

OPEN 2015 Program Overview

B. PROGRAM BACKGROUND

This FOA marks the third OPEN solicitation in the history of ARPA-E. The previous two OPEN solicitations were conducted at the inception of the agency in 2009 and again in 2012. An OPEN solicitation provides a vitally important mechanism for the support of innovative energy R&D that complements the other primary mechanism, which is through the solicitation of research projects in focused technology programs.

ARPA-E's focused programs target specific areas of technology that the agency has identified, through extensive interaction with the appropriate external stakeholders, as having significant potential impact on one or more of the Mission Areas described in Section I.A of the FOA. Awards made in response to the solicitation for focused programs support the aggressive technical targets established in that solicitation. Taken in total, ARPA-E's focused technology programs cover a significant portion of the spectrum of energy technologies and applications.

ARPA-E's OPEN FOAs ensure that the agency does not miss opportunities to support innovative energy R&D that falls outside of the topics of the focused technology programs or that develop after focused solicitations have closed. OPEN FOAs provide the agency with a remarkable sampling of new and emerging opportunities across the complete spectrum of energy applications and allow the agency to "take the pulse" of the energy R&D community. OPEN FOAs have been and will continue to be the perfect complement to the agency's focused technology programs – a unique combination of approaches for supporting the most innovative and current energy technology R&D.

C. PROGRAM OBJECTIVES

The objective of an ARPA-E OPEN FOA is simple, yet comprehensive: to support the development of potentially disruptive new technologies across the full spectrum of energy applications. ARPA-E seeks to support transformational research in all areas of energy R&D, covering transportation and stationary applications. Areas of research responsive to this FOA include (but are not limited to) electricity generation by both renewable and non-renewable means; electricity transmission, storage, and distribution; energy efficiency for buildings, manufacturing and commerce, and personal use; and all aspects of transportation, including the production and distribution of both renewable and non-renewable fuels, electrification, and energy efficiency in transportation.

Because of the enormous breadth of energy technologies solicited under an OPEN FOA, it is impossible to provide the well-defined technical targets contained in an ARPA-E FOA for a focused technology program. Rather, ARPA-E asks applicants to address the potential impact of the proposed technology on the agency's Mission Areas: reducing imported energy, reducing energy-related emissions, and improving energy efficiency. The critical question for applicants to consider in assessing potential impact is: "If it works, will it matter?" In a FOA for a focused technology program, this question has already been answered by ARPA-E. If an applicant can demonstrate that the proposed technology can achieve the technical targets specified in the FOA for a focused program, the agency believes that the technology can have significant impact on the agency's missions. In an OPEN FOA, the burden of demonstrating potential impact lies solely upon the applicant, who must make the strongest possible case for why the proposed technology will matter – that it has the potential to change our energy future.

D. TECHNICAL CATEGORIES AND SUBCATEGORIES OF INTEREST

Applications are sought that address one or more of ARPA-E's Mission Areas through the type of high-risk, transformational research described in Section I.A of this FOA. Concepts may span multiple disciplinary boundaries.

Each Notice of Intent, Concept Paper, and Full Application must identify the Technical Subcategory or Subcategories for the proposed technology. Applicants may select a single Technical Subcategory or multiple Technical Subcategories for their proposed technology, as appropriate. The Applicant may select multiple Technical Subcategories from the same Technical Category or different Technical Categories. See the table below for the list of Technical Categories and Subcategories.

The list of Technical Subcategories is intended to encompass the majority of energy-related technologies. If the proposed technology does not fall within one or more of the Technical Subcategories below, the Applicant should select from Category 8 ("None of the Above"), Subcategory A ("Technologies Which Do Not Fit In Any Of The Above Categories").

<u>CATEGORY</u>	<u>SUBCATEGORY</u>	<u>DESCRIPTION</u>
CATEGORY 1: RENEWABLE POWER (NON-BIO)	Subcategory A: Wind - Energy Capture	Technologies that lead to better capture of wind resources. This could include different configurations, blade designs and materials. Also in this category could be tools for wind resource identification, classification, and modeling.
	Subcategory B: Wind - Energy Conversion	Technologies that lead to better conversion of wind power into useable energy, such as generators and magnetic materials, electronics, etc. specifically designed for wind energy.
	Subcategory C: Geothermal Energy	Geothermal heat technologies including pumps, proppants, induced seismicity, enhanced geothermal systems (EGS), drilling, resource identification (sensors, models, tracers), zonal isolation techniques, robust equipment, low temperature generation, etc.
	Subcategory D: Hydro Energy	Technologies for capturing and/or converting hydrokinetic energy such as ocean, osmotic, tidal, etc., Technologies for hydro resource identification and modeling.
	Subcategory E: Solar - PV/CPV	Technologies for solar PV/CPV systems including materials, cell configurations, optical solar concentrators, BOS and other technologies for solar cells that convert light into electricity or fuel. Technologies to enable for cheaper installation or solar PV resource identification and modeling.
	Subcategory F: Solar - Non-PV	Technologies for non-PV conversion of solar energy including solar thermal conversion (materials, configurations, concentrators, and BOS), direct conversion of solar energy to fuels through thermal or catalytic routes, and other technologies that use or convert solar energy without PV conversion.
	Subcategory G: Power Electronics - Renewable Generation	Technologies that include advances in semiconductor materials, substrates, circuit topologies, magnetic materials, inductors, dielectric materials, capacitors, transistors, device packaging, etc. applied to renewable power generation.

	Subcategory H: Renewable Power - Other	Renewable energy technologies that do not fit one of the above categories.
CATEGORY 2: BIOENERGY	Subcategory A: Biomass Production	Technologies that improve biomass characteristics, such as yield and sustainability, and decrease cost of production and/or water use.
	Subcategory B: Biofuel Production - Biological Methods	Technologies that utilize a biological agent in one or more principal step(s) of feedstock conversion to fuels.
	Subcategory C: Biofuel Production - Nonbiological Methods	Technologies that do not utilize any biological agent in the conversion of organic feedstock to fuels, such as thermochemical and hybrid approaches or biomimetics.
	Subcategory D: Bioenergy Supply Chain	Technologies critical to supply chain development, such as feedstock collection and handling.
	Subcategory E: Bioenergy - Other	Technologies for bioenergy which do not fit in one of the above subcategories. Including but not limited to bioreactors, balance of plant, bioproducts, microbial fuel cells, sensors.
CATEGORY 3: TRANSPORTATION	Subcategory A: Alternative Fuels (Non-Bio)	Technologies that create fuels that are substitutes for gasoline/diesel, but are not bio based.
	Subcategory B: Engines - Transportation	Technologies for improved internal combustion engines and other engine types (e.g., turbines) specifically for transportation applications.
	Subcategory C: Electric Motors – Transportation	Technologies for improved electric motors specifically for transportation applications.
	Subcategory D: Fuel Cells - Transportation	Technologies for improved fuel cells specifically for transportation applications.

	Subcategory E: Advanced Vehicle Designs And Materials	Advanced or alternative vehicle designs and/or key enabling technologies. Examples could include ultralightweight vehicles, advanced components, new vehicle designs and architectures, etc.
	Subcategory F: Transportation Management	Technologies for traffic management, transportation behavior, self-driving cars and other advanced transportation management scenarios.
	Subcategory G: Power Electronics - Transportation	Technologies that include advances in semiconductor materials, substrates, circuit topologies, magnetic materials, inductors, dielectric materials, capacitors, transistors, device packaging, etc. or optimizations of electronic systems applied specifically to transportation applications..
	Subcategory H: Non-Vehicular Transportation	Technologies for advanced airplanes, human powered vehicles, marine vessels, trains, etc.
	Subcategory I: Batteries - Transportation	Technologies for improved batteries for a wide range of vehicle applications, including hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and battery electric vehicles (EVs).
	Subcategory J: Non-Battery Storage For Transportation	Technologies that apply thermal storage, and non-battery electric storage, such as supercapacitors and others specifically for transportation application.
	Subcategory K: Transportation - Other	Transportation energy technologies that do not fit one of the above categories,
CATEGORY 4: CONVENTIONAL GENERATION (NON- RENEWABLE)	Subcategory A: Combined Processes - Conventional Generation	Improved conventional generation designs which use a combination of technologies (for example- fuel cells and turbines).
	Subcategory B: Stationary Engines/Turbines For Conventional Generation	Improved engines/turbines for conventional generation applications.
	Subcategory C: Stationary Fuel Cells For Conventional Generation	Improved fuel cells intended to be coupled with conventional generation sources.

	<u>Subcategory D:</u> Nuclear Power Generation And Materials	Technologies that enhance fission, fusion, or materials specifically for safe nuclear power generation.
	<u>Subcategory E:</u> Carbon Capture, Use, And Storage	Technologies for carbon capture, use, and storage.
	<u>Subcategory F:</u> Exploration And Extraction (Non-Geothermal) Of Conventional Resources	Technologies/tools for resource identification, classification, and modeling, as well as technologies to extract conventional resources. This subcategory can include sensors and imaging technologies, predictive models and algorithms, drills, pumps, etc.
	<u>Subcategory G:</u> Planning And Operations For Conventional Generation	Technologies that improve the planning and operation of conventional power generation.
	<u>Subcategory H:</u> Combustible Gas Infrastructure	Technologies for storage, transportation, handling, and/or monitoring of combustible gases. This could include tanks, pipelines, pumps, sensors, etc.
	<u>Subcategory I:</u> Chemical and Biological Conversions From Fossil	Technologies that improve chemical or biological conversions of fossil resources such as gas to liquids (GTL), coal to liquids (CTL), and other forms of energy transduction.
	<u>Subcategory J:</u> Water Conservation In Conventional Generation	Technologies that will enable significant water savings in the generation of power, such as water recovery/recirculation systems or dry cooling of power plants.
	<u>Subcategory K:</u> Conventional Generation – Other	Conventional generation technologies that do not fit into one of the categories above.
CATEGORY 5: GRID	<u>Subcategory A:</u> Grid Transmission	Technologies for the electricity transmission system (>69 kV) planning and operations, including both AC and DC systems.
	<u>Subcategory B:</u>	

	Grid Distribution	Technologies for the electricity distribution system (≤ 69 kV) planning and operations including both AC and DC systems.
	<u>Subcategory C:</u> Modeling, Software, Algorithms, And Control For The Grid	Modeling, algorithms, or control methodologies that improve grid planning, operations, or markets.
	<u>Subcategory D:</u> Batteries - Grid Scale	Grid scale battery technologies.
	<u>Subcategory E:</u> Grid Scale (Non-Battery) Storage	Non-battery technologies for grid-scale storage such as: pumped-hydro, compressed air, high angular velocity flywheels, etc.
	<u>Subcategory F:</u> Grid Reliability	Technologies that maintain the efficient function of the grid during unusual events, particularly in the context of increasing renewable energy sources and/or distributed generation.
	<u>Subcategory G:</u> Grid – Other	Grid technologies that do not fit into one of the above categories.
CATEGORY 6: BUILDING EFFICIENCY	<u>Subcategory A:</u> Combined Heat and Power	Technologies for new Combined Heat and Power (CHP) designs/scenarios.
	<u>Subcategory B:</u> Building Heating and Cooling	Technologies that improve the efficiency of building heating and cooling systems.
	<u>Subcategory C:</u> Building Energy Demand Management	Demand response and/or management technologies such as smart meters, other building energy conservation technologies such as automatic control systems.
	<u>Subcategory D:</u> Lighting	Energy efficient and environmentally-friendly advanced lighting technologies.
	<u>Subcategory E:</u> Building Envelope	Building designs leading to better energy efficiency; technologies that could be applied to windows, insulation, roofing, etc.

	<u>Subcategory F:</u> Building Efficiency - Other	Building energy efficiency technologies that do not fit into one of the categories above.
CATEGORY 7: OTHER	<u>Subcategory A:</u> Water Production/Reuse	Technologies that enable cost-effective and energy efficient ways of providing fresh water.
	<u>Subcategory B:</u> Thermal Energy Storage	Thermal energy storage technologies that can apply to multiple applications.
	<u>Subcategory C:</u> Advanced Manufacturing	Technologies that enable energy-efficient manufacturing capabilities or methods.
	<u>Subcategory D:</u> Behavior/Education	Socio-economic energy technologies, research and/or education to use energy in efficient ways, or behave in such a way that leads to more optimal use of energy.
	<u>Subcategory E:</u> Appliance And Consumer Electronics Efficiency (End Use)	Technologies that improve the energy efficiency of appliances and consumer electronics, including but not limited to: refrigerators, washers, dryers, televisions, stoves, personal computers, phones, etc.
	<u>Subcategory F:</u> Data Centers And Computation	Technologies to improve the energy efficiency of large-scale computers, data centers, and computational infrastructure.
	<u>Subcategory G:</u> Industrial Efficiency – Materials	Technologies that improve the energy efficiency of producing industrial materials, including but not limited to glass, paper, iron, steel, plastics, aluminum, etc.
	<u>Subcategory H:</u> Industrial Efficiency – Other	Technologies that improve the energy efficiency of industrial processes which are not covered by other subcategories.
	<u>Subcategory I:</u> Heat Recovery	Technologies for heat recovery including but not limited to thermoelectrics, Sterling engines, heat exchangers, conversion of waste heat, bottoming cycles, heat capture methods, materials, devices, etc.
	<u>Subcategory J:</u> High Temperature Materials	Materials designed specifically to withstand extremely high temperatures in order to enable new energy generation technologies.

	Subcategory K: Semiconductors	Technologies that enable the development of new semiconductor materials or the use of semiconductor materials in innovative applications.
	Subcategory L: Portable Power	Technologies for portable power applications such as piezoelectrics, portable fuel cells, batteries, etc.
	Subcategory M: Critical Materials	Technologies that reduce or replace energy critical materials including but not limited to alternatives for magnetics, phosphors, and/or catalysts. This could also include advanced technologies for extracting, processing, and/or recycling of critical materials.
CATEGORY 8: NONE OF THE ABOVE	Subcategory A: Technologies That Do Not Fit In Any Of The Above Categories and Subcategories	

E. APPLICATIONS SPECIFICALLY NOT OF INTEREST

The following types of applications will be deemed nonresponsive and will not be reviewed or considered (see Section III.C.2 of the FOA):

- Applications that have been submitted in response to other currently issued ARPA-E FOAs.
- Applications that are not scientifically distinct from applications submitted in response to other currently issued ARPA-E FOAs.
- Applications for basic research aimed solely at discovery and/or fundamental knowledge generation.
- Applications for large-scale demonstration projects of existing technologies.
- Applications for proposed technologies that represent incremental improvements to existing technologies.
- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates a law of thermodynamics).
- Applications that do not address at least one of ARPA-E's Mission Areas (see Section I.A of the FOA).
- Applications for proposed technologies that are not transformational, as described in Section I.A of the FOA.
- Applications for proposed technologies that do not have the potential to become disruptive in nature, as described in Section I.A of the FOA.
- Applications that are not scientifically distinct from existing funded activities supported elsewhere, including within the Department of Energy.
- Applications that describe a technology, but that do not propose an R&D plan (e.g., a copy of a patent application or sales brochure).