U.S. DEPARTMENT OF
ENERGY

Advanced Research Projects Agency – Energy Annual Report for FY2014

Report to Congress
July 2015

United States Department of Energy
Washington, DC 20585

Message from the Director

The Advanced Research Projects Agency-Energy (ARPA-E) invests in technologies that could fundamentally change the way we use, generate and store energy. ARPA-E's mission is to catalyze energy innovations that will create a more secure, affordable and sustainable American energy future. ARPA-E explores uncharted territories of energy technology to create options for entirely new paths to accelerate the pace of innovation to reduce America's dependence on energy imports; reduce energy related emissions; improve energy efficiency across all sectors of the economy; and ensure the United States maintains a technological lead in developing and deploying advanced energy technologies. ARPA-E's rigorous program design, competitive project selection process, and hands-on engagement, ensure thoughtful expenditures while empowering America's energy researchers with funding, technical assistance, and market awareness.

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 Frank Pallone, Jr.**
  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 Randy Weber**
  Chairwoman, House Subcommittee on Energy
  Committee on Science, Space and Technology
- **The Honorable Alan Grayson**
  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 Mike Simpson**
  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 Lisa Murkowski**
  Chairwoman, Senate Committee on Energy and Natural Resources

- **The Honorable Maria Cantwell**
  Ranking Member, Senate Committee on Energy and Natural Resources

- **The Honorable James E. Risch**
  Chairman, Senate Subcommittee on Energy
  Committee on Energy and Natural Resources

- **The Honorable Joe Manchin III**
  Ranking Member, Senate Subcommittee on Energy
  Committee on Energy and Natural Resources

- **The Honorable Thad Cochran**
  Chairman, Senate Committee on Appropriations

- **The Honorable Barbara Mikulski**
  Vice Chairwoman, Senate Committee on Appropriations

- **The Honorable Lamar Alexander**
  Chairman, Senate Subcommittee on Energy and Water Development
  Committee on Appropriations

- **The Honorable Dianne Feinstein**
  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. Brad Crowell, Assistant Secretary for Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Dr. Ellen D. Williams
Director
Advanced Research Projects Agency - Energy

Executive Summary

This report presents a summary of the activities of the Advanced Research Projects Agency-Energy (ARPA-E) during Fiscal Year 2014 (FY2014).

In FY2014, ARPA-E issued funding solicitations and selected projects for three new programs covering a broad array of energy technologies, including: $27 million to develop next-generation power switching devices that improve energy efficiency in a wide range of applications; $30 million for hybrid solar energy beyond current photovoltaic (PV) and concentrated solar power (CSP) technologies; and $33 million for electrochemical technologies to enable low-cost distributed power generation.

ARPA-E released three additional funding opportunities in FY2014 with project selections that were ultimately announced in FY2015. These programs include: $30 million for localized heating and cooling devices to expand temperature ranges within buildings reducing energy consumption; $30 million for low-cost, high-sensitivity systems to detect and measure methane emissions; and $30 million for low-cost tools to aid in the future development of fusion power. ARPA-E also continued the use of a rolling open solicitation to quickly support innovative applied energy research that has the potential to lead to new focused programs.

In addition to these new programs, ARPA-E hosted the fifth annual Energy Innovation Summit from February 24-26, 2014. The Summit brought together leaders from academia, government, and business to discuss the foremost energy issues, showcase the latest technology innovations, and cultivate relationships to help advance cutting-edge technologies to market. The event drew over 2,100 attendees and featured over 120 speakers and keynote addresses. At the Summit, ARPA-E announced at least 24 ARPA-E project teams that have formed new companies and more than 16 ARPA-E projects, which have partnered with other government agencies for further development. Additionally, 22 ARPA-E projects have attracted more than $625 million in private-sector follow-on funding after ARPA-E's investment of approximately $95 million.

Lastly, ARPA-E continued to focus on providing awardees with practical training and critical business information as part of the Agency's Technology-to-Market program. This support equips projects with a clear understanding of market needs to guide technical development and help projects succeed the marketplace.

ARPA-E ANNUAL REPORT FOR FISCAL YEAR 2014

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I. Legislative Language

This report is in response to the requirements set forth in the America COMPETES Act, Public Law 110-69, section 5012(g)(1)(2007) as amended, which has been codified as 42 U.S.C. § 16538(h)(1), 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."*

ARPA-E focuses on energy technologies that can be meaningfully advanced with a modest investment over a defined period of time. ARPA-E brings together top minds in energy research, development, and commercialization to collaborate and rethink what's possible. ARPA-E's rigorous program design, competitive project selection process, and hands-on engagement, ensure thoughtful expenditures while empowering America's energy researchers with funding, technical assistance, and market awareness. ARPA-E thoroughly reviews all applications and technologies to ensure that investments are made in areas not currently undertaken by industry or other DOE applied research and development investment.

II. Fiscal Year 2014 Appropriation

ARPA-E was appropriated $280 million for FY2014, pursuant to the Consolidated Appropriations Act of 2014 (P.L. 113-76, H.R. 3547), enacted January 17, 2014.

III. Funding Opportunity Announcements (FOAs)

In FY2014, ARPA-E released four Funding Opportunity Announcements (FOA) to advance innovative energy technologies in specific program areas. Project selections for one of these FOAs, as well as two FOAs released in FY2013 were announced in FY2014. Selections for three FY2014 programs were announced in early FY2015. The focused technology programs created by these solicitations provide a unique bridge from basic science to early stage technology, drawing from the latest scientific discoveries and help create a viable path to commercial implementation through firm grounding in the economic realities and changing dynamics of the marketplace.

In FY2014 selections were announced for 39 projects across three focused technology programs. On October 21, 2013 ARPA-E announced that 14 projects were selected to receive $27 million for **SWITCHES** (*Strategies for Wide Bandgap, Inexpensive Transistors for Controlling High Efficiency Systems*), and on February 6, 2014, the Agency announced that

12 projects would receive $30 million for **FOCUS** (*Full-Spectrum Optimized Conversion and Utilization of Sunlight*). On June 19, 2014, ARPA-E announced $33 million across 13 projects for **REBELS** (*Reliable Electricity Based on ELectrochemical Systems*).

In FY2014 ARPA-E also issued solicitations for two programs with project selections announced in early FY2015. On December 16, 2014 ARPA-E announced that **MONITOR** (*Methane Observation Networks with Innovative Technology to Obtain Reductions*) and **DELTA** (*Delivering Efficient Local Thermal Amenities*) would each provide $30 million to 11 projects for a total of $60 million in funding across 22 teams. ARPA-E also released a solicitation for **ALPHA** (*Accelerating Low-Cost Plasma Heating and Assembly*) in FY2014 with project selections anticipated to be announced in May of 2015.

Throughout FY2014, ARPA-E continued utilizing **IDEAS** (*Innovative Development in Energy-Related Applied Science*), a rolling open solicitation that will allow ARPA-E to quickly support innovative applied energy research that has the potential to lead to new focused programs.

As of February 2015, ARPA-E has invested over $1.1 billion across more than 400 projects through 23 focused programs and two open funding solicitations (OPEN 2009 and OPEN 2012).

The details of the focused programs funded by FY2014 FOAs as announced[1] are:

- **SWITCHES: *Strategies for Wide Bandgap, Inexpensive Transistors for Controlling High Efficiency Systems* ($27 million)**
    - The projects in SWITCHES are focused on developing next-generation power switching devices that could dramatically improve energy efficiency in a wide range of applications, including new lighting technologies, computer power supplies, industrial motor drives, and automobiles. Most of today's high-voltage power electronics systems are based on silicon (Si) semiconductor devices, which have notable performance limitations. In contrast, SWITCHES projects are advancing bulk gallium nitride (GaN) power semiconductor devices, the manufacture of silicon carbide (SiC) devices using a foundry model, and the design of synthetic diamond-based transistors. These advances will enable increased switching frequency, enhanced temperature control, and reduced power losses, at substantially lower costs relative to today's solutions.

[1] Project counts and funding amounts on pages 2-5 (inclusive) reflect information at the time of announcement. Final number of projects and funding amounts are subject to change based on contract negotiations.

- Eight of the 14 SWITCHES projects are small businesses being funded through ARPA-E's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program.
- **Example SWITCHES Project: University of California at Santa Barbara (UCSB) – "Current Aperture Vertical Electron Transistor Device Architectures for Efficient Power Switching" – Santa Barbara, CA ($3.2 million).** The University of California, Santa Barbara (UCSB) will develop several new vertical gallium nitride (GaN) semiconductor technologies that will enhance the performance and reduce the cost of high-power electronics. The team's current aperture vertical electron transistor devices could reduce power losses and reach beyond the performance of lateral GaN devices when switching and converting power. If successful, UCSB's devices will enable high-power conversion at low cost in motor drives, electric vehicles, and power grid applications.
- **Example SWITCHES Project (SBIR/STTR): MicroLink Devices – "Vertical-Junction Field-Effect Transistors Fabricated on Low-Dislocation-Density GaN by Epitaxial Lift-Off" – Niles, IL ($1.7 million).** MicroLink Devices will engineer affordable, high-performance transistors needed for power conversion. Currently, high- performance power transistors are prohibitively expensive because they are grown on expensive gallium nitride (GaN) semiconductor wafers. In conventional manufacturing processes, this expensive wafer is permanently attached to the transistor, so the wafer can only be used once. MicroLink Devices will develop an innovative method to remove the transistor structure from the wafer without damaging any components, enabling wafer reuse that significantly reduce costs.

- **FOCUS: *Full-Spectrum Optimized Conversion and Utilization of Sunlight* ($30 Million)**
  - FOCUS seeks to develop new technologies that deliver cost-effective solar energy when the sun is not shining. The technologies developed will help advance solar energy beyond current photovoltaic (PV) and concentrated solar power (CSP) technologies to ensure solar power remains a consistent, cost-effective renewable energy option. The program is focused on two distinct technology options to deliver low-cost, high-efficiency solar energy on demand:
    1. New hybrid solar energy converters that turn sunlight into electricity for immediate use, while also producing heat that can be stored at low cost for later use; these hybrid converters will use the entire solar spectrum more efficiently than PV or CSP technologies.
    2. New hybrid energy storage systems that accept heat and electricity from variable solar sources to deliver electricity when needed.

- **Example FOCUS Project: Sharp Labs of America – "High-Concentration Full-Spectrum Solar Energy System" – Camas, WA ($4.2 million).** Sharp Labs of America will develop a hybrid solar converter that incorporates a partially transmitting mirror to reflect visible wavelengths of light to extremely high-efficiency solar cells while passing ultraviolet and most infrared light to heat a thermal fluid. The extremely high concentration of visible wavelengths of light would allow expensive solar cells to be used in an inexpensive converter. The converter could enable utilities to provide dispatchable, on-demand, solar electricity at low cost.

- **REBELS: *Reliable Electricity Based on ELectrochemical Systems* ($33 million)**
  - REBELS seeks to develop transformational fuel cell devices that operate in an intermediate temperature range in an attempt to create new pathways for low-cost distributed power generation. By creating new fuel cell functionality this program will help increase grid stability and integration of renewable energy technologies such as wind and solar.
  - **Example REBELS Project: University of South Carolina – "Novel Intermediate Temperature Bi-functional Ceramic Fuel Cell Energy System" – Columbia, SC ($3.2 million):** The University of South Carolina project team from Columbia, South Carolina will develop a ceramic-based fuel cell that will both generate and store electrical power with high efficiencies by incorporating a newly discovered ceramic electrolyte and nanostructured electrodes in one device to enable its operation at lower temperatures.

- **DELTA: *Delivering Efficient Local Thermal Amenities* ($30 million)**
  - DELTA will develop localized heating and cooling systems and devices to expand temperature ranges within buildings. DELTA projects will develop technologies that can regulate temperatures focused on a building's occupants and not the overall building. This localization of thermal management will enable facilities to operate in wider temperature ranges while still ensuring occupant comfort, which would dramatically reduce the building's energy consumption and associated emissions.
  - **Example DELTA Project: Syracuse University – "Micro-Environmental Control System" - Syracuse, NY ($3.2 million):** Syracuse University will develop a near-range micro-environmental control system transforming the way office buildings are thermally conditioned to improve occupant comfort. The system leverages a high-efficiency micro-scroll compressor in a micro vapor compression system, whose evaporator is embedded in a phase-change material. This material will store the cooling produced by the micro vapor compression system at night, releasing it as a cool breeze to make occupants more comfortable during the day. This micro-environmental

control system could save more than 15 percent of the energy provided for heating and cooling.

- **MONITOR: *Methane Observation Networks with Innovative Technology to Obtain Reductions* ($30 million)**
  - MONITOR focuses on reducing methane emissions associated with energy production to build a more sustainable energy future. MONITOR projects will develop low-cost, highly sensitive systems that detect and measure methane associated with the production and transportation of oil and natural gas.
  - **Example MONITOR Project: Bridger Photonics, Inc – "Mobile LiDAR Sensors for Methane Leak Detection" – Bozeman, MT ($1.5 million):** Bridger Photonics will develop a light-detection and ranging (LiDAR) system capable of rapid and precise methane measurements resulting in 3D topographic information about potential leak locations. A novel near-infrared fiber laser will enable long range detection with high sensitivity and can be deployed on a range of mobile platforms to survey multiple sites per day. This mobile LiDAR system will dramatically reduce the cost of identifying, quantifying and locating methane leaks compared to currently available technologies.

- **ALPHA: *Accelerating Low-cost Plasma Heating and Assembly* ($30 million)**
  - ALPHA seeks to support innovative research and development on low-cost tools to aid in the future development of fusion power. The program will focus on intermediate density fusion approaches between low-density, magnetically confined plasmas and high-density, inertially confined plasmas. ARPA-E's goal is to create a toolset to enable rapid learning through high shot rate at low cost-per-shot to catalyze the creation of new, low-cost paths to fusion power.[2]

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 FY2014 FOAs in Appendix I. Additional information related to these projects can be found on ARPA-E's website: http://arpa-e.energy.gov.

[2] As of Early May 2015, projects encompassing the ALPHA program have not yet been made publicly available. As a result, a description of an example project could not be included in this report.

ARPA-E PROGRAMS TO DATE			
	PROGRAM NAME	**NUMBER OF PROJECTS**	**FUNDING AMOUNT ($ Million)[3]**
EXISTING PROGRAMS	OPEN 2009	41	$175.0
	Batteries for Electrical Energy Storage in Transportation (BEEST)	10	$32.4
	Innovative Materials and Processes for Advanced Carbon Capture Technologies (IMPACCT)	15	$41.0
	Electrofuels	13	$48.7
	Agile Delivery of Electrical Power Technology (ADEPT)	14	$38.7
	Building Energy Efficiency Through Innovative Thermodevices (BEETIT)	17	$37.6
	Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS)	12	$34.0
	Plants Engineered to Replace Oil (PETRO)	10	$55.4
	High Energy Advanced Thermal Storage (HEATS)	15	$37.9
	Rare Earth Alternatives in Critical Technologies (REACT)	14	$37.5
	Green Electricity Network Integration (GENI)	15	$42.3
	Solar Agile Delivery of Electrical Power Technology (Solar ADEPT)	7	$13.5
	Methane Opportunities for Vehicular Energy (MOVE)	14	$40.5
	Advanced Management and Protection of Energy Storage Devices (AMPED)	14	$30.3
	Small Business Innovation Research / Small Business Technology Transfer (SBIR/STTR)	6	$12.8
	OPEN 2012	67	$158.7
	Innovative Development in Energy-related Applied Science (IDEAS)	6	$2.5
	Robust Affordable Next Generation Energy Storage Systems (RANGE)	22	$36.2
	Reducing Emissions using Methanotrophic Organisms for Transportation Energy (REMOTE)	15	$35.8
	Modern Electro/Thermochemical Advancements for Light-metal Systems (METALS)	18	$35.9
NEW IN FY2014	Full-Spectrum Optimized Conversion and Utilization of Sunlight (FOCUS)[4]	13	$35.3
	Strategies for Wide Bandgap, Inexpensive Transistors for Controlling High Efficiency Systems (SWITCHES) & SBIR/STTR	14	$29.0
	Reliable Electricity Based on ELectrochemical Systems (REBELS)	13	$33.7
	Delivering Efficient Local Thermal Amenities (DELTA)	11	$30.0
	Methane Observation Networks with Innovative Technology to Obtain Reductions (MONITOR)	11	$30.0
	Accelerating Low-cost Plasma Heating and Assembly (ALPHA)	N/A	$30.0

[3] Funding levels shown in this chart are as of January 2015. DELTA and MONITOR project counts and funding amounts reflect information at the time of announcement. Final number of projects and funding amounts are subject to change based on award negotiations. ALPHA projects have not yet been announced, funding amount reflects information at time of the ALPHA FOA announcement.

[4] The FOCUS and SWITCHES FOAs were announced in FY2013, but projects were not announced until FY2014.

IV. ARPA-E Energy Innovation Summit

The fifth annual ARPA-E Energy Innovation Summit was held from February 24-26, 2014 at the Gaylord National Convention Center, in National Harbor, Maryland. The Summit convenes thought leaders from academia, business, and government to discuss the foremost energy issues, showcase cutting-edge energy technologies, and facilitate relationships to help move technologies into the market. The unique combination of leaders, investors, and innovators at the Summit makes it the ideal forum for developing energy solutions that will enable the United States to maintain a global technological lead in advanced energy technology.

Throughout the three-day event, attendees also have the opportunity to explore the Technology Showcase which features ARPA-E awardees and a highly selective group of other companies, stakeholders, and research organizations. Many of the transformational energy technologies displayed in the Technology Showcase were being demonstrated publically for the first time.

ARPA-E Energy Innovation Summit Highlights

- Over 2,100 registered attendees from across the United States and over 20 countries
- Technology Showcase displaying more than 300 breakthrough energy technologies from ARPA-E awardees and other innovative companies
- Dynamic panel discussions and networking sessions that enabled participants to meet with ARPA-E Program Directors, global industry leaders and energy technologists
- Over 120 expert speakers and keynote addresses, including leaders from Government, Business, and Academia
- Attendance and comments by a bipartisan group of United States Senators and Representatives
- Announcement that as of early 2014, ARPA-E had recognized several notable preliminary indicators of success, including:
    - At least 24 ARPA-E project teams have formed new companies to advance their technologies;
    - Several ARPA-E awardees have announced strategic partnerships with established industry participants, ranging from jointly developing a demonstration site to being acquired by a larger company;
    - Over 16 ARPA-E projects have partnered with other government agencies for further development; and
    - 22 ARPA-E projects have attracted more than $625 million in private-sector follow-on funding after ARPA-E's investment of approximately $95 million.

V. Conclusion

In FY2014, ARPA-E released four solicitations for focused programs for the development of high-potential, high-impact energy technologies. The programs created through these solicitations cover a wide range of technical areas: intermediate temperature fuel cells for low cost distributed power generation; low-cost tools to aid in the future development of fusion power; systems for localized thermal management to improve building efficiency; and low-cost, highly sensitive systems to detect methane emissions.

At the 2014 ARPA-E Energy Innovation Summit, the Agency convened a diverse and influential group of energy experts and industry leaders focused on advancing the next generation of breakthrough energy technologies. The Summit brought together leaders with unique perspectives, experiences, and ideas with the shared goal of revolutionizing the American approach to energy innovation.

ARPA-E catalyzes transformational energy technologies that could create a more secure and affordable American future by advancing high-potential, high-impact energy projects that are too early for private sector investment. The goals of ARPA-E are to enhance the economic and energy security of the United States through the development of 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.

ARPA-E has created a unique, nimble, and adaptive structure that allows the Agency to quickly develop and execute programs, recruit a highly talented and experienced technical team, and provide awardees with technical assistance and market awareness to help projects succeed. ARPA-E Program Directors provide awardees with technical guidance and develop new programs by engaging diverse communities to identify gaps where investment by ARPA-E could lead to transformational technologies enabling entirely new ways to generate, store, and use energy. The ARPA-E technology-to-market program provides practical training and critical business information to equip awardees with a clear understanding of market needs to guide technical development and help projects succeed.

Throughout FY2014, ARPA-E has continued to demonstrate its dedication to supporting transformational projects. These breakthrough energy technologies present opportunities to revolutionize the ways we generate, store, distribute, and utilize energy in the United States.

VI. Appendix I: FY2014 Project Selectees

Data below are as of the dates on which project selections were publicly announced: October 21, 2013 (SWITCHES); February 6, 2014 (FOCUS); June 19, 2014 (REBELS); and December 16, 2014 (MONITOR & DELTA).

Additional information on these projects is available on the ARPA-E website: http://arpa-e.energy.gov.

PROGRAM	LEAD ORGANIZATION	PROJECT TITLE	LOCATION	ARPA-E FUNDING[5] (Million $)
SWITCHES SBIR / STTR	Avogy, Inc.	**Vertical GaN Transistors on Bulk GaN Substrates**	San Jose, CA	$1.7
SWITCHES SBIR / STTR	Fairfield Crystal Technology	**High Quality, Low-Cost GaN Single Crystal Substrates for High Power Devices**	New Milford, CT	$1.4
SWITCHES SBIR / STTR	iBeam Materials, Inc.	**Epitaxial GaN on Flexible Metal Tapes for Low-Cost Transistor Devices**	Santa Fe, NM	$0.8
SWITCHES SBIR / STTR	Kyma Technologies, Inc.	**High Quality, Low Cost GaN Substrate Technology**	Raleigh, NC	$3.2
SWITCHES SBIR / STTR	MicroLink Devices	**MicroLink Devices**	Niles, IL	$1.7
SWITCHES SBIR / STTR	Monolith Semiconductor, Inc.	**Advanced Manufacturing and Performance Enhancements for Reduced Cost Silicon Carbide MOSFETs**	Ithaca, NY	$3.2
SWITCHES SBIR / STTR	SixPoint Materials, Inc.	**GaN Homoepitaxial Wafers by Vapor Phase Epitaxy on Low-Cost, High-Quality Ammonothermal GaN Substrates**	Buellton, CA	$1.7
SWITCHES SBIR / STTR	Soraa, Inc.	**Large Area, Low-Cost Bulk GaN Substrates for Power Electronics**	Fremont, CA	$0.2

[5] Figures represent funding amounts at the time of project announcements. Final amounts are subject to change based on award negotiations. Please see the ARPA-E's website for updated information: http://arpa-e.energy.gov/.

SWITCHES	Arizona State University	**Diamond Power Transistors Enabled by Phosphorus Doped Diamond**	Tempe, AZ	$0.4
SWITCHES	Columbia University	**Vertical GaN Power Transistors Using Controlled Spalling for Substrate Heterogeneity**	New York, NY	$3.0
SWITCHES	HRL Laboratories, LLC	**Low-Cost Gallium Nitride Vertical Transistor**	Malibu, CA	$2.9
SWITCHES	Michigan State University	**Diamond Diode and Transistor Devices**	East Lansing, MI	$0.6
SWITCHES	University of California, Santa Barbara	**Current Aperture Vertical Electron Transistor Device Architectures for Efficient Power Switching**	Santa Barbara, CA	$3.2
SWITCHES	University of Notre Dame	**PolarJFET Novel Vertical GaN Power Transistor**	St. Joseph, IN	$2.5
FOCUS	Arizona State University	**High-Temperature Topping Cells from LED Materials**	Tempe, AZ	$3.9
FOCUS	Arizona State University	**Solar-Concentrating Photovoltaic Mirrors**	Tempe, AZ	$2.6
FOCUS	Cogenra Solar, Inc.	**Double-Focus Hybrid Solar Energy System with Full Spectrum Utilization**	Mountain View, CA	$2.0
FOCUS	Gas Technology Institute	**Double-Reflector Hybrid Solar Energy System**	Des Plaines, IL	$1.0
FOCUS	General Electric Global Research	**Electrothermal Energy Storage with a Supercritical CO2 Cycle**	Niskayuna, NY	$2.3
FOCUS	Massachusetts Institute of Technology	**Full-Spectrum Stacked Solar-Thermal and PV Receiver**	Cambridge, MA	$3.4
FOCUS	Massachusetts Institute of Technology	**Low-Cost Hetero-Epitaxial Solar Cell for Hybrid Converter**	Cambridge, MA	$0.6
FOCUS	MicroLink Devices	**Epitaxial Lift-Off III-V Solar Cell for High Temperature Operation**	Niles, IL	$3.6
FOCUS	Northrop Grumman Aerospace Systems	**Thermo-Acoustic PV Hybrid Solar Energy System**	Redondo Beach, CA	$2.4
FOCUS	Otherlab	**Hybrid Solar Converter with Solar Pond Receiver**	San Francisco, CA	$3.0

FOCUS	Sharp Labs of America	**High-Concentration Full-Spectrum Solar Energy System**	Camas, WA	$4.2
FOCUS	The University of Tulsa	**Liquid Filter with Plasmonic Nanoparticles**	Tulsa, OK	$1.8
REBELS	Argonne National Laboratory	**Hybrid Fuel Cell System for Converting Natural Gas to Electricity and Liquid Fuels**	Argonne, IL	$2.0
REBELS	Colorado School of Mines	**Fuel-Flexible Protonic Ceramic Fuel Cell Stack**	Golden, CO	$1.0
REBELS	FuelCell Energy	**Liquid Fuels and Electricity from Intermediate-Temperature Fuel Cells**	Danbury, CT	$3.5
REBELS	Georgia Tech Research Corporation	**Fuel Cell Tailored for Efficient Utilization of Methane**	Atlanta, GA	$1.0
REBELS	Materials & Systems Research, Inc	**Electrogenerative Cells for Flexible Cogeneration of Power and Liquid Fuel**	Salt Lake City, UT	$2.8
REBELS	Oak Ridge National Laboratory	**Nanocomposite Electrodes for a Solid Acid Fuel Cell Stack**	Oak Ridge, TN	$2.8
REBELS	Palo Alto Research Center	**Reformer-less Fuel Cell**	Palo Alto, CA	$1.5
REBELS	Redox Power Systems	**Low-Temperature Solid Oxide Fuel Cells**	Fulton, MD	$5.0
REBELS	SAFCell	**Solid Acid Fuel Cell Stack**	Pasadena, CA	$3.7
REBELS	SiEnergy Systems	**Hybrid Fuel Cell-Battery Electrochemical System**	Cambridge, MA	$2.7
REBELS	United Technologies Research Center	**Metal Supported Proton Conducting Solid Oxide Fuel Cell Stack**	East Hartford, CT	$3.2
REBELS	University of California Los Angeles	**Fuel Cells with Dynamic Response Capability**	Los Angeles, CA	$1.0
REBELS	University of South Carolina	**Bi-functional Ceramic Fuel Cell Energy System**	Columbia, SC	$3.2
DELTA	Cornell University	**Thermoregulatory Clothing System for Building Energy Saving**	Ithaca, NY	$3.0
DELTA	Otherlab	**Passive Thermo-Adaptive Textiles with Laminated Polymer Bimorphs**	San Francisco, CA	$1.8

DELTA	SRI International	**Wearable Electroactive Textile for Physiology-based Thermoregulation**	Menlo Park, CA	$3.9
DELTA	Stanford University	**Photonic Structure Textiles for Localized Thermal Management**	Stanford, CA	$2.4
DELTA	State University of New York at Stony Brook	**Electroactive Smart Air-Conditioner VEnt Registers (eSAVER) for Improved Personal Comfort and Reduced Electricity Consumption**	Stony Brook, NY	$2.1
DELTA	Syracuse University	**Micro-Environmental Control System**	Syracuse, NY	$3.2
DELTA	University of California at Berkeley	**Heating and Cooling the Human Body with Wirelessly Powered Devices**	Berkeley, CA	$2.6
DELTA	University of California at Irvine	**Thermocomfort Cloth Inspired by Squid Skin**	Irvine, CA	$2.4
DELTA	University of California at San Diego	**Adaptive Textiles Technology with Active Cooling & Heating (ATTACH)**	San Diego, CA	$2.6
DELTA	University of Maryland	**Meta-Cooling Textile with Synergetic Infrared Radiation and Air Convection for Bidirectional Thermoregulation**	College Park, MD	$3.1
DELTA	University of Maryland	**Robotic Personal Conditioning Device**	College Park, MD	$2.6
MONITOR	Aeris Technologies	**Miniaturized Tunable Laser Spectrometer for Methane Leak Detection**	Redwood City, CA	$2.4
MONITOR	Bridger Photonics, Inc.	**Mobile LiDAR Sensors for Methane Leak Detection**	Bozeman, MT	$1.5
MONITOR	Duke University	**Miniaturized Coded Aperture Mass Spectrometer for Methane Sensing**	Durham, NC	$2.9
MONITOR	General Electric Company	**Microstructured Optical Fiber for Methane Sensing**	Niskayuna, NY	$1.4
MONITOR	IBM	**On-Chip Optical Sensors and Network for Methane Leak Detection**	Yorktown Heights, NY	$4.5

MONITOR	LI-COR	**Fixed Cavity Mode Spectrometer for Methane Leak Detection**	Lincoln, NE	$2.7
MONITOR	Maxion Technologies, Inc.	**Tunable Mid-infrared Laser for Methane Sensing**	Jessup, MD	$1.9
MONITOR	Palo Alto Research Center	**Printed Carbon Nanotube Sensors for Methane Leak Detection**	Palo Alto, CA	$3.4
MONITOR	Physical Sciences, Inc.	**UAV-based Laser Spectroscopy for Methane Leak Detection**	Andover, MA	$3.0
MONITOR	Rebellion Photonics	**Portable Imaging Spectrometer for Methane Leak Detection**	Houston, TX	$4.3
MONITOR	University of Colorado	**Frequency Comb-based Methane Sensing**	Boulder, CO	$2.1