national security issue. This is a national security issue not just for the United States; it is the same for China and other nations as well which are importing oil. So there is a global race to figure out how to use domestic resources, like electricity, for the transportation sector. And this global race is on right now, and I think if you do not invest in it today, we are going to fall back and fall behind just like we did for the Sputnik era where for a moment, we had fallen behind, and that is when the United States went ahead and created DARPA, created NASA, other things, and won the space age, and many other things came out of that. So I think this is exactly the right time to do that.

Chairman HARRIS. Thank you very much. Thank you very much, Mr. Miller.

I am going to recognize myself for five minutes. Thank you very much again to the panel for being here.

Dr. Majumdar, let me ask you a little bit about ARPA–E because as we talked about, I loved the idea of doing this, you know, fund-

ing through this first valley of death. But you know, when we look through the list of some of the awards that have been made, they weren't in the valley of death, some of these companies.

The idea I would think would be to invest in these ideas before others have, but you know, in FloDesign, for instance, which received an award I believe in the end of 2008 to develop wind turbine technology, actually got $8 million investment from venture capitalists 18 months before ARPA–E invested $8 million. Now, one difference we talked about yesterday is because I guess of the Bayh-Dole rules, you know, the difference is those venture capitalists actually are going to make money when that technology yields, but the Federal Government isn't, and yet we came in after venture capitalists making the same size investment. And it goes on. FloDesign, Planar Energy Devices which also got $4 million from the Federal Government after $4 million from Battelle Ventures which I am pretty sure is a fairly substantial venture capital. Codexis actually got $4 million, and they actually went public and raised $78 million. Well, the difference is those shareholders are going to get a return. The Federal Government isn't.

So my concern is that we are investing in really almost, it appears to be, technologies and companies that have actually demonstrated they can do something to people with real dollars, yet our mission is supposed to be before that point. Could you address that?

Mr. MAJUMDAR. Sure. Thank you, Mr. Chairman. Let me clarify that. The policy that we have in ARPA–E is not to invest in any ideas that have been invested in the private sector, not companies, ideas. So if you look at the FloDesign or any of the technologies, these companies may have been invested in before for things that are short-term that give you returns for the venture capital, you know, in five years, et cetera. But these ideas that we invested in these companies are not the ones that the venture capital invested in.

Chairman HARRIS. Let me just ask, because I only have five minutes, let me just ask though, although that is true, if those different technologies make money for that company, it is going to go to the venture capitalists who were there before, who invested in the initial idea. That is usually how venture capital is set up, as you are aware of. Is that——

Mr. MAJUMDAR. Sure.

Chairman HARRIS. I mean, that is what I suspect. Thanks for confirming what I suspect.

Dr. Kelly, let me ask you some questions because you know, I appreciate your testimony. One of the things it says in your testimony that your key goal is put one million electric vehicles on the road by 2015, so four years from now.

What are you doing to make sure there is actually electricity at the other end of the socket when those cars get plugged in? I mean, you know, we just had an announcement by the EPA that they are issuing regulations on mercury emissions in plants that are going to result in coal-fire plants actually shutting down, actually being—this Administration directly will cause the closing of electric capacity in the country, and as you know, nuclear power is kind of on hold.

So what is EERE doing to make sure there is actually something that comes out of the outlet when you plug in the electric car that is actually affordable? So it has to be something low cost.

Mr. KELLY. Well, as I pointed out, our main goal here is to try to drive down the price of renewable electricity to the point where it is fully competitive with traditional forms of energy. We are getting very close to that. We have——

Chairman HARRIS. How close are we on photovoltaics in something that is scalable?

Mr. KELLY. Well, we have a SunShot program whose goal it is to make——

Chairman HARRIS. Dr. Kelly, not the goal. Something that is scalable right now because your—well, they are going to plug in electric cars now. Chevy Volt is out there, it is plugging in. Is there any technology that you have invested in that is actually scalable at a cost of five or six or seven cents a kilowatt hour which is what coal is priced at?

Mr. KELLY. Wind is competitive in many parts of the country.

Chairman HARRIS. Let me ask you about that because a little further down in your testimony, you actually mentioned off-shore wind as being competitive for a conventional source of electricity without subsidy. Now, Dr. Kelly, everything I read says that off-shore wind is absolutely not competitive with conventional sources of technology because of the increased infrastructure cost to bring that energy into the grid. Am I reading the wrong things?

Mr. KELLY. It is way too expensive right now, I mean, way more expensive.

Chairman HARRIS. So off-shore wind is not one of those?

Mr. KELLY. It is not——

Chairman HARRIS. So there really is nothing that EERE has done that will make sure that when you plug in that electric vehicle, that we actually can buy electricity for five or six or seven cents a kilowatt hour?

Mr. KELLY. If something that is at that stage of technical maturity, we should have been out of it a long time ago. We should be at the cutting edge of technology.

Chairman HARRIS. Let me ask you one final question. My time has run out. You actually mention clean energy sources. You are promoting clean energy. Do you consider natural gas a clean energy source as the President did in his State of the Union Address?

Mr. KELLY. Yeah, the President has a definition of clean energy that includes partial credit for natural gas, clean coal——

Chairman HARRIS. What has EERE done to promote natural gas as a clean energy source?

Mr. KELLY. Well, we have supported some natural gas powered vehicles.

Chairman HARRIS. Oh. In the second round we are going to get to that. Thank you very much.

I will recognize Ranking Member Johnson.

Ms. JOHNSON. Thank you very much. Thank you, Mr. Chairman, for holding this hearing, and let me thank the Ranking Member as well.

I would like to ask unanimous consent to put a statement in the record.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF RANKING MEMBER EDDIE BERNICE JOHNSON

I thank Chairman Harris for calling this important hearing today, and I welcome all of our distinguished panelists to the Committee. In particular, I would like to welcome Dr. Majumdar, who was chosen as the first leader of a small and specialized program that saw its origins here in this Committee. Dr. Majumdar has worked tirelessly to ensure that ARPA–E exceeds our expectations while staying true to the authorizing legislation. The President picked the right person for the job, and I want to thank you for your work.

Investments in EERE, ARPA–E, and the Loan Guarantee program serve to strengthen U.S. scientific and economic leadership as they advance innovation in a wide range of technology areas, support the next generation of scientists and technology leaders, seed the industries of tomorrow, and ultimately lay the groundwork for a cleaner, more sustainable energy future.

Unfortunately, these programs are seeing devastating cuts in the Energy and Water Appropriations bill now moving to the House floor. I understand the constraints the Appropriators were under. I commend them for working together to protect DOE innovation programs given an allocation that all but ensured that most of the programs would see significant cuts, and that some could have been eliminated altogether. However, I am deeply concerned that these and further efforts at cuts will do lasting harm to our ability to meet our energy objectives and compete in the global marketplace.

Every Member feels the pressure to act to bring down energy prices now and insulate our economy from future price shocks. Unfortunately, we are limited in the types of policies we have to achieve this, and opening up new leases for domestic oil and gas production will not be enough in the short or long term. However, Congress can continue to support the development and demonstration of energy efficiency technologies—an investment that is already paying dividends. Unfortunately, while savings through efficiency are undoubtedly saving money for families and businesses across the country, we know that this is still not enough for the private sector to act alone. It is also time to take seriously the need to modernize our energy infrastructure and transition away from energy sources and technologies of the past. We have extended the lifetimes and stretched the infrastructure's capacity to the point where massive new investments will be needed in the near future. The question is, do we kick the can down the road or replace it with the same outdated technologies, or do we take this opportunity and leverage our resources to transition to new, cleaner, more efficient technologies, many of which can be made in the U.S? If the nuclear and fossil energy sectors—some of the most profitable and technologically advanced industries in the world—warrant continued taxpayer investment, as some of my colleagues propose, then additional funding could certainly be leveraged to exploit the full potential of the less-commercially mature alternative energy technologies.

ARPA–E has been an undeniable success. If allowed the time and resources to thrive, ARPA–E may well represent the first of a new generation of smaller, more agile and efficient research programs. But, for ARPA–E to be effective, it must continue to grow. Being temporary hires, the initial team that started ARPA–E wil[be leaving soon, and new project managers must be recruited to take their place. To attract the same caliber of managers away from the private sector, and often away from their families, there must be some indication of consistent and robust funding to support new fields of exploration. With the current Energy and Water bill devoting $100 million for fiscal year 2012, while appreciated, ARPA–E gets perilously close to dying on the vine.

I believe that our constituents understand that and still rely on our collective wisdom to ensure the long-term welfare of our nation through such strategic investments. They know that this country was built on a foundation of innovation, hard work, and the willingness to take big risks, and that government still plays an indispensible role in filling the voids that the private sector is not structured to do. In a rapidly changing global marketplace, facing new competitors that do not play by the same free market rules, the only thing we can know for sure is that the future of the U.S. economy will be dictated by our willingness to push back the frontiers in all fields of science and technology. The innovation programs at the Department of Energy, with their unmatched talent, world-class facilities, and unique role in taking on technology challenges that the private sector cannot do alone, are some of our most effective tools in ensuring our long-term economic growth.

Thank you, Mr. Chairman.

Ms. JOHNSON. But I do have a question. It has been good to hear so many accomplishments in such a short period of time that you have had to achieve these, and I guess we all have to work to reshape the Department and do all we can to eliminate waste through collaboration, what have you.

Before the majority's budget cuts take effect, I am glad we are having this hearing because I think that many of the proposed cuts are irresponsible. They might not claim they pick winners and losers, and it is clear, you know, what sector they favor, and that is good except that I do think that we have a very major role to play. After investing billions of dollars from the stimulus a few years ago, we are finally beginning to see that these new technologies do flourish, and when we run into cuts, we really dismantle, we lose talent, and we end up starting over.

So what will these additional cuts to clean energy do to DOE because it is clear that we need "all the above" in looking for alternative energies? I have a different take on the White House pulling the plug on so much stuff. I think that, as I understand, what we are trying to do is find some alternative ways of getting ahead and trying to stay on the world's playing field. So give me an idea as to how directly any additional cuts will affect these programs?

Mr. MAJUMDAR. Thank you, Congresswoman. I think this President has made clean energy a priority. I believe, and he has said in his State of the Union message, that we need to out-innovate, out-build and out-educate the rest of the world. As I mentioned in my oral statement, energy and innovations in energy are the foundation of our national security, our economic security, prosperity of our children and grandchildren, as well as our environmental security.

So I think if you do not support clean energy at this point, I believe our future, our children's future and grandchildren's future are at stake because we are in a globally competitive world which is focusing on this particular issue.

Mr. KELLY. I certainly agree with what Dr. Majumdar has just said. I think the President said that this is a Sputnik moment and a Sputnik moment because like Sputnik, we have gotten a wake-up call. We have gotten a wake-up call that the technologies that are going to dominate world markets in the future in clean energy may no longer be made in the United States. So not only are we going to slow the rate of introduction of things like the clean sources of electricity that are competitive with conventional sources that also meet environmental goals, we are not going to be able to take advantage of world markets and efficient light bulbs, in the next generation of heating/cooling equipment. We are not going to be able to go in and retrofit the buildings that we work in and live in so that we can save the people who live in them, protect them from the exigencies of rising prices. We are going to find ourselves facing constantly fluctuating prices in the price of driving.

So the technologies and the businesses and the jobs that are created by solving these problems are going to be abroad and not here, and that is what we are risking.

Ms. JOHNSON. Continue.

Mr. FRANTZ. I would simply reiterate the point of my two colleagues that our continued involvement and activity in this space

we believe is critically important and should continue at a robust pace. We are very pleased that Congress has appropriated in the continuing resolution the $170 million for appropriated subsidy which will certainly help activity in the renewable space for us, but that is just a small step. We are very hopeful that the funding will continue for this program because we are in a neutral taxpayer cost basis contributing mightily now to job creation and employment of these new technologies.

Ms. JOHNSON. Thank you. My time is expired.

Chairman HARRIS. Thank you very much, Ms. Johnson. I recognize the gentleman from California, Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman, and I appreciate both the subject that you have chosen for today and also your leadership in this issue.

I would like to talk to—everybody is having trouble with your name. I am sorry.

Mr. MAJUMDAR. Majumdar.

Mr. ROHRABACHER. Okay. Got it. Thank you. Rohrabacher. Everybody gets that all wrong as well.

Mr. MAJUMDAR. I hope your question is easier than my last name.

Mr. ROHRABACHER. Listen, you were talking about battery research that you have been funding. How much total is the funding for battery research?

Mr. MAJUMDAR. For the transportation sector? From ARPA–E——

Mr. ROHRABACHER. From ARPA–E, yes, for battery research.

Mr. MAJUMDAR. It is about on the order of about $40 or $50 million.

Mr. ROHRABACHER. Forty or $50 million.

Mr. MAJUMDAR. That has been invested so far.

Mr. ROHRABACHER. Okay. And are you aware of how much money is being spent in the private sector to develop new battery technology?

Mr. MAJUMDAR. The next generation batteries that we are investing in? I am not aware of—the ones that we have invested in, for example, the all-electron battery which is going on at Stanford University, for example. There is no all-electron battery today, and so I don't think there is any investment in that. In the lithium-ion flow battery that is being developed at MIT, there was no lithium-ion flow battery.

Mr. ROHRABACHER. You are unaware of private companies that have invested large amounts of money in battery technology?

Mr. MAJUMDAR. Oh, they are investing in lithium-ion battery that is going into the Chevy Volts and things like that today but not in the batteries that we have invested. Magnesium-ion batteries——

Mr. ROHRABACHER. You don't know of any companies that are involved with developing new battery technology?

Mr. MAJUMDAR. Not the high-risk ones that we are investing in.

Mr. ROHRABACHER. Not the high-risk ones that you are investing in.

Mr. MAJUMDAR. These are risky propositions, and you know, many of them will fail. And you know, that is the kind of risk that——

Mr. ROHRABACHER. Now, if you succeed, those batteries succeed, let us say, in the private sector, the people who are investing their money will get their money back and actually make a big profit on it. What will the American taxpayers get out of this except of course a better society but are they going to get a payback if this new battery technology actually works?

Mr. MAJUMDAR. Well, if it works, I certainly hope, and I think you have shared your concern in the past that the manufacturing of these technologies, if it is created out here, remains in the United States, and I share your concern on that. And the manufacturing is going to lead to jobs, just like if you go back in the history——

Mr. ROHRABACHER. But the actual profit from the technology, what you are trying to get around is not telling me that the American taxpayers won't get a penny back?

Mr. MAJUMDAR. Well, we could create a different system, but that is the system that we have been following so far.

Mr. ROHRABACHER. I know. And would you like to see a system or would you advocate a system where if you invest in a new technology and it is the taxpayers who are paying for it, that ownership of that technology isn't just passed on and profited by people who haven't been doing the investing?

Mr. MAJUMDAR. I will be happy to work with you on that.

Mr. ROHRABACHER. All right. Let us do that. Mr. Chairman, I think that is a very important and significant point.

Chairman HARRIS. Yes.

Mr. ROHRABACHER. Let me ask our last witness. I noticed in your testimony you talked about $31 billion in financing to 30 projects, they are loans, that you have given to these energy projects. Are any of them nuclear projects?

Mr. FRANTZ. Well, yes, included in that project is the Vogtle project in Georgia, and that project, as a matter of fact, Congressman, will be the first to receive the nuclear regulatory license expected in November, and we are already in the closing process.

Mr. ROHRABACHER. Can you describe that project for us?

Mr. FRANTZ. Well, it is the first nuclear project sponsored by the Southern Company. There are three other investors.

Mr. ROHRABACHER. Are these small modular reactors?

Mr. FRANTZ. No, they are not, sir.

Mr. ROHRABACHER. Are they gas-cooled reactors?

Mr. FRANTZ. No, this is the Westinghouse 1000.

Mr. ROHRABACHER. This is money that has been put into light water reactors?

Mr. FRANTZ. I am not familiar with the specific technology.

Chairman HARRIS. I would like to note, Mr. Chairman, light water reactors have been around for a long time, and this may be a new approach——

Mr. FRANTZ. No, it is. It is.

Mr. ROHRABACHER. Okay. Why——

Mr. FRANTZ. This is a new technology.

Mr. ROHRABACHER. Well, then why haven't we put money into, instead of to new approaches, like the high-temperature gas-cooled reactors or how about the small modular reactors? Have we put money into those concepts?

Mr. FRANTZ. Our program has not. I don't know——

Mr. ROHRABACHER. All right.

Mr. FRANTZ. [continuing]. If there are other programs within the Department——

Mr. ROHRABACHER. So we have a major expenditure into a light water reactor with a new approach which is an old concept, I might add, of how to produce nuclear energy. But the modular reactors, which are being heralded as really revolutionary, as well as the high-temperature gas-cooled reactors, which are revolutionary as well, have not been invested in. I would suggest that perhaps there should be a second look. I notice your staff is giving you a little note there if you would like to answer that.

Mr. FRANTZ. We can take this question for the record and make a more fulsome response to your question, Congressman——

Mr. ROHRABACHER. All right.

Mr. FRANTZ. [continuing]. Through our nuclear group.

Mr. ROHRABACHER. Thank you very much. Thank you, Mr. Chairman.

Chairman HARRIS. Thank you very much. And we have been told we can begin as early as 3:15, so I would ask the Members to keep to the five-minute limit as much as you can. And I am going to recognize the gentleman from California, Mr. McNerney.

Mr. MCNERNEY. Thank you, Mr. Chairman. Dr. Majumdar, thank you for coming here today, and I am glad to be from Northern California where a lot of the innovation is happening, and I think you are doing a great job there at ARPA–E.

Do you see that the private sector supports your mission of investing in high-risk, high-reward projects? Do you see evidence of that?

Mr. MAJUMDAR. I think there is general support by the private sector in our mission, in some of the things that we invested because as I said before, these are too risky for the private sector. No one is going to invest in an electrofuel which is a completely different biological route for creating fuel because it did not exist before. And when I talk about this to the private sector, they feel that this is too risky for them.

So I think there is a tremendous amount of support because we don't know which one is going to win at the end, and we are not going to pick the winners. But I think out of 15 or 16 technologies where the competition has been created, which is what we did, some of them may succeed, and then we will let the private sector pick the winners. But at this stage, at this early, early stage, I don't think the private sector can invest.

And so that is exactly where we are, filling that first valley of death.

Mr. MCNERNEY. Thank you. Mr. Frantz, is it fair to say that the Loan Guarantee program which was first created by the Republican Congress, or Republican-dominated Congress, will help the private sector companies create jobs that are maintained after the loans are repaid?

Mr. FRANTZ. Oh, certainly. The objective of our program—in fact, our rule specifies that we are to only do three projects in a specific sector operating for five years as an example, as a precursor, to the investment in the private markets to follow our lead on those projects.

So it is our absolute objective to set the path and then to vacate to the private markets.

Mr. MCNERNEY. And then those jobs are maintained. Do you have any experience with jobs being maintained after the loans are repaid?

Mr. FRANTZ. Well, no, all of our projects are long-term projects. The shortest loan that I am familiar with is at least ten years. So these are permanent assignments, particularly in the manufacturing, in the new solar manufacturing and in the generation space that are creating permanent jobs that will last many years, after our loan is repaid.

Mr. MCNERNEY. Okay. Thank you. Dr. Kelly, can you describe how the work undertaken by your Department has translated into financial benefits, real financial benefits for American families?

Mr. KELLY. Well, it does this in two ways. First of all, it is developing products that help save energy and money so you can drive a vehicle that is more efficient, you can have a home that is more comfortable that uses much less energy. So that benefit directly translates into things that are useful to Americans.

But at the same time it sets up an ability to produce the technologies to achieve those goals which means setting up factories that make lithium-ion batteries, that make next generation lighting. And so this is recognized worldwide as one of the areas of rapid growth, and it is a place where U.S. investment can generate a lot of new business opportunities and jobs.

Mr. MCNERNEY. So not only will the products save money by lowering consumption, but they will also create jobs in America which will benefit the economy as a whole. That is basically what you are saying?

Mr. KELLY. Exactly.

Mr. MCNERNEY. Thank you. From a policy perspective, then, what are some of the biggest barriers to the more widespread development of renewable energy technologies?

Mr. KELLY. Well, we of course, need to drive the price down so that you don't have a price differential, and I think we are well on the track to doing that in a number of different technical areas.

But as I said in my statement, just because you have the price down doesn't mean that you have a guaranteed market for this. There are many places, for example, on siting wind or photovoltaic fields, utility scale fields, the regulatory problems are enormous. You have five or six different agencies and lot of complexity. So we are part of an interagency team that is going to greatly streamline them.

Mr. MCNERNEY. Do you see transmission as an issue?

Mr. KELLY. Transmission is a major issue. There are a lot of issues having to do with the way utilities communicate with each other. There are a lot of contractual problems that you run into, so we are trying to work with the Office of Electricity to try to make sure that we have the most efficient electricity market in the

world but that is also compatible with the introduction of intermittence.

Of course, one of the problems of some kinds of solar lights is that it is variable, and you have to integrate this variable input into a utility which is a complex process.

Mr. MCNERNEY. Okay. Thank you. I will yield back.

Chairman HARRIS. Thank you very much, Mr. McNerney. I recognize my colleague from Maryland, Dr. Bartlett.

Mr. BARTLETT. Thank you very much. I wanted to spend a few moments in putting our discussions in context. I think the staff has been able to load a couple of slides for me, if they can put the first one on the screen.

[Slide]

Mr. BARTLETT. Okay. Yeah, this is a slide from World Energy Outlook from '08, and note several significant things there. The dark blue at the bottom is conventional oil. We have been pumping more and more of that as we have used more and more of it. Now, for the last five years, we have reached a plateau that conventional oil plus the two bars above it, which is unconventional oil and natural gas liquids, add up to 84 million barrels a day. That is where we are today, 84 million barrels a day.

Note what is going to happen. When they run this out to '30, note what happens. Conventional oil is going to go down, down, down. That happened in our country in 1970. Now we produce half the oil that we produced in 1970 in our country, in spite of drilling more oil wells than all the rest of the world put together.

Notice the really dark red slice there, the small one that is enhanced oil recovery? The brighter red below that is oil that they say we are going to find from fields we haven't even found yet. These are fields yet to be discovered. And the light blue wedge there is developing fuels they already discovered, like one in the Gulf of Mexico under 7,000 feet of water, 30,000 of rock. Pretty tough to develop that field. So when oil is more expensive than $100 a barrel, they may start doing that.

Notice that by 2030 they thought that we would be producing 106 million barrels of oil a day. Just two years later, the next slide, shows you what has happened just two years later.

[Slide]

Mr. BARTLETT. Ah, there is the next slide, just two years later. The two wedges on top have flipped, so you have to notice that. They are different colors and they flipped those. And they run this out to '35. Notice that by '35, little oil they believe that we are going to be getting from conventional oil. Notice that the little dark red one I mentioned, enhanced oil recovery, that has disappeared. That is now incorporated under conventional oil. They have huge slices there for oil to be developed from fuels to be discovered, and the light blue up there, fields yet to be discovered. Those two wedges will not happen to that extent. They just won't happen. The world oil output is going to follow the United States output, and we have been going down, down, down since '70.

Notice, and maybe you can see it up there. It is too far away for me to see. But already they are showing a dip down in the total production of oil at the top. They are prognosticating that that is going to go up. I do not think that will go up.

The point I wanted to make with this was that the market forces did not result in any clean or alternative energy investments in anticipation of peak oil. Your government has paid for four reports, two of them issued in '05, two of them issued in '07. The big SAIC; the Hearst Report in '05; the Corps of Engineers Report in '05; the Government Accountability Office report, GAO report, in '07; and the National Petroleum Council report in '07, all four reports saying the same thing, a message your government did not want to hear, so they simply turned a deaf ear and paid no attention to it. The reports all said that the peaking of oil is either present or imminent with potentially devastating consequences. The Hearst Report said that the world has never faced a problem like this. You know, the social and the economic consequences of this are unprecedented, is what they said. Unless we anticipated it by a decade, there would be very serious social and economic consequences of this.

I put these slides up there to kind of put this in context. You know, we should have started a couple of decades ago. We knew very well. We knew of an absolute certainty 31 years ago in 1980 when we looked back at 1970, and we could see very clearly that M. King Hubbard was right about the United States. We did peak in oil production in 1970. The United States has to be a microcosm of the world. If it happened in the United States, it should happen in the world. The only question was, when was it going to happen in the world? So we now have blown 31 years we knew with absolute certainty we would be here today peaking in conventional oil production with essentially no possibility of making up for the fall off in conventional oil production by oil from other sources. So we should have started two or three decades ago with the technologies you are now working on. It is desperately important, my hope is, my prayer is, that ARPA–E can do for us what DARPA did for these other programs because if it doesn't, we are in a heap of trouble and the world is in a heap of trouble.

I think that once again we can become a manufacturing, exporting Nation. We are clearly still the most creative, innovative society in the world if we just get turned on and our people know. But they haven't been told. They don't know because your government has refused to tell the people the truth.

Thank you very much, Mr. Chairman.

Chairman HARRIS. Thank you very much, Dr. Bartlett, and I will recognize Mr. Luján.

Mr. LUJÁN. Thank you very much, Mr. Chairman. I almost want to give Dr. Bartlett five more minutes. I really appreciate that conversation and where he was going.

Chairman HARRIS. I am sure he had five more minutes.

Mr. LUJÁN. With that, Mr. Chairman, thank you very much for this hearing. Dr. Majumdar, I am a big supporter of technology transfer, and we have had a chance to visit about this in this committee as well as among our colleagues in many capacities. And we have actually started a tech transfer caucus to talk about these kinds of ideas.

Some view ARPA–E as a top-down technology transfer program. That is technology transfers specific technologies that have been identified or pushed from the top down. DOE has a technology

transfer coordinator; please describe how you are working with Dr. Edmonds as we talk about DOE's application of technology transfer as it impacts you in this area.

Mr. MAJUMDAR. Thank you, Congressman. Let me just describe first of all ARPA–E. I mean, ARPA–E is not a technology transfer office; it is an innovation office. It is a technology innovation office, as I said, to provide some top leadership and get the community engaged in technology development, creation, which does not exist today, and if it did, it is just too risky for the private sector.

Mr. LUJÁN. And just in clarification, understanding the role of ARPA–E, what are you doing to work with——

Mr. MAJUMDAR. With Dr. Edmonds.

Mr. LUJÁN. [continuing]. With Dr. Edmonds to make sure that we are pushing this technology out as well——

Mr. MAJUMDAR. Right.

Mr. LUJÁN [continuing]. Understanding the constraints that DOE has, unlike those with the intelligence community, DHS, DOD, where they have that private-sector component that they can match up.

Mr. MAJUMDAR. We are working very closely with Dr. Edmonds in terms of technology transfer. You know, after she joined the Department of Energy, she has worked with all the national labs, for example, to create this "America's Next Top Innovator" Award. It is a challenge. It is a competition that will be announced in our next ARPA–E energy innovation summit which is going to be the end of February next year, just like we had this year. And in this period she has reduced the cost of licensing from all the national labs to $1,000 for a certain period of time so that it takes the IP that has been created and offers it up to the entrepreneurs and innovators, take that IP and create businesses. And that is the kind of thing that she has been doing, and we are working very closely with her.

Mr. LUJÁN. I appreciate that very much. Dr. Kelly, EERE established the Efficiency and Renewables Advisory Committee to ensure that EERE is focusing on transformative research to achieve technological innovations that move quickly into the marketplace and expedite job growth. Can you comment on the effectiveness that ERAC has in helping to guide the Department's investments in renewable energy technologies and what do you envision the ERAC's role in promoting clean energy job growth?

Mr. KELLY. Well, thank you for the question. As you know, this is a new group we put together, and it has a number of functions but one of them is to get advice from a very diverse community, not only how we are choosing our research but also how we are trying to transfer and get it adopted. One of the great concerns we have got or a lot of the concerns that have been expressed by this committee is to make sure that we are in fact supporting innovation and not competing with other sources of investments. So we have significant representation from the venture capital community. The former head of research of General Electric is on the committee. The former head of technology at Honeywell is on the committee. So they have been helping us work with the financial community to make sure we can constructively engage the private sector.

They have also allowed us to make contacts with people who weren't aware of our problems of the kinds of challenges, research challenges we worked on, so we can broaden the scope of the people that we work with. So they have been very effective both in helping us open up and make our process more transparent and helping us shape our program.

Mr. LUJÁN. I appreciate that. And Mr. Chairman, I would like to ask unanimous consent to submit a few more questions into the record if I can't get to them on that second round of questioning, as well as some opening comments.

Chairman HARRIS. Without objection.

Mr. LUJÁN. Mr. Frantz, in order to take full advantage of renewable capacity as we see across the country, I appreciate the question by Congressman McNerney around transmission. If we are going to be able to solve our Nation's constraints for delivering power, when we talk about electrons being generated from any fuel source, but especially where there are renewable opportunities, can you talk about how the Guaranteed Loan program can help accelerate that?

Mr. FRANTZ. Certainly. Thank you for the question, Congressman, and for the entire committee's benefit, I think it is important to realize that our program initiates through applications on a competitive basis. So in the first instance we have to issue a solicitation for specific sectors which we have done for transmission. We have closed a transmission project. Among the 16 we have closed, we have closed the Southwest Intertie in the State of Nevada. We have three other major projects presently in the due diligence that I can't discuss right now publically.

So we are acutely aware of the need for upgrade and financing in transmission and in particular among those new solar generation projects that we are currently in the process of financing. There are critical issues associated with expansion of the transmission systems, particularly in the Southwest.

Mr. LUJÁN. Thank you. Thank you, Mr. Chairman.

Chairman HARRIS. Thank you very much, and I recognize our colleague from Illinois, Mrs. Biggert.

Mrs. BIGGERT. Thank you, Mr. Chairman, and thanks for holding this Subcommittee hearing. I have got a question for Mr. Majumdar about ARPA–E. The fiscal year 2012 budget request for ARPA–E includes $100 million in mandatory spending to be spent to develop cutting-edge wireless technologies? My question is why do innovative wireless companies, and it could be Motorola or it could be Apple or there are a lot of various companies, but why do they need an additional $100 million to fund wireless technology development? Is there a concern that there is a lack of incentive for innovation within the wireless technology sector? Why is that singled out?

Mr. MAJUMDAR. Well, first of all, Congresswoman, before I answer that, let me just thank all of you for making such an effort to pronounce my last name. I think my mother will be very appreciative of that.

This fund is a mandatory fund, as you pointed out, and this is for wireless technology. This is not for the Motorolas. This is really for—let me just give you an example. If you look at the grid today,

it is a system that does not have feedback control. It is what is called open loop which is why when—in the Northeast there is an instability. The instability grows and just breaks apart the whole grid, and you have failure. And to be able to manage that, and it is what is called in mathematical terms, a non-linear system, which goes into what is called also chaotic behavior. This is a field of mathematics and science that needs to be developed in what is called distributive control, and for that, you need the wireless communication. This is an area of science or wireless technology that has not gone in—well, it has got technology in iPhones and Blackberries, et cetera, but not for example in controlling the grid because the technology that is needed for that which will be developed in the universities and the national labs, et cetera, around the country has to be different and has to be integrated in the right——

Mrs. BIGGERT. Well, who makes that decision?

Mr. MAJUMDAR. In terms of the technologies?

Mrs. BIGGERT. No, who makes the decision that we should have the wireless technology, the $100 million?

Mr. MAJUMDAR. Well, I think this has to go through Congress in terms of which committee. It has to be approved through that. And if should it be approved, then that is the fund, you know.

Mrs. BIGGERT. But it comes from ARPA–E or it comes from DOE?

Mr. MAJUMDAR. No, it comes through ARPA–E through Congress' approval.

Mrs. BIGGERT. Okay. All right. I guess I get it but it seems like somebody has to have the idea that yes, we need to do this, and I don't think—is it somebody in Energy and Commerce that is deciding that or is it somebody that——

Mr. MAJUMDAR. I can get back to you with the committee that is responsible for that. I don't know exactly which committee that is.

Mrs. BIGGERT. Okay, but it is a committee?

Mr. MAJUMDAR. Yes.

Mrs. BIGGERT. Okay. That was my question. Then Mr. Frantz, I understand that there are about 500 different companies that have applied for loans, for the Loan Guarantee program, but only about 30 awards have been made. Doesn't the reality of limited funding for the program relative to qualified applicants result in picking winners and losers among competing companies?

Mr. FRANTZ. We do not pick winners and losers. As I mentioned, our whole process is handled through a competitive application process, and the driving factor, among all, is readiness to proceed.

So we do not spend any time concerned about geographic distributions or even the specific sectors. We look at the applications purely from a very rigorous underwriting perspective, and we work on those in a prioritized fashion on fully the basis of a readiness to proceed with the transaction itself.

Mrs. BIGGERT. So you don't think that the government involvement would result in a crowding out of some of the private investment that would rather not compete against the government-backed companies?

Mr. FRANTZ. No, not at all. As a matter of fact, as I indicated in my prepared testimony, by the allocation measure that Congress has given us as well as the appropriated subsidy, among those applications that we are now working on, we fully expect to utilize all of the appropriated subsidy in the allocation.

Mrs. BIGGERT. Okay. And I thank you. And I did miss your testimony, so I am glad that you pointed that out. Thank you. I yield back.

Chairman HARRIS. Thank you very much. We are going to be called to vote, we believe, within the next 15 minutes. So we are going to allocate five minutes to each side for one additional set of questions, and I recognize Mr. Miller.

Mr. MILLER. Thank you. Dr. Kelly, the investments in EERE technologies, have there been similar investments in the past to the kinds of things we are doing now through EERE?

Mr. KELLY. Oh, yes. We have what we think is a proud track record of supporting energy and technologies. I mentioned a few. Over half the windows now are extremely efficient because of our investments. We have gone through several generations of batteries. The batteries that were in the first generation of hybrids, the nickel metal hydride batteries were the direct result of what we have done. Our goal in all of this is to get the heck out of the business and let the private sector take over, and that is how we define success and that has happened in many occasions.

Mr. MILLER. In the testimony to this point, it sounds like all these agencies are actually talking to each other which is pretty refreshing, and also to the private sector. How do you get suggestions or do you get suggestions and if so, how do you get suggestions from the private sector on how to structure the program for what the priorities ought to be? Mr. Majumdar or Dr. Kelly.

Mr. MAJUMDAR. Well, I mean, we spend a lot of time not only talking to the industry and the businesses but also talking to the academia, really the sort of intellectual horsepower of this Nation in academia and national labs, et cetera, to identify where are the white spaces, the big gaps, and that is done in coordination with the Applied Energy offices, with the EERE, for example, Fossil Energy and others as well as with the Basic Energy Sciences in the Office of Science. And using that, we identify the white spaces that is too risky again for the private sector, that no one has created this technology but should a technology be created, this would change the ballgame and become a quantum leap in technology.

And that is how we identify the white space and then create the technology just exactly the way DARPA created Internet, GPS, et cetera.

Mr. MILLER. Dr. Kelly, you don't have to add if you don't want to, but you can.

Mr. KELLY. Just very briefly. We try very hard to get the understanding of what industry is going to do and what they are not going to do. Typically we hold a series of workshops. Many of them have been jointly with ARPA–E and Science and sort of triangulate on them. One of our flagship projects is SunShot, and we have had a number of workshops with all parts of the industry and regularly meet. These are shared with ARPA–E, and they bring in venture people. They bring in companies, they bring in academics. And we

develop very precise roadmaps of where we want to go and then have that reviewed by the community.

Mr. MILLER. Dr. Majumdar, you talked about intellectual horsepower in this area a moment ago, and in your testimony you said that one of the indicators of success would be the ability to track the "best minds" to energy R&D. How is ARPA–E going about that? Is that one of your goals and how do you do it?

Mr. MAJUMDAR. Very actively. I think this is the time that if you are to create a future of clean energy and provide the security for our children and grandchildren, it is extremely important to parallel what we did in information technology and biotechnology, that is, to get the best minds in science and engineering, the best biologists, the best anesthesiologists perhaps, and the best computer scientists and the material scientists, to say can you offer your knowledge and your intellect and the creativity to address the problems so that we can get off foreign oil so we can provide security for future generations. So we are actively pursuing that. We are trying to get people from the other fields as well. And it is not only just me and my colleagues out here. Secretary Chu is trying to do the same as well, to get the physicists and the chemists involved and looking at the energy issues, not just the medical issues for example. So this is a very active pursuit for us.

Mr. MILLER. How will cuts to the ARPA–E budget affect your ability to attract, to get the horses for the intellectual horsepower, to bring in the best minds for energy?

Mr. MAJUMDAR. I think this will, you know, severely hamper our efforts. I mean, it is absolutely true. I have been an academic myself in the past, and if you are trying to do research, you want to see whether there is an assurance of funding down the line. And you know, if that assurance is not there, you are not going to get the best minds to solve the energy problems of the future. So it is extremely important that we have sustained funding, exactly as I said before. ARPANET started in 1968 and it took sustained funding over 20 years to make it, to create ARPANET and to make it compatible for creating businesses in the commercial world. That kind of sustained funding is absolutely critical if you are to create the clean energy of the future and address the issues that Congressman Bartlett raised for our future.

Mr. MILLER. My time is expired, Mr. Chairman.

Chairman HARRIS. Thank you very much. In a second here when Mr. Bartlett returns, I am going to yield 30 seconds to him. He wants to show one more slide. Let me just start. Dr. Kelly, I respect that we have to—you know, we want to spend this money, we want to create American jobs, we want to make ourselves efficient. But I have got a press release that had been sent out that would suggest that EERE actually spends money, for instance, "engaged in multiple technology and policy efforts to improve energy efficiency in the Chinese building sector." Now look, I am all for energy efficiency, but I got to believe it should start here in the United States first.

Why is your shop spending money to improve energy efficiency in the Chinese building sector? I mean, we are literally borrowing money from them because every additional dollar we spend is a dollar borrowed from China. Why would we, as good policy, be bor-

rowing money from China to spend it to make their building sector energy efficient?

Mr. KELLY. I am not certain what that press release was about, but as you know, the Chinese are building enormous numbers of buildings. They are building the equivalent of——

Chairman HARRIS. Yeah, just to answer your question, it says "key EERE partnerships in the building sectors in China include the code standards and labeling projects, software design tools and training for energy efficient building design projects." These are all from the website.

Mr. KELLY. Well, one of the things that we had started recently is a joint research program with the Chinese that will not move any of our money to China but will—we are setting up a research program here in the United States funded partly by us and partly by business. They have set up a parallel operation in China. They are actually very sophisticated in many of the areas that we are doing research in. So there are areas where we can learn as much from them as they are learning from us. In fact, we can learn a lot from them. And so we want to make sure we take advantage of the areas where they do want to collaborate partnerships on——

Chairman HARRIS. So you think we are going to get something from China on this? You think we are that good bargainers with the Chinese?

Mr. KELLY. Well, I hope. The good thing about research, particularly on these sort of basic issues, is it really is a win-win situation. We have to be careful we choose the right areas, but there are places where, by collaborating, we both end up further ahead.

Chairman HARRIS. But this isn't to improve energy efficiency in general. It is to improve it in the Chinese building sector, and we will probably go ahead and submit some questions in writing that might follow up with that.

Now, Mr. Frantz, I did have one question because the loan program worked, it changed a little bit over the last few years because now there are federal dollars that are going to pay the cost of these guarantees that flow. So your statement that it doesn't cost, and I think I wrote it down, that the quote is "no cost to the U.S. taxpayer." But in fact, the U.S. taxpayer is paying the cost of that premium to guarantee the loan.

Mr. FRANTZ. Well, my assertion in my testimony, Mr. Chairman, was the fact that all of our admin, the overhead and admin, is covered——

Chairman HARRIS. Beyond admin there is a cost to the U.S. taxpayer with this program.

Mr. FRANTZ. That is right. But the point is it is in the form of loan or loan guarantees which are repaid in contradistinction to a grant. So we expect to be——

Chairman HARRIS. But——

Mr. FRANTZ. [continuing]. Fully repaid.

Chairman HARRIS. [continuing]. That premium, if it is not—I don't understand. We are paying a premium to guarantee that loan.

Mr. FRANTZ. You are probably referring to the credit subsidy appropriated——

Chairman HARRIS. Yes, credit subsidy. I like that word subsidy because for the oil companies it is bad, but here it is good, I guess.

Mr. FRANTZ. That——

Chairman HARRIS. Yeah.

Mr. FRANTZ. The subsidy is what, under the Federal Credit Reform Act of 1990, is a loan loss reserve which is required by that law for all Federal Government loan programs. In most Federal Government programs, that subsidy is appropriated by Congress and the reason is it is such a terrific burden to all the applicants.

In the original concept of the 1703 program designed to be tax-cost neutral of the taxpayer, that is a self-paid subsidy program. So all of our large projects are under the 1703 program, the nuclear program, the fossil program. That all has to be paid by our applicants.

Chairman HARRIS. Right. So in fact, in the 1705 program, there really is a cost to the U.S. taxpayer?

Mr. FRANTZ. There is.

Chairman HARRIS. It is not administrative but it is that other cost?

Mr. FRANTZ. And of course, that program as I mentioned is expiring on September 30.

Chairman HARRIS. Sure, no, I understand that. With regard to the loan programs, you know, the only disconcerting thing I think and one of the reasons why we hold the hearing is that you know, we open up the paper and whether it is Politico yesterday or ABC News, you know, we hear about loan guarantees going to companies where people made very large contributions to people in the Administrations, very large political contributions. Large. How are you going to assure me that the system is not biased? And I will tell you what. I am going to submit that in writing, if you can submit that in writing to me because I am going to recognize Dr. Bartlett for 30 seconds to show his slide, and then we are going to adjourn.

[Slide]

Mr. BARTLETT. This slide, is it the first one or second one? Show the second slide. This slide goes out to '30, the second one goes out to '35. This is the second one. It goes out to '35, and it peaks out not at 106 million but at 96 million barrels a day. So in just two years, they have lowered their expectations.

I want to note, Mr. Chairman, that 4–1/2 years ago I led a Codel to China to talk about energy. Nine of us went to China to talk about energy, and I was stunned when they began their discussion of energy by talking about post-oil. Of course there will be a post-oil world. By the way, the first person that I know to recognize that was Hyman Rickover, the father of our nuclear submarines who gave a fantastic talk the 15th day of May, I think it was, 1957, in St. Paul, Minnesota, to a group of physicians. And he noted then that in the 8,000 year recorded history of man, the age of oil would be but a blip. And he called this its golden age. He had no idea how long the golden age would last. He said how long it lasted was important in only one regard. The longer it lasted the more time would we have to plan an orderly transition to other sources of energy. Of course, we have done none of that, and now we are up against a real crisis here. I love crises, by the way, because they

challenge you. So I am exhilarated by this. This is a huge challenge.

And if I think our government starts being honest with the American people—the Chinese talked about post-oil. Of course there will be a post-oil world. They think in terms of decades and generations. You know, do anything you can to get yourself elected two years and you will start to be responsible. And our corporate people look at the next quarterly report. That has got to look good or hell is going to break loose. So I will do anything I have to make that look good. Who is looking down the road in our country? I know ARPA–E is, thank you, but you know, somebody else may need to be looking down the road, I think.

Thank you very much, Mr. Chairman.

Chairman HARRIS. Thank you, Dr. Bartlett. Thank you for your patience here. I will thank the witnesses for their valuable testimony and the Members for their questions. The Members of the Subcommittee may have additional questions for the witnesses, and we will ask you to respond to those in writing.

Now, I hate to make an addition here, but given the fact that I still am waiting for answers to my letter from months ago, I am going to ask you to be timely if you can. I am going to ask each of you to commit to me that you will be timely in this so it will be included in the record. You have . . .

Mr. MAJUMDAR. You have my commitment.

Chairman HARRIS. I am going to say Dr. M because I am not going to pronounce his name anymore. The record will remain open for two weeks for additional comments from Members. The witnesses are excused. The hearing is adjourned.

[Whereupon, at 3:30 p.m., the subcommittee was adjourned.]

Appendix

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Arun Majumdar, Director,
Office of Advanced Research Projects Agency–Energy

Questions Submitted by Mrs. Biggert

Q1. Who makes the decision that we should have the wireless technology, the $100 million?

A1. The House Energy and Commerce Committee and the Senate Commerce, Science and Transportation Committee have jurisdiction over the Wireless Innovation Fund and will be responsible for passing any legislation that will determine where the money will go.

QUESTION FROM CHAIRMAN HARRIS

Budget and Spending Priorities

Q1a. The budget request proposes large increases in funding for solar energy as part of DOE's "SunShot" Initiative. These are in addition to Departmental support for solar technology development through numerous programs, which include the Advanced Research Projects Agency'- Energy (ARPA-E), Energy Efficiency and Renewable Energy (EERE), loan guarantees, Energy Frontier Research Centers, and hundreds of millions in Stimulus funding.

How does your office specifically coordinate these programs with other DOE offices to ensure R&D efforts are efficient and avoid duplication of effort?

A1a. First, it is important to point out two characteristics of Sunshot:

1. Sunshot is not a new program that needs additional funding beyond what is already appropriated across the Department of Energy (DOE) for solar programs. Sunshot is a technical program that leverages and focuses the solar-related effort across DOE toward a common goal of achieving cost parity for solar electricity (without subsidies) with the rest of the grid, within this decade: thus becoming competitive with fossil fuel throughout the U.S. and the world, leading to market-driven scale-up and deployment. We estimate this cost parity to be equivalent to one dollar per watt of capacity ("a dollar a watt") or 5-6 cents per kWh equivalent. Reaching this goal will make the U.S. globally competitive with a very large export market.

2. Sunshot is not an initiative apart from the existing solar activities in the Office of Energy Efficiency and Renewable Energy (EERE), the Office of Science (SC), and the Office of Advanced Research Projects Agency-Energy (ARPA-E). Rather, it is an initiative to coordinate existing activities in DOE to make the

> whole greater than the sum of the parts by focusing on a common goal to make solar energy competitive with fossil energy without subsidies domestically and globally. The SunShot initiative leverages the different strengths and capabilities of several DOE programs and incorporated previously untapped efforts to achieve this goal and make the U.S. globally competitive. This includes advances in the performance and cost of solar modules driven by EERE, progress in power electronics crucial for solar grid integration driven by ARPA-E, and fundamental materials advances driven by SC. The targets and R&D directions of each of these offices have been developed through extensive collaboration and interaction, including coordination with the Office of Electricity Delivery and Energy Reliability, and topic-specific workshops.

More generally, ARPA-E takes great care to ensure that its projects do not overlap with other DOE programs, but instead complement them in multiple ways. The program works in close coordination with program offices on its "borders" – DOE's basic science and applied research programs – to avoid duplicative research and ensure a balanced research portfolio across the DOE. Moreover, all offices work in collaboration to identify gaps in their research portfolios ("white space") as well as through co-hosting topical workshops in the development of programs. This coordination also serves to inform all parties of each other's ongoing research activities which can facilitate the transition of successful ARPA-E projects to other DOE programs.

ARPA-E has a fundamentally different mission and function than other DOE programs. ARPA-E's central focus is to fund the early-stage development of transformational energy technologies that have high technical and market risks, but where a short-term R&D effort could deliver game-changing results down the road. The role of ARPA-E is to translate science into breakthrough technologies. This leverages, but does not duplicate, the activity in SC, which focuses on science and not technology. Furthermore, ARPA-E focuses on developing breakthrough technologies that do not exist today in the energy market and are disruptive. The Applied Energy Programs focus on significantly improving today's technologies thereby making them more compatible with the market.

Before issuing a funding opportunity announcement on a particular technology area, ARPA-E studies the technology area in depth. ARPA-E consults closely with other DOE offices and programs to avoid any duplication or redundancy. ARPA-E engages members of other DOE offices in ARPA-E workshops, defining the funding opportunity announcements, and proposal review process.

To improve coordination within DOE, ARPA-E has formed a Panel of Senior Technical Advisors (PASTA). PASTA consists of Assistant Secretaries (or their Technical Appointees) of all the relevant applied energy offices as well as the heads of all the relevant offices in SC. The purpose of PASTA is to coordinate and leverage each of its programs and also to ensure that ARPA-E provides unique value within the DOE. In addition, the Director of ARPA-E actively coordinates with the Director of SC as well as the Under Secretaries for Energy and Science.

QUESTION FROM CHAIRMAN HARRIS

Budget and Spending Priorities

Q1b. The budget request proposes large increases in funding for solar energy as part of DOE's "SunShot" Initiative. These are in addition to Departmental support for solar technology development through numerous programs, which include the Advanced Research Projects Agency'- Energy (ARPA-E), Energy Efficiency and Renewable Energy (EERE), loan guarantees, Energy Frontier Research Centers, and hundreds of millions in Stimulus funding.

Please detail all programs and activities, within ARPA-E that support solar energy-related research, development, demonstration, deployment and commercialization (RDDD&C) activities, and detail how the FY12 budget request would supplement existing programs.

A1b. The Office of Advanced Research Projects Agency-Energy's (ARPA-E) largest contribution to solar-energy related research and development is through the Department of Energy's (DOE) "SunShot" Initiative. The SunShot Initiative accelerates and advances existing DOE research efforts by refocusing its solar energy programs — valued at approximately $200 million per year — to make large-scale solar energy systems cost competitive without subsidies by the end of the decade. Within SunShot, DOE has a management structure composed of members from the Office of Science Basic Energy Sciences program (SC/BES), ARPA-E, and the Office of Energy Efficiency and Renewable Energy (EERE), with complementary approaches to supporting research on energy-relevant problems. ARPA-E's portion of the collaboration is the Solar ADEPT program, which focuses on integrating advanced power electronics into solar panels and solar farms to extract and deliver energy more efficiently. Specifically, ARPA-E aims to invest in key advances in magnetics, semiconductor switches, and charge storage, which could reduce power conversion costs by up to 50 percent for utilities and 80 percent for homeowners.

SunShot takes a unique approach to developing solar energy. Historically, solar investments focused on achieving incremental efficiency improvements to solar cells and arrays. SunShot focuses on the installed system as a whole, including non-technical barriers. In addition to investing in improvements in cell technologies and manufacturing, the SunShot Initiative also focuses on steps to reduce installation and permitting costs, which are significant contributors to the total installed system price of solar electricity. This includes efforts to streamline and digitize local permitting processes and to develop codes and standards that ensure high performance over the approximately 20-year lifetime of residential solar products.

In addition to its investment in SunShot, ARPA-E is funding two solar energy projects. One project is developing a novel crystalline silicon wafer manufacturing process that could cut the cost of installed photovoltaic systems in half and reduce wafer capital costs by 80 percent. The other project proposes to develop a solar concentrator using a novel optofluidic system. These projects were funded before the SunShot program was created, but have now been integrated into the coordinated effort of SunShot.

ARPA-E is also investing in direct solar fuel technologies. Direct solar fuel technologies utilize photosynthetic microorganisms to produce liquid fuels and fuel precursors directly from solar energy. In most cases, the microorganisms can work as biocatalysts to continuously produce fuels such as liquid hydrocarbons.

The FY12 budget request aims to complement these existing programs. In addition, ARPA-E is considering a radically different approach to meeting the demand for lighting at night, specifically the storage of incident sunlight as chemical energy that could be released as light at night, thereby reducing the need for electrical lighting.

QUESTION FROM CHAIRMAN HARRIS

Budget and Spending Priorities

Q2a. Similarly, battery and energy storage RDDD&C is funded through numerous programs throughout DOE, and the Administration is proposing to create a new batteries hub as well as increase existing programs.

How can you make sure the highest priority research is funded and avoid duplicative research?

A2a. The Department of Energy's (DOE) Office of Science focuses on understanding the basic science of materials that are used in batteries. The Office of Advanced Research Projects Agency-Energy's (ARPA-E) role is to translate that science into breakthrough battery technologies that do not exist today, but if they did they would make today's batteries obsolete. Examples include the whole class of metal-air batteries. The Vehicle Technologies Program of the Office of Energy Efficiency and Renewable Energy (EERE) focuses on R&D to make the whole class of today's lithium-ion batteries cheaper, better and safer in order for the U.S. to be globally competitive and have a large manufacturing infrastructure.

More generally, ARPA-E's mission is to aid the development of transformational and disruptive energy technologies – technologies that hold the potential to radically shift the nation's energy reality. ARPA-E selects potential investment areas by considering the science and technology landscape, the market landscape, and the regulatory landscape. Only in instances where circumstances in each of these areas are aligned to enable transformative, breakthrough discoveries that have the potential to then be brought to market scale will ARPA-E invest in technology development. Programs are created through a detailed process that begins with a thorough vetting of a technology concept to

identify potential topics for program development. ARPA-E Program Directors will coordinate with other DOE offices and federal agencies, as well as groups outside of government, to identify untapped opportunities.

ARPA-E is designed to support quick reactions to changes in the energy landscape: both to find solutions to new challenges and to seize opportunities. Technical flexibility and empowerment of Program Directors is a key aspect of ARPA-E. Through its nimble organizational structure and processes, the agency is able to quickly and efficiently respond to these new challenges. ARPA-E's Rare Earth Alternatives in Critical Technologies (REACT) program offers an excellent example. Rare earths are naturally-occurring minerals with unique magnetic properties that are used in many emerging energy technologies. As demand for these technologies continues to increase, rare earths are rapidly becoming more expensive due to limited global supply – prices of many have increased 300–700% in the past year. ARPA-E responded to this challenge by holding a technical workshop and issuing its REACT Funding Opportunity Announcement within just a few months. In developing its response to this emerging challenge, ARPA-E worked closely with other DOE offices, including the Office of Policy and International Affairs, to understand the evolving international market forces and technology opportunities in rare-earth-dependent energy technologies.

ARPA-E takes great care to ensure that its projects do not overlap with other DOE programs, but instead complement them in multiple ways. The program works in close coordination with program offices on its "borders" – DOE's basic science and applied

research programs – to avoid duplicative research and ensure a balanced research portfolio across the DOE. Moreover, all work in collaboration to identify gaps in their research portfolios ("white space") as well as through co-hosting topical workshops in the development of programs. This coordination also serves to inform all parties of each other's ongoing research activities which can facilitate the transition of successful ARPA-E projects to other DOE programs. Before issuing a funding opportunity announcement on a particular technology area, ARPA-E studies the technology area in depth. ARPA-E consults closely with other DOE offices and programs to avoid any duplication or redundancy. ARPA-E engages members of other DOE offices in ARPA-E workshops, defining the funding opportunity announcements, and proposal review process.

QUESTION FROM CHAIRMAN HARRIS

Budget and Spending Priorities

Q2b. Similarly, battery and energy storage RDDD&C is funded through numerous programs throughout DOE, and the Administration is proposing to create a new batteries hub as well as increase existing programs.

Please detail all programs and activities within your respective office that support battery and energy storage-related R&D, and detail how the FY12 budget request would supplement existing programs.

A2b. The Office of Advanced Research Projects Agency-Energy (ARPA-E) supports the following projects and programs in energy storage-related R&D:

Batteries for Electrical Energy Storage in Transportation (BEEST)

The BEEST program aims toward making a new generation of ultra-high energy density, low-cost battery technologies for long-range (300 to 500 miles) plug in hybrid electric vehicles (PHEVs) and electric vehicles (EVs). Successful development of these types of batteries will make PHEVs and EVs more useful to more people and will put more cars on the road that run on U.S.-generated electricity rather than imported oil. ARPA-E investments in this area run from moderately risky projects to take lithium ion batteries (the current industry standard) to their greatest potential performance, to pushing the boundaries of batteries by using lithium air systems that can hold as much energy as a tank of gasoline in the same volume. Other projects in the BEEST program are looking at new ways to safely store energy that will provide cars with energy for up to a 500 mile range and be able to fully charge in minutes. ARPA-E is funding research efforts that will promote U.S. leadership in the emerging EV battery market. There are currently ten projects within the BEEST program.

Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS)

The GRIDS program seeks to develop new technologies that enable widespread use of cost-effective grid-scale energy storage. While valuable applications for grid-scale storage exist, this program focuses on technologies that balance the short-duration variability in renewable generation. Investing in these technologies will position the U.S. as the technology and manufacturing leader of the emerging, and potentially massive, global market for stationary electricity storage infrastructure. The GRIDS program seeks to develop revolutionary modular storage systems that provide the same energy, cost, and lifecycle of pumped hydropower, and can be widely implemented across the power grid. Specifically, GRIDS considers two areas: 1) proof-of-concept storage-component projects focused on validating new, over-the-horizon, electrical energy storage concepts, and 2) advanced system prototypes that address critical shortcomings of existing grid-scale energy storage technologies. Ultimately, technologies developed through this program will be scalable to megawatt and megawatt-hour levels of power and energy capacity. GRIDS will complement other the Department of Energy (DOE) grid-scale energy storage efforts by focusing on technology prototyping and proof-of-concept research and development. There are currently twelve projects within the GRIDS program.

Projects from ARPA-E's Open Funding Opportunity Announcement

Seven projects from ARPA-E's open funding opportunity announcement are related to Energy Storage. These Energy Storage technologies seek to

revolutionize battery, capacitor and other energy storage methods for significantly improved efficiency.

ARPA-E is currently carrying out a solicitation for the following program, which is being funded out of the FY2011 appropriation:

High Energy Advanced Thermal Storage (HEATS)

More than 90% of energy technologies involve the transport and conversion of thermal energy. Therefore, advancements in thermal energy storage – both hot and cold – would dramatically improve performance for a variety of critical energy applications. ARPA-E seeks to develop revolutionary cost-effective thermal energy storage technologies in three focus areas: 1) high temperature storage systems to deliver solar electricity more efficiently around the clock and allow nuclear and fossil baseload resources the flexibility to meet peak demand, 2) fuel produced from the sun's heat, and 3) HVAC systems that use thermal storage to dramatically improve the driving range of electric vehicles.

Regarding the FY12 budget request, ARPA-E plans to continue supporting batteries and energy storage technologies as detailed below:

- The ARPA-E Grid-scale Renewable Intermittent Dispatchable Storage (GRIDS) program is currently developing low-cost grid-scale energy storage technologies. Future ARPA-E investment in this area will integrate novel technologies developed in the GRIDS program into full systems that can be scaled for use on the electric grid, as well as storage strategies effective over

longer time-frames. Future programs may explore other approaches to grid-scale energy storage, such as reduced transmission line congestion.

Lighting is among the greatest consumers of electricity. To produce light when the sun is below the horizon, electricity is transformed into light. ARPA-E will investigate technologies that directly store photons during the day and emit light on demand, significantly reducing the demand for electricity for lighting.

- ARPA-E will investigate integrated electrothermal energy systems integrated with electrothermal storage to match electrical and thermal energy supply and demand for building at the seasonal, weekly and daily basis. Through such a program ARPA-E expects to cut the primary energy consumption by more than 20% even if existing energy service technologies such as lighting, air-conditioning, etc., are used. Combined with the other programs on improvement of energy service technologies mentioned above, further significant reduction will be achieved in buildings.

- While remaining cognizant of other DOE activities in these areas in order to avoid duplication, future ARPA-E programs will support the design and development of advanced battery systems based on the high-capacity battery cells developed in the existing BEEST program.

QUESTION FROM CHAIRMAN HARRIS

Budget and Spending Priorities

Q3. In order to allow the Committee to better review and assess relevant program spending, please provide a list of all active spending on grants, contracts, cooperative agreements, loan guarantees, cash prizes, and 'other transactions' awards supported within your office.

A3. Below is a list of all active spending on cooperative agreements and 'other transactions' awards supported within the Office of Advanced Research Projects Agency-Energy:

ITD Costs by award type, as of July 19, 2011	
Cooperative Agreements	$ 103,954,141.81
'Other Transactions' Awards (Technology Investment Agreements)	$ 15,952,616.74
Total	$ 119,906,758.55

ITD Obligations by award type, as of July 19, 2011	
Cooperative Agreements	$ 338,906,170.42
'Other Transactions' Awards (Technology Investment Agreements)	$ 26,351,128.00
Total	$ 365,257,298.42

QUESTION FROM CHAIRMAN HARRIS

ARPA-E Project Review

Q4. Please provide an update on the status of ARPA-E's initial three Funding Opportunity Announcements (FOA) including how ARPA-E is monitoring the progress of the awardees and other program oversight activities. In addition, describe any lessons learned from the initial FOA, such as anticipated changes to the award selection process or program management.

A4. With its initial appropriation of $400 million, the Office of Advanced Research Projects Agency-Energy (ARPA-E) issued seven Funding Opportunity Announcements (FOAs) and received an overwhelming response from the technical community. ARPA-E reviewed approximately 5,000 concept papers and nearly 700 full proposals, from which 121 projects were selected for funding in six programs. These six programs are Batteries for Electrical Energy Storage in Transportation, Innovative Materials and Processes for Advanced Carbon Capture Technologies, Grid-Scale Rampable Intermittent Dispatchable Storage, Agile Delivery of Electrical Power Technology, Electrofuels, and Building Energy Efficiency Through Innovative Thermodevices.

ARPA-E is seeing some early signs of success. Because ARPA-E's initial funding allowed them to lower risk and demonstrate results, six projects funded by ARPA-E for a total of $24 million in 2010 have received over $100 million in follow-on funding largely from the private sector. ARPA-E's initial funding allowed these innovators to do the research and overcome significant technical barriers ahead of schedule. In these cases, the private sector investors have communicated that the follow-on funding would not have arrived without the technical success achieved as a result of ARPA-E's initial

investment. In addition, 17 patents have been filed as a result of ARPA-E funding. While ARPA-E is still in the early stages, these are good signs for future success.

ARPA-E is actively monitoring and managing the progress of its awardees. Upon selection of a recipient for award, we work with the recipient to establish a set of specific technical milestones and deliverables that will meet the goals of the program. ARPA-E focuses on high-risk, high-reward energy technology development, so our technical milestones and deliverables are very aggressive. We incorporate these technical milestones and deliverables into our funding agreements with the recipients. We closely monitor the recipients' progress throughout the year. The Program Director conducts at least two site visits per year for each of the projects in his/her program, during which he/she visits the laboratory to monitor the recipients' progress and assess in person whether they have met their technical milestones and deliverables, and if not, why they have not. In addition to the site visits, the Program Director conducts a comprehensive program review once a year, during which each project in the program will be reviewed in depth. The technical milestones and deliverables are used during these meetings to determine whether the project is meeting its stated objectives, and whether we should maintain funding for the project. The milestones and deliverables are an objective yardstick for measuring the recipients' technical progress each quarter. If, after a quarterly review, ARPA-E determines that the recipient has failed to meet milestones, schedule, or cost commitments, ARPA-E may at its discretion 1) renegotiate these terms/conditions and continue funding, or 2) notify the recipient that they are at risk of termination and give them an opportunity to achieve specified corrective actions. If the

recipient fails to achieve the corrective actions, ARPA-E will suspend the award and begins the termination process.

Decisions to discontinue funding are made on a case-by-case basis. Some of ARPA-E's projects will be reaching the end of their cooperative agreement with ARPA-E in the fall. We do have some projects that have been given warning that they are not meeting their goals, and we have offered them assistance to make progress. If the Department of Energy (DOE) decides to stop funding a project funded with Recovery Act funds, any remaining funds obligated for the project will return to the Treasury.

From the initial FOA, ARPA-E has learned many lessons and implemented changes to improve the award selection and program management processes. First and foremost, after the initial FOA, ARPA-E opted to build and employ its own online application portal called ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov). This system was built quickly and at low cost. ARPA-E eXCHANGE is used by ARPA-E to publish new funding solicitations, by applicants to learn about and apply to funding opportunities, by reviewers to identify potential conflicts of interest and evaluate applications, and by program managers to assign applications to reviewers and identify the applications that should be recommended for selection. ARPA-E eXCHANGE can manage the entire process from posting, to receiving and reviewing proposals, to selection in a seamless, integrated fashion. Another DOE program is already using eXCHANGE on a pilot basis In addition, ARPA-E implemented a procedure for applicants to reply to reviewer comments before selection determinations are made by ARPA-E. This process is unique

to ARPA-E and has won consistent praise from applicants. To reach a wider audience of potential applicants, ARPA-E rewrote its standard FOA template to explain application and award requirements concisely and in plain English. ARPA-E also rewrote its model cooperative agreement to describe awardees' legal obligations in plain English. In this manner, ARPA-E facilitated awardees' compliance with award requirements, such as reporting requirements. Finally, ARPA-E has developed centralized, efficient mechanisms for communicating with applicants and responding to technical and other questions about FOAs.

QUESTION FROM CHAIRMAN HARRIS

Private Funding of Unsuccessful ARPA-E Applicants

Q5. In previous testimony before Congress, you noted that the ARPA-E technology summit was used to showcase to investors technologies developed by ARPA-E applicants that did not win awards, and that this resulted in many financial deals.

Please elaborate on this effort and the success of private' funding for those that did not receive ARPA-E awards.

A5. The Office of Advanced Research Projects Agency-Energy (ARPA-E) is committed to doing all it can to see promising technologies succeed, whether they are funded by ARPA-E, or not. ARPA-E has published a list of "encouraged applicants" on its website, along with information about their technologies. "Encouraged applicants" includes those applicants who were encouraged by ARPA-E to submit a full application to one of its funding opportunity announcements, but were not selected for funding. (This is an "opt-in" list, so "encouraged applicants" are only listed if they consent to participate.) Through this list, ARPA-E intends to facilitate communication between "encouraged applicants" and potential investors, partners, and customers and accelerate technology development. "Encouraged applicants" also have the option to place an electronic badge on their websites indicating that they are an "encouraged applicant" to an ARPA-E funding opportunity, which provides some measure of third-party validation of their technological efforts.

ARPA-E invites "encouraged applicants" to participate in meetings with recipients, program reviews, and other events in order to facilitate the exchange of technical information and spur new collaborations and partnerships. ARPA-E's "encouraged

applicants" are invited to participate in upcoming workshops, as well as to come to Washington to meet with ARPA-E personnel.

ARPA-E invited all of these "encouraged applicants" to join with ARPA-E recipients in showcasing their advanced energy technologies at the ARPA-E Energy Innovation Summits in 2010 and 2011. Nearly 1,700 people attended the 2010 Summit and approximately 2,100 people attended the 2011 Summit, including hundreds of venture capitalists and other private investors. Investors are especially interested in ARPA-E recipients and "encouraged applicants" because of the rigor of ARPA-E's scientific merit review process. Many "encouraged applicants" showcased their technologies at the 2011 Summit. Of the 169 technologies participating in the Showcase at the Summit, 74 (44%) were "encouraged applicants." 38 of 74 "encouraged applicants" (51%) participated in one-on-one meetings with investors and industry. ARPA-E recognizes that private capital is absolutely necessary to ensure commercialization of these early-stage technologies, and it continues to strengthen the relationship with the private investment community by publicly showcasing our investments and highly-qualified applicants.

QUESTION FROM CHAIRMAN HARRIS

ARPA-E Duplication

Q6a. How does ARPA-E's electrofuels program differ in nature from similar research currently in progress at the Joint Center for Artificial Photosynthesis (JCAP) Energy Innovation Hub and in multiple Energy Frontier Research Centers?

A6a. The Office of Advanced Research Projects Agency-Energy's (ARPA-E) Electrofuels program, the Joint Center for Artificial Photosynthesis (JCAP) Energy Innovation Hub, and solar fuel-inspired Energy Frontier Research Centers (EFRCs) fund R&D into next-generation fuels that will be integrated into the Nation's existing fuel refining and distribution infrastructure. Although this broad goal is conserved across all three programs, ARPA-E's Electrofuels program employs a fundamentally different approach that relies solely on biological processes, while the JCAP and EFRC programs apply inorganic, non-biological catalytic approaches.

Specifically, JCAP seeks to develop a fully synthetic system capable of performing "artificial photosynthesis" whereby sunlight, water, and carbon dioxide are directly converted to fuels through a non-biological mechanism, which JCAP anticipates will have a higher efficiency than natural photosynthesis. With the objective of developing and demonstrating a prototype solar-fuels generator made of Earth-abundant elements, JCAP seeks to accelerate solar fuels towards commercial viability by making artificial photosynthesis efficient, inexpensive, and robust.

Unlike the JCAP and EFRC approaches, ARPA-E's Electrofuels program utilizes a biological system requiring microorganisms to capture energy and convert carbon dioxic

to fuel molecules without biological photosynthesis. Such microorganisms, termed "chemolithotrophs", are capable of extracting energy from various reduced chemical species such as metals, hydrogen, ammonia, hydrogen sulfide, and directly from electric current. The Electrofuels program anticipates opening a new route to biofuels through the first demonstration of chemolithotrophy as a mechanism for production. If successful, ARPA-E's Electrofuels program could yield next-generation fuels that are up to 10 times more efficient than current approaches.

It is helpful to differentiate the missions of ARPA-E and Energy Innovation Hubs on a broader level. ARPA-E funds small groups focused on breakthroughs in technology, using a highly entrepreneurial funding model to support specific new technologies where a short-term R&D effort could deliver game-changing results. By contrast, Energy Innovation Hubs are large, multi-disciplinary, highly collaborative teams of scientists and engineers working over a longer time frame to achieve a specific high priority goal. They are led by top researchers with the knowledge, resources, and authority to nimbly guide efforts, seizing new opportunities or closing off unproductive lines of research.

Nobody knows where the big energy breakthroughs are going to come from – only what has worked in the past. To reach the Nation's energy goals, we must take a portfolio approach to R&D: pursuing several research strategies that have proven to be successful in the past. This work is being coordinated and prioritized, with a 360 degree view of the pieces, and these pieces fit together. Discovering new energy solutions will take smart collaborators pushing the frontiers of science. It will take risk-takers working out of their

garages. It will take robust research teams on a mission. And it will take a Department of Energy that brings together the different parts of this research strategy to accelerate the innovation process.

QUESTION FROM CHAIRMAN HARRIS

ARPA-E Duplication

Q6b. Do you actively consider similar research programs when formulating ARPA-E programs?

A6b. Yes. The Office of Advanced Research Projects Agency-Energy (ARPA-E) takes great care to ensure that its projects do not overlap with other Department of Energy (DOE) programs, but instead complement them in multiple ways. The program works in close coordination with program offices on its "borders" – DOE's basic science and applied research programs – to avoid duplicative research and ensure a balanced research portfolio across the DOE. Moreover, all work in collaboration to identify gaps in their research portfolios ("white space") as well as through co-hosting topical workshops in the development of programs. This coordination also serves to inform all parties of each other's ongoing research activities to facilitate the transition of successful ARPA-E projects to other DOE programs.

QUESTION FROM CHAIRMAN HARRIS

ARPA-E Duplication

Q6c. If so, how do you specifically incorporate related research activities into ARPA-E Funding Opportunity Announcements and awards?

A6c. Before issuing a funding opportunity announcement on a particular technology area, the Office of Advanced Research Projects Agency-Energy (ARPA-E) studies the technology area in depth. ARPA-E consults closely with other Department of Energy (DOE) offices and programs to avoid any duplication or redundancy. ARPA-E engages members of other DOE offices in ARPA-E workshops, defining the funding opportunity announcements, and proposal review process.

In the case of Electrofuels, ARPA-E specifically required development of a microbial biological catalyst; inorganic, non-biological catalysts were being explored by the Hub and the Energy Frontier Research Centers.

QUESTION FROM CHAIRMAN HARRIS

ARPA-E Project Selection

Q7. Dr. Majumdar, ARPA-E's statutory authorization is to fund high-risk, high-reward research in areas that industry by itself is not likely to undertake. Though your testimony notes, initial investments allowed these innovators to do the research and overcome technical barriers *ahead of schedule.* This implies the technical barriers' would have been overcome absent ARPA-E funding. How does ARPA-E ensure the program adheres to its original mission and only selects appropriate projects that would otherwise not be undertaken?

A7. The Office of Advanced Research Projects Agency-Energy (ARPA-E) supports its statutory mission to accelerate "transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty." ARPA-E is technology-agnostic and selects among competing new technologies based upon their potential to meet our cost and performance metrics. ARPA-E seeks to create competition between performers. We expect that many of the projects will fail, but of those that are successful in the research phase the market must dictate which projects will ultimately succeed. In that sense, ARPA-E does not pick winners - we set the metrics, create the competition, and let the market pick the winners.

At ARPA-E, we seek to make investments in transformational energy technologies that private sector investors are not likely to fund at their present stage of development. ARPA-E investments have both high technical risk and high market risk. Private capital generally undertakes projects with minimal technical risk. It is extremely rare for private capital to finance projects that have high technical risk and high market risk. As such, ARPA-E did not mean in any way to imply that the technical barriers would have been overcome absent ARPA-E funding. ARPA-E is thrilled that certain projects have

exceeded expectations in demonstrating breakthrough success ahead of schedule, but to be clear, success with ARPA-E funding does not translate to delayed success without ARPA-E funding. It is entirely possible and even likely that many of these ideas would never have been funded or succeeded without ARPA-E's involvement.

ARPA-E has implemented numerous safeguards to ensure we adhere to our original mission and only select appropriate projects that would otherwise not be undertaken. The safeguards and criteria in place to ensure Department of Energy funding is only disbursed to projects not already being pursued by the private sector include: the nature of the projects ARPA-E funds, the type of Program Directors recruited, ARPA-E's rigorous program development process, and mandatory disclosure requirements for applicants.

ARPA-E continually assesses private sector investment in specific fields and technology areas by meeting and communicating regularly with venture capitalists and other private investors to get a sense of their appetite for risk and the types of projects they are funding and not funding. ARPA-E is careful to not fund any specific and discrete technical idea that had previously received money from industry. ARPA-E sets market-based cost and performance metrics in technology areas that if met would displace the prevailing technology.

In addition, ARPA-E hires Program Directors with backgrounds in science and business in order to make more precise determinations of the types of high risk projects that are

appropriate for ARPA-E to fund. This expertise, along with the ongoing assessments, is used to make evaluations and inform decisions in regard to applicant proposals.

ARPA-E has a rigorous program development process. Before announcing a program, ARPA-E undertakes a comprehensive process to ensure that it is locating a "white space" that is not being addressed by the private sector. ARPA-E technical staff review existing literature to identify potential program areas. From here, ARPA-E technical staff undertake "deep dive" research into specific potential program areas to determine the current state of the art, the main players in this space, the major technology challenges, and, most critically, whether there is significant technology white space for a high-impact ARPA-E program. From there, ARPA-E will hold a workshop, bringing in the relevant players from industry, academia, and government to further refine concepts for potential programs. Program Directors connect with the business world and lead a competitive, thorough review process to fund projects not being funded by the private sector.

In addition, each applicant for ARPA-E funding must fully disclose all sources of funding (past, current, or pending) for all potentially related or identical projects. Once the award is issued, recipients are required to fully disclose any additional funding that it receives from any public or private source. This ensures transparency and enables ARPA-E to make appropriate funding determinations.

QUESTION FROM CHAIRMAN HARRIS

ARPA-E Project Selection

Q8. What is entailed in ARPA-E's in-house proposal research as noted in your testimony? Do you rely solely on information provided by the applicant or do you acquire third-party financial and technical analysis of proposals? How does ARPA-E check the veracity of information provided by the applicant?

A8. The Office of Advanced Research Projects Agency-Energy's (ARPA-E) peer review process is designed to help drive toward subsequent program success. During proposal review, ARPA-E requires external (third party) input to ensure that it is funding the best technologies. ARPA-E taps the expertise of dozens of world-class scientists, engineers, and leaders from the technical community in a particular field for in-depth proposal reviews. All reviewers are first examined for conflicts of interest before they are assigned applications to evaluate. The application process occurs in two stages: first, a brief "concept paper" which describes the essence and novelty of the proposed technology and its ability to meet or exceed the technical targets described in the ARPA-E Funding Opportunity Announcement; and second, a full application which provides detailed information on the proposed project, including (among other items) an in-depth discussion of the proposed project, a detailed budget, and an environmental impact questionnaire. The purpose of the two-stage evaluation is to allow applicants to communicate their technology concept to ARPA-E, with a minimal level of investment in time and resources, and receive feedback on ARPA-E's level of interest in the concept before ARPA-E requests the submission of a more time and resource intensive Full Application.

ARPA-E reviewers evaluate applications over several weeks, and then convene for a review panel with ARPA-E leadership. During ARPA-E's oversubscribed first Funding Opportunity Announcement held in 2009, over 500 reviewers participated totaling 8,694 review hours (4.18 person-years). One notable facet of ARPA-E's evaluation process is the opportunity at the full application stage for the applicant to read reviewers' comments and to provide a reply that the Agency reviews before making selection determinations. Through this process, ARPA-E is able to ask clarifying questions and applicants are able to respond to key concerns raised by reviewers. ARPA-E's Merit Review Board uses this information to make informed choices during the project selection process and recommend the most compelling ideas to the Selection Official for final project selections.

It is precisely through ARPA-E's thorough and dynamic application and merit review processes that allows the agency to check the veracity of information provided in its applications. Through its multi-stage review process, use of leading experts in the field, and due diligence process, ARPA-E is able to ensure that it funds only the most responsive and meritorious applications.

QUESTION FROM CHAIRMAN HARRIS

ARPA-E/Duke Energy Memorandum of Understanding

Q9. On March 7, ARPA-E, Duke Energy, and the Electric Power Research Institute signed a Memorandum of Understanding establishing a partnership to test technologies developed by ARPA-E awardees at Duke facilities. The press release accompanying this announcement states that these meetings will provide an opportunity for Duke Energy "personnel to individually' review progress and information relating to relevant ARPA~E work."

This appears to suggest that the MOU provides Duke Energy with exclusive or priority access to information on ARPA-E awardees' technology? Is that correct? If so, was this partnership awarded through a competitive process?

A9. In March 2011, the Office of Advanced Research Projects Agency-Energy (ARPA-E) signed a Memorandum of Understanding (MOU) with Duke Energy to facilitate the "deployment and testing of ARPA-E-funded technologies at Duke Energy sites and facilities." This was the first of a series of non-binding and non-exclusive MOUs that ARPA-E intends to sign with utility-related entities in the United States. Indeed, the Duke Energy MOU states: "This Memorandum is non-exclusive in nature. ARPA-E will enter into similar memoranda of understanding with other utility-related entities in the United States." ARPA-E recently concluded a MOU with the Electric Power Research Institute, Inc. (EPRI), whose members represent more than 90 percent of the electricity generated in the United States. Like the Duke Energy MOU, the EPRI MOU is intended to facilitate the "deployment and testing of ARPA-E-funded technologies at EPRI and/or EPRI member sites and facilities." ARPA-E has posted a MOU template on its website so as to facilitate and expedite the negotiation of additional MOUs with utility-related entities.

Duke Energy, EPRI, and EPRI members do not receive "exclusive or priority access to information about ARPA-E Recipients' technologies." The Duke Energy MOU and EPRI MOU make clear that ARPA-E "will not communicate…non-public information resulting from ARPA-E-funded projects" to Duke Energy, EPRI, or EPRI members. Duke Energy, EPRI, and EPRI members will have to negotiate separate agreements directly with ARPA-E Recipients in order to receive confidential information regarding specific projects.

The Duke Energy MOU and EPRI MOU do not create a binding legal agreement of any kind. Both MOUs state "this Memorandum constitutes only a non-binding statement of the Parties' intentions and neither constitutes nor should be construed as evidence of any form of offer, acceptance, or binding contract...This Memorandum does not create a legally enforceable agreement…This Memorandum does not constitute a financial assistance agreement, does not provide any basis for a determination of noncompetitive financial assistance, and does not require the expenditure of any funds…This Memorandum shall not be construed as creating a partnership."

QUESTION FROM REPRESENTATIVE NEUGEBAUER

Q1. Could you point to a technology that has been developed by your office which can currently compete on the market without any government subsidies or tax incentives?

A1. The Office of Advanced Research Projects Agency-Energy (ARPA-E) supports its projects for a duration of two to four years. Initially funded in April 2009, ARPA-E selected its first 36 projects in October 2009 and rapidly completed contract negotiations by February 2010. Thus, ARPA-E's longest-running projects have been underway for only a year and a half, which is insufficient time for "high-risk/high-reward" projects to advance from early-stage to the point where they can compete on the market without subsidies or tax incentives. Most ARPA-E funded projects range from technology concept (Technology Readiness Level stage 2) through component validation in laboratory experiment (TRL 4) technology readiness levels (TRL), a widely-used systematic measurement system that assesses technology maturity.

ARPA-E and offices such as EERE do not crowd out private investment or negatively skew the marketplace. Private capital generally undertakes projects with minimal technical risk. It is extremely rare for private capital to finance projects that have high technical risk and high market risk. Public investment allows for appropriate maturation of the technologies, effectively de-risking them, which stimulates private investment for technology scale-up and manufacturing. ARPA-E, through expertise of its own staff and the access it has to the full technical expertise of the Department and its labs, is strongly positioned to carry out technical vetting of high risk technology ideas.

ARPA-E's mission is to aid the development of transformational energy technologies – technologies that hold the potential to radically shift the nation's energy reality. ARPA-E occupies a position in the technology development space not occupied by other DOE programs. ARPA-E funds early-stage energy technologies when they are considered too high-risk (both technical risk and market risk) to attract investment from other government agencies and private investors. Whereas the applied programs focus primarily on taking technologies down their economic learning curves, ARPA-E focuses on creating entirely new learning curves through transformative and disruptive new technologies. ARPA-E focuses on transferring science into breakthrough technologies.

ARPA-E takes great care to ensure that its projects do not overlap with other DOE programs, but instead complements them in multiple ways. The program works in close coordination with program offices on its "borders" – DOE's basic science and applied research programs – to avoid duplicative research and ensure a balanced research

portfolio across the DOE. Moreover, all parts of DOE work in collaboration to identify gaps in their research portfolios ("white space") as well as through co-hosting topical workshops in the development of programs. This coordination also serves to inform all parties of each other's ongoing research activities which can facilitate the transition of successful ARPA-E projects to other DOE programs.

Before issuing a funding opportunity announcement on a particular technology area, ARPA-E studies the technology area in depth. ARPA-E consults closely with other DOE offices and programs to avoid any duplication or redundancy. ARPA-E engages members of other DOE offices in ARPA-E workshops, defining the funding opportunity announcements, and proposal review process.

To improve coordination within DOE, ARPA-E has formed a Panel of Senior Technical Advisors (PASTA). PASTA consists of Assistant Secretaries (or their Technical Appointees) of all the relevant applied energy offices as well as the heads of all the relevant offices in SC. The purpose of PASTA is to coordinate and leverage each of its programs and also to ensure that ARPA-E provides unique value within the DOE. In addition, the Director of ARPA-E actively coordinates with the Director of SC as well as the Under Secretaries for Energy and Science.

Responses by Dr. Henry Kelly, Acting Assistant Secretary, Office of Energy Efficiency and Renewable Energy

Questions Submitted by Chairman Harris

Q1. So there really is nothing that EERE has done that will make sure that when you plug in that electric vehicle, that we actually can buy electricity for five or six or seven cents a kilowatt hour?

A1. Every renewable energy generation technology in EERE has been making significant strides towards grid parity, and our energy efficiency programs continue to help reduce our overall demand for energy. Today, onshore wind power is one example of an EERE technology that is competing with non-renewable fossil fuels like coal and natural gas. Currently 25% of 695 patents in the commercial wind market cite one or more of the 112 EERE-funded patents or papers relating to onshore wind electricity generation.

QUESTION FROM CHAIRMAN HARRIS

Federal Fleet Management

Q1. Has EERE calculated the additional cost of solely purchasing advanced vehicles for the federal fleet? If so, please provide the calculations, such as consideration of additional upfront costs, higher maintenance and repair costs, and infrastructure upgrades necessary to charge electric vehicles.

A1. The General Services Administration is the appropriate source for Federal agencies' purchases and leases of vehicles and would have, based on ongoing procurement actions, the most current initial cost and maintenance and repair costs for advanced vehicles available for purchase or lease by Federal agencies.

QUESTION FROM CHAIRMAN HARRIS

Market Incentives

Q2. There is a fundamental question relating to the merits of market incentives for technology development. Your testimony says, "EERE's mission to do develop systematic roadmaps for reducing the cost of efficiency and renewable technologies and streamlining their movement into commercial markets."
   a. Please delineate between the role of EERE and the private marketplace and innovators with respect to developing methods to reduce costs of technologies and strategize to commercialize technologies.
   b. How is the government more appropriately equipped to determine fundamental market decisions than the market itself?

A2. The Office of Energy Efficiency and Renewable Energy (EERE) fills gaps in the technology development chain that are not filled by private investment. There is significant value in the federal government funding applied science and the mid- to late-stages of technology development, not just basic research. EERE invests in projects and technologies that hold immense potential for improving our quality of life, but which are in many cases currently too risky or expensive for the private sector to take on. No private company would have ventured a moon mission or DARPAnet on its own; there is simply too much uncertainty and expense to be absorbed by one group. The private sector is constrained by short-term bottom line cycles and shareholder demands that generally do not provide the flexibility needed for much of the work done by EERE, which aims to unleash those private sector investments by de-risking technologies and bringing them to a commercial ready stage. Numerous innovations and improvements to existing technologies have resulted from EERE's work. Our RD&D strategies and priorities are aimed at developing a clean energy economy which will modernize our energy portfolio, create high-quality domestic jobs, improve our energy security, and reduce harmful greenhouse gas emissions. The Department of Energy's basic and

applied science activities are an important component to maintaining our standard of living as our population and energy demands grow in the coming decades.

QUESTION FROM CHAIRMAN HARRIS

EERE/Yahoo Partnership

Q3a. How much DOE funding was directed to the partnership with Yahoo cited in your testimony to "create a data center operating with 25 percent less energy?"

A3a. The Department of Energy provided Yahoo! $9,921,887.

QUESTION FROM CHAIRMAN HARRIS

EERE/Yahoo Partnership

Q3b. What criteria does EERE consider prior to such partnerships? For example, did DOE identify a market failure which Yahoo did not have sufficient incentive to increase the energy efficiency of its data centers on its own?

A3b. Conference Report 111-16 which accompanied the American Recovery and Reinvestment Act (ARRA) directed the Department of Energy (DOE) to invest $50 million to increase the efficiency of the nation's information and communications technology. In response to Congressional direction, DOE issued solicitation DE-FOA-0000107 seeking new routes to dramatically improve energy efficiency in the information and communications technology (ICT) sector.

In selecting projects for negotiation of an award, DOE relies upon an open and competitive process to ensure that the Department focuses its funding on work that the private sector either cannot or would not undertake on its own. In advance of issuing a funding opportunity, DOE identifies technology gaps and challenges as well as priority research and development areas through discussions and workshops with experts in industry, universities, national laboratories, and other stakeholder organizations. All applications submitted to DOE funding opportunities must then pass through a robust merit review process that includes evaluation by individual, independent experts followed by a panel discussion for the final external ratings. The applications and the external evaluations are then reviewed by a panel of Federal experts who are familiar with cutting edge technologies and industry activities through regular communication with industry. This also helps to ensure that the judgment of the merit review panel in selecting specific

projects for negotiation of an award is reflective of a broad range of considerations, as defined in the solicitation.

This comprehensive approach to planning, implementing and evaluating programs and projects ensures effective investment of tax dollars. The criteria considered by the merit review panel in this instance included technical merit, potential public benefits, commercialization potential, technical approach and applicant qualifications. In addition, the selection official also considered Program Policy Factors to ensure that programmatic and strategic mission requirements were addressed. These included conformity to the ARRA emphasis on projects that promoted economic recovery, created jobs and provided general economic benefit; relevance to the President's carbon reduction goals; direction provided in the Energy Policy Act of 2005; diversity of portfolio across priority technical areas; and applicant cost share.

The Yahoo! project had a goal of designing, implementing, and evaluating the energy performance of a uniquely designed data center which relies upon cooling provided almost entirely through the use of outside air, completely eliminating compressor-based systems typically used to cool data centers. Relative to today's typical data center, this results in the significant savings of data center use. The Yahoo! data center design uses outside air through natural convection 99% of the time, with a simple evaporative cooling system accounting for the remaining time.

QUESTION FROM CHAIRMAN HARRIS

EERE/Yahoo Partnership

Q3c. Does providing taxpayer support of Yahoo through this partnership unfairly disadvantage Yahoo's competitors?

A3c. No. Others within the information and communication technology sector, including Yahoo!'s competitors, had equal opportunity to apply for this funding in an open, competitive process based upon the criteria identified above. Moreover, by supporting Yahoo!'s effort to commercialize its new data center design, this partnership is helping to create further energy and cost saving opportunities for data center owners and operators. We understand that it is Yahoo!'s intention to license the unique data center design to other data center operators once a patent has been received on the design and architectural features. Through licensing, others will be able to benefit from the energy saving features created by the unique Yahoo! design.

QUESTION FROM CHAIRMAN HARRIS

Domestic Government and Economic Approaches to Innovation Policy

Q4. Please provide the Committee a detailed list, include specific awards and contracts, of how much money EERE is spending (1) to develop children's computer games; (2) on energy efficiency public service announcements and related ads, and (3) on all energy-related advertising and marketing activities.

A4. The Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy's (EERE) Office of Communications and Outreach (C&O) is not spending any money on children's computer games. Currently, C&O plans to spend the following in FY11 on energy efficiency public service announcements (PSAs) and other energy-related advertising:

- PSAs: C&O is planning to spend approximately $400,000 in FY11 funds and approximately $1,100,000 of prior year funds on advertising through a cooperative agreement with the Ad Council.

- C&O is planning to spend approximately $100,000 - $300,000 of FY11 funds for other energy-related advertising through Sentech, Inc. (now SRA International).

Owners of various media channels are anticipated to donate millions of dollars worth media time and space to air and display the PSAs through 2014. As an example, the most recent energy-related PSA campaign run through DOE and the Ad Council received well more than $60 million in donated media space and time for an approximate $2M investment -- a 30 to 1 return based on donated media. Other Ad Council campaigns (across topic areas) typically receive $30 to $40M per year in donated media.

QUESTION FROM CHAIRMAN HARRIS

Domestic Government and Economic Approaches to Innovation Policy

Q5a. The budget request proposes large increases in funding for solar energy as part of DOE's "SunShot" Initiative. These are in addition to Departmental support for solar technology development through numerous programs, which include the Advanced Research Projects Agency – Energy (ARPA-E) Energy Efficiency and Renewable Energy (EERE), loan guarantees, Energy Frontier Research Centers, and hundreds of millions in Stimulus funding.

How does your office specifically coordinate these programs with other DOE offices to ensure R&D efforts are efficient and avoid duplication of effort?

A5a. The funds requested for SunShot are not in addition to those requested for solar programs through the Office of Advanced Research Projects Agency – Energy (ARPA-E) and the Office of Energy Efficiency and Renewable Energy (EERE) research development and deployment (RD&D) programs. SunShot is an integrated effort that brings together the existing activities from the EERE Solar Energy Technologies Program, one program from ARPA-E (focused on component level power electronics for power inverter technologies), and the Office of Science (SC), which is focused on the basic science aspects of solar energy conversion. These complementary competencies are brought to bear to solve the critical basic, applied, manufacturing and deployment issues of relevance to solar electricity generation and deployment. These RD&D activities across DOE are integrated through the active participation of an RD&D management team that consists of two program level managers from SC/Basic Energy Sciences (BES), two from ARPA-E and four from EERE, and the director of SunShot. Furthermore, this RD&D management team reports to an internal management team consisting of Bill Brinkman (SC), Arun Majumdar (ARPA-E) and Henry Kelly (EERE), who ensure that the SunShot resources are being effectively utilized with no overlap. SunShot actively seeks the

participation of the external stakeholders including national labs, industry players, financial institutions and academia through a series of workshops that assist in the formulation of the RD&D agenda.

The participating SunShot programs have complementary approaches to supporting research on solar energy-relevant problems. While EERE pursues improvements in the performance and cost of solar modules, ARPA-E is focusing on essential power electronics that are critical for stable solar grid integration. These research and development projects focus on near-term technological milestones and deliverables in three to five years. SC/BES projects are targeted at improved fundamental scientific understanding of the underlying phenomena or materials. In some cases, this advanced understanding does not immediately result in technological improvements, but identifies a research pathway that is likely to produce revolutionary advances in solar energy in the next 10–20 years.

The purpose of Sunshot is two-fold:

1. SunShot is a technical program and framework that leverages and focuses the solar-related effort across DOE toward a common goal of achieving cost parity for solar electricity (without subsidies) with the rest of the grid, within this decade. This would allow solar electricity to become cost-competitive with fossil fuel throughout the U.S. and the world, enabling market-driven scale-up and deployment. We estimate this cost parity to be equivalent to one dollar per watt of capacity ("a dollar a

watt") or 4–5 cents per kWh equivalent. Reaching this goal will make the U.S. globally competitive within a very large export market.

2. SunShot is not an initiative separate from the existing solar activities in EERE, SC, and ARPA-E. Rather, it is an initiative intended to coordinate existing activities in DOE to make the whole greater than the sum of the parts. The SunShot Initiative leverages the different strengths and capabilities of several DOE programs and incorporates newly focused efforts to achieve its goal of making solar electricity cost-competitive and bolstering U.S. global competitiveness in this area. This goal incorporates advances in the performance and cost of solar modules driven by EERE, progress in power electronics crucial for solar grid integration driven by ARPA-E, and fundamental materials advances driven by SC. The targets and R&D directions of each of these offices have been developed through extensive collaboration and interaction, including coordination with the Office of Electricity Delivery and Energy Reliability, and topic-specific workshops.

QUESTION FROM CHAIRMAN HARRIS

Domestic Government and Economic Approaches to Innovation Policy

Q5b. The budget request proposes large increases in funding for solar energy as part of DOE's "SunShot" Initiative. These are in addition to Departmental support for solar technology development through numerous programs, which include the Advanced Research Projects Agency – Energy (ARPA-E) Energy Efficiency and Renewable Energy (EERE), loan guarantees, Energy Frontier Research Centers, and hundreds of millions in Stimulus funding.

Please detail all programs and activities within your office that support solar energy-related research, development, demonstration, deployment and commercialization activities, and detail how the FY12 budget request would supplement existing programs.

A5b. Solar research and development activities are supported in the Office of Science, the Office of Advanced Research Projects Agency – Energy, and the Office of Energy Efficiency and Renewable Energy. The programmatic activities in each of these offices are very different, and when combined form a continuum of research efforts from very fundamental scientific discoveries of new phenomena to deployment of new, energy relevant technologies.

The attached table provides a detailed description of ongoing FY11 activities in the Solar Energy Technologies Program. The table also includes the anticipated funding levels, a simple comparison between fiscal years, and a brief justification for the change in each activity area to complement the extensive information included in the FY12 Congressional Budget.

Activity Areas	2011 Enacted Subtotal	Description	2012 Request Subtotal	Net Change	Justification – ongoing and new activities
A.1 Advanced Photovoltaic (PV) R&D	$37,508,061	Primary focus on TRL 2, 3 and 4, with a strong focus on exploring next generation PV, implementing new concepts, and addressing pathways to enhance cell level efficiencies. The Solar Energy Technologies Program photovoltaic (PV) research in new devices emphasizes the development of novel PV devices and processes with potentially significant performance or cost advantages. The proposed research will target the following photovoltaic areas: Design, development, and preliminary degradation testing of lab-scale device prototypes; Completion of process demonstrations in lab-scale evaluations; Preliminary science investigations or literature review without component or system prototype development; Assessment of initial technical and market product or process technology concepts using laboratory investigations; Physics-based modeling; Parametric estimation; Other relevant analytical methods. http://www1.eere.energy.gov/solar/new_devices_and_processes.html	$85,000,000	$47,491,939	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/W 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/W. Foundational Program to Advance Cell Efficiency- 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. FPACE 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 (CIGS) and Cadmium Telluride (CdTe). NL Core Conversion Technology Research- 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 Advanced PV R&D allocation is directly aimed at fully leveraging this prior investment to accelerate the RD&D of solar technologies Funding increases in this core area of research and development from FY 2011 to the Budget Request in FY 2012 increase the program's activities at the TRL 2,3,4 level. These activities are critical to the SunShot Initiative's strategy to develop game changing technologies which innovate the solar industry and enable the U.S. to lead the world in solar energy technology today and in the future with the most efficient and cost effective PV conversion technologies.
A.2 Prototype Cell Development	$19,672,292	The Solar Energy Technologies Program photovoltaic (PV) research in photovoltaic (PV) component and system prototypes emphasizes development of prototype components and systems produced at pilot-scale. The PV Incubator program is the center piece of this effort. The demonstration of cost, reliability, or performance advantages is required. The proposed photovoltaic research will target the following: Development of component prototype design with full functionality and complete "look and feel" of commercial products, Accelerated and qualifications testing to improve component design and gain early insight into reliability issues, Complete proof of concept for all new manufacturing processes in pilot-scale operations, Lab testing to provide data for systems integration and optimization, Evaluation of component costing based on pilot production processes. This PV research focuses on one area: SunShot Incubator Project — targets development of PV systems and component prototypes with full functionality, produced in pilot-scale operations. http://www1.eere.energy.gov/solar/prototype_components_systems.html	$30,000,000	$10,327,708	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 companies reach the stage of development between laboratory concept and pilot scale prototype. This critical part of the SunShot Initiative enables innovative ideas to be cultivated and developed into prototypes ready for larger scale production. This early stage program enables new businesses to develop from start up concepts to successful manufactures.

Activity Areas	2011 Enacted Subtotal	Description	2012 Request Subtotal	Net Change	Justification -- ongoing and new activities
A.3 PV Supply Chain R&D	$4,087,139	The Photovoltaic (PV) Supply Chain and Cross-Cutting Technologies project identifies and accelerates the development of unique PV products or processes that will impact the solar industry. 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 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. The cost reduction as a result of these improvements might be small in terms of a single product or processing step, however the overall impact of these ideas become significant when implemented across the PV industry. The funded projects range from automated assembly to semiconductor fabrication, and target manufacturing and product cost reduction with the potential to have an impact within 2 to 6 years on a substantial segment of the PV industry. http://www1.eere.energy.gov/solar/pv_supply_chain.html	$25,000,000	$20,912,861	PV Supply Chain and Cross-Cutting Technologies: increased funding for this project would enable the program to identify and accelerate the development of unique PV products or processes that will impact the solar industry. The project supports the $1/WDC 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 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.
B.1 Innovations in Manufacturing	$49,167,599	The SunShot Advanced Manufacturing Partnerships (AMP) invests in manufacturing-focused research projects that strengthen the competitiveness of the U.S. PV module industry and supply chain. SunShot AMP funding also establishes manufacturing development facilities that provide infrastructure for demonstrating, testing, optimizing, and manufacturing new technologies with reduced capital requirements. The goals of the SunShot Advanced Manufacturing Partnerships are to: Help the solar power industry overcome technical barriers; Reduce costs for PV installations; Help the United States regain the lead in the global market for solar technologies; Provide support for clean energy jobs for years to come. http://www1.eere.energy.gov/solar/advanced_manufacturing_partnerships.html	$125,000,000	$75,832,401	PV Manufacturing Initiative (PVMI) I, PVMI II, & The Module Performance Accelerator projects: Module Performance Accelerator ($50M): As part of achieving the PV subprogram's $1/$W_{DC}$ and LCOE cost-competitiveness goals, the Module Performance Accelerator will focus on increasing efficiency and reducing cost to create a pathway to $0.50/W modules before the end of the decade. Aggressive development of new production-scale PV designs and processes at both large and small U.S. PV companies will be necessary to close the gap between production module and laboratory prototype cell efficiencies and to achieve $0.50/W modules. This effort will allow U.S. PV companies to accelerate PV module development beyond their existing technology roadmaps. It will enable industry to leverage its expertise to pursue innovative high-impact technologies with a higher level of risk than companies could otherwise afford in a competitive production environment. Increased funding 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% of the cost structure for the $1/W goal.
B.2 Measurements and Characterization	$2,946,000	The Measurements and Characterization for Photovoltaics provides characterization support, collaborative research, 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, Surface Analysis. http://www.nrel.gov/pv/measurements/	$13,200,000	$10,254,000	Measurements and Characterization: This activity provides characterization support, collaborative research, 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, Surface Analysis.

Activity Areas	2011 Enacted Subtotal	Description	2012 Request Subtotal	Net Change	Justification -- ongoing and new activities
C.1. Concentrating Solar Power (CSP) Advanced Research	$8,434,585	CSP Advanced R&D: 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 •Broaden and unify test methods to standardize qualification requirements of CSP materials, components, and systems. Three specific focus areas are: •Mirror characterization and testing •Testing standards and reliability testing methods •Industry support http://www1.eere.energy.gov/solar/component_systems_rnd.html	$10,000,000	$1,565,415	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 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 higher temperature materials developed in cooperation with industry; Broaden and unify test methods to standardize qualification requirements of CSP materials, components, and systems.
C.2. CSP Component, Systems Development, and Demonstration	$26,476,500	CSP Component Development and Demonstration: Linear Concentrator Systems—includes R&D on parabolic troughs, but also, on other line-focus systems such as linear Fresnel reflectors. Dish/Engine Systems—includes R&D on dish structures, mirrors, and Stirling engines. Power Tower Systems—includes links to R&D being done within other CSP areas, but that are relevant to heliostats, receivers, and overall systems issues for central-receiver solar plants. http://www1.eere.energy.gov/solar/csp_program.html	$29,200,000	$2,723,500	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 labs will continue work on optical tool development and performance and economic modeling software as a compliment to the hardware development performed as a part of the previously mentioned solicitation.
C.3. Thermal Storage	$5,882,715	DOE funds thermal storage R&D through these key partnerships: Industry, University, National laboratories. The key goals for TES R&D are: Develop and deploy advanced heat-transfer fluids (HTF) and thermal storage systems, Characterize advanced heat-transfer fluids and thermal storage systems to reduce storage costs, Integrate thermal storage cost and performance models into CSP system models. The selected R&D projects support the DOE goal of reducing the cost of CSP electricity from 13–16 cents per kilowatt-hour (kWh) with no storage in 2008 to 9–12 cents/kWh with six hours of storage by 2015, and to 6 cents/kWh with 12–17 hours of storage by 2020. http://www1.eere.energy.gov/solar/thermal_storage_rnd.html	$10,000,000	$4,117,285	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 advanced heat-transfer fluids and thermal storage systems to reduce storage costs, and integrate thermal storage cost and performance models into CSP system models.

Activity Areas	2011 Enacted Subtotal	Description	2012 Request Subtotal	Net Change	Justification – ongoing and new activities
D.1. Balance of System Development	$10,659,000	Balance of Systems (BOS) includes research, development, and demonstration of new components and system designs or the development of new building code language to overcome scientific, technological, and engineering barriers to achieve safe, very low cost, and high reliability balance of system hardware. Three year FOA topics include: Transformational Building Integrated Photovoltaic (BIPV) Modules , Roof and Ground Mount Innovations, Transformational Photovoltaic System Designs , Development of New Wind Load Codes for PV Systems http://www1.eere.energy.gov/solar/sunshot/financial_opps_detail.html?sol_id=394	$55,000,000	$44,341,000	PV Balance of Systems (Hardware)- PV Balance of Systems (PV-BOS) ($45 M): PV BOS is a focused effort around addressing the major factors of the BOS costs. Module prices have fallen significantly in recent years and currently only represent between 33 percent and 50 percent of the total system cost (dependent on a number of factors including system size). The cost associated with the non-module part of the system is often referred to as the Balance of Systems (BOS). The PV-BOS program 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 building integrated PV (BIPV) which can allow the PV material to replace a functional outer surface of commercial and residential buildings. An example includes 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 technology development will be coordinated with the System Integration sub-program and pursued in partnership with the EERE Building Technologies Program in order to more effectively utilize the solar energy incident on the entire building envelope.
D.2. Grid Integration	$25,892,692	Grid integration work, within the Systems Integration subprogram, helps resolve the issues associated with having a high penetration of solar technologies on the electricity grid, including: Variability, Voltage regulation, System reliability. As part of the grid integration effort, the Systems Integration subprogram developed the Solar Energy Grid Integration Systems (SEGIS) Program. SEGIS collaborates with industry partners to develop advanced photovoltaic (PV) systems with intelligent interfaces that seamlessly integrate solar into the electricity grid. http://www1.eere.energy.gov/solar/sunshot/finding_solutions.html	$13,500,000	-$12,392,692	Resources have been reclassified for Balance of Systems Development projects.
D.3. Technology Validation	$26,746,479	Technology validation efforts, within the Systems Integration subprogram, focus on reducing the risk of new and existing solar technologies by developing protocols for testing, evaluating, and improving the performance and reliability of solar systems. In addition to sharing system modeling software with stakeholders, the technology validation effort also develops codes and standards to facilitate new technologies—especially those developed under the SunShot Initiative—entering the marketplace. http://www1.eere.energy.gov/solar/sunshot/validating_technologies.html	$14,500,000	-$12,246,479	Resources have been reclassified for Balance of Systems Development projects.
D.4. Solar Resource	$2,863,267	As part of its solar resource development effort, the Systems Integration subprogram develops new techniques for forecasting and methods for evaluating the solar resource across the United States. This work is essential for making large-scale solar energy systems cost competitive by the end of the decade, which is a primary goal of the SunShot Initiative. The efforts below highlight DOE-funded progress in solar resource development. http://www1.eere.energy.gov/solar/sunshot/assessing_solar_resources.html	$3,000,000	$136,733	No Significant Change

Activity Areas	2011 Enacted Subtotal	Description	2012 Request Subtotal	Net Change	Justification – ongoing and new activities
D.5. Systems Analysis	$0	The system analysis efforts within the Systems Integration subprogram focus on two areas: Technical modeling, simulation, and analysis, Economic modeling and policy analysis. System analysis of renewable energy focuses on analyzing the technical, economic, and policy aspects of the impacts of high levels of renewables on the power grid. Within the Systems Integration subprogram, these analytical activities include developing scenarios of photovoltaics (PV) in the electrical distribution system, identifying barriers to these scenarios, and providing solutions to enable higher levels of renewables, primarily distributed, to connect with the grid. http://www1.eere.energy.gov/solar/systems_analysis.html	$2,150,000	$2,150,000	No Significant Change. Ongoing activities in FY 2011 were supported with funding "carried over" from FY 2010. This resulted in no additional FY 2011 funding being added to the activity. In FY 2012 additional funding will be required to continue this activity.
E.1. Market Barrier Reduction	$15,220,000	Market Transformation (MT): Reduces the market barriers to widespread dissemination of solar technologies, including: A shortage of information about solar technologies and little consumer awareness, Insufficient product standards, Inconsistent interconnection, net metering, and utility rate structures and practices for solar systems, Inadequate codes and zoning laws, Inconsistent state and local financial incentives and other market drivers, A lack of flexible, sophisticated, and proven financing mechanisms, Limited education for and insufficient numbers of trained and experienced personnel and services	$10,750,000	-$4,470,000	Funding has been re-classified to the Non-Hardware BOS projects.
E.2. Non-Hardware BOS Cost Reduction	$8,130,000	MT activities significantly reduce market barriers and the balance of system non-hardware cost components of photovoltaic (PV) systems. Activities to reduce costs by improving information technology systems and streamlining the implementation of building codes and complex and expensive permitting procedures, and business processes for installing solar systems. Cross-cutting multi-year FOA topics include: Codes, Standards, and Processes, Software Design Tools and Databases, Utility-Scale Project Siting Tool, Plug-and-Play Tools to Facilitate Preparation and Review of Permit Applications, Database of PV Permitting Processes in Authorities Having Jurisdiction (AHJ), PV System Verification Tool, Utility Rates Database, Regulatory, Financial, and Utility Solutions http://www1.eere.energy.gov/solar/sunshot/financial_opps_detail.html?sol_id=409	$16,250,000	$8,120,000	Our Market Transformation activities from 2011 have evolved significantly into more of an R&D activity, focused on using standard scientific techniques of data collection, analysis and the development of algorithms to reduce the permitting costs/time for solar installation. This is reflected in the lower percentage funding allocation for this topic area. Activities address non-hardware BOS cost by reducing the costs of permitting, interconnection, inspection, installation, and siting.
Program and Facilities Management	$15,851,971		$10,000,000	-$5,851,971	Program Management activities have been realigned to support the program's new management structure, reducing the resources required to support program operations and management.
SBIR/STTR	$3,944,000		$4,450,000	$506,000	No Significant Change
Unplanned Amount	$17,700				
Total	$263,500,000		$457,000,000	$193,517,700	

QUESTION FROM CHAIRMAN HARRIS

Domestic Government and Economic Approaches to Innovation Policy

Q6. Similarly, battery and energy storage RDDD&C is funded through numerous programs throughout DOE, and the Administration is proposing to create a new batteries hub as well as increase existing programs.

Please detail all programs and activities within your respective office that support battery and energy storage-related R&D, and detail how the FY12 budget request would supplement existing programs.

A6. The Department of Energy (DOE) supports a robust battery and energy storage research and development (R&D) effort across multiple offices, including the Office of Energy Efficiency and Renewable Energy (EERE), Office of Electricity Delivery and Energy Reliability (OE), the Office of Advanced Research Projects Agency-Energy (ARPA-E), and the Office of Science (SC). DOE's Energy Storage Working Group (ESWG) ensures coordination of current research and strategic planning across programs and offices and links researchers to facilitate information sharing and coordination across the basic science/deployment continuum. The ESWG holds joint workshops, facilitates mutual participation in peer reviews, and enables joint principal investigator meetings. These actions ensure shared understanding of the work and prevent duplication while leveraging resources and expertise across programs.

Within EERE, the FY12 budget request for the Vehicle Technologies Program includes $136 million for battery-related R&D. EERE conducts applied research that supports the development of advanced high-energy batteries for plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) and advanced materials to enable the development of next generation batteries and systems. Low-cost, abuse-tolerant batteries with higher energy, higher power, and lower weight are needed for the development of

the next generation of PHEVs and BEVs. The FY12 budget request includes funding to support the Battery Readiness Initiative (BRI), intended to move battery technologies closer to market entry through the design and development of advanced pre-production battery prototypes. The BRI will accelerate the development of advanced battery computer-aided engineering tools and support battery standardization activities, as well as facilitate market entry of advanced battery materials by supporting material scale-up, pilot production, and commercial sampling activities. These activities will help to accelerate the development of lower-cost, higher-performing, and more abuse-tolerant batteries that will lead to faster adoption of electric drive vehicles in the marketplace.

The Department's budget request for FY12 includes $57 million for energy storage R&D activities in OE. The OE energy storage program is focused on reducing capital and lifecycle costs of storage systems. This includes the development of inexpensive self-assembled lithium-ion electrodes and cells with potential for meeting performance requirements for community energy storage; continued development of novel lead-carbon batteries with potential photovoltaic applications showing vastly increased cycle life compared to traditional lead-acid batteries; and work on compressed air energy storage to reduce uncertainties in evaluating deployment feasibility. The FY12 request also includes development and testing of analysis and modeling tools, field testing with renewable energy developers and utilities, and outreach to educate regulators and other non-technical stakeholders in energy storage. Funds would also support a new solicitation for highly leveraged grid-scale energy storage demonstrations to build on

work initiated under the American Recovery and Reinvestment Act and on promising Small Business Innovation Research and ARPA-E projects.

The Department's FY12 budget request includes $16.4 million for battery-related research in the DOE-SC, Basic Energy Sciences (BES). The BES core program supports fundamental research to understand the underlying science of materials and chemistry issues related to electrical energy storage. Current projects focus on electrode and electrolyte phenomena. Six Energy Frontier Research Centers (EFRCs) are conducting fundamental research on electrical energy storage with a link to new energy technologies or technology roadblocks, addressing subject matter from among a large set of scientific grand challenges and electrical energy storage-related topics based on the *"Directing Matter and Energy: Five Challenges for Science and the Imagination"* and *"Basic Research Needs in Electrical Energy Storage"* reports, respectively. Research focuses on tailored interfaces, nanostructures, and fundamentals of chemistry and chemical reactions for energy storage.

The Department's FY12 budget request also proposes a new Batteries and Energy Storage Hub to be supported with $24 million, plus one-time funding of $10 million for Hub start-up needs (and that excludes new construction). The proposed Hub would integrate fundamental research through potential commercialization of electrical energy storage relevant to transportation and the electric grid. The Hub would address a number of specific areas of research that include efficacy of materials architectures and structure in energy storage, charge transfer and transport, electrolytes, multi-scale modeling, and

probes of energy storage chemistry and physics at all time and length scales. However it would focus on next-generation energy storage technologies beyond those currently supported by DOE and it would comprise a large set of disciplines with investigators spanning science, engineering, and policy disciplines in a single, integrated facility

QUESTION FROM CHAIRMAN HARRIS

Domestic Government and Economic Approaches to Innovation Policy

Q7. In order to allow the Committee to better review and assess relevant program spending, please provide a list of all active spending on grants, contracts, cooperative agreements, loan guarantees, cash prizes, and 'other transactions' awards supported within your office.

A7. The following spreadsheet outlines the Office of Energy Efficiency and Renewable Energy's (EERE) FY10 and FY11 Program spending amounts by award type. Additionally, EERE recently developed a Project Funding widget that includes all closed and active project grants, contracts, cooperative agreements, and discretionary grants supported within EERE dating back to 1994, which is publicly available for viewing these details. EERE does not issue loan guarantees. The widget may be found at: http://www1.eere.energy.gov/office_eere/.

2010 and 2011 EERE Program Obligation Amounts by Award Type

As of June 30, 2011

Data Source: IDW STARS

Awarded Amount	Column Labels		
Program, Award Type, Recipient, Awardee	2010	2011	Grand Total
Biomass	$215,258,307	$59,517,374	$274,775,681
Cooperative Agreement	$109,054,231	$2,277,360	$111,331,591
Grants	$11,630,717	($16,981)	$11,613,736
Other	$792,674	$662,663	$1,455,337
Contracts and Orders	$93,780,685	$56,594,333	$150,375,018
Building Technologies Program	$193,680,348	$150,646,605	$344,326,953
Cooperative Agreement	$25,580,177	$26,440,013	$52,020,190
Grants	$2,600,000	$235,592	$2,835,592
Other	$4,449,815	$7,271,745	$11,721,560
Contracts and Orders	$161,050,356	$116,699,255	$277,749,611
Congressionally Directed Projects	$205,027,133	$31,677,592	$236,704,725
Cooperative Agreement	$18,925,000	($5,429,505)	$13,495,495
Grants	$181,845,433	$37,290,369	$219,135,802

Contracts and Orders	$4,256,700	($183,271)	$4,073,429
Facilities and Infrastructure	$19,000,000	$36,416,040	$55,416,040
Contracts and Orders	$19,000,000	$36,416,040	$55,416,040
Federal Energy Management Program	$31,753,509	$18,947,373	$50,700,881
Other	$677,834	$2,719,426	$3,397,260
Contracts and Orders	$31,075,675	$16,227,946	$47,303,621
Geothermal Technology	$43,120,000	$9,083,259	$52,203,259
Cooperative Agreement	$8,482,326	($9,201)	$8,473,125
Grants	$12,613,767	$289,457	$12,903,224
Other	$2,138,351	$37,441	$2,175,792
Contracts and Orders	$19,885,556	$8,765,561	$28,651,117
Hydrogen Technology	$170,286,895	$61,663,048	$231,949,943
Cooperative Agreement	$24,689,042	$3,950,496	$28,639,538
Grants	$39,559,258	$13,008,896	$52,568,154
Other	$6,398,081	$2,249,251	$8,647,332
Contracts and Orders	$99,640,514	$42,454,405	$142,094,919
Industrial Technology	$94,270,082	$44,052,819	$138,322,901
Cooperative Agreement	$25,763,760	$8,111,120	$33,874,880
Grants	$22,231,826	$10,493,087	$32,724,913
Other	$1,044,951	$251,110	$1,296,062
Contracts and Orders	$45,229,545	$25,197,501	$70,427,046
Other	$0	($143,631)	($143,631)
Cooperative Agreement	$0	($165,123)	($165,123)
Other	$0	$21,492	$21,492
Program Direction	$139,474,801	$98,632,469	$238,107,270
Cooperative Agreement	$0	$3,850	$3,850
Grants	$100,000	$108,433	$208,433
Other	$98,800,807	$89,020,201	$187,821,009
Contracts and Orders	$40,573,993	$9,499,985	$50,073,978
Program Support	$43,522,933	$9,637,641	$53,160,574
Cooperative Agreement	$350,000	$1,498,062	$1,848,062
Grants	$2,148,952	$0	$2,148,952
Other	$2,395,758	$177,000	$2,572,758
Contracts and Orders	$38,628,223	$7,962,579	$46,590,802
Solar Energy	$241,494,059	$77,979,744	$319,473,803
Cooperative Agreement	$51,375,234	$7,321,530	$58,696,764
Grants	$34,718,985	$6,592,289	$41,311,274
Other	$647,947	$3,566,243	$4,214,190

Contracts and Orders	$154,751,893	$60,499,682	$215,251,575
Vehicle Technology	$304,223,000	$167,483,443	$471,706,443
Cooperative Agreement	$73,414,549	$19,861,187	$93,275,736
Grants	$10,914,436	$390,120	$11,304,556
Other	$10,966,548	$2,891,098	$13,857,646
Contracts and Orders	$208,927,467	$144,341,038	$353,268,505
Water Power Energy R&D	$48,448,627	$14,476,086	$62,924,713
Cooperative Agreement	$378,000	$0	$378,000
Grants	$22,154,313	$3,329,657	$25,483,970
Other	$996,041	$388,690	$1,384,731
Contracts and Orders	$24,920,273	$10,757,740	$35,678,013
Weatherization and Intergovernmental Programs	$269,114,185	$131,247,733	$400,361,918
Cooperative Agreement	$16,539,100	$381,286	$16,920,386
Grants	$243,904,003	$128,070,938	$371,974,941
Other	$310,000	($22,102)	$287,898
Contracts and Orders	$8,361,082	$2,817,612	$11,178,694
Wind Energy Systems	$78,205,473	$38,130,095	$116,335,568
Cooperative Agreement	$1,505,502	$434,492	$1,939,994
Grants	$11,286,734	$731,521	$12,018,255
Other	$3,369,600	$1,596,918	$4,966,518
Contracts and Orders	$62,043,637	$35,367,164	$97,410,801
Grand Total	$2,096,879,352	$949,447,691	$3,046,327,043

Other: Includes reimbursement for merit reviewers and interagency agreements for small joint activities, such as conferences or internships.

Note: Credit reflect deobligation of prior years' obligations.

QUESTION FROM CHAIRMAN HARRIS

Role of Government/Funding for Large Corporations

Q8. As I'm sure you're aware, DOE awards millions in R&D funding to large multinational corporations, such as Dow Chemical, DuPont, GE, and Phillips Lighting, to name just a few.

Please explain how EERE evaluates funding applications from corporations to ensure they aren't already pursuing the proposed activities, and that tax dollars aren't simply supplanting private funding.

A8. The Office of Energy Efficiency and Renewable Energy's (EERE) uses a comprehensive approach to planning, implementing and evaluating its programs and projects to ensure effective investment of tax dollars. In advance of issuing a funding opportunity, EERE programs identify technology gaps and challenges, and priority research and development areas, through discussions and workshops with experts in industry, universities, national laboratories, and other stakeholder organizations.

All applications submitted to EERE funding opportunities go through a robust merit review process that includes evaluation by individual independent experts followed by a panel discussion for the final external ratings. The applications and the external evaluations are then reviewed by a panel of Federal experts. Federal reviewers also ensure that the industry cost share is appropriate to the technology readiness level proposed, a minimum of 20% for R&D projects and a minimum of 50% for demonstrations.

After projects are selected, EERE program managers typically conduct site visits to monitor progress. These site visits also enable managers to see other work being pursued

by industry. In addition, EERE projects are presented and evaluated annually at program peer review meetings. All reviewers are screened by EERE program managers to ensure that they are qualified experts with no conflicts of interest.

QUESTION FROM CHAIRMAN HARRIS

Clean Technology Subsidies

Q9. The Administration's goal is to make a solar technology grid competitive with existing sources of electricity and enable it to scale-up without subsidies. Using this criteria, how will projects be evaluated? If, for example, current existing demonstration and deployment programs turn out to be considered successful, will that enable those respective technologies to compete with fossil generated electricity absent subsidies?

At what point is a technology commercially viable and able to scale-up or subsist without the generous tax credits?

A9. At a total installed system cost of utility solar equivalent to the wholesale cost of electricity from fossil fuels — approximately $.05–$.06 per kilowatt-hour (kWh) — utility solar will be commercially viable without tax credits or subsidies of any kind. To achieve $.05–$.06 per kWh, the installed cost for a photovoltaic (PV) system must be approximately $1 per watt. Through the Department of Energy's (DOE) SunShot Initiative, DOE is supporting research, development, demonstration, and deployment projects to achieve that cost by the end of the decade. That cost represents approximately a 75% reduction in cost from today's level for utility-scale PV systems, and projects will be deemed successful as they make meaningful contributions to that reduction.

QUESTION FROM CHAIRMAN HARRIS

National Clean Fleets Partnership

Q10a. According to an April 1, 2011 White House press release, the Administration announced the National Clean Fleets Partnership as part of the DOE Vehicle Technology Program's CleanCities Initiative. DOE will accordingly provide specialized resources, technical expertise and support to the charter members, including Fortune 500 companies with large commercial fleets such as AT&T, FedEX, PepsiCO, UPS and Verizon. By joining the partnership companies will enjoy benefits such as peer-to-peer information exchange; collaboration with DOE and national laboratories surrounding research and development initiatives; and assistance in pursuing group purchasing.

How much DOE funding is going to companies for this program?

A10a. The Department of Energy (DOE) does not provide funding directly to companies that join the Clean Fleets Partnership. Like any other company or fleet, Clean Fleet Partners may be eligible to submit proposals under DOE funding opportunity announcements (FOAs) as part of an open and competitive process.

QUESTION FROM CHAIRMAN HARRIS

National Clean Fleets Partnership

Q10b. According to an April 1, 2011 White House press release, the Administration announced the National Clean Fleets Partnership as part of the DOE Vehicle Technology Program's CleanCities Initiative. DOE will accordingly provide specialized resources, technical expertise and support to the charter members, including Fortune 500 companies with large commercial fleets such as AT&T, FedEX, PepsiCO, UPS and Verizon. By joining the partnership companies will enjoy benefits such as peer-to-peer information exchange; collaboration with DOE and national laboratories surrounding research and development initiatives; and assistance in pursuing group purchasing.

Under this program, does the Department have any evaluation criteria that consider the financial capability of the participants to address the needs of their commercial fleet on their own?

A10b. The National Clean Fleets Partnership is open to fleets that own or have contractual control over at least 50% of their vehicles and have vehicles operating in multiple states. The Department of Energy (DOE) works with Clean Fleet Partners to develop individual petroleum reduction plans that identify practical and feasible measures and steps to help them reduce their gasoline and diesel fuel consumption in daily fleet operations. Because DOE does not provide funds directly to companies in the National Clean Fleets Partnership, resource leveraging and teaming arrangements among private-sector partners are a key part of any proposed planning and sustainability analysis.

QUESTION FROM CHAIRMAN HARRIS

EERE – Industrial Technologies Program

Q11. The DOE Industrial Technologies Program (ITP) requested an increase of $226 million, or 240 percent, for the FY12 budget. DOE describes an effort within the program as providing companies tailored assistance with establishing an energy intensity baseline and developing an energy management plan. Dozens of major national corporations are listed as participants, including Dow, Whirlpool, Nissan and AT&T.

What is EERE's rationale to spend tax dollars to support the manufacturing operations of these major corporations? Please identify the lack of incentive for these companies to take steps to increase energy efficiency as a means to reduce cost and increase competitiveness.

A11. U.S. manufacturers continue to significantly under-invest in proven energy management practices and technologies even though practical, cost-effective savings opportunities are available to them.[1,2] In significant part, this situation is the result of barriers that impede greater investment in energy efficiency, including such causes as inadequate information on energy efficiency opportunities, lack of technical expertise to pursue those opportunities, and competition for capital with other business priorities. In accordance with Section 106 of the Energy Policy Act of 2005, the Industrial Technologies Program (ITP) launched the *Save Energy Now* LEADER program to provide industry sufficient information to overcome these barriers with a suite of online ITP tools, training, and information resources for companies to use in identifying energy-saving opportunities and implementing plans for continual energy management improvement and increased manufacturing competitiveness. As companies' understanding of how to capture energy-

[1] McKinsey analysis indicates that, over ten years, $442 billion can be achieved with $113 billion in upfront investment (2009 $U.S.) in cost-effective energy efficiency improvements. Savings achieved are net present value (NPV) positive for the 10-year period of 2010-2020. Source: McKinsey & Company. *Unlocking Energy Efficiency in the U.S. Economy*. July 2009.

[2] According to EIA's latest *Manufacturing Energy Consumption Survey*, 82% of manufacturing companies do not have a designated energy manager, 60% have not set efficiency goals, and 78% have never conducted an energy audit of their facilities. Source: U.S. Energy Information Administration. *Manufacturing Energy Consumption Survey 2006*: Table 8.4. U.S. Department of Energy. June 2009.

saving opportunities grows, they will increasingly demand private-sector services and efficient technologies that lead to new jobs and improved competitiveness. The Department of Energy's (DOE) primary role in working with these companies is to provide information as well as recognition for continual energy improvement.

In addition, DOE is supporting the implementation of the ISO50001 energy management standard through its Superior Energy Performance (SEP) program. Through SEP, ITP is developing energy baselining tools and protocols to help companies to measure and manage their energy use in a standard and comparable way. Many LEADER companies also participate in the SEP program. ITP is funding the establishment and early-years administration of the SEP program. We project that the program will become self-sustaining based on user certification fees by the end of 2014. This projection is based on our estimates of the rate of uptake of the SEP program by industry, and the level of revenues realized from application fees in the early years.

QUESTION FROM CHAIRMAN HARRIS

E15 DOE Vehicle Studies

Q12a. In providing a partial waiver for midlevel ethanol blends, specifically E15, under the Clean Air Act, the EPA relied almost exclusively on a so-called DOE Catalyst Study that purported to claim that E15 would not cause emissions violations in light-duty vehicles. This study was ongoing when the EPA issued their November 2010 decision for Model Year 2007 and new vehicles.

What was the role of DOE and EERE in interpreting this date for EPA? Do you believe this study adequately investigated the long-term effects from using E15 in vehicles?

A12a. The Department of Energy (DOE) Catalyst Study, conducted with the Coordinating Research Council (CRC), included 86 vehicles at three independent test laboratories and comprised more than six million miles and more than 1,000 emissions tests at a cost of approximately $21 million over two years. DOE provided the vehicle testing data to the Environmental Protection Agency (EPA) and CRC in a continuous manner and as soon as possible following completion of the laboratories' internal quality checks. The internal quality checks were necessary to ensure each test was valid and not affected by errors such as failed test instruments. DOE did not interpret or analyze the data for either EPA or CRC.

The scope of the testing program was designed to give the best possible determination of the long-term effects of E15 on emissions control systems, within budget and time constraints. The program included experts from DOE, EPA, and major automotive and oil companies to ensure it would provide the most relevant data for public policy decisions. The DOE Catalyst Study is the most comprehensive study of emissions durability with E15 that exists to date.

QUESTION FROM CHAIRMAN HARRIS

E15 DOE Vehicle Studies

Q12b. In providing a partial waiver for midlevel ethanol blends, specifically E15, under the Clean Air Act, the EPA relied almost exclusively on a so-called DOE Catalyst Study that purported to claim that E15 would not cause emissions violations in light-duty vehicles. This study was ongoing when the EPA issued their November 2010 decision for Model Year 2007 and new vehicles.

In that same month, a National Renewable Energy Laboratory report showed that long-term exposure tests of vehicles with intermediate ethanol blends resulted in significant leaks and failures in hoses, nozzles, swivels, meters, manifolds, valve assemblies, and breakaway couplings. Considering EPA's heavy reliance on DOE date for their decision, did the Department or EERE specifically communicate these results to EPA?

A12b. The National Renewable Energy Laboratory (NREL) report focused on fuel dispensing equipment (i.e., service station pumps) – and not vehicles. While NREL did not issue a report assessing the impact of intermediate ethanol blends on leaks in vehicles, it did publish a report resulting from work with Underwriters Laboratory (UL) that tested several fuel dispensing components. The fuel dispensing components were tested under conditions modeled on a recent UL procedure, UL Subject 87A – a more rigorous test than the one used to test E0 and E10 equipment (UL Standard 87) and one that includes high temperatures and aggressive fuels. Results from UL Subject 87A are not directly comparable to results from UL Standard 87 because of the different test conditions. (UL Subject 87A is a newer test procedure for greater-than-10% ethanol blends and is expected to replace UL Standard 87 for gasolines/blends, including E0 and E10, in the near future). These test results do not involve vehicle emission control systems and are not addressed by the decision criteria in Clean Air Act §211(f). Environmental Protection Agency officials in the Office of Underground Storage Tanks, as well as representatives of the American Petroleum Institute, Petroleum Equipment Institute, and

manufacturers of all tested equipment were made aware of the report for their information as soon as possible after publication.

QUESTION FROM CHAIRMAN HARRIS

E15 DOE Vehicle Studies

Q12c. In providing a partial waiver for midlevel ethanol blends, specifically E15, under the Clean Air Act, the EPA relied almost exclusively on a so-called DOE Catalyst Study that purported to claim that E15 would not cause emissions violations in light-duty vehicles. This study was ongoing when the EPA issued their November 2010 decision for Model Year 2007 and new vehicles.

In light of the NREL study, do you believe EPA should reconsider their E15 waiver decision?

A12c. The National Renewable Energy Laboratory (NREL) study on fuel dispensing equipment does not directly address the criteria of Clean Air Act §211(f). The impact of E15 on fuel dispensing equipment will not affect the emissions durability of vehicles.

QUESTION FROM CHAIRMAN HARRIS

Light Bulb Enforcement

Q13a. Last year, Deputy Assistant Secretary Kathleen Hogan testified before the Senate about EERE's responsibility to enforce numerous appliance standards, from refrigerators to light bulbs to showerheads. Dr. Hogan testified that DOE wanted to strengthen its enforcement of appliance standards, and that is specifically wanted to increase the fines for violators of these standards.

What is the status of your office's efforts to crackdown on illegal appliances?

A13a. The Department of Energy (DOE) has established a program to enforce federal efficiency standards systematically and fairly. The Office of Enforcement in the Office of the General Counsel, with the support of the Building Technologies Program in the Office of Energy Efficiency and Renewable Energy (EERE), seeks to ensure that manufacturers meet energy conservation standards and American consumers and businesses realize the energy and cost savings provided by such standards. DOE is working to protect consumers through verification testing on these appliances, while also supporting validation and enforcement for the voluntary ENERGY STAR program to ensure that products bearing the ENERGY STAR symbol deliver the additional energy savings they advertise. The recently published Compliance, Certification, and Enforcement Rulemaking revised procedures covering certification, verification testing, enforcement testing, and adjudication for most covered products and clarifies that DOE may test products at any time. DOE has collected over 700,000 product certification records and is pursuing manufacturers who ignore certification reporting requirements. DOE also pursues all complaints of products suspected of failing to meet Federal standards. To date, DOE has collected over $600,000 in penalties for non-compliance.

QUESTION FROM CHAIRMAN HARRIS

Light Bulb Enforcement

Q13b. Last year, Deputy Assistant Secretary Kathleen Hogan testified before the Senate about EERE's responsibility to enforce numerous appliance standards, from refrigerators to light bulbs to showerheads. Dr. Hogan testified that DOE wanted to strengthen its enforcement of appliance standards, and that is specifically wanted to increase the fines for violators of these standards.

What specific plans are in place to enforce the ban on 100-watt light bulbs when it goes into effect at the end of this year?

A13b. The Department of Energy (DOE) enforces energy conservation standards for all covered products and equipment. DOE investigates all enforcement complaints it receives, including reviewing manufacturer test data and performing product testing. DOE has no additional specific plans outside its aforementioned activities to enforce the 100-watt light bulb standard, which becomes effective at the end of this year.

QUESTION FROM CHAIRMAN HARRIS

Electricity Portfolio

Q14. Please describe EERE's activities to ensure a near-term robust generation portfolio cost competitive with existing forms of fossil generation. Please provide specific examples to support your answer.

A14. The fundamental mission of the Office of Energy Efficiency and Renewable Energy (EERE) is not to ensure generation capacity but rather to conduct applied research and development (R&D) on clean new energy technologies in order to overcome technical and market barriers to commercial adoption of these technologies. EERE addresses the Nation's energy challenges by developing technologies that address our current and future energy needs. This helps keep American companies at the leading edge of emerging clean energy innovation and provides consumers with an array of clean energy sources and energy services that meet their needs.

Through the efforts of this Administration, the U.S. is on track to more than double domestic renewable energy generation – from 71.2 terrawatt-hours (TWh) generation from solar, wind, and geothermal in 2008 to 144.19 TWh of generation in 2012[3].

The Department of Energy (DOE) is also working with the Department of Treasury to implement programs to incentivize new renewable energy projects nationwide and

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[3] Annual Energy Outlook 2011. U.S. Energy Information Administration http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=0-AEO2011&table=16-AEO2011&region=0-0&cases=ref2011-d020911a

expand clean energy manufacturing capacity in the United States. Under the Section 1603 payments-in-lieu-of-tax credits program, for instance, over 15,000 projects have been awarded for a total of $7.7 billion, as of June 16, 2011. This program has led to more than $26 billion in total projects and 30.4 TWh of total estimated electricity generation installed, again as of June 16, 2011. In addition, DOE's cooperation with the Department of Treasury as part of the 48C program enabled $2.3 billion in tax credits for 183 clean energy manufacturing projects across 43 states.

Additionally, DOE is continuing to undertake research, development and demonstration projects to bring down the costs of renewable energy and accelerate the deployment of new renewable energy resources. For instance, DOE's SunShot initiative aims to dramatically reduce the cost of solar energy by the end of the decade through carefully targeted basic and applied research and demonstrations in partnership with industry, and through investments geared towards producing competitively-priced generation from concentrated solar power and solar photovoltaics. The Department is also working with local and municipal governments to reduce the costs and time necessary to permit and install solar energy systems in communities nationwide.

QUESTION FROM CHAIRMAN HARRIS

International Programs

Q15. The EERE International Programs website lists a number of activities conducted by EERE. These activities include:

- funding to "train energy assessors, who will assist manufacturing facilities in China and India to reduce their energy use;"
- "multiple technology and policy efforts to improve energy efficiency in the Chinese building sector;"
- "working with large Indian software companies to promote energy efficiency in the IT sector;"
- "conducting energy assessments to reduce unnecessary energy expenditures and boost productive" in partnership with the government of Kazakhstan.

Please provide a detailed list of all DOE funding for international projects for the three previous fiscal years, including the funding level, date the funding was obligated, project description, program offices involved, and metrics to monitor the success of the project.

A15. The Office of Energy Efficiency and Renewable Energy (EERE) International Program can accelerate progress of the Department of Energy's (DOE) domestic R&D programs by leveraging resources and expertise of partner countries. The program's technical assistance activities help to prime markets for clean technologies in major emerging economies. Working closely with U.S. companies, the Department of Commerce, and other governments, projects focused on product testing, minimum standards, and certification can increase U.S. exports of clean energy technologies (including energy efficiency technologies) and create U.S. jobs.

The program works with rapidly growing emerging economies to serve as test beds for new technologies and policy approaches. The program can bring home lessons learned from others' experience to share at the national, State, and local level (e.g., fostering sharing of policy successes through city partnerships). The program can promote U.S. national security and reduce global demand for oil.

Attached is a list of projects funded by the International Program for FY09, FY10, and FY11 that can help achieve the outcomes described above. For each project, we collect feedback from U.S. companies and other participants through evaluations forms and potentially follow-up contact to assess project outcomes. These evaluations are used to ascertain, upon project completion, effectiveness with influencing U.S. exports of clean energy technologies, sales of U.S. products and services, partner countries' clean energy policy or technology approaches, investors' willingness to fund clean tech projects, and related outcomes. In addition, the program will conduct periodic independent impact evaluations to comprehensively assess overall program success in achieving the outcomes described above, identifying contributions from specific projects to the extent possible.

Other EERE programs support international collaborations that contribute to accelerating domestic program goals. Most notably, the Buildings and Vehicles programs each provided $2.5 million per year in FY10 and FY11 to the U.S. components of the U.S.-China Clean Energy Research Centers (CERC). By working collaboratively and sharing information, the U.S. and China can leverage each other's resources and expertise to tackle common technical challenges. The same logic applies to EERE programs' participation in International Energy Agency tasks and multilateral implementing agreements, as well as with other bilateral R&D cooperation projects (albeit at generally lower funding levels and less formalized than the CERC.)

It is important to note that all international projects funded both by the International Program and by other EERE programs support U.S.-based project performers and do not transfer funds to foreign governments. For example, the competitively selected CERC Vehicles prime awardee is the University of Michigan. (More information about CERC Vehicles project performers is available here: http://www.us-china-cerc.org/Clean_Vehicles.html.) EERE International program activities directly support the mission of the Department to advance development and deployment of clean energy technologies:

> *"...the Department will foster international partnerships to advance our common goals for developing and deploying clean energy technologies and addressing climate change, energy security, and energy scarcity...Technologies must be deployed globally if they are to materially impact consumption and emissions. U.S. leadership through the Department can help promote clean energy technologies around the world...International partnerships could offer more diverse projects to increase learning rates, promote the global adoption of clean energy technologies, and perhaps ease foreign market entry for U.S. firms..."*
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> -- DOE Strategic Plan, May 2011

The following tables outline the International Program's funding activities over the past three fiscal years.

International Program Funding Activities FY11				
Country / Region	**Per-former**	**Agreements Supported**	**Project goals**	**Total funding**
APEC	Alliance to Save Energy	Asia-Pacific Economic Cooperation	Support for APEC's Peer Review of Energy Efficiency and Cooperative Energy Efficiency Design for Sustainability by facilitating the transfer of best practices among APEC economies and planning two transportation-related workshops.	$70,000
Argentina	NREL	U.S.-Argentina Energy Working Group; DOE/Ministry Of Federal Planning, Public Investment & Utilities MOU	Market development for U.S. energy efficiency service companies and renewable energy forecasting.	$150,000
Brazil	NREL	U.S.-Brazil Energy Working Group; U.S.-Brazil Strategic Energy Dialogue	Promote technical exchange and collaborative R&D between Petrobras and NREL scientists on pyrolysis, a promising conversion technology for renewable aviation fuels; Comparative sustainability analyses of Brazilian and US integrated biorefineries from biomass.	$350,000
	ORNL	U.S.-Brazil Energy Working Group; U.S.-Brazil Strategic Energy Dialogue	Sustainability analysis of biofuels, modeling and industrial energy efficiency training.	$200,000
Canada	NREL	US-Canada Energy Dialogue	Incorporating Canadian renewable resource data in U.S. capacity expansion models and joint R&D on biomass pyrolysis.	$270,000
Caribbean	NREL	Energy and Climate Partnership of Americas	Renewable energy strategy development for Caribbean island nations and the development of a regional clean energy center at the University of the Virgin Islands to help reduce oil dependence.	$200,000
Chile	LBNL	Energy and Climate Partnership of Americas	Geothermal market analysis and recommendations, potentially leading to increased market opportunities for U.S. geothermal technology and service providers.	$14,368

International Program Funding Activities FY11				
Country / Region	**Per-former**	**Agreements Supported**	**Project goals**	**Total funding**
China	Alliance to Save Energy	US-China Strategic & Economic Dialogue; US-China Ten Year Framework for Cooperation on Energy & Environment; US-China Energy Efficiency Action Plan; US-China MOU for Cooperation in Energy Efficient Buildings & Communities; US-China MOU to Enhance Cooperation on Climate Change, Energy & the Environment	Logistical support for exchange trip of delegation of Chinese mayors' visit to the U.S. and U.S. mayors' visit to China for the purposes of sharing lessons learned to respectively adapt in local communities. Chinese mayors' visit to the U.S. to include promotion of U.S. goods and services from U.S.-based companies.	$300,000
	BNL	US-China Strategic & Economic Dialogue; US-China Ten Year Framework for Cooperation on Energy & Environment; US-China Energy Efficiency Action Plan; US-China MOU for Cooperation in Energy Efficient Buildings & Communities; US-China MOU to Enhance Cooperation on Climate Change, Energy & the Environment; US-China EcoPartnerships Initiative	Promotion of energy efficiency and renewable energy activities at the municipal level, including the development and promotion of partnerships between U.S. and Chinese cities.	$125,000
	INL	US-China Strategic & Economic Dialogue; US-China MOU to Enhance Cooperation on Climate Change, Energy & the Environment; US-China MOU for the Cooperation in the Development of Biofuels	Collaborative R&D on advanced biofuels.	$50,000
	NREL	US-China Strategic & Economic Dialogue; US-China MOU to Enhance Cooperation on Climate Change, Energy, & the Environment; US-China MOC Establishing a US-China Renewable Energy Partnership; US-China MOU for Cooperation in the Development of Biofuels	Development of clean energy commercial partnerships between U.S. and Chinese companies; advance progress toward the technology development and deployment goals of both countries; collaborative R&D on advanced biofuels; Development of guidelines for a China Solar Decathlon modeled after the U.S. university competition.	$450,000

International Program Funding Activities FY11				
Country / Region	**Per-former**	**Agreements Supported**	**Project goals**	**Total funding**
	PNNL	US-China Strategic and Economic Dialogue; US-China Ten Year Framework for Cooperation on Energy & Environment; US-China Energy Efficiency Action Plan; US-China MOU for Cooperation in Energy Efficient Buildings & Communities; US-China Clean Energy Research Center; US-China MOU for Cooperation in the Development of Biofuels	Study of the potential impact of and technical support for the development and implementation of a new building energy efficiency code. Seek to understand synergies of US and China building codes programs for potential technology deployment and ultimately export of U.S. goods that can help China meet more stringent codes; collaborative R&D on advanced biofuels.	$235,000
Costa Rica	NREL	Energy and Climate Partnership of Americas	Development of the regional energy efficiency programs through the EE Center to create market opportunities for U.S. companies and EE service providers.	$50,000
Haiti	NREL	Energy and Climate Partnership of Americas; U.S. Haiti Energy Sector Working Group	Analysis of opportunities to incorporate renewable energy technologies in the Haitian energy sector development plan.	$50,000
India	BNL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Promotion of energy efficiency and renewable energy activities at the municipal level, including the development and promotion of green building guidelines and training programs.	$449,000
	LBNL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Develop municipal sustainability action plans, leading to increased market opportunities for U.S. clean tech goods and services.	$127,000
	NREL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Verification and validation of wind turbine design codes; resource assessments to identify wind potential in India, leading to increased market opportunities for U.S.-based manufacturers, developers, and financiers.	$100,000
	ORNL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Technical support for the inclusion of geothermal heat pumps in building design, leading to increased market opportunities for U.S. geothermal technology producers and consultants.	$100,000

International Program Funding Activities FY11				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Total funding**
	PNNL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Technical support in the implementation of a building energy efficiency code, leading to increased market opportunities for U.S. companies and EE service providers.	$110,000
Israel	Binational Industrial R&D Foundation	DOE/Ministry of National Infrastructure Energy Cooperation Agreement; U.S-Israel Energy Cooperation Act; U.S-Israel Implementing Agreement	Joint multi-technology R&D solicitation: past projects include the development of drop-in replacement biofuels, building sensors, and building-integrated photovoltaics.	$300,000
Kazakhstan	ANL	U.S.-Kazakhstan Energy Partnership	Development of safety codes for natural gas-fuelled buses, leading to increased market opportunities for U.S. technology providers.	$35,000
	NREL	U.S.-Kazakhstan Energy Partnership	Support of the US-Kazakhstan Energy Partnership including ESCO market development and renewable energy analysis, leading to increased market opportunities for U.S.-based providers of EE goods and services.	$60,000
	ORNL	U.S.-Kazakhstan Energy Partnership	Identification of opportunities to promote industrial energy efficiency providing opportunities for sales of U.S. EE goods and services.	$100,000
Multiple	ANL		Development of biofuel sustainability standards through the International Standards Organization.	$25,000
	IEA	International Partnership for Energy Efficiency Cooperation Terms of Reference	Annual dues and programmatic activities related to the International Partnership for Energy Efficiency Cooperation, including analysis and sharing international best practices in utility programs and regulatory schemes to promote energy efficiency.	$260,000
	NREL	Energy Development in Island Nations Terms of Reference; International Partnership for Energy Efficiency Cooperation Terms of Reference	Energy Development in Island Nations (an integrated approach to addressing the unique energy needs of islands worldwide) leading to increased market demand for U.S. technologies and the development of lessons learned that can be applied to domestic clean energy deployment; international biofuels sustainability analysis, Open EI support (web platform to disseminate energy-related data and decision-assistance tools for policymakers); energy efficiency technical training in support of the International Partnership for Energy Efficiency Cooperation.	$315,000

International Program Funding Activities FY11				
Country / Region	**Per-former**	**Agreements Supported**	**Project goals**	**Total funding**
	ORNL		Development of biofuel sustainability standards through the ISO; Development and delivery of two industrial energy efficiency training workshops, leading to increased market opportunities for U.S. companies and EE service providers.	$175,000
	TBD	Asia-Pacific Economic Cooperation	Competitive solicitation focused on a high energy-demand growth country in the Asia-Pacific region, designed to reduce global demand for oil and create market opportunities for U.S. firms.	$1,726,232
Russia	PNNL	U.S.-Russia Bilateral Presidential Commission	Collaborate with Russia on the national launch of the Russian program to improve energy efficiency in public buildings, leading to increased market opportunities for U.S. companies.	$200,000
United Arab Emirates	NREL	US-Abu Dhabi Future Energy Company MOU	Advance demonstration, testing, and evaluation of advanced solar and building technologies, including dust mitigation for PV panels, through collaboration with Masdar. 3M makes the solar panel coating being tested.	$200,000
Total				**$6,796,600**

International Program Funding Activities FY10				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Funding**
Canada	NREL	US-Canada Energy Dialogue	Activities in support of the U.S.-Canada Energy Dialogue, including incorporating Canadian renewable resource data in U.S. capacity expansion models, increasing the accuracy of modeling efforts.	$100,000
China	LBNL	US-China Strategic & Economic Dialogue; US-China Ten Year Framework (TYF) for Cooperation on Energy & Environment; US-China MOU to Enhance Cooperation on Climate Change, Energy, & the Environment; US-China Energy Efficiency Action Plan; US-China MOU for Industrial	Introduce US technologies for the design and development of energy efficient buildings and data centers; comparison study of large US manufacturing plants and Chinese top 1000 enterprises; joint work on eco-cities to advance the knowledge base and application of US technologies in both countries, including documenting ongoing eco-city work in the US and collaborating with China to develop guidelines, policies and demonstrations that will promote the concept of eco-cities (cities that have policies, practices, and designs to minimize pollution and environmental impacts).	$1,045,000

International Program Funding Activities FY10				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Funding**
		Energy Efficiency Cooperation; US-China MOU for Cooperation in Energy Efficient Buildings & Communities		
	NASEO	US-China Strategic & Economic Dialogue; US-China Ten Year Framework (TYF) for Cooperation on Energy & Environment; US-China MOU to Enhance Cooperation on Climate Change, Energy, & the Environment; US-China EcoPartnerships Initiative; US-China Energy Efficiency Action Plan; US-China MOU for Cooperation in Energy Efficient Buildings & Communities	Promotion of energy efficiency activities and examples of US technologies and practices at the municipal level, support for U.S.-China cities pairings, leading to widespread application of US technologies in the rapidly growing Chinese urban market.	$200,000
	NREL	US-China Strategic & Economic Dialogue; US-China MOU to Enhance Cooperation on Climate Change, Energy, & the Environment; US-China MOC Establishing a US-China Renewable Energy Partnership	Development of clean energy commercial partnerships between the US and China; advance progress toward the renewable energy technology development and deployment goals of both countries; development of internationally-recognized testing and standards to assure US products compete under fair quality standards.	$675,000

International Program Funding Activities FY10				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Funding**
	PNNL	Asia-Pacific Partnership; US-China Strategic and Economic Dialogue; US-China Ten Year Framework for Cooperation on Energy & Environment; US-China Energy Efficiency Action Plan; US-China MOU for Cooperation in Energy Efficient Buildings & Communities; US-China MOU for Cooperation in the Development of Biofuels	Documentation of the important steps China has made to improve its enforcement of building energy codes in the last two years to inform progress in this area in the U.S. which would be innovative to adapt here. For example, China has developed code compliance software that is integrated with architectural design software and building energy simulation software. Documenting what has worked well and what problems China has encountered can help both U.S. and Chinese experts with future software development; understanding and support for the implementation of building energy efficiency codes that can improve US product sales; joint advanced biofuels R&D.	$524,000
Haiti	NREL	Energy and Climate Partnership of Americas; U.S. Haiti Energy Sector Working Group	Analysis of opportunities to incorporate renewable energy technologies in the Haiti energy sector development plan.	$100,000
India	ASE	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Support for implementation of energy efficient buildings practices that demonstrate U.S. technologies and products.	$456,000
	BNL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Promotion of U.S.-India cities partnerships; promotion of energy efficient activities at the municipal level, leading to application of U.S. technologies in the rapidly growing Indian urban market.	$300,000

International Program Funding Activities FY10				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Funding**
	LBNL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Introduction of U.S. technologies and practices for energy efficiency activities in buildings and data centers, leading to application of U.S. products in the large building and data center sectors.	$450,000
	NREL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Collaboration with India on low-wind speed activities to remove informational barriers and facilitate deployment of U.S. technologies in India; development of informational papers for Delhi International Renewable Energy Conference; joint solar R&D.	$700,000
	PNNL	US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Development and application of building energy code compliance tools and technical support for the development of a building energy efficiency code that support U.S. product sales.	$83,000
Israel	Binational Industrial R&D Foundation	DOE/Ministry of National Infrastructure Energy Cooperation Agreement; U.S-Israel Energy Cooperation Act; U.S-Israel Implementing Agreement	Joint multi-technology R&D solicitation.	$2,000,000
Kazahk-stan	NREL	U.S.-Kazakhstan Energy Partnership	Support of the US-Kazakhstan Energy Partnership, including ESCO market development and renewable energy technical training, leading to increased market demand for U.S. technologies.	$100,000
	ORNL	U.S.-Kazakhstan Energy Partnership	Industrial energy efficiency training, in support of the US-Kazakhstan Energy Partnership, leading to increased market demand for U.S. technologies.	$50,000

International Program Funding Activities FY10				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Funding**
Multi-lateral	IEA	International Partnership for Energy Efficiency Cooperation Terms of Reference	Create networks and reports to identify and share international best practices in industrial energy management; identify macroeconomic indicators to assess energy efficiency policies/programs; support efforts to provide best practice training in energy efficiency policy implementation and program design.	$200,000
	LBNL	Asia-Pacific Partnership on Clean Development and Climate; Clean Energy Ministerial	Technical input to the IEA's Global Energy Assessment; programmatic activities in support of the International Partnership for Energy Efficiency Cooperation's Super-efficient Equipment and Appliance Deployment (SEAD) initiative.	$205,000
	NREL	Energy Development in Island Nations Terms of Reference; International Partnership for Energy Efficiency Cooperation Terms of Reference	Energy Development in Island Nations (an integrated approach to addressing the unique energy needs of islands worldwide), leading to increased market demand for U.S. technologies and the development of lessons learned that can be applied to domestic clean energy deployment; technical review of the IEA World Energy Outlook; IEA WEO Review; development of communications materials in support of EERE's international industrial efficiency work; analysis in support of the International Renewable Energy Agency; OpenEI support (web platform to disseminate energy-related data and decision-assistance tools for policymakers).	$785,000
	ORNL	US-China Strategic & Economic Dialogue; US-China Ten Year Framework (TYF) for Cooperation on Energy & Environment; US-China MOU to Enhance Cooperation on Climate Change, Energy, & the Environment; US-China Energy Efficiency Action Plan; US-China MOU for Cooperation in Energy Efficient Buildings & Communities; US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance	Design charrettes in support of building energy efficiency; development of software tools for industrial energy efficiency analysis, leading to increased market access for U.S. companies.	$280,000

International Program Funding Activities FY10				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Funding**
		Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change		
	PNNL	US-China Strategic & Economic Dialogue; US-China Ten Year Framework (TYF) for Cooperation on Energy & Environment; US-China MOU to Enhance Cooperation on Climate Change, Energy, & the Environment; US-China Energy Efficiency Action Plan; US-China MOU for Cooperation in Energy Efficient Buildings & Communities; US-India Strategic Dialogue ; U.S.-India Energy Dialogue; US-India MOU to Enhance Coop. on Energy Security, Energy Efficiency, Clean Energy & Climate Change	Design and implementation of building energy efficiency codes in the Asia-Pacific region that are compatible with U.S. technologies.	$200,000
Russia	PNNL	U.S.-Russia Bilateral Presidential Commission	Support for the national launch of Russia's program to improve energy efficiency in public buildings, leading to increased market access for U.S. companies.	$200,000
Total				**$8,653,000**

International Program Funding Activities FY09				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Total funding**
Argentina	NREL	Energy and Climate Partnership of Americas	Activities in support of the U.S.-Argentina Energy Dialogue, including market development for energy efficiency service companies and renewable energy forecasting.	$100,000
Brazil	NREL	Energy and Climate Partnership of Americas	Joint advanced biofuels R&D and sustainability analyses, in support of the U.S.-Brazil Strategic Energy Dialogue.	$100,000
Caribbean	NREL	Energy and Climate Partnership of Americas	Development of renewable energy strategies for Caribbean island nations, leading to increased market demand for U.S. technologies and the development of lessons learned that can be applied to domestic clean energy deployment.	$200,000
Chile RE Center	NREL	Energy and Climate Partnership of Americas	Technical support to the regional Renewable Energy Center, increasing the country's capacity to exploit its renewable energy potential and leading to increased market opportunity for U.S. manufacturers, engineering firms, and project developers.	$250,000
Colombia	NREL	Energy and Climate Partnership of Americas	Testing and characterization of Colombia biomass feedstocks, to help tap their domestic resources and reduce global demand for oil.	$100,000
Costa Rica	NREL	Energy and Climate Partnership of Americas	Technical support for the regional Energy Efficiency Center, in support of the Energy and Climate Partnership of Americas, increasing the region's capacity to exploit its renewable energy potential and leading to increased market opportunities for U.S. EE providers.	$100,000
Dominica	NREL	Energy and Climate Partnership of Americas	Analysis of opportunities for small-scale utility wind generation, leading to increased market access for U.S. companies.	$150,000
Haiti	NREL	Energy and Climate Partnership of Americas	Analysis of opportunities to incorporate renewable energy technologies in the Haiti energy sector development plan.	$200,000
Israel	Binational Industrial R&D Foundation	DOE/Ministry of National Infrastructure Energy Cooperation Agreement; U.S-Israel Energy Cooperation Act; U.S-Israel Implementing Agreement	Joint multi-technology R&D solicitation (per statutory direction).	$2,000,000

International Program Funding Activities FY09				
Country / Region	**Performer**	**Agreements Supported**	**Project goals**	**Total funding**
Mexico	NREL	Energy and Climate Partnership of Americas	Collaboration with the Mexican Electrical Research Institution to develop more accurate wind resource maps, improve wind forecasting methods, and develop and test advanced wind turbine technology. These activities will facilitate regional wind development planning and provide potential investors with information necessary for decision-making, which can help lead to an expanded market for U.S. wind turbine manufacturers and U.S. engineering firms and renewable project developers.	$370,000
Peace Corps	NREL	Energy and Climate Partnership of Americas	Delivering technical training to Peace Corps volunteers to help them promote EE and RE on assignments and thereby help reduce demand for fossil resources.	$30,000
Peru	NREL	Energy and Climate Partnership of Americas	Technical assistance with energy efficiency project development, leading to increased market demand for U.S. technologies.	$100,000
Puerto Rico	NREL	Energy and Climate Partnership of Americas	Technical assistance to the government of Puerto Rico in support of the development of a comprehensive clean energy strategy.	$157,000
USVI	NREL	Energy Development in Island Nations Terms of Reference	Support for the U.S. Virgin Islands effort to reduce oil consumption by 60% by 2025, leading to increased market demand for U.S. technologies and the development of lessons learned that can be applied to domestic clean energy deployment.	90,000
Total				$3,947,000

QUESTION FROM REPRESENTATIVE BARTLETT

Q1. In view of the greater fuel use in the heavy duty sector, can you please address the Department's plans to continue to support efforts such as the Super Truck program to address the lack of any clear alternatives for Heavy Duty vehicles?

A1. As part of the FY12 Vehicle Technologies Program (VTP) budget request, the Department plans to continue funding all of the non-American Recovery Reinvestment Act-supported SuperTruck awards and may extend award periods if needed. Since SuperTruck projects incorporate multiple vehicle technologies (e.g., hybridization, lightweighting, combustion, etc.), several VTP key activities will provide funding to support this effort.

QUESTION FROM REPRESENTATIVE BARTLETT

Q2. As follow up, why after finally focusing on an integrated vehicle approach to Heavy Duty R&D, is DOE appearing to back away from fully funding the program, even before providing any chance to demonstrate success?

A2. The Department of Energy's (DOE) Vehicle Technologies Program (VTP) continues its strong commitment to heavy-duty vehicle R&D. Although the program initially proposed to "delay or eliminate non- American Recovery Reinvestment Act-supported SuperTruck awards" in FY12, it has subsequently examined options for fully funding all SuperTruck projects. Since SuperTruck projects incorporate multiple vehicle technologies (e.g., hybridization, lightweighting, combustion, etc.), several VTP key activities provide funding and there is sufficient flexibility to incorporate SuperTruck project components into existing activity areas. As a result, DOE believes that, under current funding levels, it can fully fund the SuperTruck awards.

QUESTION FROM REPRESENTATIVE BARTLETT

Q3. As you know the EPA will be coming out with new emissions standards for medium and heavy duty trucks and buses. I believe the government needs to work with private industry to ensure those standards are met given they are mandated by the government. Can you please tell me the status of programs within EERE that will help address this issue?

A3. Although the Department of Energy (DOE) has no direct role in establishing emissions standards, we will continue to support the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) efforts by communicating R&D results and progress toward technical targets.

Within the Vehicle Technologies Program, the Combustion and Emission Control activity supports research on innovative emission control strategies through National Laboratory, industry, and university projects designed to reduce cost and increase performance and durability of NO_x reduction and particulate matter oxidation systems. 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. In addition, the Program's four competitively-awarded SuperTruck projects focus on developing and demonstrating a 50% improvement in overall freight efficiency, measured in ton-miles per gallon, using technologies including hybridization, lightweighting, improved aerodynamics, waste heat recovery, auxiliary power, and combustion improvements.

DOE coordinates heavy-truck R&D activities with other Federal agencies and industry partners through the 21st Century Truck Partnership. 21st Century Truck brings together DOE, EPA, DOT, the Department of Defense, and fifteen heavy-duty original equipment

manufacturer and supplier partners to collaborate on R&D activities with the goal of making trucks and buses safer, cleaners, and more efficient. Partners meet regularly to discuss R&D needs, develop joint goals, and discuss R&D progress.

QUESTION FROM REPRESENTATIVE NEUGEBAUER

Q1. At what point can we expect a technology such as solar energy to be legitimately viable on the open market? We have spent millions of dollars on tax expenditures, research and development, and other federal programs to incentivize this technology, yet it still seems to have no ability to compete with traditional forms of energy. In fact, many countries throughout Europe have scaled back support for ineffective technologies such as solar, and the demand for those forms of energy has essentially collapsed. Isn't this indicative of inefficient allocation of money for a technology that cannot survive in the long-term without massive government support? In how many months, years, or decades can we expect that the industry, and others like it, will be able to survive without taxpayer subsidies?

A1. Solar technologies are rapidly becoming viable on the broader scale throughout the country and even more so in Europe. This is because the Balance-of-System cost in Europe, which accounts for nearly 40% of the installed system cost in the U.S., is closer to 10% in a country like Germany. This decreases the cost of solar, therefore making it a more attractive form of energy. Additionally, the growth of solar energy in Europe was accelerated by Feed-in-tariffs, specifically in Germany and Spain. Although the tariffs are being eased back, the deployment rates are not expected to scale back, and there is a strong expectation that European deployment levels in 2011 and beyond will be even higher than in 2010.

Deployment in the U.S. was ~ 900 MW in 2010 and was over 8 GW in Germany in 2010. The deployment of 900 MW at $3/watt equates to at least $3 billion in additional economic activity. As in every technology, cost is the key driver for increased market adoption.

QUESTION FROM REPRESENTATIVE NEUGEBAUER

Q2. Could you point to a technology that has been developed by your office which can currently compete on the market without any government subsidies or tax incentives?

A2. While all renewable energy generation technologies in the Office of Energy Efficiency and Renewable Energy (EERE) have been making significant strides towards grid parity, onshore wind power is the EERE technology that can best compete with non-renewable fossil fuels like coal and natural gas today. EERE's Wind Program has helped onshore wind power become more competitive in the marketplace through strategic investments that have reduced project costs and market barriers, both of which traditionally hindered deployment of wind power. In areas with large wind resources and high retail electricity prices, such as Hawaii and parts of the Northeastern United States, wind is currently cost-competitive without subsidies. Further R&D is needed, however, to continue to reduce wind energy costs so it is competitive without subsidies throughout the United States.

- In 2009 there were ~10 GW of wind turbines installed at $2.144B/GW, which equates to $21.4 billion in economic activity;[4]

Each gigawatt[5] (GW) of land-based wind power added in the United States produces the following benefits versus electricity generation from fossil fuels such as coal and natural gas:

- 1.4 million tons avoided coal consumption per year[6,7] or 21.2 billion cubic feet avoided natural gas consumption per year;[8]

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4 EERE 2010 Wind Technologies Market Report. Page 47. DOE/GO-102011-3322. June 2011

5 One gigawatt (GW) = one million kilowatts (kW) of electrical generating capacity.

6 CO2 reduction is based on offsetting the national average marginal power generation mix. NREL memo to DOE, *Onshore wind emissions savings analysis*. January 11, 2011.

- 2.1 million metric tons of avoided carbon dioxide (CO2) emissions per year;[9] and
- $44 million in avoided social cost of carbon per year.[10]

Wind power also provides significant benefits in the form of avoided health costs from criteria pollutants. About 43% of U.S. wind power offsets coal generation.[11] In 2009, 35 GW of wind power offset roughly 32 billion kWh of coal generation[12], providing a benefit of ~$1.0 billion in avoided health costs that year from reduced criteria emissions from coal generation alone.[13] Looking forward, EERE plans on increasing off-shore R&D efforts in order to meet deployment scenarios of 10 GW by 2020 and 54 GW by 2030.

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7 *Retrospective Benefit–Cost Evaluation of U.S. DOE Wind Energy R&D Program: Impact of Selected Energy Technology Investments.* U.S. Department of Energy. DOE/EE-0348. June 2010.

8 *Op. cit.* 2, 3

9 *Op. cit.* 2

10 The US Interagency Working Group on Social Cost of Carbon puts central value of carbon at $21 per metric ton of CO2 ($2007) in 2010. Here we calculate that (2.1 million tonnes CO2 avoided/year) x ($21/tonne CO2) = $44.1 million/year. Social costs of carbon include changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Human health damages include vector-borne diseases, heat waves, catastrophic events, and cardiovascular and respiratory mortality related to carbon emissions. *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866.* February 2010. http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf

11 *Op. cit.* 3

12 The US produced 74,000 million kWh of electricity from wind in 2009. *Electric Power Annual 2009.* November 23, 2010. http://www.eia.doe.gov/cneaf/electricity/epa/epaxlfile2_1_a.xls

13 According to the U.S. National Academies of Science, the non-climate damages caused by criteria pollutants from coal-fired power plants in 2005 were estimated at $62 billion per year, or about 3.2 cents per generated kWh. Here we calculate that (73,886 million wind kWh/year) x (43% coal fuel mix avoided) x ($0.032 health benefit/kWh) = $1,024 billion/year in 2009. More than 90% of monetized damages were associated with premature human mortality. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use.* National Research Council of the National Academies. 2010.

QUESTION FROM REPRESENTATIVE NEUGEBAUER

Q3. The Administration repeatedly touts the need for the United States to be the world leader in clean energy and energy efficiency technologies. However, the Department of Energy recently announced a $1 million funding project to train energy assessors to assist manufacturing facilities in India and China to reduce their energy usage. This project seems to conflict with the apparent goal of the Administration to beat out foreign countries like China and India in these industries. EERE also specifically mentions its involvement in several projects to encourage renewable energy development in South America. What is the value of such programs to the U.S. when we're spending billions of dollars at home in attempts to beat foreign countries in developing renewable technologies?

A3. The value of the Office of Energy Efficiency and Renewable Energy (EERE) international engagement is to improve U.S. energy security and increase U.S. exports by accelerating development and global deployment of clean energy technologies. No Department of Energy (DOE) funding is provided to foreign governments, and no intellectual property is given away. Only *pre-competitive* R&D is conducted in collaboration with other countries (e.g., basic understanding of battery chemistry that could lead to batteries with lower cost, greater power density, etc.) By working collaboratively with partner countries, we leverage resources and avoid duplication of effort. By providing policy assistance and training in concert with U.S. industry, we prime markets for exports of U.S. clean technology, and improve U.S. energy security by reducing global demand for increasingly scarce fossil resources.

Led by China and India, the demand for energy continues to rapidly increase in developing countries. In 2005, China and India together accounted for 18% of total global consumption; by 2035, that figure will be 31%.[14]

14 Source: United States Energy Information Agency, *International Energy Outlook 2010.*

Since the vast majority of energy demand growth will occur outside the borders of the U.S., foreign markets are critical for U.S. companies. The U.S. currently exports roughly $2 billion of manufactured renewable energy goods annually.[15] EERE's International Program pursues opportunities to increase U.S. exports by increasing the competitiveness of the U.S. clean energy technology and service industry through "market priming" activities. Countries around the world are enacting policies and strategies to increase energy efficiency and renewable energy use. Since increased exports often result from strong partnerships between U.S. companies and foreign buyers, EERE organizes activities coordinated with industry to increase their access to the international markets. Trade promotion activities alone are not enough – foreign policymakers and technology customers benefit from understanding the policy frameworks and quality control procedures that business requires. EERE activities offer opportunities for this learning while introducing U.S. providers of clean technology goods and services to potential customers. This approach "primes" the market for U.S. exports.

By promoting high-value, pre-competitive technology collaborations between U.S. and key research institutions abroad, EERE International Program investments enable DOE's domestic R&D programs to achieve results faster by eliminating duplication of effort and utilizing joint research planning to leverage each other's resources. For example, through the U.S.-China Clean Energy Research Center (CERC), a five-year, $100 million R&D initiative, EERE is mobilizing 3 dollars of external investment for every dollar of DOE investment for research on building energy efficiency and clean transportation

15 U.S. Department of Commerce, Renewable Energy and Energy Efficiency Export Initiative

technologies. EERE is in the process of establishing a similar center with India that will focus on biofuels, building energy efficiency, and solar energy technologies. EERE conducts joint R&D with Canada on lightweight materials, which can reduce the weight of vehicles and improve efficiency. Collaboration with Brazil, the world's second largest producer of ethanol, involves joint work on conversion R&D, as well as sustainability analyses to ensure that increasing the production of biofuels does not create unanticipated adverse social or environmental impacts.

In summary, the value of international collaboration is to improve the speed and scale of research, progress, and global deployment of clean energy technologies in the U.S. and the world, providing economic and energy security benefits for the U.S.

QUESTION FROM REPRESENTATIVE MILLER

Q1. Does the Department have plans to continue to support efforts such as the Super Truck program to help address the lack of clear alternatives for Heavy Duty vehicles?

A1. The Department of Energy (DOE) plans to continue funding all of the SuperTruck awards and may extend award periods if needed.

Although the program initially proposed to "delay or eliminate non-American Recovery and Reinvestment Act-supported SuperTruck awards" in FY12, it has subsequently examined options for fully funding all SuperTruck projects. Since SuperTruck projects incorporate multiple vehicle technologies (e.g., hybridization, lightweighting, combustion, etc.), several Vehicle Technologies Program key activities provide funding and there is sufficient flexibility to incorporate SuperTruck project components into existing activity areas. As a result, DOE believes that, under current funding levels, it can fully fund the SuperTruck awards.

QUESTION FROM REPRESENTATIVE MILLER

Q2a. As you know, the EPA will be coming out with new emission standards for medium and heavy duty trucks and buses. Will DOE have a role in providing R&D to demonstrate/establish what is technologically feasible in the area of fuel efficiency and emissions in these trucks? If so, can you please tell me the status of programs within EERE that will help address this issue?

A2a. The Department of Energy's (DOE) Vehicle Technologies Program (VTP) meets regularly with the Environmental Protection Agency (EPA) and Department of Transportation (DOT) staff to share R&D results and discuss plans for future work.

Within VTP, the Combustion and Emission Control activity supports research on innovative emission control strategies through National Laboratory, industry, and university projects designed to reduce cost and increase performance and durability of NO_x reduction and particulate matter oxidation systems. 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. In addition, the Program's four competitively-awarded SuperTruck projects focus on developing and demonstrating a 50% improvement in overall freight efficiency, measured in ton-miles per gallon, using technologies including hybridization, lightweighting, improved aerodynamics, waste heat recovery, auxiliary power, and combustion improvements.

DOE coordinates heavy-truck R&D activities with other Federal agencies and industry partners through the 21st Century Truck Partnership. 21st Century Truck brings together DOE and EPA, DOT, the Department of Defense, and fifteen heavy-duty original equipment manufacturer and supplier partners to collaborate on R&D activities with the

goal of making trucks and buses safer, cleaner, and more efficient. Partners meet regularly to discuss R&D needs, develop joint goals, and discuss R&D progress.

QUESTION FROM REPRESENTATIVE MILLER

Q2b. Finally, will DOE be collaborating with EPA and NHTSA in establishing these standards?

A2b. Although the Department of Energy has no direct role in establishing emissions standards, we will continue to support the Environmental Protection Agency and the Department of Transportation efforts by communicating R&D results and progress toward technical targets.

QUESTION FROM REPRESENTATIVE LUJAN

Q1. ARPA-E targets projects selected with venture capital guided criteria for high-risk, high-payoff technologies that are transformational and close to market ready. EERE targets foundation applied energy programs that are beyond basic science but not nearly market ready. What is the DOE strategy for bridging between these areas, and how are technologies chosen?

A1. The Office of Energy Efficiency and Renewable Energy (EERE) works in close collaboration with other Department of Energy (DOE) organizations that have distinct but related missions, including the Office of Advanced Research Projects Agency-Energy (ARPA-E) and the Office of Science (SC). SC focuses on understanding the basic science of how energy and matter interact. ARPA-E's role is to translate that science into breakthrough technologies that have the potential to make today's technologies obsolete, if they could be developed. EERE focuses on R&D to make today's existing and emerging clean energy technologies cheaper, better, and safer in order to help strengthen the U.S. economy and manufacturing base, increase energy security and reduce dependence on oil, and protect the environment.

Certain activities span multiple offices across DOE. For instance, SunShot is an integrated effort that brings together the existing funds from the EERE Solar Energy Technologies Program, a program from ARPA-E focused on component level power electronics for power inverter technologies, and SC's work on the basic science aspects of solar energy conversion. EERE and ARPA-E conduct complimentary research and develop projects focused on near-term technological milestones and deliverables in the three to five year range. For example, while EERE pursues improvements in the performance and cost of solar modules, ARPA-E is focusing on essential power

electronics that are critical for stable solar grid integration. SC projects are targeted at improved fundamental scientific understanding, which might not result in immediate technological improvements, but could identify a research pathway producing revolutionary advances in solar energy in the next 10-20 years. These complementary competencies are brought to bear to solve the critical basic, applied, manufacturing, and deployment issues of relevance to solar electricity generation and deployment.

In order to ensure these activities across DOE remain well-coordinated, SunShot has an integrated R&D management team consisting of two program-level managers from Basic Energy Sciences, two from ARPA-E, four from EERE, and the director of SunShot. This R&D management team is overseen by the Director of SC, the Director of ARPA-E, and the Acting Assistant Secretary of EERE, who ensure that the SunShot resources are being effectively utilized with no overlap.

Each of these managers evaluate and pursue technologies in part by using Technology Readiness Levels (TRLs) which have been used by the Department of Defense and NASA for many years. TRLs assess the maturity of evolving technologies prior to commercialization. TRLs range from basic research (TRL 1) to systems proven and ready for full commercial development (TRL 9). EERE funds activities from applied research (TRL 2) through system incorporated in commercial design (TRL 8). EERE does not work at all on basic research (TRL 1), which is exclusively an SC and National Nuclear Security Administration function in DOE, or on full commercial deployment (TRL 9).

All of the technologies EERE invests in have very specific cost, performance and lifetime targets designed to be competitive with fossil fuels on an unsubsidized basis, and SunShot is no exception. The goal of SunShot is to reduce the total cost of installed solar systems by 75 percent by the end of the decade, enabling solar electricity to be broadly competitive with electricity from conventional generation sources without subsidies.

QUESTION FROM REPRESENTATIVE LUJAN

Q2. The DOE national laboratories have played a fundamental role in bridging science R&D into technology. How is the DOE fostering the interactions between industry and the DOE national laboratories in order to accelerate technology development and transfer for clean energy technologies? Is there a dedicated funding aimed at this goal?

A2. National laboratories work to find post-research, pre-venture capital funding for innovations that are no longer considered research projects but are not sufficiently prototyped to attract private investment – this span of the development path is commonly known as the "Commercialization Valley of Death."

The Department of Energy (DOE) is working to identify and remove barriers in this development path through effective licensing, as well as enabling the creation of meaningful private-public partnerships. DOE has undertaken a complete rewrite of the Cooperative Research and Development Agreement (CRADA) guidelines and plans to introduce a shortened "small CRADA" for projects under $250K. The Advance Payment requirement has recently been reduced from 90 to 60 days – this is the amount of funding that industry must provide the Lab before work can begin on a project. DOE is also working to provide more access to our Labs by small companies and entrepreneurs. The launch of "America's Next Top Energy Innovator" will help achieve this by offering newly created companies a one-year option to license DOE patents for a low, fixed fee ($1,000) while deferring patent costs for up to two years.

Communicating partnership opportunities and technologies available for licensing is a key component for effective technology transfer from our national laboratories. To this end we have launched the Energy Innovation Portal which lists technologies developed by DOE

laboratories and other participating research institutions and provides industry an opportunity to explore licensing innovative lab technologies.

The Technology Commercialization Fund (TCF) is one vehicle that is designed to bring together DOE's national laboratories and industry to identify promising technologies that are facing the "Commercialization Valley of Death." The lab then makes matching funds available to any private sector partner that wishes to pursue deployment of the technology.

The TCF is designed to seed public-private partnership projects at national labs with Technology Readiness Levels 3-6 (proof of concept through engineering-scale prototype). The fund totaled nearly $14.3 million in FY07 and FY08. Each project in the TCF was competitively selected by national laboratories that were selected by DOE. Authorization to fund this was established in section 1001 of the Energy Policy Act of 2005, which allows for the Secretary to use 0.9 percent of the total applied energy R&D budget for this purpose.

As an example, one TCF recipient has successfully leveraged TCF funds and national laboratory innovations to develop a new disruptive thin-film solar technology. Through a TCF-funded CRADA, this recipient was able to successfully bundle intellectual property (IP) from the Oak Ridge National Laboratory and the National Renewable Energy Laboratory to develop a differentiated product with real commercial viability. As a result of this public/private R&D effort, the recipient has raised $10 million in private funding and continues to expand.

QUESTION FROM REPRESENTATIVE TONKO

Q1. Your budget request for FY2012 for Lighting R&D, within the Building Technologies Program of EERE, asks for $25.8 million. Very efficient solid state lights already exist. Would the Department not be better off instead focusing on manufacturing improvements to bring the cost of the product down in order to achieve widespread adoption in the marketplace?

A1. More solid state lamps (SSLs) are beginning to appear in the marketplace and these products are more energy efficient than earlier models. However, significant technological hurdles must be overcome in order to reach the Department of Energy (DOE) goal of SSLs having efficiencies of over 200 lumens per watt (lpw). For example, through the Commercially Available LED Product Evaluation and Reporting (CALiPER) program, DOE tested approximately 30 products, comprising a range of lamps for a "market basket" of products, and found the average efficacy of the tested units to be 46 lpw, which is less efficient than many compact fluorescent lamps (CFLs) in the market.

DOE's SSL research program has three major components: core technology, product, and manufacturing research. Through our core and product research we expect to achieve our efficiency research targets of over 200 lpw by 2025. Significant reductions in cost must also be achieved in order to support market adoption of these new technologies. Through our manufacturing research on tools, equipment and processes, we expect to see a more than ten-fold reduction in the cost of SSL lamps and even greater reductions in the cost of luminaires by 2025.

QUESTION FROM REPRESENTATIVE TONKO

Q2. According to EERE, the number of fuel cell and hydrogen megawatts shipped by non-US companies has increased by 40 percent in just one year. And yet, in my opinion, the budget does not provide enough funding for this critical technology. It is a proven technology, including some companies within the United States, such as those used for fork lift applications that are commercially deployed today. In your opinion, is there a role for fuel cells in complimenting renewable and traditional fuels?

A2. The Department of Energy (DOE) believes fuel cells can play a role in complementing renewable and traditional fuels. For example, fuel cells can use diverse fuels such as natural gas, biogas, or hydrogen produced from renewables and can provide benefits across diverse stationary and mobile applications. They can also serve as reliable energy storage platforms for integrating intermittent renewable energy technologies.

DOE will continue its critical efforts in hydrogen and fuel cell research and development (R&D), which have already reduced the projected cost of transportation fuel cells at manufacturing scale by more than 30% since 2008 and 80% since 2002.[16] In addition to DOE's R&D efforts, $9.7 million in Recovery Act funding plus $11.9 million in industry cost share were allocated to fuel cell fork lift applications. The FY12 budget request of $100 million sustains DOE's core R&D efforts which will continue to enable U.S. leadership in advancing fuel cell technologies.

16 http://hydrogen.energy.gov/pdfs/10004_fuel_cell_cost.pdf

Responses by Mr. David Frantz, Director,
Loan Programs Office

Questions Submitted by Chairman Harris

Q1. With regard to the loan programs, the only disconcerting thing I think and one of the reasons why we hold the hearing is that we open up the paper and whether it is Politico yesterday or ABC News, we hear about loan guarantees going to companies where people made very large contributions to people in the Administrations, very large political contributions. Large. How are you going to assure me that the system is not biased?

A1. The process by which loan guarantee applications are reviewed and loan guarantees awarded is not biased in favor of any individuals, entities, locations, or technologies. Every application is subject to a rigorous, comprehensive, fair, and transparent review process, and decisions arebased solely on the project's financial and technical attributes and merit.

Questions Submitted by Mr. Rohrabacher

Q2. We have a major expenditure into a light water reactor with a new approach which is an old concept of how to produce nuclear energy. But the modular reactors, which are being heralded as really revolutionary, as well as the high-temperature gas-cooled reactors, which are revolutionary as well, have not been invested in. I would suggest that perhaps there should be a second look. I notice your staff is giving you a little note there if you would like to answer that.

A2. The Department of Energy (DOE) is very supportive of modular nuclear reactor technology.To date, however, no such projects have applied for DOE loan guarantees, and the program currently has no open solicitations and insufficient authority to support even the projects in its active pipeline. Should the Loan Programs have sufficient authority in the future, DOE would welcome applications from eligible, creditworthy projects employing modular reactor technologies.

QUESTION FROM CHAIRMAN HARRIS

Innovative Nuclear Technologies

Q1a. During the hearing, you noted your office has not extended a loan guarantee to new nuclear technology concepts.

Have you received any applications for innovative nuclear technologies?

A1a. The Department of Energy's (DOE) Loan Programs Office has issued two solicitations for nuclear technologies under the Section 1703 loan guarantee program, which requires that eligible projects be innovative in nature: (1) the Loan Guarantee Solicitation Announcement for Federal Loan Guarantees for Nuclear Power Facilities, issued on July 11, 2008; and (2) the Loan Guarantee Solicitation Announcement for Federal Loan Guarantees for Front End Nuclear Facilities, issued on July 11, 2008. To date, the Department has issued conditional commitments to two nuclear projects: (1) conditional commitments for loan guarantees in an aggregate amount of $8.3 billion for the construction and operation of two nuclear reactors at the Vogtle plant in Waynesboro, Georgia; and (2) a $2 billion conditional commitment to Areva Enrichment Services, LLC, for a front-end nuclear enrichment facility near Idaho Falls, Idaho.

QUESTION FROM CHAIRMAN HARRIS

Innovative Nuclear Technologies

Q1b. During the hearing, you noted your office has not extended a loan guarantee to new nuclear technology concepts.

Will the Loan Guarantee Program office consider offering loan guarantees for innovative nuclear technologies beyond existing light-water technologies?

A1b. The Department of Energy's (DOE) Loan Programs Office has issued two solicitations for nuclear technologies under the Section 1703 loan guarantee program, which requires that eligible projects be innovative in nature: (1) the Loan Guarantee Solicitation Announcement for Federal Loan Guarantees for Nuclear Power Facilities, issued on July 11, 2008; and (2) the Loan Guarantee Solicitation Announcement for Federal Loan Guarantees for Front End Nuclear Facilities, issued on July 11, 2008. DOE is evaluating applications received pursuant to these solicitations. To date, DOE has issued conditional commitments to two nuclear projects: (1) conditional commitments for loan guarantees in an aggregate amount of $8.3 billion for the construction and operation of two nuclear reactors at the Vogtle plant in Waynesboro, Georgia; and (2) a $2 billion conditional commitment to Areva Enrichment Services, LLC, for a front-end nuclear enrichment facility near Idaho Falls, Idaho. DOE does not currently have any open solicitations for nuclear loan guarantees.

QUESTION FROM CHAIRMAN HARRIS

Innovative Nuclear Technologies

Q1c. During the hearing, you noted your office has not extended a loan guarantee to new nuclear technology concepts.

Can you assure the Committee your office will look at truly high-risk and groundbreaking technologies beyond renewable technologies?

A1c. The Loan Programs Office is committed to the commercialization of innovative technologies in all energy sectors in which it has authority. The Department recognizes the importance of nuclear, advanced fossil, and other non-renewable projects, and currently has several such projects in due diligence.

QUESTION FROM CHAIRMAN HARRIS

Loan Guarantee Selection Process

Q2. A number of news articles have detailed the close political association of loan guarantee recipients to the Obama Administration. In light of these reports, can you provide assurance that the award process is not inherently biased?

A2. The process by which loan guarantee applications are reviewed and loan guarantees awarded is not biased in favor of any individuals, entities, locations, or technologies. Every application is subject to a rigorous, comprehensive, fair, and transparent review process, and decisions are based solely on the project's financial and technical attributes and merit.

QUESTION FROM CHAIRMAN HARRIS

Role of Private Financing in Technology Commercialization

Q3a. Section 609.7 of the DOE regulation governing loan guarantees states that applications must demonstrate commercial viability of a proposed project. The same rulemaking states that loans will focus on technologies for which there is often not readily available private market financing at reasonable terms.

How does the program work to confirm that applicants are unable to receive private financing before making an award? If an applicant's status changes during the review process – due to a stock price increase or bond sale, for example – will the program factor such changes into the review and award process?

A3a. The Department of Energy's underwriting process is detailed, comprehensive, and lengthy. It does not rely simply on information submitted about the project at the time of application. Instead, it is continually refreshed by up-to-date information about the project and its sponsors. All available information is considered in the review and award process.

QUESTION FROM CHAIRMAN HARRIS

Role of Private Financing in Technology Commercialization

Q3b. Section 609.7 of the DOE regulation governing loan guarantees states that applications must demonstrate commercial viability of a proposed project. The same rulemaking states that loans will focus on technologies for which there is often not readily available private market financing at reasonable terms.

If an applicant can demonstrate commercial viability, wouldn't a private bank stand to profit if it loaned the company money?

A3b. At its core, commercial viability is dependent on the project's cost of capital, which is dependent on cost of debt, cost of equity, scalability of technology, and other factors. Loan guarantees help to reduce the cost of capital for projects, thereby improving their commercial viability. Moreover, many conventional lenders are unwilling to issue loans – particularly the type of high-dollar, long-tenor loans that many energy projects require – to projects that demonstrate any significant technology or completion risk, as many of the projects the Loan Programs Office (LPO) supports do. Thus, LPO helps companies scale up innovative clean energy technologies. The Department of Energy expects that, in the future, as the efficacy of these technologies is demonstrated, conventional lenders will be willing to finance similar projects on terms that enable such projects to be economically viable without government support.

QUESTION FROM CHAIRMAN HARRIS

Role of Private Financing in Technology Commercialization

Q3c. Section 609.7 of the DOE regulation governing loan guarantees states that applications must demonstrate commercial viability of a proposed project. The same rulemaking states that loans will focus on technologies for which there is often not readily available private market financing at reasonable terms.

How does the Loan Guarantee Office conduct the necessary rigorous review of applications? Do you rely solely on information provided by the applicant or do you acquire third-party financial and technical analysis of proposals? How does the loan guarantee office check the veracity of information provided by the applicant?

A3c. For each application, the Loan Programs Office (LPO) conducts a rigorous, comprehensive, and lengthy underwriting process similar to what a private sector lender would conduct before committing any funds. LPO does not simply rely on information provided by the applicants, though we do work closely with each applicant over the course of the underwriting process to understand and verify information they have provided as well as to address issues that arise during the Department of Energy's (DOE) due diligence. In addition, for each project, DOE engages third-party advisors (e.g., independent engineers, outside counsel, and, where appropriate, market consultants). These external advisors conduct independent reviews of the projects, which LPO's highly-experienced, professional staff rely upon in structuring, negotiating, and executing the loan guarantee transactions. In addition, when appropriate, LPO utilizes the resources and expertise of DOE program offices and national labs.

QUESTION FROM CHAIRMAN HARRIS

Loan Guarantee Program Enforcement

Q4. Are there enforcement mechanisms associated with the Loan Guarantee Program to ensure reimbursement of funds? Please elaborate on the process of repayment.

A4. The loan guarantee agreements provide for the loans to be repaid over a period of time at pre-established intervals, typically commencing after completion of construction of the project. Where a payment is not received on time and in the amount required, the Department of Energy (DOE) has certain legal rights including calling in the full amount outstanding. The DOE's position in guaranteed loans is secured, typically by a first priority lien on substantially all of the project assets. In the event of non-payment, DOE would have all of the rights of a secured lender, including the right to foreclose on such assets. In some cases, DOE may also have the benefit of credit support from a creditworthy parent or other affiliate. The most common form of such support would be a contingent equity commitment, to cover construction cost overruns, or a guarantee of completion of the project. Such a commitment or completion guarantee may, in some cases, be supported by a letter of credit from a creditworthy institution. The objective of such credit support is to ensure that the project is complete and operating at anticipated levels, so that it can generate cash flow to repay the loan. When a loan closes, it moves into active monitoring. This includes reviewing all requests for advances to ensure that pre-specified conditions precedent to funding (CPs) are met. In addition, the monitoring group conducts periodic reassessment of project risks and where issues are noted, works with project management and sponsors to craft solutions with the support of external and internal subject matter experts.

QUESTION FROM CHAIRMAN HARRIS

Loan Guarantee Information

Q5. Provide a breakdown of the overall number of applications received through this program including the applicant, amount sought, credit subsidy sought, stage of the application and type of technology.

A5. Information about specific applications, including the applicant's name, amount sought, credit subsidy cost, or current status cannot be provided in this response, as such information may be protected by the Trade Secrets Act.

In total, the Title XVII programs have received the following number of applications (by solicitation):

Solicitation	**Applications Received**
Federal Loan Guarantees for Projects that Manufacture Commercial Technology Renewable Energy Systems and Components (Manufacturing)	6
Financial Institution Partnership Program (FIPP)	37
Energy Efficiency, Renewable Energy and Advanced Transmission and Distribution Technologies (EERE 2009)	169
Transmission Infrastructure Investment Projects (Transmission)	12
Fossil Energy Advanced Technologies (Fossil)	8
Energy Efficiency, Renewable Energy and Advanced Transmission and Distribution Technologies (EERE 2008)	67
Nuclear Power Facilities (Nuclear)	19
Front-end Nuclear Facilities (Front-end)	2
Projects that Employ Innovative Technologies in Support of the Advanced Energy Initiative (mixed)	140
Total	**460**

QUESTION FROM CHAIRMAN HARRIS

Loan Guarantee Information

Q6a. It has been noted that many of these loan guarantee applications submitted under section 1705 have been in process for many months and have now been referred to the section 1703 program.

How does the Department ensure that applications transferred from the Recovery Act program related to clean technology are appropriate for consideration under the 1703 program?

A6a. Pursuant to the FY11 Continuing Resolution (FY11 CR), "projects for which an application ha[d] been submitted...prior to February 24, 2011...for a loan guarantee under [the] section 1705" loan program are eligible for loan guarantees under the 1703 program (subject to other applicable terms of the FY11 CR) to the extent provided pursuant to the self-pay authority or appropriated credit subsidy made available under the FY11 CR. (Many of these projects would have been eligible for 1703 in any event, as they meet the 1703 program's eligibility requirements and their applications were submitted in response to a joint 1703/1705 solicitation).

QUESTION FROM CHAIRMAN HARRIS

Loan Guarantee Information

Q6b. It has been noted that many of these loan guarantee applications submitted under section 1705 have been in process for many months and have now been referred to the section 1703 program.

How do you ensure material changes in a company's financial situation are factored into this highly competitive program? For example, we are aware of one company that requested $280M under the 1703 program, then raised its initial capital requirement of $550M in the market. With this success, it then revised its financial needs to over $800M and recently told shareholders it is seeking $100M in DOE loan guarantees for projects that "increase shareholder value." Is "increasing shareholder value" an appropriate goal of the DOE Loan Guarantee Program? Do you consider these statements to shareholders in your review process?

A6b. The Department of Energy's underwriting process is detailed, comprehensive, and lengthy. It does not rely simply on information submitted about the project at the time of application. Instead, it is continually refreshed by up-to-date information about the project and its sponsors. The goal of the 1703 loan guarantee program is to support the commercial deployment of innovative clean energy technologies, while ensuring that taxpayer funds are wisely employed and appropriately safeguarded.

QUESTION FROM REPRESENTATIVE MILLER

Q1. For various categories of projects applying for loans (solar, wind, manufacturing, biomass power, biofuels) what is the average Credit Subsidy Cost? And on average for each category how much cash, equity, or secured line-of-credit debt are you requiring of project sponsors? Please provide those percentages as both the percentage of the DOE loan amount and the total project cost.

A1. The 2012 Budget (Federal Credit Supplement) indicates that the average credit subsidy cost at origination for 100% guaranteed loans obligated in FY10 was 10.16% and for partial guarantees was 3.78%. As of September 27, 2011, the average debt, equity, total project costs and loan guarantees of closed Section 1705 loan guarantees by sector are as follows:

Loan Program Office
Section 1705 Closings
Average Debt/Equity by Sector

Sector	Debt	Equity	Total Project Costs ($ B)	Total Loan Guarantee ($ B)
Biomass	40%	60%	$0.3	$0.1
Geothermal	49%	51%	$1.1	$0.5
Solar Generation	69%	31%	$10.5	$6.9
Solar Manufacturing	61%	39%	$2.1	$1.2
Transmission/Storage	77%	23%	$0.5	$0.4
Wind	60%	40%	$2.8	$1.7

QUESTION FROM REPRESENTATIVE MILLER

Q2. How significant a barrier is the statutory requirement that each loan sponsor demonstrate a "reasonable prospect of repayment?"

A2. The "reasonable prospect of repayment" standard is a prudent standard to ensure that taxpayer funds are appropriately safeguarded and used to support only those projects with a reasonable chance of commercial viability.

QUESTION FROM REPRESENTATIVE MILLER

Q3. Are any projects that will provide advanced, drop-in biofuels still in the 1705 program?

A3. None of the projects in the 1705 program pipeline will produce drop-in biofuels (defined as fuels such as diesel and gasoline).