U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
Subcommittee on Energy & Environment

HEARING CHARTER

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**, 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

[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."

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 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,

[2] http://www.whitehouse.gov/blog/2011/01/31/keeping-america-competitive-innovation-and-clean-energy
[3] All mission statements taken from the relevant Department of Energy website.
[4] The program funding levels based on DOE's FY11 spend plan found at https://filemanager.capwiz.com/filemanager/file-mgr/doeca/2_FY_2011_Full_Year_CR_Bill___Operating_Plan_2011_05_18.pdf
[5] All FY12 Energy and Water Appropriations funding levels contained in draft bill found at http://appropriations.house.gov/_files/EnergyWaterDPOSTED_xml.pdf

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 3 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 FY10 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 NREL. The Administration request for the Golden office is $550.4 million for FY12, a $64.6 million (13.2 percent) increase from the FY10 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

[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/

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 FY2012 **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 FY2011. 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 emphasis 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 FY2011 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 (dollars 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

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

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 FY12 budget request for DOE's Loan Guarantee Program Office (LPO) is $200 million, $30 million above the FY11 funding. The FY11 Continuing Resolution was the first time a credit subsidy was appropriated for use by the original loan program authorized under Section 1703 of the Energy Policy Act of 2005. 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) Section 1703 loans. 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 (dollars 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	170.0	200.0	160.0	30	17.6

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;

[13] http://arpa-e.energy.gov/media/news/tabid/83/vw/1/itemid/32/Default.aspx
[14] https://lpo.energy.gov/?page_id=17

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

- Biomass
- 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

April 2011	BrightSource Energy, Inc	$1.6 billion	Solar Generation
April 2011	SunPower Corporation, Systems (California Valley Solar Ranch)	$1.187 billion	Solar Generation
May 2011	SolarReserve, LLC (Crescent Dunes)	$734 million	Solar Generation
May 2011	Cogentrix of Alamosa, LLC.	$90.6 million	Solar Generation
May 2011	Record Hill Wind	$102 million	Wind Generation