

**FINANCIAL ASSISTANCE  
FUNDING OPPORTUNITY ANNOUNCEMENT**



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

**OPEN 2018**

Announcement Type: Modification 03  
Funding Opportunity No. DE-FOA- 0001858  
CFDA Number 81.135

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| <b>Funding Opportunity Announcement (FOA) Issue Date:</b>   | December 13, 2017  |
| <b>First Deadline for Questions to <a href="mailto:ARPA-E-CO@hq.doe.gov">ARPA-E-CO@hq.doe.gov</a>:</b>  | 5 PM ET, Friday, February 2, 2018  |
| <b>Submission Deadline for Concept Papers:</b>  | 9:30 AM ET, Friday, February 16, 2018  |
| <b>Second Deadline for Questions to <a href="mailto:ARPA-E-CO@hq.doe.gov">ARPA-E-CO@hq.doe.gov</a>:</b> | 5 PM ET, Friday, June, 22, 2018  |
| <b>Submission Deadline for Full Applications:</b>   | 9:30 AM ET, Monday, July 2, 2018   |
| <b>Submission Deadline for Replies to Reviewer Comments:</b>  | 5 PM ET, Friday, August 24   |
| <b>Expected Date for Selection Notifications:</b>   | October 2018   |
| <b>Total Amount to Be Awarded</b>   | Approximately \$100 million, subject to the availability of appropriated funds.                                  |
| <b>Anticipated Awards</b>   | ARPA-E may issue one, multiple, or no awards under this FOA. Awards may vary between \$500,000 and \$10 million. |

- **This FOA document is abridged for the convenience of the reader. Some provisions, requirements, and other information on the FOA are referenced and hyperlinked.**
- For eligibility criteria, see Section III.A of the FOA.
- For cost share requirements under this FOA, see Section III.B of the FOA.
- To apply to this FOA, Applicants must register with and submit application materials through ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/Registration.aspx>). For detailed guidance on using ARPA-E eXCHANGE, see Section IV.H.1 of the FOA.
- Webinar: In this Webinar, an ARPA-E Program Director provides an overview of OPEN 2018 Full Application Best Practices <https://youtu.be/axntQWNBfn4>
- Applicants are responsible for meeting each submission deadline. Applicants are strongly encouraged to submit their applications at least 48 hours in advance of the submission deadline.
- For detailed guidance on compliance and responsiveness criteria, see Sections III.C.1 through III.C.4 of the FOA.

Questions about this FOA? Check the Frequently Asked Questions available at <http://arpa-e.energy.gov/faq>. For questions that have not already been answered, email [ARPA-E-CO@hq.doe.gov](mailto: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](mailto: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       | 01/19/2018 | <ul style="list-style-type: none"> <li>• Revised Content and Form requirements of Concept Papers. See Section IV.C of the FOA and Concept Paper Template.</li> </ul>   |
| 02       | 2/13/2018  | <ul style="list-style-type: none"> <li>• Extended the Submission Deadline for Concept Papers to 9:30 AM ET, Friday, February 16, 2018. See Cover Page and Required Documents Checklist.</li> </ul>   |
| 03       | 5/23/2018  | <ul style="list-style-type: none"> <li>• Inserted certain deadlines, including the deadlines for submitting questions and Full Applications. See Cover Page and Required Documents Checklist.</li> <li>• Revised the following sections of the FOA to provide guidance on required application forms and the content and form of Full Applications and Replies to Reviewer Comments: Required Documents Checklist and Sections IV.D, IV.E, and IV.G of the FOA. Applicants are strongly encouraged to use the templates provided on ARPA-E eXCHANGE (<a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a>).</li> <li>• Inserted criteria that ARPA-E will use to evaluate Full Applications, see Section V.A.2 of the FOA.</li> <li>• Inserted criteria that ARPA-E will use to evaluate Replies to Reviewer Comments in Section V.A.3 of the FOA.</li> <li>• Inserted information on the anticipated announcement and award dates, see Section V.C of the FOA.</li> <li>• Inserted information concerning Full Application Notifications, see Section VI.A.3 of the FOA.</li> <li>• Inserted Administrative and National Policy Requirements, see Section VI.B of the FOA.</li> <li>• Inserted Reporting Requirements, see Section VI.C of the FOA.</li> </ul> |

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Questions about this FOA? Check the Frequently Asked Questions available at <http://arpa-e.energy.gov/faq>. For questions that have not already been answered, email [ARPA-E-CO@hq.doe.gov](mailto: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](mailto: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 of the FOA.

For guidance regarding requisite application forms, see Section IV.B of the FOA.

For guidance regarding the content and form of Concept Papers, Full Applications, and Replies to Reviewer Comments, see Sections IV.C, IV.D, and IV.E of the FOA.

| SUBMISSION       | COMPONENTS  | OPTIONAL/<br>MANDATORY | FOA<br>SECTION | DEADLINE                              |
|------------------|---|------------------------|----------------|---------------------------------------|
| Concept Paper    | <ul style="list-style-type: none"> <li>• Each Applicant must submit a Concept Paper in Adobe PDF format by the stated deadline. The Concept Paper must not exceed 4 pages in length and must include the following:                             <ul style="list-style-type: none"> <li>○ Concept Summary</li> <li>○ Innovation and Impact</li> <li>○ Proposed Work</li> <li>○ Team Organization and Capabilities</li> </ul> </li> </ul>   | Mandatory              | IV.C           | 9:30 AM ET, Friday, February 16, 2018 |
| Full Application | <ul style="list-style-type: none"> <li>• Each Applicant must submit a Technical Volume in Adobe PDF format by the stated deadline. Applicants may use the Technical Volume template available on ARPA-E eXCHANGE (<a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a>). The Technical Volume must include the following:                             <ul style="list-style-type: none"> <li>○ Executive Summary (1 page max.)</li> <li>○ Sections 1-5 (20 pages max.)                                     <ul style="list-style-type: none"> <li>• 1. Innovation and Impact</li> <li>• 2. Proposed Work</li> <li>• 3. Team Organization and Capabilities</li> <li>• 4. Technology to Market</li> <li>• 5. Budget</li> </ul> </li> <li>○ Bibliographic References (no page limit)</li> <li>○ Personal Qualification Summaries (each PQS limited to 3 pages in length, no cumulative page limit)</li> </ul> </li> <li>• The Technical Volume must be accompanied by:                             <ul style="list-style-type: none"> <li>○ SF-424 (no page limit, Adobe PDF format);</li> <li>○ Budget Justification Workbook/SF424A (no page limit, Microsoft Excel format)</li> <li>○ Summary for Public Release (250 words max., Adobe PDF format);</li> <li>○ Summary Slide (1 page limit, Microsoft PowerPoint format) – Applicants may use the Summary Slide template available on ARPA-E eXCHANGE (<a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a>);</li> </ul> </li> </ul> | Mandatory              | IV.D           | 9:30 AM ET, Monday, July 2, 2018      |

Questions about this FOA? Check the Frequently Asked Questions available at <http://arpa-e.energy.gov/faq>. For questions that have not already been answered, email [ARPA-E-CO@hq.doe.gov](mailto: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](mailto:ExchangeHelp@hq.doe.gov) (with FOA name and number in subject line).

|                                   |   |                 |             |   |
|-----------------------------------|---|-----------------|-------------|---|
|                                   | <ul style="list-style-type: none"> <li>⊖ Completed and signed Business Assurances &amp; Disclosures Form (no page limit, Adobe PDF format); and</li> <li>○ U.S. Manufacturing Plan (1 page limit, Adobe PDF format).</li> </ul>   |                 |             |   |
| <p>Reply to Reviewer Comments</p> | <ul style="list-style-type: none"> <li>• Each Applicant may submit a Reply to Reviewer Comments in Adobe PDF format. This submission is optional. Applicants may use the Reply to Reviewer Comments template available on ARPA-E eXCHANGE (<a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a>). The Reply may include:             <ul style="list-style-type: none"> <li>○ Up to 2 pages of text; and</li> <li>○ Up to 1 page of images.</li> </ul> </li> </ul> | <p>Optional</p> | <p>IV.E</p> | <p>5 PM ET, Friday, August 24, 2018</p> |

Questions about this FOA? Check the Frequently Asked Questions available at <http://arpa-e.energy.gov/faq>. For questions that have not already been answered, email [ARPA-E-CO@hq.doe.gov](mailto: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](mailto:ExchangeHelp@hq.doe.gov) (with FOA name and number in subject line).

## I. FUNDING OPPORTUNITY DESCRIPTION

<https://arpa-e.energy.gov/?q=site-page/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:

- “(A) to enhance the economic and energy security of the United States through the development of energy technologies that result in—
  - (i) reductions of imports of energy from foreign sources;
  - (ii) reductions of energy-related emissions, including greenhouse gases; and
  - (iii) improvement in the energy efficiency of all economic sectors; and
- (B) to ensure that the United States maintains a technological lead in developing and deploying advanced energy technologies.”

ARPA-E issues this Funding Opportunity Announcement (FOA) under the programmatic authorizing statute codified at 42 U.S.C. § 16538. The FOA and any awards made under this FOA are subject to 2 C.F.R. Part 200 as amended by 2 C.F.R. Part 910.

ARPA-E funds research on and the development of high-potential, high-impact energy technologies that are too early for private-sector investment. The agency focuses on technologies that can be meaningfully advanced with a modest investment over a defined period of time in order to catalyze the translation from scientific discovery to early-stage technology. For the latest news and information about ARPA-E, its programs and the research projects currently supported, see: <http://arpa-e.energy.gov/>.

***ARPA-E funds transformational research.*** Existing energy technologies generally progress on established “learning curves” where refinements to a technology and the economies of scale that accrue as manufacturing and distribution develop drive down the cost/performance metric in a gradual fashion. This continual improvement of a technology is important to its increased commercial deployment and is appropriately the focus of the private sector and it can be spurred by early-stage R&D supported by the applied energy offices in DOE. By contrast, ARPA-E supports high-risk, potentially transformative research that has the potential to create fundamentally new learning curves. ARPA-E R&D projects typically start with cost/performance estimates for the proposed technology that are well above the level of the competitive incumbent technology. Given the high risk inherent in these projects, many will fail to progress, but some may succeed in generating a new learning curve with a projected cost/performance metric that is significantly lower than that of the incumbent technology.

**ARPA-E funds technology with the potential to be disruptive in the marketplace.** The mere creation of a new learning curve does not ensure market penetration. Rather, the ultimate value of a technology is determined by the marketplace, and impactful technologies ultimately become disruptive – that is, they are widely adopted and displace existing technologies from the marketplace or create entirely new markets. ARPA-E understands that definitive proof of market disruption takes time, particularly for energy technologies. Therefore, ARPA-E funds the development of technologies that, if technically successful, have the clear disruptive potential, e.g., by demonstrating capability for manufacturing at competitive cost and deployment at scale.

**ARPA-E funds applied research and development.** The Office of Management and Budget defines “applied research” as an “original investigation undertaken in order to acquire new knowledge...directed primarily towards a specific practical aim or objective” and defines “development” as “creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes.”<sup>1</sup> Applicants interested in receiving financial assistance for basic research should contact the DOE’s Office of Science (<http://science.energy.gov/>). Office of Science national scientific user facilities (<http://science.energy.gov/user-facilities/>) are open to all researchers, including ARPA-E applicants and awardees. These facilities provide advanced tools of modern science including accelerators, colliders, supercomputers, light sources and neutron sources, as well as facilities for studying the nanoworld, the environment, and the atmosphere. Projects focused on early-stage R&D for the improvement of technology along defined roadmaps may be more appropriate for support through the DOE applied energy offices including: 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://www.energy.gov/ne/office-nuclear-energy>), and the Office of Electricity Delivery and Energy Reliability (<http://energy.gov/oe/office-electricity-delivery-and-energy-reliability>).

## **B. PROGRAM BACKGROUND**

This FOA marks the fourth OPEN solicitation in the history of ARPA-E. The previous OPEN solicitations were conducted at the inception of the agency in 2009 and again in 2012 and 2015. OPEN 2018 therefore continues the three-year periodic cycle for ARPA-E OPEN solicitations. 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.

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<sup>1</sup> OMB Circular A-11  
([https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/assets/a11\\_current\\_year/a11\\_2017.pdf](https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/assets/a11_current_year/a11_2017.pdf)), Section 84, pgs. 3-4.



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. Indeed, one third of the sixty projects featured in the first two volumes describing ARPA-E impacts stem from OPEN solicitations (<https://arpa-e.energy.gov/?q=site-page/arpa-e-impact>). Potential applicants to this FOA are strongly encouraged to examine the OPEN projects in these two volumes and all of the projects supported in the previous three OPEN solicitations (<https://arpa-e.energy.gov/?q=site-page/open>) for examples of the creative and innovative R&D ARPA-E seeks in its OPEN solicitations.

### **C. PROGRAM OBJECTIVES**

The objective of an ARPA-E OPEN FOA is simple, yet comprehensive: to support high-risk R&D leading to the development of potentially disruptive new technologies across the full spectrum of energy applications. ARPA-E seeks to support early-stage, but potentially 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 conventional and 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. In order to organize the submissions to this FOA for the purposes of merit review, ARPA-E requires that each Concept Paper and Full Application identify a Technical Subcategory or Subcategories for the proposed technology from the list provided below. 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.

The list of Technical Subcategories is intended to encompass the majority of energy-related technologies. If the proposed technology does not fall within any of the Technical Subcategories below, the Applicant should select from Category 7, "Other Energy Technologies," Subcategory L, "Other Energy Technologies Not Listed Above."

| <b>CATEGORY</b>                       | <b>SUBCATEGORY</b>   | <b>DESCRIPTION</b>  |
|---------------------------------------|--|---|
| <b>CATEGORY 1:<br/>GRID</b>           | <b><u>Subcategory A:</u></b>   |   |
|                                       | <b>Grid Transmission</b>   | Technologies for the electricity transmission system (>69 kV) planning and operations, including both AC and DC systems.                    |
|                                       | <b><u>Subcategory B:</u></b>   |   |
|                                       | <b>Grid Distribution</b>   | Technologies for the electricity distribution system ( $\leq$ 69 kV) planning and operations including both AC and DC systems.              |
|                                       | <b><u>Subcategory C:</u></b>   | Modeling, algorithms, or control methodologies that improve grid planning, operations, or markets.  |
|                                       | <b>Modeling, Software, Algorithms, And Control For The Grid</b>  |   |
|                                       | <b><u>Subcategory D:</u></b>   | Grid scale battery technologies.  |
|                                       | <b>Batteries - Grid Scale</b>  |   |
|                                       | <b><u>Subcategory E:</u></b>   | Non-battery technologies for grid-scale storage such as: pumped-hydro, compressed air, high angular velocity flywheels, etc.                |
|                                       | <b>Grid Scale (Non-Battery) Storage</b>  |   |
| <b><u>Subcategory F:</u></b>          | 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. |   |
| <b>Grid Reliability</b>               |  |   |
| <b><u>Subcategory G:</u></b>          | Grid technologies that do not fit into one of the above categories.  |   |
| <b>Grid – Other</b>                   |  |   |
| <b>CATEGORY 2:<br/>TRANSPORTATION</b> | <b><u>Subcategory A:</u></b>   | Technologies that create fuels that are substitutes for gasoline/diesel, but are not bio based.   |
|                                       | <b>Alternative Fuels (Non-Bio)</b>   |   |
|                                       | <b><u>Subcategory B:</u></b>   | Technologies for improved internal combustion engines and other engine types (e.g., turbines) specifically for transportation applications. |
|                                       | <b>Engines - Transportation</b>  |   |
|                                       | <b><u>Subcategory C:</u></b>   | Technologies for improved electric motors specifically for transportation applications.   |
|                                       | <b>Electric Motors – Transportation</b>  |   |
| <b><u>Subcategory D:</u></b>          | Technologies for improved fuel cells specifically for transportation applications.   |   |
| <b>Fuel Cells - Transportation</b>    |  |   |
| <b><u>Subcategory E:</u></b>          |  |   |

|  |   |  |
|--|---|--|
|  | <b>Advanced Vehicle Designs And Materials</b>                                 | Advanced or alternative vehicle designs and/or key enabling technologies. Examples could include ultralightweight vehicles, advanced components, new vehicle designs and architectures, etc.   |
|  | <b><u>Subcategory F:</u></b><br><b>Transportation Management</b>              | Technologies for traffic management, transportation behavior, self-driving cars and other advanced transportation management scenarios.  |
|  | <b><u>Subcategory G:</u></b><br><b>Power Electronics - Transportation</b>     | 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.. |
|  | <b><u>Subcategory H:</u></b><br><b>Non-Vehicular Transportation</b>           | Technologies for advanced airplanes, human powered vehicles, marine vessels, trains, etc.  |
|  | <b><u>Subcategory I:</u></b><br><b>Batteries - Transportation</b>             | 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).  |
|  | <b><u>Subcategory J:</u></b><br><b>Non-Battery Storage For Transportation</b> | Technologies that apply thermal storage, and non-battery electric storage, such as supercapacitors and others specifically for transportation application.   |
|  | <b><u>Subcategory K:</u></b><br><b>Transportation - Other</b>                 | Transportation energy technologies that do not fit one of the above categories,  |
| <b>CATEGORY 3:</b><br><b>BUILDING</b><br><b>EFFICIENCY</b> | <b><u>Subcategory A:</u></b><br><b>Combined Heat and Power</b>                | Technologies for new Combined Heat and Power (CHP) designs/scenarios.  |
|  | <b><u>Subcategory B:</u></b><br><b>Building Heating and Cooling</b>           | Technologies that improve the efficiency of building heating and cooling systems.  |
|  | <b><u>Subcategory C:</u></b><br><b>Building Energy Demand Management</b>      | Demand response and/or management technologies such as smart meters, other building energy conservation technologies such as automatic control systems.  |
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|  | <b><u>Subcategory D:</u></b>   | Energy efficient and environmentally-friendly advanced lighting technologies.   |
|  | <b>Lighting</b>  |   |
|  | <b><u>Subcategory E:</u></b>   | Building designs leading to better energy efficiency; technologies that could be applied to windows, insulation, roofing, etc.  |
|  | <b>Building Envelope</b>   |   |
|  | <b><u>Subcategory F:</u></b>   | Building energy efficiency technologies that do not fit into one of the categories above.   |
|  | <b>Building Efficiency - Other</b>   |   |
| <b><u>CATEGORY 4:</u></b><br><b>POWER</b><br><b>GENERATION AND</b><br><b>ENERGY</b><br><b>PRODUCTION:</b><br><b>FOSSIL/NUCLEAR</b> | <b><u>Subcategory A:</u></b>   | Improved generation designs which use a combination of technologies (for example- fuel cells and turbines) with fossil fuels.   |
|  | <b>Combined Processes - Generation with Fossil Fuels</b>   |   |
|  | <b><u>Subcategory B:</u></b>   | Improved engines/turbines for generation applications using fossil fuels.   |
|  | <b>Stationary Engines/Turbines For Generation with Fossil Fuels</b>                                    |   |
|  | <b><u>Subcategory C:</u></b>   | Improved fuel cells intended to be coupled with generation sources using fossil fuels.  |
|  | <b>Stationary Fuel Cells For Generation with Fossil Fuels</b>  |   |
|  | <b><u>Subcategory D:</u></b>   | Technologies that enhance fission, fusion, or materials specifically for safe nuclear power generation.   |
|  | <b>Nuclear Power Generation And Materials</b>  |   |
|  | <b><u>Subcategory E:</u></b>   | Technologies for carbon capture, use, and storage.  |
|  | <b>Carbon Capture, Use, And Storage</b>  |   |
|  | <b><u>Subcategory F:</u></b>   | Technologies/tools for resource identification, classification, and modeling, as well as technologies to extract conventional and unconventional fossil resources. This subcategory can include sensors and imaging technologies, predictive models and algorithms, drills, pumps, etc. |
|  | <b>Exploration And Extraction (Non-Geothermal) Of Conventional and Unconventional Fossil Resources</b> |   |
| <b><u>Subcategory G:</u></b>   | Technologies that improve the planning and operation of power generation with fossil fuels.            |   |
| <b>Planning And Operations For Generation with Fossil Fuels</b>  |  |   |

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|  | <b><u>Subcategory H:</u></b>   | Technologies for storage, transportation, handling, and/or monitoring of combustible gases. This could include tanks, pipelines, pumps, sensors, etc.  |
|  | <b>Combustible Gas Infrastructure</b>  |  |
|  | <b><u>Subcategory I:</u></b>   | 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.  |
|  | <b>Chemical and Biological Conversions From Fossil Fuels</b>   |  |
|  | <b><u>Subcategory J:</u></b>   | Technologies that will enable significant water savings in the generation of power, such as water recovery/recirculation systems or dry cooling of power plants.   |
|  | <b>Water Conservation In Power Generation</b>  |  |
| <b><u>Subcategory K:</u></b>                               | Generation technologies that do not fit into one of the categories above.  |  |
| <b>Generation with Fossil Fuels – Other</b>                |  |  |
| <b>CATEGORY 5:<br/>POWER<br/>GENERATION:<br/>RENEWABLE</b> | <b><u>Subcategory A:</u></b>   | 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.                   |
|  | <b>Wind - Energy Capture</b>   |  |
|  | <b><u>Subcategory B:</u></b>   | 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.   |
|  | <b>Wind - Energy Conversion</b>  |  |
|  | <b><u>Subcategory C:</u></b>   | 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. |
|  | <b>Geothermal Energy</b>   |  |
|  | <b><u>Subcategory D:</u></b>   | Technologies for capturing and/or converting hydrokinetic energy such as ocean, osmotic, tidal, etc., Technologies for hydro resource identification and modeling.   |
| <b>Hydro Energy</b>  |  |  |
| <b><u>Subcategory E:</u></b>                               | 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. |  |
| <b>Solar - PV/CPV</b>                                      |  |  |

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|   | <b><u>Subcategory F:</u></b><br><b>Solar - Non-PV</b>                             | 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. |   |
|   | <b><u>Subcategory G:</u></b><br><b>Power Electronics - Renewable Generation</b>   | 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.  |   |
|   | <b><u>Subcategory H:</u></b><br><b>Renewable Power - Other</b>                    | Renewable energy technologies that do not fit one of the above categories.  |   |
| <b><u>CATEGORY 6:</u></b><br><b>BIOENERGY</b> | <b><u>Subcategory A:</u></b><br><b>Biomass Production</b>                         | Technologies that improve biomass characteristics, such as yield and sustainability, and decrease cost of production and/or water use.  |   |
|   | <b><u>Subcategory B:</u></b><br><b>Biofuel Production - Biological Methods</b>    | Technologies that utilize a biological agent in one or more principal step(s) of feedstock conversion to fuels.   |   |
|   | <b><u>Subcategory C:</u></b><br><b>Biofuel Production - Nonbiological Methods</b> | Technologies that do not utilize any biological agent in the conversion of organic feedstock to fuels, such as thermochemical and hybrid approaches or biomimetics.   |   |
|   | <b><u>Subcategory D:</u></b><br><b>Bioenergy Supply Chain</b>                     | Technologies critical to supply chain development, such as feedstock collection and handling.   |   |
|   | <b><u>Subcategory E:</u></b><br><b>Bioenergy - Other</b>                          | 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.  |   |
|   | <b><u>CATEGORY 7:</u></b><br><b>OTHER ENERGY TECHNOLOGIES</b>                     | <b><u>Subcategory A:</u></b><br><b>Water Production/Reuse</b>   | Technologies that enable cost-effective and energy efficient ways of providing fresh water. |
|   |   | <b><u>Subcategory B:</u></b><br><b>Thermal Energy Storage</b>   | Thermal energy storage technologies that can apply to multiple applications.                |

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| <b><u>Subcategory C:</u></b>                                   | Technologies that enable energy-efficient manufacturing capabilities or methods or that use advanced manufacturing to enable new energy technologies.   |
| <b>Advanced Manufacturing</b>                                  |   |
| <b><u>Subcategory D:</u></b>                                   | 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. |
| <b>Appliance And Consumer Electronics Efficiency (End Use)</b> |   |
| <b><u>Subcategory E:</u></b>                                   | Technologies to improve the energy efficiency of large-scale computers, data centers, and computational infrastructure.   |
| <b>Data Centers And Computation</b>                            |   |
| <b><u>Subcategory F:</u></b>                                   | Technologies that improve the energy efficiency of producing industrial materials, including but not limited to glass, paper, iron, steel, plastics, aluminum, etc.   |
| <b>Industrial Efficiency – Materials</b>                       |   |
| <b><u>Subcategory G:</u></b>                                   | Technologies that improve the energy efficiency of industrial processes which are not covered by other subcategories.   |
| <b>Industrial Efficiency – Other</b>                           |   |
| <b><u>Subcategory H:</u></b>                                   | Technologies for heat recovery including but not limited to thermoelectrics, Stirling engines, heat exchangers, conversion of waste heat, bottoming cycles, heat capture methods, materials, devices, etc.  |
| <b>Heat Recovery</b>   |   |
| <b><u>Subcategory I:</u></b>                                   | Materials designed specifically to withstand extremely high temperatures in order to enable new energy generation technologies.   |
| <b>High Temperature Materials</b>                              |   |
| <b><u>Subcategory J:</u></b>                                   | Technologies that enable the development of new semiconductor materials or the use of semiconductor materials in innovative applications.   |
| <b>Semiconductors</b>  |   |
| <b><u>Subcategory K:</u></b>                                   | Technologies for portable power applications such as piezoelectrics, portable fuel cells, batteries, etc.   |
| <b>Portable Power</b>  |   |
| <b><u>Subcategory L:</u></b>                                   |   |
| <b>Other Energy Technologies Not Listed Above</b>              |   |



## II. AWARD INFORMATION

<https://arpa-e.energy.gov/?q=site-page/ii-award-information>

### A. AWARD OVERVIEW

ARPA-E expects to make approximately \$100 million available for new awards under this FOA, subject to the availability of appropriated funds. ARPA-E anticipates making approximately 30-50 awards under this FOA. ARPA-E may issue one, multiple, or no awards.

Individual awards may vary between \$500,000 and \$10 million.

The period of performance for funding agreements may not be less than 18 months and may not exceed 36 months.

ARPA-E encourages applications stemming from ideas that still require proof-of-concept R&D efforts as well as those for which some proof-of-concept demonstration already exists.

Submissions requiring proof-of-concept R&D can propose a project with the goal of delivering on the program metric at the conclusion of the period of performance. These submissions must contain an appropriate cost and project duration plan that is described in sufficient technical detail to allow reviewers to meaningfully evaluate the proposed project. If awarded, such projects should expect a rigorous go/no-go milestone early in the project associated with the proof-of-concept demonstration. Alternatively, submissions requiring proof-of-concept R&D can propose a project with the project end deliverable being an extremely creative, but partial solution. However, the Applicants are required to provide a convincing vision how these partial solutions can enable the realization of the program metrics with further development.

Applicants proposing projects for which some initial proof-of-concept demonstration already exists should submit concrete data that supports the probability of success of the proposed project.

ARPA-E will provide support at the highest funding level only for applications with significant technology risk, aggressive timetables, and careful management and mitigation of the associated risks.

ARPA-E will accept only new applications under this FOA. Applicants may not seek renewal or supplementation of their existing awards through this FOA.

ARPA-E plans to fully fund your negotiated budget at the time of award.

**B. ARPA-E FUNDING AGREEMENTS**

Through Cooperative Agreements, Technology Investment Agreements, and similar agreements, ARPA-E provides financial and other support to projects that have the potential to realize ARPA-E's statutory mission. ARPA-E does not use such agreements to acquire property or services for the direct benefit or use of the U.S. Government.

For more information on ARPA-E Funding Agreements, see the *Provisions Incorporated by Reference*, hyperlinked via the Award Information Header or at <https://arpa-e.energy.gov/?q=site-page/ii-award-information> .

**C. STATEMENT OF SUBSTANTIAL INVOLVEMENT**

ARPA-E is substantially involved in the direction of projects from inception to completion. For more information on Substantial Involvement, see the *Provisions Incorporated by Reference*, hyperlinked via the Award Information Header or at <https://arpa-e.energy.gov/?q=site-page/ii-award-information>.

### III. ELIGIBILITY INFORMATION

<https://arpa-e.energy.gov/?q=site-page/iii-eligibility-information>

#### A. ELIGIBLE APPLICANTS

This FOA is open to U.S. universities, national laboratories, industry and individuals. For more information on eligible Applicants, see the *Provisions Incorporated by Reference*, hyperlinked via the Eligibility Information Header or at <https://arpa-e.energy.gov/?q=site-page/iii-eligibility-information>.

#### B. COST SHARING<sup>2</sup>

Awards resulting from this FOA require cost share. For more information on cost share requirements, see the *Provisions Incorporated by Reference*, hyperlinked via the Eligibility Information Header or at <https://arpa-e.energy.gov/?q=site-page/iii-eligibility-information>.

#### C. OTHER

##### 1. COMPLIANT CRITERIA

Full Applications are deemed compliant if:

- The Applicant submitted a compliant and responsive Concept Paper;
- The Applicant meets the eligibility requirements in Section III.A of the FOA;
- The Full Application complies with the content and form requirements in Section IV.D of the FOA; and
- The Applicant entered all required information, successfully uploaded all required documents, and clicked the “Submit” button in ARPA-E eXCHANGE by the deadline stated in the FOA.

Full Applications found to be noncompliant may not be merit reviewed or considered for award. ARPA-E may not review or consider noncompliant Full Applications, including Full Applications submitted through other means, Full Applications submitted after the applicable deadline, and incomplete Full Applications. A Full Application is incomplete if it does not include required information and documents, such as Forms SF-424 and SF-424A. ARPA-E will

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<sup>2</sup> Please refer to Section VI.B.3-4 of the FOA for guidance on cost share payments and reporting.

not extend the submission deadline for Applicants that fail to submit required information and documents due to server/connection congestion.

Replies to Reviewer Comments are deemed compliant if:

- The Applicant successfully uploads its response to ARPA-E eXCHANGE by the deadline stated in the FOA; and
- The Replies to Reviewer Comments comply with the content and form requirements of Section IV.E of the FOA.

ARPA-E will not review or consider noncompliant Replies to Reviewer Comments, including Replies submitted through other means and Replies submitted after the applicable deadline. ARPA-E will not extend the submission deadline for Applicants that fail to submit required information due to server/connection congestion. ARPA-E will review and consider each compliant and responsive Full Application, even if no Reply is submitted or if the Reply is found to be noncompliant.

## **2. RESPONSIVENESS CRITERIA**

ARPA-E performs a preliminary technical review of Concept Papers and Full Applications. The following types of submissions may be deemed nonresponsive and may not be reviewed or considered:

- Submissions that fall outside the technical parameters specified in this FOA.
- Submissions that have been submitted in response to other currently issued ARPA-E FOAs.
- Submissions that are not scientifically distinct from applications submitted in response to other currently issued ARPA-E FOAs.
- Submissions for basic research aimed solely at discovery and/or fundamental knowledge generation.
- Submissions for large-scale demonstration projects of existing technologies.
- Submissions for proposed technologies that represent incremental improvements to existing technologies.
- Submissions for proposed technologies that are not based on sound scientific principles (e.g., violates a law of thermodynamics).
- Submissions for proposed technologies that are not transformational, as described in Section I.A of the FOA.
- Submissions for proposed technologies that do not have the potential to become disruptive in nature, as described in Section I.A of the FOA. Technologies must be scalable such that they could be disruptive with sufficient technical progress.

- Submissions that are not distinct in scientific approach or objective from activities currently supported by or actively under consideration for funding by any other office within Department of Energy.
- Submissions that are not distinct in scientific approach or objective from activities currently supported by or actively under consideration for funding by other government agencies or the private sector.
- Submissions that describe a technology but do not propose a R&D plan that allows ARPA-E to evaluate the submission under the applicable merit review criteria provided in Section V.A of the FOA.

### **3. LIMITATION ON NUMBER OF SUBMISSIONS**

ARPA-E is not limiting the number of submissions from Applicants. Applicants may submit more than one application to this FOA, provided that each application is scientifically distinct.

## **IV. APPLICATION AND SUBMISSION INFORMATION**

<https://arpa-e.energy.gov/?q=site-page/iv-application-and-submission-information>

### **A. APPLICATION PROCESS OVERVIEW**

#### **1. REGISTRATION IN ARPA-E eXCHANGE**

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

#### **2. CONCEPT PAPERS**

Deleted and reserved for future use.

#### **3. FULL APPLICATIONS**

Applicants must submit a Full Application by the deadline stated in the FOA. Applicants will have approximately 45 days from receipt of the Encourage/Discourage notification to prepare and submit a Full Application. Section IV.D of the FOA provides instructions on submitting a Full Application.

ARPA-E performs a preliminary review of Full Applications to determine whether they are compliant and responsive, as described in Section III.C of the FOA. Full Applications found to be noncompliant or nonresponsive may not be merit reviewed or considered for award. ARPA-E makes an independent assessment of each compliant and responsive Full Application based on the criteria and program policy factors in Sections V.A.2 and V.B.1 of the FOA.

#### **4. REPLY TO REVIEWER COMMENTS**

Once ARPA-E has completed its review of Full Applications, reviewer comments on compliant and responsive Full Applications are made available to Applicants via ARPA-E eXCHANGE. Applicants may submit an optional Reply to Reviewer Comments, which must be submitted by the deadline stated in the FOA. Section IV.E of the FOA provides instructions on submitting a Reply to Reviewer Comments.

ARPA-E performs a preliminary review of Replies to determine whether they are compliant, as described in Section III.C.1 of the FOA. ARPA-E will review and consider compliant Replies only. ARPA-E will review and consider each compliant and responsive Full Application, even if no Reply is submitted or if the Reply is found to be non-compliant.

## **5. PRE-SELECTION CLARIFICATIONS AND “DOWN-SELECT” PROCESS**

Once ARPA-E completes its review of Full Applications and Replies to Reviewer Comments, it may, at the Contracting Officer’s discretion, conduct a pre-selection clarification process and/or perform a “down-select” of Full Applications. Through the pre-selection clarification process or down-select process, ARPA-E may obtain additional information from select Applicants through pre-selection meetings, webinars, videoconferences, conference calls, written correspondence, or site visits that can be used to make a final selection determination. ARPA-E will not reimburse Applicants for travel and other expenses relating to pre-selection meetings or site visits, nor will these costs be eligible for reimbursement as pre-award costs.

ARPA-E may select applications for award negotiations and make awards without pre-selection meetings and site visits. Participation in a pre-selection meeting or site visit with ARPA-E does not signify that Applicants have been selected for award negotiations.

## **6. SELECTION FOR AWARD NEGOTIATIONS**

ARPA-E carefully considers all of the information obtained through the application process and makes an independent assessment of each compliant and responsive Full Application based on the criteria and program policy factors in Sections V.A.2 and V.B.1 of the FOA. The Selection Official may select all or part of a Full Application for award negotiations. The Selection Official may also postpone a final selection determination on one or more Full Applications until a later date, subject to availability of funds and other factors. ARPA-E will enter into award negotiations only with selected Applicants.

Applicants are promptly notified of ARPA-E’s selection determination. ARPA-E may stagger its selection determinations. As a result, some Applicants may receive their notification letter in advance of other Applicants. Please refer to Section VI.A of the FOA for guidance on award notifications.

### **B. APPLICATION FORMS**

Required forms for Full Applications are available on ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov>). For more information regarding the Applications Forms, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application and Submission Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/iv-application-and-submission-information>.

**C. CONTENT AND FORM OF CONCEPT PAPERS**

Concept Papers were due February 16, 2018. Only individuals and organizations that submitted a compliant and responsive Concept Paper may submit a Full Application under this FOA.

**D. CONTENT AND FORM OF FULL APPLICATIONS**

Full Applications must conform to the content requirements described below.

| <b>Component</b>                                  | <b>Required Format</b> | <b>Description and Information</b>  |
|---|------------------------|---|
| <b>Technical Volume</b>                           | PDF                    | The centerpiece of the Full Application. Provides a detailed description of the proposed R&D project and Project Team. A Technical Volume template is available on ARPA-E eXCHANGE ( <a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a> ).   |
| <b>SF-424</b>                                     | PDF                    | Application for Federal Assistance ( <a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a> ). Applicants are responsible for ensuring that the proposed costs listed in eXCHANGE match those listed on forms SF-424 and SF-424A. Inconsistent submissions may impact ARPA-E's final award determination.  |
| <b>Budget Justification Workbook/SF-424A</b>      | XLS                    | Budget Information – Non-Construction Programs ( <a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a> )  |
| <b>Summary for Public Release</b>                 | PDF                    | Short summary of the proposed R&D project. Intended for public release. A Summary for Public Release template is available on ARPA-E eXCHANGE ( <a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a> ).  |
| <b>Summary Slide</b>                              | PPT                    | A four-panel project slide summarizing different aspects of the proposed R&D project. A Summary Slide template is available on ARPA-E eXCHANGE ( <a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a> ).   |
| <b>Business Assurances &amp; Disclosures Form</b> | PDF                    | Requires the Applicant to make responsibility disclosures and disclose potential conflicts of interest within the Project Team. Requires the Applicant to describe the additionality and risks associated with the proposed project, disclose applications for funding currently pending with Federal and non-Federal entities, and disclose funding from Federal and non-Federal entities for work in the same technology area as the proposed R&D project. If the Applicant is a FFRDC/DOE Lab, requires the Applicant to provide written authorization from the cognizant Federal agency and, if a DOE/NNSA FFRDC/DOE Lab, a Field Work Proposal. Allows the Applicant to request a waiver or modification of the Performance of Work in the United States requirement and/or the Technology Transfer & Outreach (TT&O) spending requirement. This form is available on ARPA-E eXCHANGE at <a href="https://arpa-e-foa.energy.gov">https://arpa-e-foa.energy.gov</a> . A sample response to the Business Assurances & Disclosures Form is also available on ARPA-E eXCHANGE. |
| <b>U.S. Manufacturing Plan</b>                    | PDF                    | As part of the application, Applicants are required to submit a U.S. Manufacturing Plan. The U.S. Manufacturing Plan represents the Applicant's measurable commitment to support U.S. manufacturing as a result of its award.   |



For pricing purposes, assume a project start date of February 2019, or as negotiated.

For more information regarding the Content and Form of Full Applications, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application and Submission Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/iv-application-and-submission-information>.

**E. CONTENT AND FORM OF REPLIES TO REVIEWER COMMENTS**

For information regarding Content and Form of Replies to Reviewer Comments, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application and Submission Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/iv-application-and-submission-information>.

**F. INTERGOVERNMENTAL REVIEW**

For information regarding Intergovernmental Review, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application and Submission Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/iv-application-and-submission-information>.

**G. FUNDING RESTRICTIONS**

For information regarding Funding Restrictions, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application and Submission Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/iv-application-and-submission-information>.

**H. OTHER SUBMISSION REQUIREMENTS**

For information regarding Other Submission Requirements, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application and Submission Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/iv-application-and-submission-information>.

## V. APPLICATION REVIEW INFORMATION

<https://arpa-e.energy.gov/?q=site-page/v-application-review-information>

### A. CRITERIA

ARPA-E performs a preliminary review of Full Applications to determine whether they are compliant and responsive (see Section III.C of the FOA). ARPA-E also performs a preliminary review of Replies to Reviewer Comments to determine whether they are compliant.

ARPA-E considers a mix of quantitative and qualitative criteria in determining whether to encourage the submission of a Full Application and whether to select a Full Application for award negotiations.

#### 1. **CRITERIA FOR CONCEPT PAPERS**

Deleted and reserved for future use.

#### 2. **CRITERIA FOR FULL APPLICATIONS**

Full Applications are evaluated based on the following criteria:

(1) *Impact of the Proposed Technology* (30%) - This criterion involves consideration of the following:

- The potential for a transformational and disruptive (not incremental) advancement in one or more energy-related fields;
- Thorough understanding of the current state-of-the-art and presentation of an innovative technical approach to significantly improve performance over the current state-of-the-art;
- Awareness of competing commercial and emerging technologies and identification of how the proposed concept/technology provides significant improvement over these other solutions; and
- A reasonable and effective strategy for transitioning the proposed technology from the laboratory to commercial deployment.

(2) *Overall Scientific and Technical Merit* (30%) - This criterion involves consideration of the following:

- Whether the proposed work is unique and innovative;
- Clearly defined project outcomes and final deliverables;
- Substantiation that the proposed project is likely to meet or exceed the technical performance targets identified in this FOA;
- Feasibility of the proposed work based upon preliminary data or other background information and sound scientific and engineering practices and principles;
- A sound technical approach, including appropriately defined technical tasks, to accomplish the proposed R&D objectives; and
- Management of risk, to include identifying major technical R&D risks and feasible, effective mitigation strategies.

(3) *Qualifications, Experience, and Capabilities of the Proposed Project Team* (30%) - This criterion involves consideration of the following:

- The PI and Project Team have the skill and expertise needed to successfully execute the project plan, evidenced by prior experience that demonstrates an ability to perform R&D of similar risk and complexity; and
- Access to the equipment and facilities necessary to accomplish the proposed R&D effort and/or a clear plan to obtain access to necessary equipment and facilities.

(4) *Soundness of Management Plan* (10%) - This criterion involves consideration of the following:

- Plausibility of plan to manage people and resources;
- Allocation of appropriate levels of effort and resources to proposed tasks;
- Reasonableness of the proposed project schedule, including major milestones; and
- Reasonableness of the proposed budget to accomplish the proposed project.

Submissions will not be evaluated against each other since they are not submitted in accordance with a common work statement.

The above criteria will be weighted as follows:

|   |     |
|---|-----|
| Impact of the Proposed Technology   | 30% |
| Overall Scientific and Technical Merit                                    | 30% |
| Qualifications, Experience, and Capabilities of the Proposed Project Team | 30% |
| Soundness of Management Plan  | 10% |

### **3. CRITERIA FOR REPLIES TO REVIEWER COMMENTS**

ARPA-E has not established separate criteria to evaluate Replies to Reviewer Comments. Instead, Replies to Reviewer Comments are evaluated as an extension of the Full Application.

#### **B. REVIEW AND SELECTION PROCESS**

##### **1. PROGRAM POLICY FACTORS**

In addition to the above criteria, ARPA-E may consider the following program policy factors in determining which Concept Papers to encourage to submit a Full Application and which Full Applications to select for award negotiations:

- I. **ARPA-E Portfolio Balance.** Project balances ARPA-E portfolio in one or more of the following areas:
  - a. Diversity of technical personnel in the proposed Project Team;
  - b. Technological diversity;
  - c. Organizational diversity;
  - d. Geographic diversity;
  - e. Technical or commercialization risk; or
  - f. Stage of technology development.
  
- II. **Relevance to ARPA-E Mission Advancement.** Project contributes to one or more of ARPA-E's key statutory goals:
  - a. Reduction of US dependence on foreign energy sources;
  - b. Stimulation of domestic manufacturing/U.S. Manufacturing Plan;
  - c. Reduction of energy-related emissions;
  - d. Increase in U.S. energy efficiency;
  - e. Enhancement of U.S. economic and energy security; or
  - f. Promotion of U.S. advanced energy technologies competitiveness.
  
- III. **Synergy of Public and Private Efforts.**
  - a. Avoids duplication and overlap with other publicly or privately funded projects;

- b. Promotes increased coordination with nongovernmental entities for demonstration of technologies and research applications to facilitate technology transfer; or
  - c. Increases unique research collaborations.
- IV. **Low likelihood of other sources of funding.** High technical and/or financial uncertainty that results in the non-availability of other public, private or internal funding or resources to support the project.
- V. **High-Leveraging of Federal Funds.** Project leverages Federal funds to optimize advancement of programmatic goals by proposing cost share above the required minimum or otherwise accessing scarce or unique resources.
- VI. **High Project Impact Relative to Project Cost.**

## 2. ARPA-E REVIEWERS

For information regarding ARPA-E Reviewers, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application Review Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/v-application-review-information>.

## 3. ARPA-E SUPPORT CONTRACTOR

For information regarding ARPA-E's use of a Support Contractor, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Application Review Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/v-application-review-information>.

## C. ANTICIPATED ANNOUNCEMENT AND AWARD DATES

ARPA-E expects to announce selections for negotiations in approximately October 2018 and to award funding agreements in approximately February 2019.

## **VI. AWARD ADMINISTRATION INFORMATION**

<https://arpa-e.energy.gov/?q=site-page/vi-award-administration-information>

### **A. AWARD NOTICES**

#### **1. REJECTED SUBMISSIONS**

For information regarding Rejected Submissions, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Award Administration Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/vi-award-administration-information>.

#### **2. CONCEPT PAPER NOTIFICATIONS**

Deleted and reserved for future use.

#### **3. FULL APPLICATION NOTIFICATIONS**

ARPA-E promptly notifies Applicants of its determination. ARPA-E 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 may inform the Applicant that its Full Application was selected for award negotiations, or not selected. Alternatively, ARPA-E may notify one or more Applicants that a final selection determination on particular Full Applications will be made at a later date, subject to the availability of funds and other factors.

Written feedback on Full Applications is made available to Applicants before the submission deadline for Replies to Reviewer Comments. By providing feedback, ARPA-E intends to guide the further development of the proposed technology and to provide a brief opportunity to respond to reviewer comments.

##### ***a. SUCCESSFUL APPLICANTS***

ARPA-E has discretion to select all or part of a proposed project for negotiation of an award. A notification letter selecting a Full Application for award negotiations does not authorize the Applicant to commence performance of the project. **ARPA-E selects Full Applications for award negotiations, not for award.** Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement. ARPA-E may terminate award negotiations at any time for any reason.

Please refer to Section IV.G.2 of the FOA for guidance on pre-award costs. Please also refer to the "Applicants' Guide to ARPA-E Award Negotiations" (<https://arpa-e.energy.gov/?q=arpa-e-site-page/pre-award-guidance>) for guidance on the award negotiation process.

### ***b. POSTPONED SELECTION DETERMINATIONS***

A notification letter postponing a final selection determination until a later date does not authorize the Applicant to commence performance of the project. ARPA-E may ultimately determine to select or not select the Full Application for award negotiations.

Please refer to Section IV.G.2 of the FOA for guidance on pre-award costs.

### ***c. UNSUCCESSFUL APPLICANTS***

By not selecting a Full Application, ARPA-E intends to convey its lack of programmatic interest in the proposed project. Such assessments do not necessarily reflect judgments on the merits of the proposed project. ARPA-E hopes that unsuccessful Applicants will submit innovative ideas and concepts for future FOAs.

## **B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS**

For information regarding Administrative and National Policy Requirements, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Award Administration Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/vi-award-administration-information>. VI.B.8 U.S. Manufacturing Requirement is included in both the FOA below as well as in the Provisions Incorporated by Reference.

## **8. U.S. MANUFACTURING REQUIREMENT**

As part of its Full Application, each applicant is required to submit a U.S. Manufacturing Plan that includes the following U.S. Manufacturing Requirements. For more information on the required U.S Manufacturing Plan, see Section IV.D.7 above.

### ***a. SMALL BUSINESSES (including Small Business Concerns)***

Small businesses (and in rare cases where a non-profit might manufacture) that are Prime Recipients or Subrecipients under ARPA-E funding agreements must agree that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States for any use or sale anywhere in the world.

Small business must also agree that, for their exclusive and nonexclusive licensees, any products that embody any subject invention or that will be produced through the use of any subject invention will be manufactured substantially in the United States for any use or sale anywhere in the world.

Small businesses must require their assignees and entities acquiring a controlling interest in the small business to apply the same U.S. Manufacturing requirements to their licensees.

**b. *LARGE BUSINESSES***

Large businesses that are Prime Recipients or Subrecipients (and in rare cases, foreign entities that are subrecipients) under ARPA-E funding agreements are required to substantially manufacture the following products in the United States: (1) products embodying subject inventions, and (2) products produced through the use of subject inventions. This requirement applies to products that are manufactured for use or sale in the United States and outside the United States.

Large businesses (and in rare cases, foreign entities that are subrecipients) must apply the same U.S. Manufacturing requirements to their assignees, licensees, and entities acquiring a controlling interest in the large business or foreign entity. Large businesses must require their assignees and entities acquiring a controlling interest in the large business to apply the same U.S. Manufacturing requirements to their licensees.

**c. *EDUCATIONAL INSTITUTIONS AND NONPROFITS***

Domestic educational institutions and nonprofits that are Prime Recipients or Subrecipients under ARPA-E funding agreements must require their exclusive and nonexclusive licensees to substantially manufacture the following products in the United States for any use or sale anywhere in the world: (1) articles embodying subject inventions, and (2) articles produced through the use of subject inventions. Educational institutions and nonprofits must require their assignees to apply the same U.S. Manufacturing requirements to their licensees.

**d. *FFRDCs/DOE Labs and State and Local Government Entities***

FFRDCs/DOE Labs that are GOCOs and state and local government entities that are Prime Recipients or Subrecipients under ARPA-E funding agreements must require their exclusive licensees to substantially manufacture the following products in the United States for any use or sale in the United States: (1) products embodying subject inventions, and (2) products produced through the use of subject inventions. This requirement does not apply to products that are manufactured for use or sale overseas. They must also require their assignees to apply the same U.S. Manufacturing requirements to their exclusive licensees. GOGOs are subject to the requirements in 37 CFR § 404.5(a)(2).

**e. *Criteria for Waiving U.S. Manufacturing Requirements***

ARPA-E seeks to “enhance the economic and energy security of the United States ...” and “ensure that the United States maintains a technological lead in developing and deploying



advanced energy technologies.” The preferred benefit to the U.S. economy is the creation and maintenance of manufacturing capabilities and jobs within the United States. However, an applicant or awardee may request a modification or waiver of the standard U.S. Manufacturing Requirement, or its submitted U.S. Manufacturing Plan, if the applicant/awardee can demonstrate to the satisfaction of DOE/ARPA-E that it is not commercially feasible to comply with U.S. manufacturing requirements. In addition, such requests must include a description of specific economic or other benefits to the U.S. economy which are related to the commercial use by requestor of the technology being funded by ARPA-E and which are commensurate with the Government’s contribution to the proposed work. These types of benefits are more easily measured and evaluated after technical advance has been made under an award, such as by the making of a subject invention.

Such benefits may include one or more of the following:

- Direct or indirect investment in U.S.-based plant and equipment.
- Creation of new and/or higher-quality U.S.-based jobs.
- Enhancement of the domestic skills base.
- Further domestic development of the technology.
- Significant reinvestment of profits in the domestic economy.
- Positive impact on the U.S. balance of payments in terms of product and service exports as well as foreign licensing royalties and receipts.
- Appropriate recognition of U.S. taxpayer support for the technology; e.g., a quid-pro-quo commensurate with the economic benefit that would be domestically derived by the U.S. taxpayer from U.S.-based manufacture.
- Cross-licensing, sublicensing, and reassignment provisions in licenses which seek to maximize the benefits to the U.S. taxpayer.
- Any foreign manufacturing/use will occur in a country that protects U.S. patents/intellectual property.

## **VII. AGENCY CONTACTS**

<https://arpa-e.energy.gov/?q=site-page/vii-agency-contacts>

### **A. COMMUNICATIONS WITH ARPA-E**

Upon the issuance of a FOA, only the Contracting Officer may communicate with Applicants. ARPA-E personnel and our support contractors are prohibited from communicating (in writing or otherwise) with Applicants regarding the FOA. This “quiet period” remains in effect until ARPA-E’s public announcement of its project selections.

During the “quiet period,” Applicants are required to submit all questions regarding this FOA to [ARPA-E-CO@hq.doe.gov](mailto:ARPA-E-CO@hq.doe.gov). Questions and Answers (Q&As) about ARPA-E and the FOA are available at <http://arpa-e.energy.gov/faq>. For questions that have not already been answered, please send an email with the FOA name and number in the subject line to [ARPA-E-CO@hq.doe.gov](mailto:ARPA-E-CO@hq.doe.gov). Due to the volume of questions received, ARPA-E will only answer pertinent questions that have not yet been answered and posted at the above link.

- ARPA-E will post responses on a weekly basis to any questions that are received that have not already been addressed at the link above. ARPA-E may re-phrase questions or consolidate similar questions for administrative purposes.
- ARPA-E will cease to accept questions approximately 10 business days in advance of each submission deadline. Responses to questions received before the cutoff will be posted approximately one business day in advance of the submission deadline. ARPA-E may re-phrase questions or consolidate similar questions for administrative purposes.
- Responses are published in a document specific to this FOA under “CURRENT FUNDING OPPORTUNITIES – FAQs” on ARPA-E’s website (<http://arpa-e.energy.gov/faq>).

Applicants may submit questions regarding ARPA-E eXCHANGE, ARPA-E’s online application portal, to [ExchangeHelp@hq.doe.gov](mailto: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](mailto: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.

During the “quiet period,” only the Contracting Officer may authorize communications between ARPA-E personnel and Applicants. The Contracting Officer may communicate with Applicants

as necessary and appropriate. As described in Section IV.A of the FOA, the Contracting Officer may arrange pre-selection meetings and/or site visits during the “quiet period.”

**B. DEBRIEFINGS**

ARPA-E does not offer or provide debriefings. ARPA-E provides Applicants with a notification encouraging or discouraging the submission of a Full Application based on ARPA-E’s assessment of the Concept Paper. In addition, ARPA-E provides Applicants with reviewer comments on Full Applications before the submission deadline for Replies to Reviewer Comments.

## VIII. OTHER INFORMATION

<https://arpa-e.energy.gov/?q=site-page/viii-other-information>

### A. TITLE TO SUBJECT INVENTIONS

Ownership of subject inventions is governed pursuant to the authorities listed below. Typically, either by operation of law or under the authority of a patent waiver, Prime Recipients and Subrecipients may elect to retain title to their subject inventions under ARPA-E funding agreements.

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions. If they elect to retain title, they must file a patent application in a timely fashion.
- All other parties: The Federal Non-Nuclear Energy Research and Development Act of 1974, 42 U.S.C. 5908, provides that the Government obtains title to new inventions unless a waiver is granted (*see below*).
- Class Waiver: Under 42 U.S.C. § 5908, title to subject inventions vests in the U.S. Government and large businesses and foreign entities do not have the automatic right to elect to retain title to subject inventions. However, ARPA-E typically issues “class patent waivers” under which large businesses and foreign entities that meet certain stated requirements, such as cost sharing of at least 20%, may elect to retain title to their subject inventions. If a large business or foreign entity elects to retain title to its subject invention, it must file a patent application in a timely fashion. If the class waiver does not apply, a party may request a waiver in accordance with 10 C.F.R. §784.
- GOGOs are subject to the requirements of 37 C.F.R. Part 501.
- Determination of Exceptional Circumstances (DEC): DOE has determined that exceptional circumstances exist that warrant the modification of the standard patent rights clause for small businesses and non-profit awardees under Bayh-Dole to maximize the manufacture of technologies supported by ARPA-E awards in the United States. The DEC, including a right of appeal, is dated September 9, 2013 and is available at the following link: <http://energy.gov/gc/downloads/determination-exceptional-circumstances-under-bayh-dole-act-energy-efficiency-renewable>. Please see Section IV.D.7 and VI.B.8 for more information on U.S. Manufacturing Requirements.

## **B. GOVERNMENT RIGHTS IN SUBJECT INVENTIONS**

Where Prime Recipients and Subrecipients retain title to subject inventions, the U.S. Government retains certain rights.

### **1. GOVERNMENT USE LICENSE**

The U.S. Government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any subject invention throughout the world. This license extends to contractors doing work on behalf of the Government.

### **2. MARCH-IN RIGHTS**

The U.S. Government retains march-in rights with respect to all subject inventions. Through “march-in rights,” the Government may require a Prime Recipient or Subrecipient who has elected to retain title to a subject invention (or their assignees or exclusive licensees), to grant a license for use of the invention. In addition, the Government may grant licenses for use of the subject invention when Prime Recipients, Subrecipients, or their assignees and exclusive licensees refuse to do so.

The U.S. Government may exercise its march-in rights if it determines that such action is necessary under any of the four following conditions:

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfactory manner;
- The owner has not met public use requirements specified by Federal statutes in a reasonably satisfactory manner; or
- The U.S. Manufacturing requirement has not been met.

## **C. RIGHTS IN TECHNICAL DATA**

Data rights differ based on whether data is first produced under an award or instead was developed at private expense outside the award.

- Background or “Limited Rights Data”: The U.S. Government will not normally require delivery of technical data developed solely at private expense prior to issuance of an

award, except as necessary to monitor technical progress and evaluate the potential of proposed technologies to reach specific technical and cost metrics.

- **Generated Data:** The U.S. Government normally retains very broad rights in technical data produced under Government financial assistance awards, including the right to distribute to the public. However, pursuant to special statutory authority, certain categories of data generated under ARPA-E awards may be protected from public disclosure for up to five years in accordance with provisions that will be set forth in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

#### **D. 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).

**E. FOAs AND FOA MODIFICATIONS**

For information regarding FOAs and FOA Modifications, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Other Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/viii-other-information>.

**F. OBLIGATION OF PUBLIC FUNDS**

For information regarding Obligation of Public Funds, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Other Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/viii-other-information>.

**G. REQUIREMENT FOR FULL AND COMPLETE DISCLOSURE**

For information regarding the Requirement for Full and Complete Disclosure, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Other Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/viii-other-information>.

**H. RETENTION OF SUBMISSIONS**

For information regarding Retention of Submissions, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Other Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/viii-other-information>.

**I. MARKING OF CONFIDENTIAL INFORMATION**

For information regarding Marking of Confidential Information, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Other Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/viii-other-information>.

**J. COMPLIANCE AUDIT REQUIREMENT**

For information regarding the Compliance Audit Requirement, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Other Information Section Header or at <https://arpa-e.energy.gov/?q=site-page/viii-other-information>.

**IX. GLOSSARY**

<https://arpa-e.energy.gov/?q=site-page/ix-glossary>

For information regarding the Glossary for the FOA, refer to the *Provisions Incorporated by Reference*, hyperlinked via the Glossary Section Header or at <https://arpa-e.energy.gov/?q=site-page/ix-glossary>.