ARPA-E PROJECT SELECTIONS –
OPEN FOA – Advanced Fuels

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These projects have been selected for negotiation of awards; final award amounts may vary.

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Allylix, Inc.	$4,499,256	Lexington, KY	**Energy-Dense Aviation Fuels from Biomass** The Allylix project team will develop energy-dense terpenes as high performance liquid aviation fuels. The increased energy density of these terpene-based fuels could outperform existing petroleum fuels by increasing flight range up to 20%.
Bio2Electric, LLC	$601,909	Princeton, NJ	**Methane Converter to Electricity and Fuel** Bio2Electric will develop a small-scale reactor that converts natural gas into a liquid transportation fuel by combining fuel cell technology with advanced catalysts. Conventional large-scale gas-to-liquid reactors produce waste-heat, reducing the energy efficiency of the process. In contrast, this reactor produces electricity as a byproduct of fuel production. If successful, this small-scale reactor could be deployed in remote locations to provide not only liquid fuel but also electricity, increasing the utility of geographically isolated gas reserves.
Ceramatec, Inc.	$1,734,665	Salt Lake City, UT	**Natural Gas Reactor for Remote Chemical Conversion** Ceramatec, Inc. will develop a small-scale membrane reactor to convert natural gas into transportable liquids in one step. Many remote oil wells burn natural gas as a by-product because it is not economical to store or transport. Such natural gas contains energy that equals 20% of annual U.S. electricity production (5 quadrillion BTUs worldwide). Capturing this energy would reduce both waste and greenhouse gas emissions and could be deployed in remote areas to convert otherwise wasted gas into usable chemicals that can be transported to market.
Colorado State University	$2,090,000	Fort Collins, CO	**Synthetic Gene Circuits to Enhance Production of Transgenic Bioenergy Crops** Researchers from Colorado State University will develop a system to rapidly introduce new genetic traits into crops that currently cannot be engineered. If successful, this technology would widen the variety of plants that could be improved for biofuel production.

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Cornell University	$910,000	Ithaca, NY	**High-Density Algae-Fuel Reactor** Cornell University will develop a compact reactor that distributes sunlight more efficiently for use in algae-fuel production. A smaller reactor makes it more economical both to grow engineered algae and to collect fuel the algae produces. The reactor delivers sunlight through low-cost, plastic light-guiding sheets and then collects fuel through tiny porous tubes. By distributing optimal amounts a sunlight, Cornell's design will increase efficiency and decrease water use compared to conventional algae reactors.
Gas Technology Institute	$772,899	Des Plaines, IL	**Methane to Methanol Fuel: A Low Temperature Process** The Gas Technology Institute (GTI) will develop a new process to convert natural gas into methanol and hydrogen. Current methods to produce liquid fuels from natural gas require large and expensive facilities that use significant amounts of energy. GTI's process uses metal oxide catalysts that are continuously regenerated in a reactor, similar to a battery. This process operates at room temperature, is more energy efficient, and less capital-intensive than existing methods.
Massachusetts Institute of Technology	$547,289	Cambridge, MA	**Small and Efficient Reformer for Converting Natural Gas to Liquid Fuels** The Massachusetts Institute of Technology (MIT) will develop a compact reformer for natural gas. Reformers produce synthesis gas, the first step in the commercial process of converting natural gas to liquid fuels. Unlike other systems that are too large to be deployed remotely, MIT's reformer could be used for small, remote sources of gas.
Plant Sensory Systems	$1,800,000	Baltimore, MD	**Development of High-Output, Low-Input Energy Beets** Researchers at Plant Sensory Systems will produce an enhanced energy beet, optimized for biofuel production. These beets will be engineered to use fertilizer and water more efficiently and produce higher levels of fermentable sugars than most existing crops. If successful, the new crop would have a lower cost of production and increased yield of biofuels without competing against food-grade sugar.

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Pratt & Whitney, Rocketdyne	$3,796,189	Canoga Park, CA	**Turbo-POx For Ultra Low-Cost Gasoline** Pratt & Whitney Rocketdyne will develop a system to improve the conversion of natural gas to liquid fuels. Their approach would partially oxidize natural gas in the high-temperature, high-pressure combustor of a natural gas turbine, facilitating its conversion into a liquid fuel. This approach could simultaneously improve the efficiency of gas conversion into fuels and chemicals, generating electricity in the process.
University of Colorado	$380,000	Boulder, CO	**Atomic Layer Deposition for Creating Liquid Fuels from Natural Gas** The University of Colorado Boulder will use nanotechnology to improve the structure of gas-to-liquids catalysts, increasing surface area and improving heat transfer compared to current catalysts. The new structure of these catalysts would be used to create a small-scale reactor, for converting natural gas to liquid fuels, which could be located at remote sources of gas.
University of Minnesota	$1,816,239	Minneapolis, MN	**Flexible Molecular Sieve Membranes** The University of Minnesota will develop an ultra-thin separation membrane to improve the production of biofuels, plastics, and other industrial materials. Today's separation methods are energy intensive and costly. If fully implemented by industry, such a new class of membranes could reduce U.S. energy consumption by as much as 3%.
University of Tennessee	$441,747	Knoxville, TN	**Transformable Single Cell Line for Rapid Assessment of Cell Wall Genes for Biofuels** The University of Tennessee will develop a technology that enables high throughput bioengineering and trait testing in switchgrass. This development will significantly reduce the time required to engineer switchgrass to maximize biofuel production.
University of Washington	$4,000,000	Seattle, WA	**Biocatalyst for Small-Scale Conversion of Natural Gas into Diesel Fuel** The University of Washington will develop microbes that convert methane found in natural gas into liquid diesel fuel. These microbes enable small-scale gas-to-liquid conversion at lower cost than current methods, which require infrastructure that is too expensive to deploy at smaller scales. Small-scale conversion would leverage abundant, domestic natural gas resources and reduce U.S. dependence on foreign oil.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Advanced Vehicle Design and Materials

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Electron Energy Corporation	$ 2,904,000	Landisville, PA	**Improved Manufacturing for High-Performance Magnets** 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 generators and electric vehicle motors with alternative higher-performance materials compared to the imported rare earth magnets currently used in these machines.
United Technologies Research Center	$ 2,699,970	East Hartford, CT	**Additive Manufacturing of Optimized Ultra-High Efficiency Electric Machines** United Technologies Research Center will use additive manufacturing to develop an ultra-high efficiency electric motor for automobiles. Additive manufacturing uses a laser to deposit copper and insulation layer by layer, instead of winding wires. The resulting motors will reduce electricity use and will require less rare earth material. This project will also examine the application of additive manufacturing more widely for energy systems.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Building Efficiency

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Lawrence Berkeley National Laboratory	$3,000,000	Berkeley, CA	**Low-Cost Smart Window Coatings for Heat and Light** Lawrence Berkeley National Laboratory (LBNL) will develop low-cost coatings that control how both light and heat enter buildings through windows. By individually blocking infrared (heat) and visible (light) components, LBNL will significantly enhance both the energy efficiency of buildings and the comfort of occupants. These coatings can be applied to windows using inexpensive techniques similar to spray-painting a car.
Lawrence Berkeley National Laboratory	$1,940,719	Berkeley, CA	**Automated Modeling and Simulation of Existing Buildings for Energy Efficiency** Lawrence Berkeley National Laboratory (LBNL) will develop a portable system of sensing and computer hardware to rapidly generate indoor thermal and physical building maps. This mapping technology allows for cost-effective evaluation of heat loss and building inefficiencies. The system enables rapid data collection and export to existing computer models to guide strategies that reduce building energy usage.
Stanford University	$399,901	Palo Alto, CA	**Photonic Radiative Day-Time Cooling Devices** Stanford University will develop a coating for the rooftops of buildings and cars that reflects sunlight and allows heat to escape, enabling passive cooling, even when the sun is shining. This device requires no electricity and would reduce the need for air conditioning, leading to energy and cost savings.

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ARPA-E PROJECT SELECTIONS – OPEN FOA - Carbon Capture

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Arizona State University	$612,131	Tempe, AZ	**Energy-Efficient Electrochemical Capture and Release of CO_2** Arizona State University (ASU) will develop an innovative electro-chemical technology for the capture of carbon dioxide coming from power plants. ASU's technology aims to cut both the energy use and the cost, in half, compared to current methods.
Dioxide Materials, Inc.	$3,997,437	Champaign, IL	**Enabling Efficient Electrochemical Conversion of Carbon Dioxide into Fuels** Dioxide Materials will develop a technology to produce transportation fuels and industrial chemicals electrochemically from carbon dioxide emitted by power plants. Dioxide Material's approach would improve conversion efficiency and reduce energy input that would cut costs, greenhouse gas emissions, and reduce U.S. dependence on foreign oil.
University of Massachusetts, Lowell	$3,000,000	Lowell, MA	**Plasmonic-Enhanced Photocatalysis** The University of Massachusetts will develop a metal catalyst to convert sunlight, carbon dioxide (CO_2), and water into fuel. The catalyst's microscopic shape focuses sunlight to cause a chemical reaction, producing precursors to transportation fuel. If successful, this process would reduce fossil fuel imports and net CO_2 emissions.
University of Pittsburgh	$2,400,000	Pittsburgh, PA	**Increased Viscosity Carbon Dioxide for Enhanced Oil Recovery and Fracturing** The University of Pittsburgh will develop a compound to thicken liquid carbon dioxide (CO_2). This higher viscosity CO_2 compound could be used to improve the performance of enhanced oil recovery and potentially replace water in hydraulic fracturing of oil and gas wells.

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ARPA-E PROJECT SELECTIONS – OPEN FOA - Grid Modernization

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Board of Trustees of the University of Illinois	$1,500,000	Champaign, IL	**Cyber Modeling and Analysis for a Smart Grid** The University of Illinois at Urbana-Champaign will develop grid modeling, monitoring, and analysis tools that increase the resiliency and reliability of the grid during cyber attacks. Electrical infrastructure modeling will be combined with cyber analysis to examine the impact of failures and malicious threats to grid infrastructure. These tools and analysis could lead to higher reliability, improved efficiency, and facilitate renewable technology deployment.
GE Global Research	$4,071,019	Niskayuna, NY	**High-Voltage and High-Power Gas Tube Technology for HVDC Transmission** GE Global Research will develop a new electrical power switching technology for high voltage transmission lines. Currently, electricity is routed using silicon-based switches that require multiple devices to function at high voltages. GE will develop a robust, gas-based switch that could reduce the cost of transmission infrastructure, improve grid reliability, and facilitate renewable technology deployment.
Grid Logic, Incorporated	$3,800,000	Lapeer, MI	**Low-Cost, High-Temperature Superconducting Wires** 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.
Hexatech, Inc.	$2,207,327	Morrisville, NC	**Aluminum Nitride-Based Devices for High-Voltage Power Electronics** Hexatech, Inc. will develop new switches to more efficiently control the flow of electricity across high-voltage electrical lines. The technology will use a new material that exceeds the performance of currently used materials, enabling smaller, more reliable devices. Implementation of these devices would decrease the cost of electricity transmission while increasing overall grid security and reliability.

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Pacific Northwest National Laboratory	$1,600,033	Richland, WA	**Non-Wire Methods for Transmission Congestion Management** Pacific Northwest National Laboratory will develop high-performance computing algorithms and software to use power transmission lines in the electric grid more efficiently. By analyzing unused capacity of existing transmission lines, this software would increase the efficiency of existing electrical infrastructure by 30%, eliminating the need to construct costly power lines.
RamGoss, Inc.	$1,225,000	Boston, MA	**Development of High-Performance Gallium Nitride Transistors** RamGoss will use innovative designs and materials to develop new switches to more efficiently control the flow of electricity across high-voltage electrical lines. RamGoss's innovative transistor design would reduce both size and cost of power electronics. Implementation of these devices would lower the cost of electricity transmission while increasing overall grid security and reliability.
Rensselaer Polytechnic Institute	$803,908	Rensselaer, NY	**High Voltage SiC-Based Power Switches for Smart Grid Utility Applications** Rensselaer Polytechnic Institute (RPI) will develop a new type of silicon-carbide switch for higher voltage transmission. RPI's innovative power switch employs a compact design that enables higher voltage switching with less material. This technology would reduce the cost of transmission infrastructure, improve grid reliability, and facilitate renewable technology deployment.
Silicon Power Corporation	$4,750,000	Malvern, PA	**Optically-Switched, Single-Bias, High-Frequency Thyristor** Silicon Power Corporation will develop a semiconducting device that switches high power and high voltage electricity using optical signals. This device will use light to trigger control circuits or mechanisms more rapidly, greatly simplifying the control of high-voltage equipment. Unlike current switching mechanisms that predominately use silicon, this device employs silicon carbide. Using these switches could improve high-power motors and renewable energy technologies such as wind and solar generators.

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University of California Berkeley / California Institute for Energy and Environment	$4,000,000	Berkeley, CA	**Micro-Synchrophasors in Distribution Systems** The California Institute for Energy and Environment (CIEE) will develop a device to monitor and measure electric power data from the grid's distribution system. Data collected from a network of these devices would provide new capabilities to monitor and control grid power flow, a critical element for integrating intermittent and renewable resources such as rooftop solar and wind energy. If widely deployed, these devices could also enhance grid reliability.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Other

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Massachusetts Institute of Technology	$2,000,000	Cambridge, MA	**Modular Low-Power Water Purification Technology** The Massachusetts Institute of Technology (MIT) will develop a new water purification technique for water with high salt content. This approach would also remove other contaminants such as metals and microorganisms. MIT's device would require less power than competing technologies and has important applications for mining, oil and gas production and water treatment for remote locations.
Wyss Institute at Harvard University	$ 2,000,000	Boston, MA	**Slippery Coatings to Reduce Pumping Energy in Liquid Pipelines** Harvard University will develop self-repairing coatings for the inside surfaces of oil and water pipes to reduce friction. This reduced friction would potentially reduce energy use, by up to 50%. The coatings could also reduce biofouling of pipes and ship hulls.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Renewable Power

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
National Renewable Energy Laboratory	$800,000	Golden, CO	**Negating Energy Losses in Organic Photovoltaics Using Photonic Structures** Researchers at the National Renewable Energy Laboratory (NREL) will develop a new approach to enhance the efficiency of low-cost plastic solar cells using specially engineered photonic structures to capture a larger part of the solar spectrum. NREL's approach could triple the efficiency of plastic photovoltaics, enabling the adoption of this low-cost, clean, and renewable electricity source.
Brown University	$750,000	Providence, RI	**Marine Hydrokinetic Energy Harvesting Using Cyber-Physical Systems** Brown University will develop an oscillating underwater wing to capture energy from flowing water in rivers and tidal basins. The wing would be coupled with adaptive control software to maximize power production. Brown's design could reduce the cost of producing electricity from flowing water.
California Institute of Technology	$2,400,000	Pasadena, CA	**Optics for Ultra High-Efficiency Solar Energy Conversion** The California Institute of Technology (CalTech) will develop an optical device that focuses and splits sunlight into individual color bands to improve the efficiency of solar electricity generation. Once light is separated into colors, CalTech's tailored solar cells match each separated color band to dramatically improve the overall efficiency of solar energy conversion.
GE Power and Water	$3,703,184	Schenectady, NY	**Tensioned Fabric Wind Blades** Today, wind turbines use rigid fiberglass blades that are difficult to manufacture and transport. GE Power and Water will develop wind turbine blades using fabric stretched across a frame. Such fabric-based blades could be manufactured in sections and assembled on-site, enabling the construction of much larger wind turbines with higher efficiency and lower cost.
Georgia Institute of Technology	$3,700,000	Atlanta, GA	**Electric Power Generation by a Vertical-Axis Turbine Driven by an Anchored Vortex and Sustained by the Air Layer over Solar-Heated Ground** The Georgia Institute of Technology (Georgia Tech) will develop a method to capture energy from wind vortices that harvest the thin layer of hot air along the ground created by the sun. "Dust devils" are a random and intermittent example of this phenomenon in nature. If successful, Georgia Tech's approach is expected to cost 25% less than conventional wind and 60% less than traditional solar power.

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Glint Photonics, Inc.	$523,172	Menlo Park, CA	**Self-Tracking Concentrator Photovoltaics** Glint will develop a solar concentrator that can capture the full amount of available sunlight regardless of the sun's position. Unlike today's technology, this concentrator does not require complex moving parts to track the sun's movements. Glint's inexpensive design uses an automatic optical system of fluid layers that adjust their positions in response to solar heat.
MicroLink Devices	$3,316,705	Niles, IL	**High Efficiency, Lattice-Matched Solar Cells Using Epitaxial Lift-Off** MicroLink Devices will develop high-efficiency solar cells to capture concentrated sunlight with a unique blend of crystal layers in an innovative design. These cells will improve concentrated photovoltaic products to increase the amount of energy generated from solar power plants. MicroLink will use sophisticated manufacturing techniques to allow for reuse of expensive growth templates to minimize costs normally associated with high-performance solar cells.
Otherlab, Inc.	$1,600,000	San Francisco, CA	**Adaptive Hydraulic Solar Field** Otherlab will develop an inexpensive method to reflect sunlight onto a solar tower using small mirrors. Many of today's mirrors are 20-30 feet tall, making them difficult to stabilize and rotate. Otherlab's hydraulic drivers, made with low-cost plastic parts, precisely position smaller energy-collecting mirrors to dramatically lower solar field costs.
Sea Engineering, Inc.	$343,260	Santa Cruz, CA	**Cost-Effective, Real-Time Wave Assessment Tool** Sea Engineering, Inc. will develop an ocean wave buoy that will measure and wirelessly relay real-time wave data at a fraction of the cost of current technologies. This device will more effectively assess the optimal locations and designs for ocean energy conversion systems and could be used to optimize the performance of ocean energy systems in real time. If successful, this system would enable more efficient and cost-effective ocean energy conversion systems.
University of California Santa Cruz	$1,624,030	Santa Cruz, CA	**Adiabatic Waveguide Coupler for High-Power Solar Energy Collection and Transmission** The University of California Santa Cruz will develop an innovative optical device for harvesting concentrated sunlight into optical fibers, solar cells and thermal storage devices, which maximizes use of the solar spectrum. The optical device uses unique thin-film materials and structures to transfer and transform concentrated sunlight with minimum losses compared to traditional light concentrating optics.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Stationary Energy Storage

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Alveo Energy	$4,000,000	Palo Alto, CA	**Open Framework Electrode Batteries for Cost-Effective Energy Storage** Alveo Energy will develop a grid-scale storage battery using Prussian Blue dye as the basis for active material within the battery. Prussian Blue is inexpensive, readily available, and most commonly known for its application in blueprint documents. Alveo will repurpose this inexpensive dye for a new battery that can endure more charges under more extreme circumstances without suffering internal damage, helping to facilitate the adoption and deployment of renewable energy technology.
Case Western Reserve University	$567,805	Cleveland, OH	**Iron Flow Battery for Electric Grid-Scale Energy Storage** Case Western Reserve University will develop a water-based, all-iron flow battery for grid-scale energy storage at low cost. Flow batteries store chemical energy in external tanks instead of within the battery container. Using iron provides a low-cost, safe solution for energy storage because iron is both abundant and non-toxic. If successful, this technology would surpass the DOE 2015 cost targets for stationary energy storage and facilitate the adoption and deployment of renewable energy technology.
Harvard University	$590,035	Cambridge, MA	**Small Organic Molecule-Based Flow Battery** Harvard University will develop an innovative grid-scale flow battery to store electricity from renewable sources. Flow batteries store chemical energy in external tanks instead of within the battery container. Harvard's battery will use active material that is relatively inexpensive and non-toxic and can hold up to ten times more energy by volume compared to other flow batteries.
Sharp Laboratories of America	$2,904,393	Camas, WA	**Low-Cost Sodium-Ion Battery for Grid-Scale Energy Storage** Sharp Laboratories of America will develop a sodium-ion based battery that will dramatically increase battery cycle life at a low cost, while maintaining a high-energy capacity. If successful, this battery would surpass the DOE 2015 cost targets for stationary energy storage and facilitate the adoption and deployment of renewable energy technology.

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Tai Yang Research Company	$2,150,082	Knoxville, TN	**Novel, Low-Cost, High-Field Conductor for Superconducting Magnetic Energy Storage** The Tai Yang Research Company will develop a grid-scale device that stores energy in a high-power, superconducting cable. This innovative cable enables an increase in magnetic field strength by optimizing cable design when connected to a power source. This approach would enable higher power storage densities that decrease cost and overall size of the system.
Teledyne Scientific Company	$556,732	Thousand Oaks, CA	**Potassium-Ion Flow Battery for Electric Grid-Scale Energy Storage** Teledyne Scientific Company will develop a water-based, potassium-ion flow battery for low-cost stationary energy storage. Flow batteries store chemical energy in external tanks instead of within the battery container. If successful, this safe, scalable and low-cost technology would surpass the DOE 2015 cost targets for stationary energy storage and facilitate the adoption and deployment of renewable energy technology.
University of Delaware	$793,071	Newark, DE	**High-Voltage Flow Batteries for Stationary Energy Storage** The University of Delaware will develop a low-cost, water-based, flow battery that uses membrane technology to increase voltage and energy storage capacity. Flow batteries store chemical energy in external tanks instead of within the battery container. If successful, this flow battery would surpass the DOE 2015 cost targets for stationary energy storage and facilitate the adoption and deployment of renewable energy technology.
University of Southern California	$569,019	Los Angeles, CA	**Inexpensive Metal-Free Organic Redox Flow Battery for Grid- Scale Storage** The University of Southern California will develop a water-based, metal free, grid-scale, flow battery. Flow batteries stores chemical energy in external tanks instead of within the battery container. With innovative designs and materials, this battery has the potential to reduce cost, increase durability, and promote greater renewable energy deployment.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Stationary Generation

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Pratt & Whitney, Rocketdyne	$ 650,000	Canoga Park, CA	**Continuous Detonation Combustors for Natural Gas Turbines** Pratt & Whitney Rocketdyne will develop a new combustor for gas turbine engines that use shockwaves to increase pressure through a process called continuous detonation. These combustors would enable more electricity to be generated from a given amount of natural gas, raising the efficiency and reducing the emissions from gas turbine engines.
Pratt & Whiney, Rocketdyne	$ 600,000	Canoga Park, CA	**Ultra High-Temperature Gas Turbine Cycle** Pratt & Whitney Rocketdyne will develop a high efficiency gas turbine by using pure oxygen, instead of air, to burn fuel, creating ultra-high temperatures. To prevent melting, Pratt & Whitney Rocketdyne will apply their expertise in liquid rocket engines to develop advanced cooling technology. This cycle has the potential to reduce the fuel used to power natural gas turbines by as much as 50%.
University of North Dakota	$472,586	Grand Forks, ND	**Novel Dry Cooling Technology for Power Plants** The University of North Dakota Energy and Environmental Research Center will develop an air-cooled device for power plants that helps maintain water and power efficiency during electricity production with low environmental impact. The University of North Dakota's device uses an air-cooled adsorbent liquid that retains and releases moisture to cool power plants that could result in efficient power production with minimal water loss.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Thermal Energy Storage

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
National Renewable Energy Laboratory	$890,000	Golden, CO	**High-Temp, High-Efficiency Solar-Thermoelectric Generators (STEG)** The National Renewable Energy Laboratory (NREL) will develop a solar thermal electric generator to directly convert heat from concentrated sunlight to electricity using a new generation of thermoelectric materials that can operate at higher temperatures and efficiencies. The new materials and advanced engineering designs could convert solar heat to electricity at three times the efficiency of current systems.
e Nova, Inc	$640,000	Kingwood, TX	**Waste Heat-Powered Gas Compressor** e Nova will develop a gas compressor powered by waste heat from the exhaust of a gas turbine. This compressor could be used to increase the efficiency of gas turbines or to compress natural gas for pipeline transport.
Georgia Institute of Technology	$3,600,000	Atlanta, GA	**High-Efficiency Solar Fuels Reactor** The Georgia Institute of Technology (Georgia Tech) will develop a high-efficiency solar reactor to produce solar fuel. Using liquid metal, the reactor transports heat away from the sunlight-collection point to a chemical reaction zone, minimizing the loss of solar heat. This system would enable cost-effective solar fuels that can be used for transportation and continuous electric power generation.
Texas A&M University - Engineering Experiment Station	$1,700,000	San Antonio, TX	**Generating Electricity from Waste Heat Using Metal Hydrides** Texas A&M Engineering Experiment Station will develop a system to generate electricity from low-temperature waste heat. The system would cycle between heating and cooling a metal hydride to produce a flow of high-pressure hydrogen. This hydrogen flow is then used to generate electricity via a turbine and generator.
Yale University	$2,648,074	New Haven, CT	**Power Generation from Waste Heat with Closed-Loop Membrane-Based System** Yale University will develop a system to generate electricity using low-temperature waste heat from power plants, industrial facilities, and geothermal wells. This system will use waste heat and the difference in salt content between two liquid streams to create electricity through membrane processes known as pressure-retarded osmosis (PRO) or reverse electrodialysis (RED). This technology could produce electricity from waste heat at low cost.

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ARPA-E PROJECT SELECTIONS –
OPEN FOA - Transportation Energy Storage

Lead Research Organization	Amount	Lead Organization Location (City, State)	*Project Title* Project Description
Ceramatec, Inc	$2,119,759	Salt Lake City, UT	**Mid-Temperature Fuel Cells for Transportation Applications** Ceramatec will develop a solid-state fuel cell that operates at temperature ranges similar to internal combustion engines. Ceramatec's design would allow for low-cost materials and catalysts that demonstrate high performance without the need for expensive components. The project would engineer a fuel cell stack that performs at lower cost than current automotive designs.
Georgia Institute of Technology	$2,115,000	Atlanta, GA	**High-Performance Supercapacitors using Structurally Modified Graphene** The Georgia Institute of Technology (Georgia Tech) will develop a supercapacitor using graphene, a two-dimensional sheet of carbon atoms, to store energy at ten times greater density than current technologies. Supercapacitors store energy in a manner similar to a battery, yet can charge and discharge much more rapidly. The Georgia Tech team will improve the internal structure of graphene sheets to store more energy at lower cost.
Palo Alto Research Center	$935,196	Palo Alto, CA	**Printed Integral Batteries** Palo Alto Research Center (PARC) will develop an innovative manufacturing process for lithium-ion batteries that reduces manufacturing costs and improves performance. PARC's printing process would manufacture narrow stripes within battery layers that could improve the amount of energy storage allowing an extended electric vehicle driving range.
PolyPlus Battery Company	$4,500,000	Berkeley, CA	**High-Performance, Low-Cost Aqueous Lithium-Sulfur Batteries** PolyPlus Battery Company and Johnson Controls will develop an innovative water-based, lithium-sulfur battery. Today, lithium-sulfur battery technology offers the lightest high-energy batteries that are completely self-contained. New features in these water-based batteries make PolyPlus's unique, lightweight battery ideal for a variety of military and consumer applications. If successful, this technology would be able to transition to a widespread commercial and military market.

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University of California at Santa Barbara	$1,600,000	Santa Barbara, CA	**High-Energy Electro-Chemical Capacitor** The University of California at Santa Barbara will develop an energy storage device for hybrid electric vehicles that combines the properties of capacitors and batteries into one technology. This energy storage device could charge within minutes, extend driving range, and have a longer life expectancy compared to today's electric vehicle batteries.
University of Nevada Las Vegas	$2,520,429	Las Vegas, NV	**Lithium-Rich Anti-Perovskites as Superionic Solid Electrolytes** The University of Nevada Las Vegas (UNLV) will develop a new, fire-resistant electrolyte to make today's Lithium-ion (Li-ion) vehicle batteries safer. Today's Li-ion batteries use a flammable liquid electrolyte that can catch fire when overheated or overcharged. UNLV will replace this flammable electrolyte with a fire-resistant, solid rock-like material called lithium-rich anti-perovskite. If successful, this new electrolyte technology would help make vehicle batteries safer in an accident while also increasing performance by extending vehicle range and acceleration.
Vorbeck Materials Corp.	$1,500,000	Jessup, MD	**Low-Cost, Fast-Charging Batteries for Hybrid Vehicles** Vorbeck Materials Corp. will develop a low-cost, fast-charging storage battery for hybrid vehicles. The battery cells are based on lithium-sulfur chemistries, which have a greater energy density compared to today's lithium-ion batteries. If successful, the system has the potential to capture more breaking energy, increasing the efficiency of hybrid vehicles by up to 20% while also reducing cost and emissions.

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