



U.S. DEPARTMENT OF
ENERGY

Advanced Research Projects Agency – Energy Annual Report for FY2012

**Report to Congress
July 2013**

**United States Department of Energy
Washington, DC 20585**

Message from the Deputy Director

The Advanced Research Projects Agency-Energy (ARPA-E) catalyzes transformational energy technologies that will enhance the economic and energy security of the United States through the development of transformational technologies that reduce America's dependence on energy imports; reduce U.S. energy related emissions; improve energy efficiency across all sectors of the U.S. economy; and ensure the U.S. maintains a technological lead in the development and deployment of advanced energy technologies. We advance high-potential, high-impact energy technologies that are too early for private-sector investment. ARPA-E awardees are unique because they are developing entirely new ways to generate, store, and use energy.

Pursuant to statutory requirements, this report is being provided to the following Members of Congress:

- **The Honorable Fred Upton**
Chairman, House Committee on Energy and Commerce
- **The Honorable Henry Waxman**
Ranking Member, House Committee on Energy and Commerce
- **The Honorable Lamar Smith**
Chairman, House Committee on Science, Space and Technology
- **The Honorable Eddie Bernice Johnson**
Ranking Member, House Committee on Science, Space and Technology
- **The Honorable Cynthia Lummis**
Chairwoman, House Subcommittee on Energy
Committee on Science, Space and Technology
- **The Honorable Eric Swalwell**
Ranking Member, House Subcommittee on Energy
Committee on Science, Space & Technology
- **The Honorable Hal Rogers**
Chairman, House Committee on Appropriations
- **The Honorable Nita Lowey**
Ranking Member, House Committee on Appropriations
- **The Honorable Rodney P. Frelinghuysen**
Chairman, House Subcommittee on Energy and Water Development
Committee on Appropriations

- **The Honorable Marcy Kaptur**
Ranking Member, House Subcommittee on Energy and Water Development
Committee on Appropriations
- **The Honorable Ron Wyden**
Chairman, Senate Committee on Energy and Natural Resources
- **The Honorable Lisa Murkowski**
Ranking Member, Senate Committee on Energy and Natural Resources
- **The Honorable Al Franken**
Chairman, Senate Subcommittee on Energy
Committee on Energy and Natural Resources
- **The Honorable James E. Risch**
Ranking Member, Senate Subcommittee on Energy
Committee on Energy and Natural Resources
- **The Honorable Barbara Mikulski**
Chairwoman, Senate Committee on Appropriations
- **The Honorable Richard Shelby**
Ranking Member, Senate Committee on Appropriations
- **The Honorable Dianne Feinstein**
Chairman, Senate Subcommittee on Energy and Water Development
Committee on Appropriations
- **The Honorable Lamar Alexander**
Ranking Member, Senate Subcommittee on Energy and Water Development
Committee on Appropriations

If you have any questions or need additional information, please contact me or Mr. Jeff Lane, Assistant Secretary for Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,



Cheryl Martin

Deputy Director

Advanced Research Projects Agency — Energy
(ARPA-E)

Executive Summary

This report presents a summary of ARPA-E's activities during Fiscal Year 2012.

ARPA-E issued four new funding solicitations in Fiscal Year 2012 spanning the entire spectrum of energy technologies. ARPA-E awarded \$30 million in July 2012 within the Methane Opportunities for Vehicular Energy (MOVE) program, which aims to find cost-effective ways to power passenger cars and other light-duty vehicles with natural gas. In August 2012, \$43 million was awarded across two programs for energy storage: the Advanced Management and Protection of Energy Storage Devices (AMPED), which looked at advanced battery management technology, and the Small Business Innovation Research / Small Business Technology Transfer program, which focused on developing new, innovative battery chemistries and designs. Finally in November of 2012, \$130 million was awarded in an "OPEN" funding covering 11 technology areas.

From February 27 – 29, 2012, ARPA-E hosted the third annual Energy Innovation Summit in National Harbor, Maryland. The Summit brought together leaders and innovators from academia, business, and government to share ideas for developing and deploying the next generation of energy technologies. The event drew over 2,600 attendees from 49 states, Puerto Rico, and 26 countries and featured 107 expert speakers and keynote addresses, including leaders from government, business and academia.



ARPA-E ANNUAL REPORT FOR FISCAL YEAR 2012

Table of Contents

I.	Legislative Language	1
II.	Fiscal Year 2012 Appropriation.....	1
III.	Funding Opportunity Announcements (FOAs)	1
IV.	ARPA-E Energy Innovation Summit	6
V.	Measuring Success.....	6
VI.	Conclusion	7
VII.	Appendix I: Fiscal Year 2012 Project Selectees.....	8

I. Legislative Language

This report responds to legislative language set forth in the America COMPETES Act, P.L. 110-69, sec. 5012(g)(1)(2007), wherein it is stated:

“...the Director shall provide to the relevant authorizing and appropriations committees of Congress a report describing projects supported by ARPA-E during the previous fiscal year.”

The projects referenced throughout this report have been chosen on a highly selective, competitive basis. ARPA-E thoroughly reviews all applications and technologies to ensure that investments are made in areas not currently undertaken by industry.

II. Fiscal Year 2012 Appropriation

FY2012 marked ARPA-E’s second annual appropriation since the American Recovery and Reinvestment Act of 2009. ARPA-E was appropriated \$275 million for FY2012 as part of the Consolidated Appropriations Act, 2012, P.L. 112-74, which was signed into law on December 23, 2011.

III. Funding Opportunity Announcements (FOAs)

In 2012, ARPA-E announced four solicitations to fund innovative energy technologies, including three solicitations in specific program areas and one solicitation open to all technology areas. On July 12, 2012, ARPA-E announced 13 research projects totaling \$30 million as part of the Methane Opportunities for Vehicular Energy (MOVE) program. On August 2, 2012, ARPA-E announced 12 awards totaling \$30 million under the Advanced Management and Protection of Energy Storage Devices (AMPED) program and \$13 million through the Department-wide Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) program.

On November 28, 2012, ARPA-E announced \$130 million in awards for 66 breakthrough energy technology projects under OPEN 2012, the Agency’s second open solicitation¹. Awardees came from 24 states, with roughly 47% of projects led by universities, 29% by small businesses, 15% by large businesses, 7.5% by national labs, and 1.5% by nonprofits. Projects funded by OPEN 2012 encompass a wide array of technology areas, such as

¹ The OPEN 2012 FOA was issued in March 2012 (FY2012) and selected projects were announced in November 2012 (FY2013).

advanced fuels, advanced vehicle design and materials, building efficiency, carbon capture, grid modernization, renewable power, and energy storage.

These funding announcements increase ARPA-E's total portfolio to-date to include 285 projects and approximately \$770 million in awards.

The programs funded by the FY2012 FOAs are:

- **MOVE: Methane Opportunities for Vehicular Energy (\$30,000,000)**
 - Funding provided through the MOVE program will advance technologies to expand the use of natural gas in cars and trucks. These 13 projects are focused on developing light-weight, affordable natural gas tanks for vehicles and natural gas compressors to fuel natural gas vehicles at home. The recent boom in U.S. natural gas production from domestic shale resources has the potential to change the way Americans fuel their cars and trucks. In order to take advantage of this opportunity, however, the size and cost of natural gas tanks must come down. MOVE awardees are working to address these and other barriers in order to encourage widespread use of natural gas vehicles.
 - **Example MOVE Project: REL, Inc. "Shape Conformable Foam Core Gas Tanks" – Calumet, MI (\$3,000,000).** REL will develop a low-cost, conformable natural gas tank for light-duty vehicles that has an internal foam core. Unlike normal hollow pressure vessels that are cylindrical, this internal foam design will allow tanks to be formed into any shape. If successful, the foam core will enable higher storage capacity than current carbon fiber tanks at one third the cost.
 - **Example MOVE Project: Center for Electromechanics at the University of Texas at Austin "Single-Piston Four-Stage Linear Home Natural Gas Compressor" – Austin, TX (\$4,000,000).** The University of Texas at Austin will develop an at-home natural gas refueling system that compresses gas with a single piston. Unlike current four piston compressors, UT Austin's highly integrated single-piston system will use fewer moving parts, which could lead to a more reliable, lighter, and cost-effective compressor.

- **AMPED: Advanced Management and Protection of Energy Storage Devices (\$30,000,000)**
 - AMPED projects are aimed at developing advanced sensing and control technologies that could dramatically improve and provide new innovations in safety, performance, and lifetime for grid-scale and vehicle batteries. Unlike other initiatives currently funded by the Department, the 13 AMPED projects are focused on maximizing the potential of existing battery chemistries to reduce costs and improve performance. Significant achievements in this area will enable use of next generation storage technologies in both plug-in electric and hybrid-electric vehicles.

- **Example AMPED Project: GE Global Research “Ultrathin Strain and Temperature Sensor System” – Niskayuna, NY (\$3,128,285).** GE Global Research will develop thin-film sensors that enable real-time, two-dimensional mapping of temperature and surface pressure for each cell within a battery pack. These new sensors will provide higher resolution than today’s thermal sensors, improving internal battery measurement capabilities and potentially lowering the cost of electric vehicles.
- **SBIR/STTR: Small Business Innovation Research / Small Business Technology Transfer (\$13,000,000)**
 - Projects funded by ARPA-E’s SBIR/STTR program will focus on developing new, innovative battery chemistries and designs. Seven enterprising small businesses are pursuing novel energy storage designs applicable to both stationary power and electric vehicles. SBIR/STTR funding is allocated specifically to enterprising small businesses at the cutting-edge of their field.
 - **Example SBIR/STTR Project: Sila Nanotechnologies, Inc. “Doubling the Energy Density of Lithium-ion Batteries for Transportation”– Atlanta, GA (\$1,725,000).** Sila will develop an electric vehicle battery that doubles the capacity of today’s Lithium-ion batteries. This technology uses low-cost nano-composite materials that could cut energy storage costs in half or more. This cost reduction could accelerate electric vehicle adoption and decrease range anxiety associated with current electric vehicles.
- **OPEN 2012 (\$130,000,000²)**
 - ARPA-E’s second open funding solicitation attracted over 4,000 concept papers and resulted in the selection of 66 potentially transformational energy technology projects. These projects could produce game-changing breakthroughs in energy technology, form the foundation for entirely new industries, and have large commercial impacts. The projects are located in 24 states and encompass 11 technology areas, including advanced fuels, advanced vehicles, building efficiency, carbon capture, grid modernization, renewable power, stationary generation, stationary energy storage, transportation energy storage, water, and thermal energy storage. 47% of projects are led by universities, 29% by small businesses, 15% by large businesses, 7.5% by national labs, and 1.5% by non-profits.
 - **Example OPEN 2012 Project: Electron Energy Corporation “Improved Manufacturing For High-Performance Magnets” – Landisville, PA (\$2,904,000).** Electron Energy Corporation will develop a technology to manufacture permanent magnets that are both stronger and lower cost than those available today, based on a friction consolidation extrusion process. If successful, this technology would supply the growing market of wind turbine

² Final funding for OPEN 2012 projects is subject to change based on contract negotiations.

generators and electric vehicle motors with alternative higher-performance materials compared to the imported rare earth magnets currently used in these machines.

- **Example OPEN 2012 Project: Grid Logic, Incorporated, - Low-Cost, High-Temperature Superconducting Wires - , Lapeer, MI (\$3,800,000).** Grid Logic will develop a low-cost and innovative superconducting wire for electric utility applications. Using a new manufacturing technique, Grid Logic will embed very fine superconducting particles in a combination of metals to induce superconductivity. Such a wire would reduce the cost of transmission lines, motors for wind turbines, and other electric devices.

The table on the following page summarizes ARPA-E's programs to date. Please find a full list of the projects announced under ARPA-E's FY2012 FOAs in Appendix I.

	PROGRAM NAME	NUMBER OF PROJECTS³	FUNDING AMOUNT⁴ (Million \$)
EXISTING PROGRAMS	Agile Delivery of Electrical Power Technology (ADEPT)	14	\$37.7
	Batteries for Electrical Energy Storage in Transportation (BEEST)	10	\$35.5
	Building Energy Efficiency Through Innovative Thermodevices (BEET-IT)	14	\$34.4
	Electrofuels	13	\$48.3
	Green Electricity Network Integration (GENI)	15	\$39.0
	Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS)	12	\$33.1
	High Energy Advanced Thermal Storage (HEATS)	15	\$37.6
	Innovative Materials and Processes for Advanced Carbon Capture Technologies (IMPACCT)	15	\$39.9
	OPEN 2009	37	\$167.2
	Plants Engineered to Replace Oil (PETRO)	10	\$37.3
	Rare Earth Alternatives in Critical Technologies (REACT)	14	\$27.6
	Solar Agile Delivery of Electrical Power Technology (Solar ADEPT)	7	\$14.1
NEW IN 2012	Advanced Management and Protection of Energy Storage Devices (AMPED)	14	\$30.1
	Small Business Innovation Research / Small Business Technology Transfer (SBIR/STTR)	7	\$13.0
	Methane Opportunities for Vehicular Energy (MOVE)	13	\$30.0
	OPEN 2012	66	\$130.0

³ Project count at the time of announcement. Final number of projects is subject to change.

⁴ Funding amounts at the time of announcement. Final amounts are subject to change based on contract negotiations.

IV. ARPA-E Energy Innovation Summit

The third annual ARPA-E Energy Innovation Summit was held from February 27-29, 2012. It brought together key players from across the energy ecosystem – researchers, entrepreneurs, investors, corporate executives, and government officials – to share ideas for developing and deploying the next generation of energy technologies. The Summit’s unique combination of leaders makes it the perfect forum for developing energy solutions that will enable America to out-innovate our global competitors.

The Summit opened with the Technology Developers Workshop, where researchers, entrepreneurs, and technology developers gained strategic insights into ARPA-E’s existing and future program priorities. Participants learned the key criteria in proposal evaluation, engaged in discussions with ARPA-E program managers, and received advice and direction related to energy technology commercialization.

Throughout the three-day Summit, attendees were invited to participate in the Technology Showcase, highlighting recent ARPA-E award winners and other stakeholders involved in advancing emerging energy technologies.

Program Highlights

- Attracted over 2,600 attendees from 49 states, Puerto Rico, and 26 countries
- Technology Showcase displaying more than 240 breakthrough energy technologies from ARPA-E awardees and other innovative companies
- Dynamic pre-conference workshops and networking sessions that enabled participants to meet with ARPA-E Program Directors, global industry leaders, and energy technologists
- Attendance and comments by a bipartisan group of U.S. Senators and Representatives
- Special announcement of an ARPA-E funding opportunity for OPEN 2012, available to all breakthrough technologies
 - 107 expert speakers and keynote addresses, including leaders from Government, Business and Academia

V. Measuring Success

While it is too soon to know if ARPA-E projects will find commercial success, preliminary indicators of likely success include: handoffs of supported technologies to the next stage of development (including follow-on funding); establishment of new partnerships; and major technical achievements, as well as publications and patents to a lesser degree.

As of early 2013, ARPA-E has already recognized several notable preliminary indicators of likely success. Seventeen projects have attracted over \$450 million in private sector follow-on funding after ARPA-E’s initial investment of approximately \$70 million, 12 have

leveraged their technologies to form new companies, and over ten have partnered with other government agencies for later stage investment. ARPA-E performers have doubled the world record energy density for a rechargeable lithium-ion battery (to 400 Whr/kg), developed a 1-megawatt silicon carbide transistor the size of a fingernail, engineered microbes that use hydrogen and carbon dioxide to make liquid transportation fuel, and pioneered a near-isothermal compressed air energy storage system. Finally, ARPA-E performers have applied for at least 34 patents and submitted at least 48 technical papers as the result of their ARPA-E awards.

ARPA-E evaluates the effectiveness of its projects by practicing active program management that includes detailed high-impact milestones, performer site visits, quarterly report evaluation, and project terminations when goals are not being met. ARPA-E builds the milestones for its projects with significant understanding of the potential impact in the market, which drives early engagement and investment by the private sector to advance the technologies to market.

VI. Conclusion

In FY2012, ARPA-E announced four funding opportunities focused on advancing a broad array of promising, innovative emerging energy technologies. Projects supported by these four programs have the potential to reshape the U.S. energy landscape. At the 2012 Energy Innovation Summit, a diverse group of energy experts and industry leaders gathered with the shared goal of advancing the next generation of energy technologies.

ARPA-E's mission is to quickly and efficiently catalyze energy breakthroughs that will enhance the economic and energy security of the United States through the development of transformational technologies that reduce America's dependence on energy imports; reduce U.S. energy related emissions; improve energy efficiency across all sectors of the U.S. economy; and ensure the U.S. maintains a technological lead in the development and deployment of advanced energy technologies. By attracting some of the best and brightest minds from emerging energy technology industries and focusing on overcoming major technical challenges, ARPA-E's work is catalyzing innovation and growth. Over the past year, ARPA-E has continued to demonstrate its dedication to supporting transformational projects that are already showing signs of technical and commercial success. These breakthrough energy technologies present opportunities to revolutionize the ways we generate, store, distribute, and utilize energy in the United States.

VII. Appendix I: Fiscal Year 2012 Project Selectees

Figures listed below are as of the dates on which these project selections were publicly announced: July 12, 2012 (MOVE), August 2, 2012 (AMPED and SBIR/STTR), and November 28, 2012 (OPEN 2012). More detailed information on each project is available on the ARPA-E website: <http://arpa-e.energy.gov/?q=projects/search-projects>.

Program	Awardee	Project Title	ARPA-E Funds ⁵ (Million \$)
MOVE	Center for Electromechanics - University of Texas at Austin	Single-Piston Four-Stage Linear Home Natural Gas Compressor	\$4.3
MOVE	Oregon State University	Engine-Integrated Natural Gas Compressor	\$0.7
MOVE	Eaton Corporation	Liquid-Piston Isothermal Home Natural Gas Compressor	\$3.4
MOVE	Ford Motor Company	Adsorbed Natural Gas System for Vehicles	\$5.5
MOVE	Gas Technology Institute	Engineered Adsorption Materials for Gas Storage	\$1.5
MOVE	Gas Technology Institute	Nano-Valved Materials for Natural Gas Storage	\$0.9
MOVE	General Electric Global Research	Chilled Natural Gas for At-Home Refueling	\$1.8
MOVE	OtherLab, Inc.	Safe, Conformal, Gas Intestine Storage	\$0.3
MOVE	Pacific Northwest National Laboratory	Superplastic-Formed Gas Storage Tanks	\$0.6
MOVE	REL, Inc.	Shape Conformable Foam Core Gas Tanks	\$3.0
MOVE	SRI International	Container-less Natural Gas Storage	\$0.9
MOVE	Texas A&M University	Advanced Porous Materials for Vehicular Natural Gas Storage	\$3.0
MOVE	United Technologies Research Center	Low Cost Modular Natural Gas Tanks	\$4.4
AMPED	Palo Alto Research Center	Smart Embedded Network of Sensors with Optical Readout (SENSOR)	\$4.0
AMPED	Ford Motor Company	High Precision Life Testing of Automotive and Grid Storage Batteries	\$3.1
AMPED	GE Global Research	Ultrathin Strain and Temperature Sensor System	\$3.1
AMPED	Oak Ridge National Laboratory	Temperature Regulation for Lithium-Ion Cells	\$1.0
AMPED	Utah State University	Cell-level Power Management of Large Battery Packs	\$3.1
AMPED	Battelle Memorial Institute	Battery Fault Sensing in Operating Batteries	\$0.6

⁵ Figures represent funding amounts at the time of project announcements. Final amounts are subject to change based on contract negotiations.

AMPED	Pennsylvania State University	Health Management System for Reconfigurable Battery Packs	\$1.0
AMPED	Washington University in St. Louis	Optimal Operation and Management of Batteries Based on Real Time Predictive Modeling and Adaptive Battery Management Techniques	\$2.0
AMPED	Det Norske Veritas	Sensor Enhanced and Model Validated Batteries for Energy Storage	\$2.0
AMPED	Southwest Research Institute	Strain Estimation Technology for Lithium-Ion Batteries	\$0.7
AMPED	Robert Bosch LLC	Advanced Battery Management System	\$3.1
AMPED	Eaton Corporation	Predictive Battery Management for Hybrid Vehicles	\$2.5
AMPED	*Gayle Technologies, Inc.	Ultrasonic Battery Monitoring	\$0.7
AMPED	*Lawrence Livermore National Laboratory	Battery Management System with Distributed Wireless Sensors	\$2.0
SBIR/STTR	ITN Energy Systems, Inc.	Advanced Vanadium Redox Flow Battery	\$1.7 (SBIR)
SBIR/STTR	Energy Storage Systems, Inc.	Iron Flow Battery	\$1.7 (SBIR)
SBIR/STTR	TVN Systems, Inc.	Hydrogen-Bromine Electrical Energy Storage System	\$1.7 (STTR)
SBIR/STTR	Materials & Systems Research, Inc.	Advanced Sodium Battery	\$1.7 (SBIR)
SBIR/STTR	Pellion Technologies, Inc.	Rechargeable Multivalent Batteries from Common Metals	\$2.5 (SBIR)
SBIR/STTR	Sila Nanotechnologies, Inc.	Doubling the Energy Density of Lithium-ion Batteries for Transportation	\$1.7 (SBIR)
SBIR/STTR	Xiletric, Inc.	Reinvention of the Edison Battery	\$1.7 (SBIR)
OPEN 2012 (Advanced Fuels)	Allylix, Inc.	Energy-Dense Aviation Fuels from Biomass	\$4.5
OPEN 2012 (Advanced Fuels)	Bio2Electric, LLC	Methane Converter to Electricity and Fuel	\$0.6
OPEN 2012 (Advanced Fuels)	Ceramatec, Inc.	Natural Gas Reactor for Remote Chemical Conversion	\$1.7
OPEN 2012 (Advanced Fuels)	Colorado State University	Synthetic Gene Circuits to Enhance Production of Transgenic Bioenergy Crops	\$2.1
OPEN 2012 (Advanced Fuels)	Cornell University	High-Density Algae-Fuel Reactor	\$0.9
OPEN 2012 (Advanced Fuels)	Gas Technology Institute	Methane to Methanol Fuel: A Low Temperature Process	\$0.8
OPEN 2012 (Advanced Fuels)	Massachusetts Institute of Technology	Small and Efficient Reformer for Converting Natural Gas to Liquid Fuels	\$0.5
OPEN 2012 (Advanced Fuels)	Plant Sensory Systems	Development of High-Output, Low-Input Energy Beets	\$1.8
OPEN 2012 (Advanced Fuels)	Pratt & Whitney Rocketdyne	Turbo-POx For Ultra Low-Cost Gasoline	\$3.8
OPEN 2012 (Advanced Fuels)	University of Colorado	Atomic Layer Deposition for Creating Liquid Fuels from Natural Gas	\$0.4
OPEN 2012 (Advanced Fuels)	University of Minnesota	Flexible Molecular Sieve Membranes	\$1.8
OPEN 2012 (Advanced Fuels)	University of Tennessee	Transformable Single Cell Line for Rapid Assessment of Cell Wall Genes for Biofuels	\$0.4

OPEN 2012 (Advanced Fuels)	University of Washington	Biocatalyst for Small-Scale Conversion of Natural Gas into Diesel Fuel	\$4.0
OPEN 2012 (Advanced Vehicle Design & Materials)	Electron Energy Corporation	Improved Manufacturing for High-Performance Magnets	\$2.9
OPEN 2012 (Advanced Vehicle Design & Materials)	United Technologies Research Center	Additive Manufacturing of Optimized Ultra-High Efficiency Electric Machines	\$2.7
OPEN 2012 (Building Efficiency)	Lawrence Berkeley National Laboratory	Low-Cost Smart Window Coatings for Heat and Light	\$3.0
OPEN 2012 (Building Efficiency)	Lawrence Berkeley National Laboratory	Automated Modeling and Simulation of Existing Buildings for Energy Efficiency	\$1.9
OPEN 2012 (Building Efficiency)	Stanford University	Photonic Radiative Day-Time Cooling Devices	\$0.4
OPEN 2012 (Carbon Capture)	Arizona State University	Energy-Efficient Electrochemical Capture and Release of CO ₂	\$0.6
OPEN 2012 (Carbon Capture)	Dioxide Materials, Inc.	Enabling Efficient Electrochemical Conversion of Carbon Dioxide into Fuels	\$4.0
OPEN 2012 (Carbon Capture)	University of Massachusetts, Lowell	Plasmonic-Enhanced Photocatalysis	\$3.0
OPEN 2012 (Carbon Capture)	University of Pittsburgh	Increased Viscosity Carbon Dioxide for Enhanced Oil Recovery and Fracturing	\$2.4
OPEN 2012 (Grid Modernization)	Board of Trustees of the University of Illinois	Cyber Modeling and Analysis for a Smart Grid	\$1.5
OPEN 2012 (Grid Modernization)	GE Global Research	High-Voltage and High-Power Gas Tube Technology for HVDC Transmission	\$4.1
OPEN 2012 (Grid Modernization)	Grid Logic, Inc.	Low-Cost, High-Temperature Superconducting Wires	\$3.8
OPEN 2012 (Grid Modernization)	Hexatech, Inc.	Aluminum Nitride-Based Devices for High-Voltage Power Electronics	\$2.2
OPEN 2012 (Grid Modernization)	Pacific Northwest National Laboratory	Non-Wire Methods for Transmission Congestion Management	\$1.6
OPEN 2012 (Grid Modernization)	RamGoss, Inc.	Development of High-Performance Gallium Nitride Transistors	\$1.2
OPEN 2012 (Grid Modernization)	Rensselaer Polytechnic Institute	High Voltage SiC-Based Power Switches for Smart Grid Utility Applications	\$0.8
OPEN 2012 (Grid Modernization)	Silicon Power Corporation	Optically-Switched, Single-Bias, High-Frequency Thyristor	\$4.8
OPEN 2012 (Grid Modernization)	University of California Berkeley / California Institute for Energy and Environment	Micro-Synchrophasors in Distribution Systems	\$4.0
OPEN 2012 (Renewable Power)	National Renewable Energy Laboratory	Negating Energy Losses in Organic Photovoltaics Using Photonic Structures	\$0.8
OPEN 2012 (Renewable Power)	Brown University	Marine Hydrokinetic Energy Harvesting Using Cyber-Physical Systems	\$0.8
OPEN 2012 (Renewable Power)	California Institute of Technology	Optics for Ultra High-Efficiency Solar Energy Conversion	\$2.4
OPEN 2012 (Renewable Power)	GE Power and Water	Tensioned Fabric Wind Blades	\$3.7

OPEN 2012 (Renewable Power)	Georgia Institute of Technology	Electric Power Generation by a Vertical-Axis Turbine Driven by an Anchored Vortex and Sustained by the Air Layer over Solar-Heated Ground	\$3.7
OPEN 2012 (Renewable Power)	Glint Photonics, Inc.	Self-Tracking Concentrator Photovoltaics	\$0.5
OPEN 2012 (Renewable Power)	MicroLink Devices	High Efficiency, Lattice-Matched Solar Cells Using Epitaxial Lift-Off	\$3.3
OPEN 2012 (Renewable Power)	Otherlab, Inc.	Adaptive Hydraulic Solar Field	\$1.6
OPEN 2012 (Renewable Power)	Sea Engineering, Inc.	Cost-Effective, Real-Time Wave Assessment Tool	\$0.3
OPEN 2012 (Renewable Power)	University of California Santa Cruz	Adiabatic Waveguide Coupler for High-Power Solar Energy Collection and Transmission	\$1.6
OPEN 2012 (Stationary Energy Storage)	Alveo Energy	Open Framework Electrode Batteries for Cost-Effective Energy Storage	\$4.0
OPEN 2012 (Stationary Energy Storage)	Case Western Reserve University	Iron Flow Battery for Electric Grid-Scale Energy Storage	\$0.6
OPEN 2012 (Stationary Energy Storage)	Harvard University	Small Organic Molecule-Based Flow Battery	\$0.6
OPEN 2012 (Stationary Energy Storage)	Sharp Laboratories of America	Low-Cost Sodium-Ion Battery for Grid-Scale Energy Storage	\$2.9
OPEN 2012 (Stationary Energy Storage)	Tai Yang Research Company	Novel, Low-Cost, High-Field Conductor for Superconducting Magnetic Energy Storage	\$2.2
OPEN 2012 (Stationary Energy Storage)	Teledyne Scientific Company	Potassium-Ion Flow Battery for Electric Grid-Scale Energy Storage	\$0.6
OPEN 2012 (Stationary Energy Storage)	University of Delaware	High-Voltage Flow Batteries for Stationary Energy Storage	\$0.8
OPEN 2012 (Stationary Energy Storage)	University of Southern California	Inexpensive Metal-Free Organic Redox Flow Battery for Grid-Scale Storage	\$0.6
OPEN 2012 (Stationary Generation)	Pratt & Whitney Rocketdyne	Continuous Detonation Combustors for Natural Gas Turbines	\$0.7
OPEN 2012 (Stationary Generation)	Pratt & Whitney Rocketdyne	Ultra High-Temperature Gas Turbine Cycle	\$0.6
OPEN 2012 (Stationary Generation)	University of North Dakota	Novel Dry Cooling Technology for Power Plants	\$0.5
OPEN 2012 (Thermal Energy Storage)	National Renewable Energy Laboratory	High-Temp, High-Efficiency Solar-Thermoelectric Generators (STEG)	\$0.9
OPEN 2012 (Thermal Energy Storage)	e Nova, Inc.	Waste Heat-Powered Gas Compressor	\$0.6

OPEN 2012 (Thermal Energy Storage)	Georgia Institute of Technology	High-Efficiency Solar Fuels Reactor	\$3.6
OPEN 2012 (Thermal Energy Storage)	Texas A&M University Experiment Station	Generating Electricity from Waste Heat Using Metal Hydrides	\$1.7
OPEN 2012 (Thermal Energy Storage)	Yale University	Power Generation from Waste Heat with Closed-Loop Membrane-Based System	\$2.6
OPEN 2012 (Transportation Energy Storage)	Ceramatec, Inc.	Mid-Temperature Fuel Cells for Transportation Applications	\$2.1
OPEN 2012 (Transportation Energy Storage)	Georgia Institute of Technology	High-Performance Supercapacitors using Structurally Modified Graphene	\$2.1
OPEN 2012 (Transportation Energy Storage)	Palo Alto Research Center	Printed Integral Batteries	\$0.9
OPEN 2012 (Transportation Energy Storage)	PolyPlus Battery Company	High-Performance, Low Cost Aqueous Lithium-Sulfur Batteries	\$4.5
OPEN 2012 (Transportation Energy Storage)	University of California at Santa Barbara	High-Energy Electro-Chemical Capacitor	\$1.6
OPEN 2012 (Transportation Energy Storage)	University of Nevada Las Vegas	Lithium-Rich Anti-Perovskites as Superionic Solid Electrolytes	\$2.5
OPEN 2012 (Transportation Energy Storage)	Vorbeck Materials Corp.	Low-Cost, Fast-Charging Batteries for Hybrid Vehicles	\$1.5
OPEN 2012 (Other)	Massachusetts Institute of Technology	Modular Low-Power Water Purification Technology	\$2.0
OPEN 2012 (Other)	Wyss Institute at Harvard University	Slippery Coatings to Reduce Pumping Energy in Liquid Pipelines	\$2.0