

FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT



ADVANCED RESEARCH PROJECTS AGENCY – ENERGY (ARPA-E)
U.S. DEPARTMENT OF ENERGY

**OPEN INNOVATIVE DEVELOPMENT IN
ENERGY-RELATED APPLIED SCIENCE
(OPEN IDEAS)**

Announcement Type: ~~Initial Announcement~~ **Modification 01**

Funding Opportunity No. DE-FOA-0001002
CFDA Number 81.135

Issue Date:	Sep 27, 2013
Close Date:	5 PM ET, Sep 26, 2014
Submission Deadline:	None
Questions Deadline:	None

- For eligibility criteria, see Section III.A.
- To apply to this FOA, Applicants must register with and submit application materials through ARPA-E's online application portal, ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/Registration.aspx>). For detailed guidance on using ARPA-E eXCHANGE, see Section IV.C.1.
- ARPA-E will not review or consider noncompliant or nonresponsive submissions. For detailed guidance on compliance and responsiveness criteria, see Sections III.C.1 and III.C.2.

Questions about this FOA? Email ARPA-E-CO@hq.doe.gov (with FOA name and number in subject line); see FOA Sec. VII.A.
Problems with ARPA-E eXCHANGE? Email ExchangeHelp@hq.doe.gov (with FOA name and number in subject line).

MODIFICATIONS

All modifications to the Funding Opportunity Announcement (FOA) are highlighted in yellow in the body of the FOA.

Mod. No.	Date	Description of Modifications
01	12/04/2013	<ul style="list-style-type: none">• Inserted additional information regarding the content and form of Concept Papers. See Section IV.B of the FOA.

Questions about this FOA? Email ARPA-E-CO@hq.doe.gov (with FOA name and number in subject line); see FOA Sec. VII.A.
Problems with ARPA-E eXCHANGE? Email ExchangeHelp@hq.doe.gov (with FOA name and number in subject line).

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Problems with ARPA-E eXCHANGE? Email ExchangeHelp@hq.doe.gov (with FOA name and number in subject line).

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Problems with ARPA-E eXCHANGE? Email ExchangeHelp@hq.doe.gov (with FOA name and number in subject line).

REQUIRED DOCUMENTS CHECKLIST

For an overview of the application process, see Section IV.A.

For guidance regarding the content and form of Concept Papers, see Section IV.B of the FOA and the Concept Paper template available in ARPA-E's online application portal, ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/>).

SUBMISSION	COMPONENTS	OPTIONAL/ MANDATORY	FOA SECTION
Concept Paper	<ul style="list-style-type: none">Each Applicant must submit a Concept Paper in Adobe PDF format.	Mandatory	IV.A-IV.B

PREFACE

This Funding Opportunity Announcement (FOA) is intended to provide rapid support to revolutionary applied energy research (Studies) that may lead to new ARPA-E programs to develop transformational and disruptive energy technologies. Studies are defined as single-phase efforts of durations less than 12 months and cost less than \$500,000. Awards will be issued through Grants.¹

ARPA-E is issuing this FOA as a *one-year pilot initiative*. If successful, this or a similar FOA will be issued annually.

Applicants will submit brief Concept Papers (4 page maximum) as described below, and selected Concept Paper Applicants will then be invited to submit Full Applications. This FOA addresses only the Concept Paper process. Applicants must propose energy research that *is not* (1) covered by current ARPA-E projects, programs, FOAs, and RFIs (Requests for Information) and (2) an incremental improvement to existing technology. Applicants are encouraged to review current ARPA-E projects, programs, FOAs, and RFIs prior to application.² The following are highlights of the Concept Paper submission process:

- 1. Prior to Submission.** Prior to submitting a Concept Paper to this FOA, Applicants may contact an ARPA-E Program Director to discuss their research concept and its potential responsiveness to this FOA, subject to Program Director availability. However, once a Concept Paper is submitted to the FOA, any communications regarding that submission

¹ Except for funding provided to Federally Funded Research and Development Centers (FFRDCs) and other federal laboratories.

² Information on current ARPA-E programs can be found at <http://arpa-e.energy.gov/?q=arpa-e-site-page/view-programs>, projects at <http://arpa-e.energy.gov/?q=arpa-e-site-page/projects>, and FOAs and RFIs at <http://arpa-e.energy.gov/?q=faq/current-funding-opportunities>.

Questions about this FOA? Email ARPA-E-CO@hq.doe.gov (with FOA name and number in subject line); see FOA Sec. VII.A.
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must be through the Contracting Officer, as specified below. Program Director's biographies and email contact information can be accessed at <http://arpa-e.energy.gov/?q=about/arpa-e-team/program-directors>.

Note: *This FOA and the FOA selection process will control all ARPA-E selection decisions. The Contracting Officer is the only individual authorized to make awards on behalf of ARPA-E or obligate ARPA-E to the expenditure of public funds. A commitment or obligation by any individual other than the Contracting Officer, either explicit or implied, is neither valid nor binding.*

2. **Concept Paper Submission.** Applicants may submit Concept Papers at any time during the open period of this FOA.
3. **Concept Paper Review.** Concept Papers determined compliant with application procedures and responsive to the FOA (see Section III.C) will be subject to technical review by ARPA-E technical experts under established ARPA-E merit review procedures. Only the most technically meritorious concepts may result in a subsequent invitation from ARPA-E to submit a Full Application.
4. **Full Application Invitation.** Selected Concept Paper Applicants will be invited to submit a Full Application via ARPA-E's online application portal, ARPA-E eXCHANGE. ARPA-E intends to provide prompt notice of whether or not a Concept Paper Applicant is invited to submit a Full Application.

I. **FUNDING OPPORTUNITY DESCRIPTION**

A. **AGENCY OVERVIEW**

The Advanced Research Projects Agency – Energy (ARPA-E), an organization within the Department of Energy (DOE), is chartered by Congress in the America COMPETES Act of 2007 (P.L. 110-69), as amended by the America COMPETES Reauthorization Act of 2010 (P.L. 111-358), to support the creation of transformational energy technologies and systems through funding and managing Research and Development (R&D) efforts. Originally chartered in 2007, the Agency was first funded through the American Recovery and Reinvestment Act of 2009. Since that time, the Agency has funded about 285 projects totaling approximately \$770 million across the entire technology landscape.³

The mission of ARPA-E is to identify and fund research to translate science into breakthrough energy technologies that are too risky for the private sector and that, if successfully developed, will create the foundation for entirely new industries. Successful projects will address at least one of ARPA-E's two key Mission Areas:

³ Information on ARPA-E's projects is available at <http://arpa-e.energy.gov/?q=projects>.

1. Enhance the economic and energy security of the United States through the development of energy technologies that result in:
 - a. reductions of imports of energy from foreign sources;
 - b. reductions of energy-related emissions, including greenhouse gases; and
 - c. improvement in the energy efficiency of all economic sectors.
2. Ensure that the United States maintains a technological lead in developing and deploying advanced energy technologies.

ARPA-E funds applied research and development. ARPA-E exists to fund applied research and development, defined by the Office of Management and Budget as a “study (designed) to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met” and as the “systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.” ARPA-E funds technology-focused applied research to create real-world solutions to important problems in energy creation, distribution and use and, as such, will not support basic research, defined as a “systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.” While it is anticipated that in some instances some minor aspects of fundamental science will be clarified or uncovered during the conduct of the supported applied research, the major portion of activities supported by ARPA-E are directed towards applied research and development of new technologies.

While all technology-focused applied research will be considered, two instances are especially fruitful for the creation of transformational technologies:

- The first establishment of a technology based upon recently elucidated scientific principles; and
- The synthesis of scientific principles drawn from disparate fields that do not typically intersect.

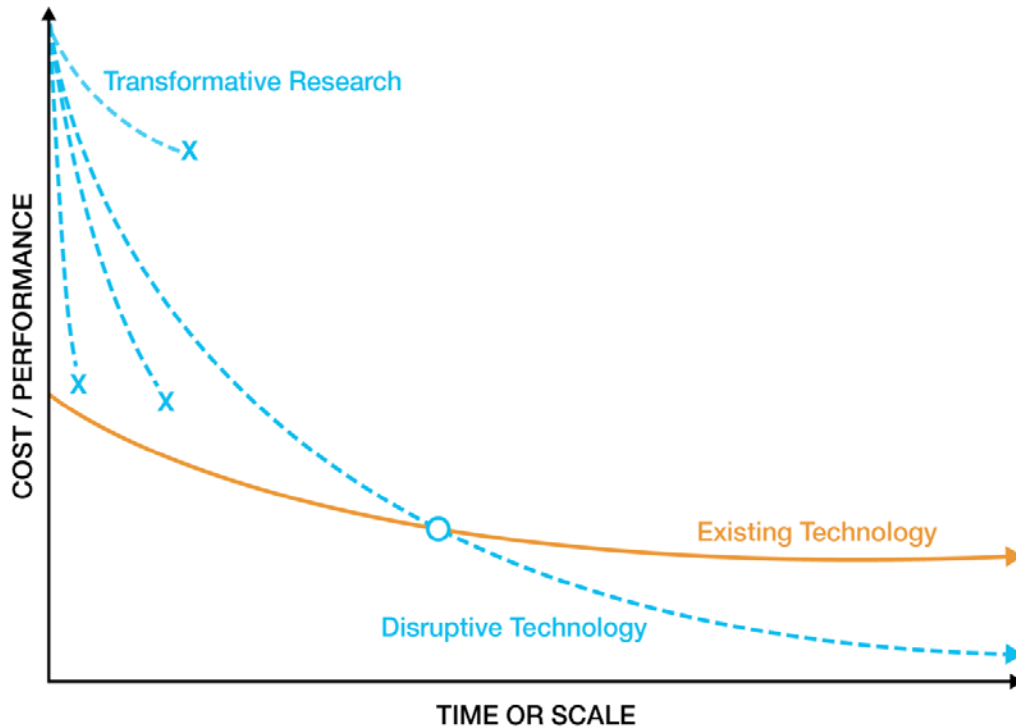


Figure 1: Description of transformational and disruptive technologies in terms of cost per unit performance versus time or scale. ARPA-E seeks to support research that establishes new learning curves that lead to disruptive technologies.

ARPA-E exists to support transformational, rather than incremental research. Technologies develop along learning curves (Figure 1). Following the creation of a technology, refinements to that technology and the economies of scale that accrue as manufacturing and widespread distribution develop drive technology down that learning curve until meaningful improvements accrue only slowly. While this incremental improvement of technology is important to the ultimate success of a technology in the marketplace, ARPA-E exists to fund transformational research – i.e., research that creates fundamentally new learning curves rather than moving existing technologies down their learning curves.

ARPA-E funded technology has the potential to be disruptive in the marketplace. The mere creation of a new learning curve does not ensure market penetration. Rather, the marketplace determines the ultimate value of a technology, and impactful technologies ultimately become disruptive – that is, they are widely adopted and displace existing technologies from the marketplace or create entirely new markets. Energy technologies typically become disruptive at maturity rather than close to inception and the maturation of nascent technologies often require significant incremental development to drives the technology down its natural learning curve to its ultimate equilibrium (see Figure 1 above). Such development might include modification of the technology itself, the means to produce and distribute that technology, or both. Thus, while early incarnations of the automobile were transformational in the sense that they created a fundamentally new learning curve for transportation, they were not disruptive, because of the unreliability and high cost of early automobiles. Continuous, incremental

refinement of the technology ultimately led to the Ford Model T: as the first affordable, reliable, mass-produced vehicle, the Model T had a disruptive effect on the transportation market.

ARPA-E does not support technology development for extended periods of time; rather, ARPA-E supports the initial creation of technology. Following initial testing of the first prototype of a device, a system, or a process, other Federal agencies and the private sector should support the development necessary to bring the technology to market.

While ARPA-E does not require technologies to be disruptive at the conclusion of ARPA-E funding, ARPA-E will not support technologies that cannot be disruptive even if successful. Examples of such technologies are approaches that require elements with insufficient abundances of materials to be deployed at scale, or technologies that could not scale to levels required to be impactful because of, for example, physical limits to productivity.

ARPA-E will not support basic research aimed at discovery and fundamental knowledge generation, nor will it undertake large-scale demonstration projects of existing technologies.

ARPA-E is not a substitute for existing R&D organizations within DOE, but rather complements existing organizations by supporting R&D objectives that are transformational and translational. Applicants interested in receiving basic research financial assistance should work with the Department of Energy's Office of Science (<http://science.energy.gov/>). Similarly, projects focused on the improvement of existing technology platforms may be appropriate for support by the applied programs – for example, the Office of Energy Efficiency and Renewable Energy (<http://www.eere.energy.gov/>), the Office of Fossil Energy (<http://fossil.energy.gov/>), the Office of Nuclear Energy (<http://nuclear.energy.gov/>), and the Office of Electricity Delivery and Energy Reliability (<http://energy.gov/oe/office-electricity-delivery-and-energy-reliability>).

B. PROGRAM OVERVIEW

This announcement is purposely broad in scope to encourage the submission of the most innovative, out-of-the-box ideas in energy technology. Since the first law of thermodynamics states that energy is always conserved, i.e. it can never be created or destroyed, our principal concern is with the conversion of energy into useful energy or maximizing usable energy (exergy). Useful energy can take many forms including: radiant energy from lights, electrical energy for appliances, thermal energy to heat homes, mechanical energy for transportation, chemical energy in the form of food, and energy used to make products. From the second law of thermodynamics, the entropy of a system cannot decrease when converting energy from one form to another ($\Delta S \geq 0$), the end effect being that all useful energy humans consume ultimately results in the production of heat that is radiated into space, except for a few exceptions such as the energy embedded in products. It is therefore our endeavor to identify technologies that enable the efficient and cost-effective conversion between or within the various different forms of energy (Figure 2) while minimizing exergy destruction. Within this general framework, ARPA-E seeks transformative ideas that enable the most efficient,

economical, sustainable, and environmentally benign conversion of energy while minimizing energy destruction.

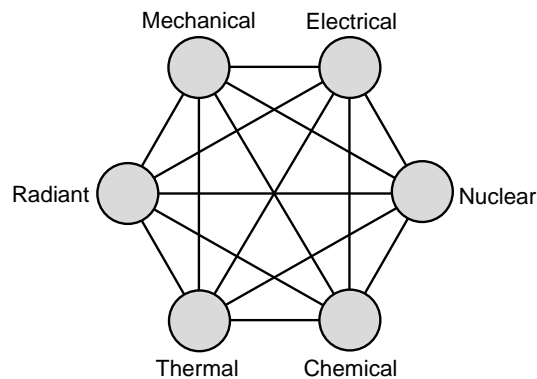


Figure 2. Six primary energy forms of interest and possible pathways for conversion or other interaction.

C. PROGRAM OBJECTIVES

The broad objective of this FOA is to identify disruptive concepts in energy-related technologies that challenge the status quo and represent a leap beyond today’s technology and that could lead to new ARPA-E Programs. An innovative concept alone is not enough; the idea must also have the potential to be impactful—meaning that, if successful, it represents a fundamentally new paradigm in energy technology with the potential to make a significant impact on ARPA-E’s Mission Areas (see Section I.A). Concepts of particular interest have the potential to achieve percentage-level reductions in U.S. energy consumption, energy-related imports, or greenhouse gas emissions.

D. AREAS OF INTEREST

Applicants may propose any idea that addresses an *ARPA-E Mission Area* (see Section I.A) and falls within one or more *Areas of Interest* selected from the six forms of energy involved in the conversion or interaction of energy (Figure 3). Each Applicant must explain how the proposed concept represents a transformative approach to more efficiently, economically, or sustainably (including reduced use and conservation) utilize energy for useful work. Areas of Interest and some topical examples of conversions and interactions between and within these energy categories are shown in Figure 3. Technical Subcategories for the FOA are derived from these Areas of Interest. Concept Papers must identify one Technical Subcategory listed in Table 1 that is appropriate for the proposed concept topic area. (Note: each Technical Subcategory represents conversion/interaction in either direction. For example, Subcategory 1.3 includes concepts for converting mechanical to chemical energy and chemical to mechanical energy.)

Figure 3. A matrix providing representative examples of energy conversions within or between the six energy categories. Technical subcategories for submission are derived from these energy conversions (see Table 1).

1. Mechanical	2. Thermal	3. Chemical	4. Electrical	5. Radiant	6. Nuclear	
1.1 compressors, transmissions, hydraulics	1.2 turbines/engines, acoustic cooling, geothermal, tribology	1.3 pressure swing sorption, osmotic pumps	1.4 electromagnetic generators, flywheels, CAES	1.5 triboluminescence, photomechanical devices	1.6 centrifugal isotope enrichment, fusion ion propulsion	1. Mechanical
	2.2 heat pipes, thermal storage, heat exchangers, phase change materials	2.3 combustors, chemical cooling, thermochemical processing, desalinization	2.4 solid-state heat engines (thermionic or thermoelectric), HVAC, heat pumps	2.5 concentrated solar thermal, selective emitters, optical heat pumps	2.6 thermonuclear fusion, radioisotope thermoelectrics	2. Thermal
		3.3 gas-to-liquid technology, separations, extractions	3.4 electrochemical devices/storage, fuel cells, electrochemical processing	3.5 chemiluminescence, photochemical reactors, biofuels, solar fuels	3.6 chemonuclear reactors, low-energy nuclear reactions, nuclear fuel chemistry	3. Chemical
			4.4 smart grid, SMES, power electronics	4.5 light emitting diodes, lasers, photovoltaics	4.6 particle accelerators or accelerator-driven systems, betavoltaics	4. Electrical
				5.5 spectral splitters, concentrators, optically-pumped lasers, daylighting	5.6 optoelectric nuclear battery, radioisotope thermophotovoltaics, inertial confinement fusion	5. Radiant
					6.6 nuclear fuel cycles, hybrid fission-fusion reactors	6. Nuclear

Table 1. Technical Subcategories spanning the Areas of Interest for this FOA, derived from Figure 3.

Technical Subcategories	
1.1 Mechanical-Mechanical	4.4 Electrical-Electrical
1.2 Mechanical-Thermal	4.5 Electrical-Radiant
1.3 Mechanical-Chemical	4.6 Electrical-Nuclear
1.4 Mechanical-Electrical	
1.5 Mechanical-Radiant	
1.6 Mechanical-Nuclear	

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2.2 Thermal-Thermal 2.3 Thermal-Chemical 2.4 Thermal-Electrical 2.5 Thermal-Radiant 2.6 Thermal-Nuclear	5.5 Radiant-Radiant 5.6 Radiant-Nuclear
3.3 Chemical-Chemical 3.4 Chemical-Electrical 3.5 Chemical-Radiant 3.6 Chemical-Nuclear	6.6 Nuclear-Nuclear

E. AREAS SPECIFICALLY NOT OF INTEREST

Concept Paper Applicants will not be invited to submit Full Applications if their Concept Papers:

1. Do not address an ARPA-E Mission Area (see Section I.A);
2. Do not address one of the FOA's Areas of Interest (see Section I.D);
3. Are not based on sound scientific principles (e.g., violates a law of thermodynamics);
4. Propose basic research aimed at discovery and fundamental knowledge generation;
5. Propose demonstration projects of existing technologies;
6. Propose incremental improvements to existing technologies;
7. Propose a concept without the potential to be disruptive in nature, as described in Section I.A;

II. AWARD INFORMATION

A. AWARD OVERVIEW

ARPA-E expects to make approximately \$10 million available for new awards under this FOA, subject to the availability of appropriated funds. ARPA-E anticipates making approximately 20 awards during the one-year open period for this FOA. Individual awards may vary up to \$500,000. The period of performance for awards may not exceed 12 months.

Questions about this FOA? Email ARPA-E-CO@hq.doe.gov (with FOA name and number in subject line); see FOA Sec. VII.A.
Problems with ARPA-E eXCHANGE? Email ExchangeHelp@hq.doe.gov (with FOA name and number in subject line).

B. FUNDING

Congress directed ARPA-E to “establish and monitor project milestones, initiate research projects quickly, and just as quickly terminate or restructure projects if such milestones are not achieved.”⁴ Accordingly, ARPA-E is involved in the direction of every project, as described in Section II.C below.

1. GRANTS

ARPA-E expects to award Grants⁵ for research funded under this FOA, except in special cases as provided immediately below.

2. FUNDING AGREEMENTS WITH FFRDCs, GOGOs, AND FEDERAL INSTRUMENTALITIES⁶

Any FFRDC involved as a member of a Project Team⁷ will be required to complete the “FFRDC Authorization” and “Field Work Proposal” section of the Business Assurances Form, which is submitted with a Full Application.

When a FFRDC is the *lead organization* for a Project Team, ARPA-E executes a funding agreement directly with the FFRDC and a single, separate Grant with the rest of the Project Team. Notwithstanding the use of multiple agreements, the FFRDC is the lead organization for the entire project, including all work performed by the FFRDC and the rest of the Project Team.

When a FFRDC or non-DOE/National Nuclear Security Administration (NNSA) Government-Owned, Government-Operated laboratory (GOGO) is a *member* of a Project Team, ARPA-E executes a funding agreement directly with the FFRDC or non-DOE/NNSA GOGO and a single, separate Grant with the rest of the Project Team. Notwithstanding the use of multiple agreements, the Prime Recipient⁸ under the Grant is the lead organization for the entire project, including all work performed by the FFRDC or non-DOE/NNSA GOGO and the rest of the Project Team.

Funding agreements with DOE/NNSA FFRDCs take the form of Work Authorizations issued to DOE/NNSA FFRDCs through the DOE/NNSA Field Work Proposal system for work performed

⁴ U.S. Congress, Conference Report to accompany the 21st Century Competitiveness Act of 2007, H. Rpt. 110-289 at 171-172 (Aug. 1, 2007).

⁵ A Grant is an award instrument used by ARPA-E to accomplish research pursuant to ARPA-E’s statutory authority. ARPA-E’s participation in Grant research is not substantial compared with ARPA-E awards through Cooperative Agreements.

⁶ DOE/NNSA GOGOs are not eligible to apply for funding, as described in Section III.A.

⁷ A Project Team is any entity with multiple players working collaboratively and could encompass anything from an existing organization to an ad hoc teaming arrangement. A Project Team consists of the Prime Recipient, Subrecipients, and others performing or otherwise supporting work under an ARPA-E award.

⁸ A Prime Recipient is the signatory to an ARPA-E Grant.

under Department of Energy Management & Operation Contracts. Funding agreements with non-DOE/NNSA FFRDCs, GOGOs, and Federal instrumentalities (e.g., Tennessee Valley Authority) generally take the form of Interagency Agreements. Any funding agreement with a FFRDC or non-DOE/NNSA GOGO will have substantially similar terms and conditions as ARPA-E's Model Grant (accessible at <http://arpa-e.energy.gov/arpa-e-site-page/award-guidance>) except for provisions indicating monitoring of the research effort by ARPA-E.

C. STATEMENT OF RESEARCH OVERSIGHT

ARPA-E will conduct oversight of projects from inception to completion. For the purposes of an ARPA-E project funded through a Grant under this FOA, oversight means:

- ARPA-E may address the conduct or performance of project activities;
- During award negotiations, ARPA-E Program Directors and awardees establish a schedule of quarterly milestones and deliverables;
- Prime Recipients document the achievement of these milestones and deliverables in quarterly technical and financial progress reports, which are reviewed and evaluated by ARPA-E Program Directors;
- ARPA-E Program Directors visit each Prime Recipient at least twice per year, and hold periodic meetings, conference calls, and webinars with Project Teams;
- ARPA-E reviews reimbursement requests for compliance with applicable Federal cost principles. Upon request, Prime Recipients are required to provide additional information and documentation to support claimed expenditures;
- Prime Recipients are required to comply with agency-specific and programmatic requirements;
- As appropriate, ARPA-E works closely with Prime Recipients to facilitate and expedite the deployment of ARPA-E-funded technologies to market;
- ARPA-E works with other government agencies and nonprofits to provide mentoring and networking opportunities for Prime Recipients; and
- ARPA-E organizes and sponsors events to educate Prime Recipients about key barriers to the deployment of their ARPA-E-funded technologies. In addition, ARPA-E establishes collaborations with private and public entities to provide continued support for the development and deployment of ARPA-E-funded technologies.

III. ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

1. INDIVIDUALS

U.S. citizens or permanent residents may apply for funding in their individual capacity as a Standalone Applicant,⁹ as the lead for a Project Team, or as a member of a Project Team.

2. DOMESTIC ENTITIES

For-profit entities, educational institutions, and nonprofits¹⁰ that are incorporated in the United States, including U.S. territories, are eligible to apply for funding as a Standalone Applicant, as the lead organization for a Project Team, or as a member of a Project Team.

FFRDCs are eligible to apply for funding as the lead organization for a Project Team or as a member of a Project Team, but not as a Standalone Applicant.

DOE/NNSA GOGOs are not eligible to apply for funding.

Non-DOE/NNSA GOGOs are eligible to apply for funding as a member of a Project Team, but not as a Standalone Applicant or as the lead organization for a Project Team.

State and local government entities are eligible to apply for funding as a member of a Project Team, but not as a Standalone Applicant or as the lead organization for a Project Team.

Federal agencies and instrumentalities (other than DOE) are eligible to apply for funding as a member of a Project Team, but not as a Standalone Applicant or as the lead organization for a Project Team.

3. FOREIGN ENTITIES

Foreign entities, whether for-profit or otherwise, are eligible to apply for funding as Standalone Applicants, as the lead organization for a Project Team, or as a member of a Project Team. All work by foreign entities must be performed by subsidiaries or affiliates incorporated in the United States (including U.S. territories). The Applicant may request a waiver of this requirement in the Business Assurances Form, which is submitted with the Full Application.

⁹A Standalone Applicant is an Applicant that applies for funding on its own, not as part of a Project Team.

¹⁰Nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995 are not eligible to apply for funding as a Prime Recipient or Subrecipient.

Please refer to the Business Assurances Form for guidance on the content and form of the request.

4. CONSORTIUM ENTITIES

Consortia, which may include domestic and foreign entities, must designate one member of the consortium as the consortium representative to the Project Team. The consortium representative must be incorporated in the United States. The eligibility of the consortium will be determined by reference to the eligibility of the consortium representative under Section III.A. Each consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium entity must provide a written description of its internal governance structure and its internal rules to the Contracting Officer (ARPA-E-CO@hq.doe.gov).

Unincorporated consortia must provide the Contracting Officer with a collaboration agreement, commonly referred to as the articles of collaboration, which sets out the rights and responsibilities of each consortium member. This agreement binds the individual consortium members together and should discuss, among other things, the consortium's:

- Management structure;
- Method of making payments to consortium members;
- Means of ensuring and overseeing members' efforts on the project;
- Provisions for members' cost sharing contributions; and
- Provisions for ownership and rights in intellectual property developed previously or under the agreement.

B. COST SHARING

Cost sharing requirements for OPEN IDEAS are as follows:

- Cost sharing will not be required for Full Applications submitted by domestic educational institutions, domestic nonprofits, domestic small businesses and/or FFRDCs submitted as a Standalone Applicant or a Project Team composed exclusively of these types of entities.
- For-profit entities qualifying as “large businesses” are required to provide 5% of the Total Project Cost as cost share as a Standalone Applicant or member of a Project Team.

If cost sharing is required, the funding agreement makes the Prime Recipient responsible for paying the entire cost share and enforcing cost share obligations assumed by Project Team members in subawards or related agreements.

C. OTHER

1. COMPLIANT CRITERIA

Concept Papers are deemed compliant if:

- The Applicant meets the eligibility requirements in Section III.A;
- The Concept Paper complies with the content and form requirements in Section IV.B; and
- The Applicant entered all required information, successfully uploaded all required documents, and clicked the “Submit” button through ARPA-E’s online application portal, ARPA-E eXCHANGE.

ARPA-E will not review or consider noncompliant Concept Papers, including Concept Papers submitted through other means, Concept Papers submitted after the applicable deadline, and incomplete Concept Papers. A Concept Paper is incomplete if it does not include required information (see Section IV.C.1).

2. RESPONSIVENESS CRITERIA

ARPA-E performs a preliminary technical responsiveness review of Concept Papers. Concept Papers are deemed nonresponsive and are not reviewed or considered if they:

1. Are not scientifically distinct from other projects supported by Federal agencies and/or other sources; and/or
2. Present a concept in areas already being explored by current or planned ARPA-E projects, programs, FOAs, and/or RFIs.
 - Potential Applicants are highly encouraged to review the current ARPA-E programs listed at <http://arpa-e.energy.gov/?q=arpa-e-site-page/view-programs>, ARPA-E projects at <http://arpa-e.energy.gov/?q=arpa-e-site-page/projects>, and ARPA-E FOAs and RFIs at <http://arpa-e.energy.gov/?q=faq/current-funding-opportunities>.

3. LIMITATION ON NUMBER OF CONCEPT PAPERS

ARPA-E is not limiting the number of Concept Papers that may be submitted by Applicants. Applicants may submit more than one Concept Paper in response to this FOA, provided that each is scientifically distinct.

IV. CONCEPT PAPER SUBMISSION INFORMATION

A. SUBMISSION PROCESS OVERVIEW

1. REGISTRATION IN ARPA-E eXCHANGE

The first step in applying to this FOA is registration in ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov>), ARPA-E's online application portal. For detailed guidance on using ARPA-E eXCHANGE, please refer to Section IV.C.1 of the FOA and the "ARPA-E eXCHANGE User Guide" (<https://arpa-e-foa.energy.gov/Manuals.aspx>).

2. CONCEPT PAPERS

Section IV.C provides instructions on submitting a Concept Paper.

ARPA-E performs a preliminary review of Concept Papers to determine whether they are compliant and responsive, as described in Section III.C. ARPA-E makes an independent assessment of each compliant and responsive Concept Paper based on the criteria in Section V.A.

3. FULL APPLICATIONS

Only selected Concept Paper Applicants will be invited to submit Full Applications. Directions for submitting Full Applications will be provided to invited Applicants through ARPA-E's online application portal, ARPA-E eXCHANGE. Non-selected Concept Paper Applicants will receive written notice from ARPA-E.

B. CONTENT AND FORM OF CONCEPT PAPERS

Submission of a Concept Paper is required for initial consideration under this FOA. Concept Papers must conform to the following requirements:

- Concept Papers must be submitted in Adobe PDF format, be written in English, be single spaced, use black 12 point Times New Roman font (except in Figures and

Tables), and be formatted to fit on 8.5 inch by 11 inch paper with margins no less than 1 inch;

- Concept Papers shall not exceed four (4) pages in length including graphics, figures, and/or tables;
- Concept Papers must prominently display on each page the Principle Investigator's Last Name and assigned Control Number in the upper right corner and page numbers in the bottom right corner; and

ARPA-E strongly encourages Applicants to use the Concept Paper template provided under the header "Required Application Documents" for the OPEN IDEAS FOA on ARPA-E's online application portal, ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/>). Responding to each question in the template ensures that each Applicant's concept is presented in a manner that can be efficiently evaluated by ARPA-E. Applicants that use alternative Concept Paper formats should ensure that their submission includes responses for all requested information in the Concept Paper template and complies with the requirements listed above.

ARPA-E will not review or consider noncompliant and/or nonresponsive Concept Papers (see Section III.C).

C. OTHER SUBMISSION REQUIREMENTS

1. USE OF ARPA-E eXCHANGE

To apply to this FOA, Applicants must register with ARPA-E's online application portal, ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/Registration.aspx>). Concept Papers must be submitted through ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/login.aspx>). ARPA-E will not review or consider Concept Papers submitted through other means (e.g., fax, hand delivery, email, postal mail). For detailed guidance on using ARPA-E eXCHANGE, please refer to the "ARPA-E eXCHANGE User Guide" (<https://arpa-e-foa.energy.gov/Manuals.aspx>).

Upon creating a Concept Paper submission in ARPA-E eXCHANGE, Applicants will be assigned a Control Number. If the Applicant creates more than one submission, a different Control Number will be assigned for each Concept Paper.

Once logged in to ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/login.aspx>), Applicants may access their submissions by clicking the "My Submissions" link in the navigation on the left side of the page. Every Concept Paper that the Applicant has submitted to ARPA-E and the corresponding Control Number is displayed on that page.

ARPA-E will not review or consider incomplete Concept Papers. Such Concept Papers will be deemed noncompliant (see Section III.C.1). The following errors could cause a Concept Paper to be deemed “incomplete” and thus noncompliant:

- Failing to comply with the form and content requirements in Section IV.B;
- Failing to enter required information in ARPA-E eXCHANGE;
- Failing to upload required document(s) to ARPA-E eXCHANGE; and
- Uploading the wrong document(s) to ARPA-E eXCHANGE.

V. CONCEPT PAPER REVIEW INFORMATION

A. REVIEW CRITERIA

ARPA-E performs a preliminary review of Concept Papers to determine whether they are compliant and responsive (see Section III.C).

The following merit review criteria are used to evaluate compliant and responsive Concept Papers. Submissions will not be evaluated against each other since they are not submitted in accordance with a common work statement.

(1) Impact

- The proposed approach is a transformational (not incremental) advancement over existing solutions;
- The proposed approach has the potential to be disruptive in nature, as described in Section I.A of the FOA; that is technologies that, if developed, could supplant existing technology and/or create entirely new marketplaces; and
- The proposed approach falls within this FOA’s *Areas of Interest* (see Section I.D) and could significantly impact one or more of ARPA E’s *Mission Areas* (see Section I.A).

(2) Innovation

- The proposed approach is unique and innovative;
- The proposed approach is technically sound; and
- The proposed approach is aimed at the development of technology, as opposed to basic research aimed at discovery and fundamental knowledge generation.

(3) State of the Art

- The applicant demonstrates an understanding of existing and other emerging solutions.

(4) Risks and Challenges

- The proposal clearly identifies the technical and techno-economic risks and challenges.

(5) Project Plan

- The proposal clearly outlines how the key risks and challenges will be addressed; and
- The proposed project objectives, if achieved, validate the proposed concept.

(6) Team

- The proposed team has the necessary expertise and resources to carry out the proposed work.

B. REVIEW AND SELECTION PROCESS

ARPA-E intends to promptly review Concept Papers and rapidly notify Applicants whether their Concept Papers have been selected for invitation to submit Full Applications.

1. ARPA-E REVIEWERS

ARPA-E selects reviewers based on their knowledge and understanding of the relevant field and application, their experience and skills, and their ability to provide constructive feedback on applications.

ARPA-E requires all reviewers to complete a Conflict-of-Interest Certification and Nondisclosure Agreement through which they disclose their knowledge of any actual or apparent conflicts and agree to safeguard confidential information contained in Concept Papers and Full Applications. In addition, ARPA-E trains its reviewers in proper evaluation techniques and procedures.

Applicants are not permitted to nominate reviewers for their Concept Papers. Applicants may contact the Contracting Officer by email (ARPA-E-CO@hq.doe.gov) if they have knowledge of a potential conflict of interest or a reasonable belief that a potential conflict exists.

2. ARPA-E SUPPORT CONTRACTOR

ARPA-E utilizes contractors to assist with the evaluation of Concept Papers and project management. To avoid actual and apparent conflicts of interest, ARPA-E prohibits its support contractors from submitting or participating in the preparation of Concept Papers to ARPA-E.

By submitting a Concept Paper to ARPA-E, Applicants represent that they are not performing support contractor services for ARPA-E in any capacity and did not obtain the assistance of ARPA-E's support contractor to prepare the Concept Paper. ARPA-E will not consider any Concept Papers that are submitted by or prepared with the assistance of its support contractors.

VI. SELECTION NOTICES

A. REJECTED SUBMISSIONS

Noncompliant and nonresponsive Concept Papers are rejected by the Contracting Officer and are not reviewed or considered. The Contracting Officer sends a notification letter by email to the technical and administrative points of contact designated by the Applicant in ARPA-E eXCHANGE. The notification letter states the basis upon which the Concept Paper was rejected.

B. CONCEPT PAPER NOTIFICATIONS

ARPA-E promptly notifies Concept Paper Applicants of its determination to invite or not invite submission of a Full Application. ARPA-E sends a notification letter by email to the technical and administrative points of contact designated by the Applicant in ARPA-E eXCHANGE. Selected Concept Paper Applicants will be invited to submit a Full Application via a web portal provided to the selected Applicants.

VII. AGENCY CONTACTS

A. COMMUNICATIONS WITH ARPA-E

Communication	ARPA-E Contact	Email
FOA Questions	Contracting Officer	ARPA-E-CO@hq.doe.gov
ARPA-E eXCHANGE Submission Help	eXCHANGE help desk	ExchangeHelp@hq.doe.gov
Technical Inquiries (Pre-Submission Only)	Program Directors	Available at: http://arpa-e.energy.gov/?q=about/arpa-e-team/program-directors

1. FOA QUESTIONS

Applicants are required to submit all questions regarding this FOA to ARPA-E-CO@hq.doe.gov.

- ARPA-E will post responses periodically to any questions that are received. ARPA-E may re-phrase questions or consolidate similar questions for administrative purposes.
- Responses are posted to “Frequently Asked Questions” on ARPA-E’s website (<http://arpa-e.energy.gov/faq>).

Questions about this FOA? Email ARPA-E-CO@hq.doe.gov (with FOA name and number in subject line); see FOA Sec. VII.A.
Problems with ARPA-E eXCHANGE? Email ExchangeHelp@hq.doe.gov (with FOA name and number in subject line).

2. ONLINE SUBMISSION HELP

Applicants may submit questions regarding ARPA-E eXCHANGE, ARPA-E's online application portal, to ExchangeHelp@hq.doe.gov. ARPA-E will promptly respond to emails that raise legitimate, technical issues with ARPA-E eXCHANGE. ARPA-E will refer any questions regarding the FOA to ARPA-E-CO@hq.doe.gov.

ARPA-E will not accept or respond to communications received by other means (e.g., fax, telephone, mail, hand delivery). Emails sent to other email addresses will be disregarded.

3. TECHNICAL INQUIRIES

Prior to submitting a Concept Paper to this FOA, Applicants may contact an ARPA-E Program Director to discuss their research concept and its potential responsiveness to this FOA, subject to Program Director availability. However, once a Concept Paper is submitted to the FOA, any communications regarding that submission must be through the Contracting Officer, as specified below. Program Director's biographies and email contact information can be accessed at <http://arpa-e.energy.gov/?q=about/arpa-e-team/program-directors>.

***Note:** This FOA and the FOA selection process will control all ARPA-E selection decisions. The Contracting Officer is the only individual authorized to make awards on behalf of ARPA-E or obligate ARPA-E to the expenditure of public funds. A commitment or obligation by any individual other than the Contracting Officer, either explicit or implied, is neither valid nor binding.*

B. DEBRIEFINGS

ARPA-E does not offer or provide debriefings. ARPA-E provides Applicants with a notification of its determination to invite or not invite submission of a Full Application based on ARPA-E's assessment of the Concept Paper.

VIII. OTHER INFORMATION

A. FOAs AND FOA MODIFICATIONS

FOAs are posted on ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/>), Grants.gov (<http://www.grants.gov/>), and FedConnect (<https://www.fedconnect.net/FedConnect/>). Any modifications to the FOA are also posted to these websites. You can receive an e-mail when a modification is posted by registering with FedConnect as an interested party for this FOA. It is recommended that you register as soon as possible after release of the FOA to ensure that you

Questions about this FOA? Email ARPA-E-CO@hq.doe.gov (with FOA name and number in subject line); see FOA Sec. VII.A.
Problems with ARPA-E eXCHANGE? Email ExchangeHelp@hq.doe.gov (with FOA name and number in subject line).

receive timely notice of any modifications or other announcements. More information is available at <https://www.fedconnect.net>.

B. OBLIGATION OF PUBLIC FUNDS

The Contracting Officer is the only individual who can make awards on behalf of ARPA-E or obligate ARPA-E to the expenditure of public funds. A commitment or obligation by any individual other than the Contracting Officer, either explicit or implied, is invalid.

ARPA-E awards may not be transferred, assigned, or assumed without the prior written consent of a Contracting Officer.

C. RETENTION OF SUBMISSIONS

ARPA-E expects to retain copies of all Concept Papers. No submissions will be returned. By applying to ARPA-E for funding, Applicants consent to ARPA-E's retention of their submissions.

D. MARKING OF CONFIDENTIAL INFORMATION

ARPA-E will use data and other information contained in Concept Papers strictly for evaluation purposes. Applicants should not include confidential, proprietary, or privileged information in their Concept Papers, unless such information is necessary to convey an understanding of the proposed project.

Concept Papers, and other submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

The first page of the Concept Paper must be marked as follows and identify the specific pages containing confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [___] of this document may contain confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source.

The footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: “Contains Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure.” In addition, every line and paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

E. PROTECTED PERSONALLY IDENTIFIABLE INFORMATION

Applicants may not include any Protected Personally Identifiable Information (Protected PII) in their submissions to ARPA-E. Protected PII is defined as data that, if compromised, could cause harm to an individual such as identity theft. Listed below are examples of Protected PII that Applicants must not include in their submissions.

- Social Security Numbers in any form;
- Place of birth associated with an individual;
- Date of birth associated with an individual;
- Mother’s maiden name associated with an individual;
- Biometric record associated with an individual;
- Fingerprint;
- Iris scan;
- DNA;
- Medical history information associated with an individual;
- Medical conditions, including history of disease;
- Metric information, e.g. weight, height, blood pressure;
- Criminal history associated with an individual;
- Ratings;
- Disciplinary actions;
- Performance elements and standards (or work expectations) are PII when they are so intertwined with performance appraisals that their disclosure would reveal an individual’s performance appraisal;
- Financial information associated with an individual;
- Credit card numbers;
- Bank account numbers; and
- Security clearance history or related information (not including actual clearances held).

F. INTELLECTUAL PROPERTY AND U.S. MANUFACTURING REQUIREMENTS

Intellectual property and U.S. manufacturing requirements for awards resulting from this FOA may be found at <http://arpa-e.energy.gov/arpa-e-site-page/award-guidance>.

**APPENDIX : FUNDING RESTRICTIONS, ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS,
AND REPORTING REQUIREMENTS**

Awards resulting from this FOA will be subject to programmatic funding restrictions, administrative and national policy requirements, and reporting requirements. Applicants may access information concerning ARPA-E funding restrictions, administrative and national policy requirements, and reporting requirements at the following:

1. ARPA-E Model Grant Agreement

<http://arpa-e.energy.gov/?q=arpa-e-site-page/award-guidance>

Attachment 1

- Restrictions on Work Outside the United States
- Purchase of New Equipment
- Lobbying Restrictions
- NEPA Compliance/Environmental Impact Questionnaire

Attachment 4

- ARPA-E Reporting Requirements
- Intellectual Property Management Plan Requirement

Attachment 6

- National Policy Assurances

2. Applicants Guide to ARPA-E Award Negotiations

<http://arpa-e.energy.gov/?q=arpa-e-site-page/pre-award-guidance>

- DUNS, SAM, FSRS, FedConnect Registrations
- Pre-Award Costs

3. Funding Agreements & Project Guidance

<http://arpa-e.energy.gov/?q=arpa-e-site-page/funding-agreements-project-guidance>

- DUNS, SAM, FSRS, FedConnect Registrations
- NEPA Compliance/Environmental Impact Questionnaire
- Allowable Costs
- Intellectual Property Management Plan Requirement
- U.S. manufacturing Requirement

4. Budget Justification Guidance

<http://arpa-e.energy.gov/?q=arpa-e-site-page/pre-award-guidance>

- Allowability of Patent Costs
- Allowability of Foreign Travel
- Technology Transfer and Outreach Costs