FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

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

Announcement Type: Initial Announcement
Funding Opportunity No. DE-FOA-0002784
CFDA Number 81.135

Funding Opportunity Announcement (FOA) Issue Date:	September 13, 2022
FOA Close Date:	Open continuously until otherwise amended.
Application Due Date:	See Exploratory Topics Table for topic-specific application due dates.
Total Amount to Be Awarded	Approximately $10 million, subject to the availability of appropriated funds to be shared between FOAs DE-FOA-0002784 and DE-FOA-0002785. See Exploratory Topics Table for topic-specific information.
Anticipated Awards	ARPA-E may issue one, multiple, or no awards under this FOA. See Exploratory Topics Table for topic-specific award amount requirements.

- 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.G.1 of the FOA.
- Applicants are responsible for meeting the submission deadline associated with each Exploratory Topic. Applicants are strongly encouraged to submit their applications at least 48 hours in advance of the Exploratory Topic submission deadline.
- For detailed guidance on compliance and responsiveness criteria, see Sections III.C.1 through III.C.3 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 (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).

TABLE 1. EXPLORATORY TOPICS

Appendix	Exploratory Topic Title	Issue Date	Deadline for Questions to ARPA-E CO	Full Application Submission Deadline	Submission Deadline for Replies to Reviewer Comments	Total Amount to be Awarded (subject to the availability of funds)	Anticipated Awards	Max Period of Performance	Expected date for Notifications
A	LOW-ENERGY NUCLEAR REACTIONS	9/13/2022	5 PM ET, 11/4/2022	9:30 AM ET, 11/15/2022	5:00 PM ET, 12/20/2022	Approximately $10M total	5-8 awards	30 months	February, 2023

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REQUIRED DOCUMENTS CHECKLIST

Unless an exception or exceptions are described under a particular Exploratory Topic, the following are applicable to all Exploratory Topics published under this FOA.

- 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 Full Applications see Sections IV.C of the FOA.

SUBMISSION	COMPONENTS	OPTIONAL/ MANDATORY	FOA SECTION
Full Application	• Each Applicant must submit a Technical Volume in Adobe PDF format by the stated deadline. The Technical Volume must include the following: ○ Executive Summary (1 page max.) ○ Sections 1-5 (14 pages max.) • 1. Innovation and Impact • 2. Proposed Work • 3. Team Organization and Capabilities • 4. Technology to Market • 5. Budget ○ Bibliographic References (no page limit) ○ Personal Qualification Summaries (each Personal Qualification Summary limited to 3 pages in length, no cumulative page limit) • The Technical Volume must be accompanied by: ○ SF-424 (no page limit, Adobe PDF format); ○ Budget Justification Workbook/SF424A (no page limit, Microsoft Excel format); ○ Summary for Public Release (250 words max., Adobe PDF format); ○ Summary Slide (1 page limit, Microsoft PowerPoint format; ○ Completed and signed Business Assurances & Disclosures Form (no page limit, Adobe PDF format)	Mandatory	IV.C
Reply to Reviewer Comments	• As set forth in Table 1, each Applicant may submit a Reply to Reviewer Comments in Adobe PDF format. This submission is optional. The Reply may include: ○ Up to 2 pages of text; and ○ Up to 1 page of images.	Optional	IV.D

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), as further amended by the Energy Act of 2020 (P.L. 116-260) to:

"(A) to enhance the economic and energy security of the United States through the development of energy technologies that—
(i) reduce imports of energy from foreign sources;
(ii) reduce energy-related emissions, including greenhouse gases;
(iii) improve in the energy efficiency of all economic sectors;
(iv) provide transformative solutions to improve the management, clean-up, and disposal of radioactive waste and spent nuclear fuel; and
(v) improve the resilience, reliability, and security of infrastructure to produce, deliver, and store energy; 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 its 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 supplemented by 2 C.F.R. Part 910.

ARPA-E funds research on and the development of transformative science and technology solutions to address the energy and environmental missions of the Department. 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 improvements to 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 or the applied technology offices within DOE. By contrast, ARPA-E supports transformative research that has the potential to create fundamentally new learning curves. ARPA-E technology projects typically start with cost/performance estimates well above the level of an 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 better 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 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 "experimental 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."[1] Applicants interested in receiving financial assistance for basic research (defined by the Office of Management and Budget as "experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts")[2] 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 and Carbon Management (https://www.energy.gov/fecm/office-fossil-energy-and-carbon-management), the Office of Nuclear Energy (http://www.energy.gov/ne/office-nuclear-energy), and the Office of Electricity (https://www.energy.gov/oe/office-electricity).

B. PROGRAM OVERVIEW AND OBJECTIVES

This announcement is purposely broad in scope, and will cover a wide range of topics to encourage the submission of the most innovative and unconventional ideas in energy technology. The objective of this solicitation is to support high-risk R&D leading to the development of potentially disruptive new technologies across the full spectrum of energy applications. Topics under this FOA will explore new areas of technology development that, if

[1] OMB Circular A-11 (https://www.whitehouse.gov/wp-content/uploads/2018/06/a11_web_toc.pdf), Section 84, pg. 3.
[2] OMB Circular A-11 (https://www.whitehouse.gov/wp-content/uploads/2018/06/a11_web_toc.pdf), Section 84, pg. 3.

successful, could establish new program areas for ARPA-E, or complement the current portfolio of ARPA-E programs.

Applications to this solicitation must have the potential for high impact — if successful, it could create a new class or new trajectory for an energy technology, with the potential to make a significant impact on ARPA-E's Mission Areas (see Section I.A).

Awards under this program may take the form of analyses or exploratory research that provides the agency with information useful for the subsequent development of focused technology programs. Alternatively, awards may support proof-of-concept research for a particular new technology, either in an area not currently supported by the agency or as a potential enhancement to an ongoing focused technology program.

C. EXPLORATORY TOPICS OVERVIEW

This FOA will only accept applications in prespecified Exploratory Topics. Specific areas of interest and relevant deadlines will be posted on the ARPA-E eXCHANGE website (https://arpa-e-foa.energy.gov). For your convenience you can subscribe to the ARPA-E mailing list to receive ARPA-E newsletters and news alerts, as well as updates on when new Exploratory Topics are posted.

Each Exploratory Topic announcement will be visible on ARPA-E eXCHANGE as a supporting FOA document. Exploratory Topic details will only be visible in eXCHANGE while the notice is accepting applications. Once the topic deadline has passed the notice will be taken down and ARPA-E will no longer be accepting applications in that area. ARPA-E will only review applications that are responsive to the Exploratory Topic(s) open at the time the application is submitted.

II. AWARD INFORMATION

A. AWARD OVERVIEW

See Exploratory Topic Table and Topic Appendices for total amounts and anticipated number of awards for each Topic.

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

Unless otherwise stated in the Exploratory Topic, ARPA-E plans to fully fund your negotiated budget at the time of award.

B. RENEWAL AWARDS

At ARPA-E's sole discretion, awards resulting from this FOA may be renewed by adding one or more budget periods, extending the period of performance of the initial award, or issuing a new award. Renewal funding is contingent on: (1) availability of funds appropriated by Congress for the purpose of this program; (2) substantial progress towards meeting the objectives of the approved application; (3) submittal of required reports; (4) compliance with the terms and conditions of the award; (5) ARPA-E approval of a renewal application; and (6) other factors identified by the Agency at the time it solicits a renewal application.

C. ARPA-E FUNDING AGREEMENTS

Through Grants, Cooperative Agreements, other transactions, 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.

1. GRANTS

A Grant is a legal instrument that is used to provide Federal financial assistance or other things of value to carry out a public purpose of support or stimulation authorized by Federal statute. Grants are distinguished from Cooperative Agreements in that they do not provide for substantial involvement between the Federal awarding agency (in this case ARPA-E) and the Recipient.

2. COOPERATIVE AGREEMENTS

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."[3] Accordingly, ARPA-E has substantial involvement in the direction of every Cooperative Agreement, as described in Section II.D below.

Cooperative Agreements involve the provision of financial or other support to accomplish a public purpose of support or stimulation authorized by Federal statute. Under Cooperative Agreements, the Government and Prime Recipients share responsibility for the direction of projects.

ARPA-E encourages Prime Recipients to review the Model Cooperative Agreement, which is available at https://arpa-e.energy.gov/technologies/project-guidance.

3. FUNDING AGREEMENTS WITH FFRDCS/DOE LABS, GOGOS, AND FEDERAL INSTRUMENTALITIES

Any Federally Funded Research and Development Centers (FFRDC) involved as a member of a Project Team must provide the information requested in the "FFRDC Lab Authorization" and "Field Work Proposal" section of the Business Assurances & Disclosures Form, which is submitted with the Applicant's Full Application.

When a FFRDC/DOE Lab (including the National Energy Technology Laboratory or NETL) is the *lead organization* for a Project Team, ARPA-E executes a funding agreement directly with the FFRDC/DOE Lab and a single, separate Cooperative Agreement with another entity on the Project Team. Notwithstanding the use of multiple agreements, the FFRDC/DOE Lab is the lead organization for the entire project, including all work performed by the FFRDC/DOE Lab and the rest of the Project Team.

When a FFRDC/DOE Lab is a *member* of a Project Team, ARPA-E executes a funding agreement directly with the FFRDC/DOE Lab and a single, separate Cooperative Agreement with the Prime Recipient, as the lead organization for the Project Team. Notwithstanding the use of multiple agreements, the Prime Recipient under the Cooperative Agreement is the lead organization for the entire project, including all work performed by the FFRDC/DOE Lab 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 under Department of Energy Management & Operation Contracts. Funding agreements with non-DOE/NNSA FFRDCs, GOGOs (including NETL), and Federal instrumentalities (e.g., Tennessee Valley Authority) will be consistent with the sponsoring agreement between the U.S. Government and the Laboratory. Any funding agreement with an FFRDC or GOGO will have

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

similar terms and conditions as ARPA-E's Model Cooperative Agreement (https://arpa-e.energy.gov/technologies/project-guidance/pre-award-guidance/funding-agreements).

Non-DOE GOGOs and Federal agencies may be proposed to provide support to the Project Team members on an applicant's project, through a Cooperative Research and Development Agreement (CRADA) or similar agreement.

4. OTHER TRANSACTIONS AUTHORITY

ARPA-E may use its "other transactions" authority under the America COMPETES Reauthorization Act of 2010 to enter into an other transaction agreement with Prime Recipients, on a case-by-case basis.

ARPA-E may negotiate an other transaction agreement when it determines that the use of a standard cooperative agreement, grant, or contract is not feasible or appropriate for a project.

In general, an other transaction agreement would normally requires a minimum cost share of 50%. See Section III.B.2 of the FOA.

D. FEDERAL STEWARDSHIP

ARPA-E will exercise Federal stewardship in overseeing the project activities performed under a grant. Stewardship activities include, but are not limited to, conducting site visits; reviewing performance and financial reports; providing technical assistance and/or temporary intervention in unusual circumstances to correct deficiencies which develop during the project; assuring compliance with terms and conditions of the Award; and reviewing technical performance during and after project completion to ensure that the Award objectives are being/have been accomplished.

E. STATEMENT OF SUBSTANTIAL INVOLVEMENT

ARPA-E is substantially involved in the direction of Cooperative Agreements from inception to completion. For the purposes of an ARPA-E project, substantial involvement means:

- Project Teams must adhere to ARPA-E's agency-specific and programmatic requirements.
- ARPA-E may intervene at any time in the conduct or performance of work under an award.
- ARPA-E does not limit its involvement to the administrative requirements of an award. Instead, ARPA-E has substantial involvement in the direction and redirection of the technical aspects of the project as a whole.
- ARPA-E may, at its sole discretion, modify or terminate projects that fail to achieve

predetermined Go/No Go decision points or technical milestones and deliverables.

- During award negotiations, ARPA-E Program Directors and Prime Recipients mutually establish an aggressive schedule of quantitative milestones and deliverables that must be met every quarter. In addition, ARPA-E will negotiate and establish "Go/No-Go" milestones for each project. If the Prime Recipient fails to achieve any of the "Go/No-Go" milestones or technical milestones and deliverables as determined by the ARPA-E Contracting Officer, ARPA-E may – at its discretion - renegotiate the statement of project objectives or schedule of technical milestones and deliverables for the project. In the alternative, ARPA-E may suspend or terminate the award in accordance with 2 C.F.R. §§ 200.339 – 200.343.
- ARPA-E may provide guidance and/or assistance to the Prime Recipient to accelerate the commercial deployment of ARPA-E-funded technologies. Guidance and assistance provided by ARPA-E may include coordination with other Government agencies and nonprofits[4] to provide mentoring and networking opportunities for Prime Recipients. ARPA-E may also organize and sponsor events to educate Prime Recipients about key barriers to the deployment of their ARPA-E-funded technologies. In addition, ARPA-E may establish 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

This FOA is open to U.S. universities, national laboratories, industry, and individuals.

1. INDIVIDUALS

U.S. citizens or permanent residents may apply for funding in their individual capacity as a Standalone Applicant,[5] as the lead for a Project Team,[6] or as a member of a Project Team. However, ARPA-E will only award funding to an entity formed by the Applicant.

[4] The term "nonprofit organization" or "nonprofit" is defined in Section IX.
[5] A Standalone Applicant is an Applicant that applies for funding on its own, not as part of a Project Team.
[6] A Project Team consists of the Prime Recipient, Subrecipients, and others performing or otherwise supportingwork under an ARPA-E funding agreement.

2. DOMESTIC ENTITIES

For-profit entities[7], educational institutions[8], and nonprofits[9] 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/DOE Labs are eligible to apply for funding as the lead organization for a Project Team or as a member of a Project Team that includes institutions of higher education, companies, research foundations, or trade and industry research collaborations, but not as a Standalone Applicant.

State, local, and tribal 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. Foreign entities must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed or to be formed) under the laws of a State or territory of the United States to receive funding. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate. All work under the ARPA-E award must be performed in the United States. The Applicant may request a waiver of this requirement in the Business Assurances & Disclosures Form, which is submitted with the Full Application and can be found at https://arpa-e-foa.energy.gov/ (see "View Template Application Documents"). Refer to the Business Assurances & Disclosures 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

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[7] For-Profit Organizations (Other than Small Businesses) (or *large businesses*): Means entities organized for-profit other than small businesses as defined elsewhere in this Glossary.
[8] Institutions of Higher Education (or educational institutions): Has the meaning set forth at 20 U.S.C. 1001.
[9] Nonprofit 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.

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 of the FOA. 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 collaboration agreement binds the individual consortium members together and shall include 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[10]

Applicants are bound by the cost share proposed in their Full Applications.

1. BASE COST SHARE REQUIREMENT

ARPA-E generally uses Cooperative Agreements to provide financial and other support to Prime Recipients (see Section II.C of the FOA). Under a Cooperative Agreement or Grant, the Prime Recipient must provide at least 20% of the Total Project Cost[11] as cost share, except as provided in Sections III.B.2 or III.B.3 below.[12]

2. INCREASED COST SHARE REQUIREMENT

Large businesses[13] are strongly encouraged to provide more than 20% of the Total Project Cost as cost share. ARPA-E may consider the amount of cost share proposed when selecting applications for award negotiations (see Section V.B.1 of the FOA).

[10] Please refer to Section VI.B.3-4 of the FOA for guidance on cost share payments and reporting.
[11] The Total Project Cost is the sum of the Prime Recipient share and the Federal Government share of total allowable costs. The Federal Government share generally includes costs incurred by GOGOs and FFRDCs.
[12] Energy Policy Act of 2005, Pub.L. No. 109-58, § 988.
[13] The term "For-Profit Organizations (Other than Small Businesses)" or "large business" is defined in Section IX.

Under an "other transaction" agreement, the Prime Recipient is normally expected to provide at least 50% of the Total Project Cost as cost share. ARPA-E may reduce this cost share requirement, as appropriate.

3. REDUCED COST SHARE REQUIREMENT

ARPA-E has reduced the base cost share requirement for the following types of projects:

- A domestic educational institution or domestic nonprofit applying as a Standalone Applicant is required to provide at least 5% of the Total Project Cost as cost share.

- Project Teams composed exclusively of domestic educational institutions, domestic nonprofits, and/or FFRDCs/DOE Labs/Federal agencies and instrumentalities (other than DOE) are required to provide at least 5% of the Total Project Cost as cost share.

- Small businesses – or consortia of small businesses – may provide 0% cost share from the outset of the project through the first 12 months of the project (hereinafter the "Cost Share Grace Period").[14] If the project is continued beyond the Cost Share Grace Period, then at least 10% of the Total Project Cost (including the costs incurred during the Cost Share Grace Period) will be required as cost share over the remaining period of performance.

- Project Teams where a small business is the lead organization and small businesses perform greater than or equal to 80%, of the total work under the funding agreement (as measured by the Total Project Cost) are entitled to the same cost share reduction and Cost Share Grace Period as provided above to Standalone small businesses or consortia of small businesses.[15]

- Project Teams where domestic educational institutions, domestic nonprofits, small businesses, and/or FFRDCs perform greater than or equal to 80%, of the total work under the funding agreement (as measured by the Total Project Cost) are required to provide at least 10% of the Total Project Cost as cost share. However, any entity (such as a large business) receiving patent rights under a class waiver, or other patent waiver, that is part of a Project Team receiving this reduction must continue to meet the statutory minimum cost share requirement (20%) for its portion of the Total Project Cost.

- Projects that do not meet any of the above criteria are subject to the base cost share requirements described in Sections III.B.1 and III.B.2 of the FOA.

[14] The term "small business" is defined in Section IX.

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4. LEGAL RESPONSIBILITY

Although the cost share requirement applies to the Project Team as a whole, the funding agreement makes the Prime Recipient legally responsible for paying, or ensuring payment of the entire cost share. The Prime Recipient's cost share obligation is expressed in the funding agreement as a static amount in U.S. dollars (cost share amount) and as a percentage of the Total Project Cost (cost share percentage). If the funding agreement is terminated prior to the end of the period of performance, the Prime Recipient is required to contribute at least the cost share percentage of total expenditures incurred through the date of termination.

The Prime Recipient is solely responsible for managing cost share contributions by the Project Team and enforcing cost share obligations assumed by Project Team members in subawards or related agreements.

5. COST SHARE ALLOCATION

Each Project Team is free to determine how much each Project Team member will contribute towards the cost share requirement. The amount contributed by individual Project Team members may vary, as long as the cost share requirement for the project as a whole is met.

6. COST SHARE TYPES AND ALLOWABILITY

Every cost share contribution must be allowable under the applicable Federal cost principles, as described in Section IV.F.1 of the FOA.

Project Teams may provide cost share in the form of cash or in-kind contributions. Cash contributions may be provided by the Prime Recipient or Subrecipients. Allowable in-kind contributions include but are not limited to personnel costs, indirect costs, facilities and administrative costs, rental value of buildings or equipment, and the value of a service, other resource, or third party in-kind contribution. Project Teams may use funding or property received from state or local governments to meet the cost share requirement, so long as the funding or property was not provided to the state or local government by the Federal Government.

The Prime Recipient may <u>not</u> use the following sources to meet its cost share obligations:

- Revenues or royalties from the prospective operation of an activity beyond the period of performance;
- Proceeds from the prospective sale of an asset of an activity;
- Appropriated Federal funding or property (e.g., Federal grants, equipment owned by the Federal Government); or
- Expenditures that were reimbursed under a separate Federal program.

- Add IR&D and then reference the section where it is described in more detail

In addition, Project Teams may not use independent research and development (IR&D) funds[16] to meet their cost share obligations under Cooperative Agreements. However, Project Teams may use IR&D funds to meet their cost share obligations under "other transaction" agreements.

Project Teams may not use the same cash or in-kind contributions to meet cost share requirements for more than one project or program.

Cost share contributions must be specified in the project budget, verifiable from the Prime Recipient's records, and necessary and reasonable for proper and efficient accomplishment of the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

Applicants may wish to refer to 2 C.F.R. Parts 200 and 910, and 10 C.F.R Part 603 for additional guidance on cost sharing, specifically 2 C.F.R. §§ 200.306 and 910.130, and 10 C.F.R. §§ 603.525-555.

7. COST SHARE CONTRIBUTIONS BY FFRDCS AND GOGOS

Because FFRDCs are funded by the Federal Government, costs incurred by FFRDCs generally may not be used to meet the cost share requirement. FFRDCs may contribute cost share only if the contributions are paid directly from the contractor's Management Fee or a non-Federal source.

Because GOGOs/Federal Agencies are funded by the Federal Government, GOGOs/Federal Agencies may not provide cost share for the proposed project. However, the GOGO/Agency costs would be included in Total Project Costs for purposes of calculating the cost-sharing requirements of the applicant.

8. COST SHARE VERIFICATION

Upon selection for award negotiations, Applicants are required to provide information and documentation regarding their cost share contributions. Please refer to Section VI.B.3 of the FOA for guidance on the requisite cost share information and documentation.

[16] As defined in Federal Acquisition Regulation SubSection 31.205-18.

C. OTHER

1. COMPLIANT CRITERIA

Full Applications are deemed compliant if:

- 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.C 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 Exploratory Topic submission deadline stated in Table 1 of this 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 not extend the submission deadline for Applicants that fail to submit required information and documents due to server/connection congestion.

If applicable to the Exploratory Topic (refer to Table 1), Replies to Reviewer Comments are deemed compliant if:

- The Applicant successfully uploads its response to ARPA-E eXCHANGE by the deadline stated in the Exploratory Topic Table 1; and
- The Replies to Reviewer Comments comply with the content and form requirements of Section IV.D 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 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 the Exploratory Topic Appendix

- Submissions that have been submitted in response to currently issued ARPA-E FOAs.
- Submissions that are not scientifically distinct from applications submitted in response to 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 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.

Each Exploratory Topic may also include a section entitled "Submissions Specifically not of Interest." Submissions that propose items contained within this section in each Exploratory Topic may be deemed nonresponsive and may not be reviewed or considered.

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 each Exploratory Topic attached to this FOA, provided that each application is scientifically distinct.

Small business Applicants that qualify as a "Small Business Concern"[17] may apply to only one of the two ARPA-E, Exploratory Topics FOAs for each Exploratory Topics: DE-FOA-0002785

[17] Please refer to the U.S. Small Business Administration (SBA) website. A Small Business Concern is a for-profit entity that: (1) maintains a place of business located in the United States; (2) operates primarily within the United States or makes a significant contribution to the United States economy through payment of taxes or use of American products, materials or labor; (3) is an individual proprietorship, partnership, corporation, limited liability

(Exploratory Topic SBIR/STTR), or DE-FOA-0002784 (Exploratory Topic). Small businesses that qualify as "Small Business Concerns" are strongly encouraged to apply under the former (SBIR/STTR FOA). To determine eligibility as a "Small Business Concern" under DE-FOA-0002785 (SBIR/STTR), please review the eligibility requirements in Sections III.A – III.D of that FOA.

company, joint venture, association, trust, or cooperative; and (4) meets the size eligibility requirements set forth in 13 C.F.R. § 121.702. Where the entity is formed as a joint venture, there can be no more than 49% participation by foreign business entities in the joint venture.

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.G.1 of the FOA and the "ARPA-E eXCHANGE User Guide" (https://arpa-e-foa.energy.gov/Manuals.aspx).

2. FULL APPLICATIONS

Applicants must submit a Full Application by the Exploratory Topic Full Application Submission Deadline stated in Table 1 of this FOA. Section IV.C 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.1 and V.B.1 of the FOA.

3. REPLY TO REVIEWER COMMENTS

If applicable to the Exploratory Topic (refer to Table 1), 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.D 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.

4. PRE-SELECTION CLARIFICATIONS AND "DOWN-SELECT" PROCESS

Once ARPA-E completes its review of Full Applications (and Replies to Reviewer Comments, if applicable), 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.

5. 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.1 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), including the SF-424 and Budget Justification Workbook/SF-424A. A sample Summary Slide is available on ARPA-E eXCHANGE. Applicants may use the templates available on ARPA-E eXCHANGE, including the template for the Technical Volume of the Full Application, the template for the Summary Slide, the template for the Summary for Public Release, the template for the Reply to Reviewer Comments and the template for the Business Assurances & Disclosures Form. A sample response to the Business Assurances & Disclosures Form is available on ARPA-E eXCHANGE.

C. CONTENT AND FORM OF FULL APPLICATIONS

Full Applications must conform to the following formatting requirements:

- Each document must be submitted in the file format prescribed below.
- The Full Application must be written in English.
- All pages must be formatted to fit on 8-1/2 by 11 inch paper with margins not less than one inch on every side. Single space all text and use Times New Roman

typeface, a black font color, and a font size of 12 point or larger (except in figures and tables).

- The ARPA-E assigned Control Number, the Lead Organization Name, and the Principal Investigator's Last Name must be prominently displayed on the upper right corner of the header of every page. Page numbers must be included in the footer of every page.

Full Applications found to be noncompliant or nonresponsive may not be merit reviewed or considered for award (see Section III.C of the FOA).

Each Full Application should be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated in a single Full Application.

Fillable Full Application template documents are available on ARPA-E eXCHANGE at https://arpa-e-foa.energy.gov.

Full Applications must conform to the content requirements described below.

Component	Required Format	Description and Information
Technical Volume	PDF	The Technical Volume is the centerpiece of the Full Application. Provides a detailed description of the proposed R&D project and Project Team.
SF-424	PDF	Application for Federal Assistance. 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.
Budget Justification Workbook/SF-424A	XLS	Budget Information – Non-Construction Programs
Summary for Public Release	PDF	Short summary of the proposed R&D project. Intended for public release.
Summary Slide	PPT	A four-panel project slide summarizing different aspects of the proposed R&D project.
Business Assurances & Disclosures Form	PDF	Applicants should provide comprehensive responses to the questions on this form. Requires the Applicant to make responsibility disclosures and disclose 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. This form allows the Applicant to request a waiver or modification of the Performance of Work in the United States requirement. A sample response to the Business Assurances & Disclosures Form is also available on ARPA-E eXCHANGE.

1. FIRST COMPONENT: TECHNICAL VOLUME

The Technical Volume must be submitted in Adobe PDF format. A Technical Volume template is available at https://arpa-e-foa.energy.gov. The Technical Volume must conform to the content and form requirements included within the template, including maximum page lengths. If Applicants exceed the maximum page lengths specified for each section, ARPA-E may review only the authorized number of pages and disregard any additional pages, or ARPA-E may determine that the submission as a whole is noncompliant per Section III.C of the FOA.

Applicants must provide sufficient citations and references to the primary research literature to justify the claims and approaches made in the Technical Volume. ARPA-E and reviewers may review primary research literature in order to evaluate applications. However, all relevant technical information should be included in the body of the Technical Volume.

2. SECOND COMPONENT: SF-424

The SF-424 must be submitted in Adobe PDF format. This form is available on ARPA-E eXCHANGE at https://arpa-e-foa.energy.gov.

The SF-424 includes instructions for completing the form. Applicants must complete all required fields in accordance with the instructions. Applicants may identify and include in Block 14 the entities, their addresses, and corresponding census tract numbers for any project activities that will occur within any designated Qualified Opportunity Zone (QOZ). To locate Qualified Opportunity Zones go to: https://www.cdfifund.gov/opportunity-zones.

Prime Recipients and Subrecipients are required to complete SF-LLL (Disclosure of Lobbying Activities), available at https://www.grants.gov/forms/post-award-reporting-forms.html, if any non-Federal funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with your application or funding agreement. The completed SF-LLL must be appended to the SF-424.

ARPA-E provides the following supplemental guidance on completing the SF-424:

- Each Project Team should submit only one SF-424 (i.e., a Subrecipient should not submit a separate SF-424).

- The list of certifications and assurances in Block 21 can be found at http://energy.gov/management/downloads/certifications-and-assurances-use-sf-424.
- The dates and dollar amounts on the SF-424 are for the entire period of performance (from the project start date to the project end date), not a portion thereof.
- 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.

3. THIRD COMPONENT: BUDGET JUSTIFICATION WORKBOOK/SF-424A

Applicants are required to complete the Budget Justification Workbook/SF-424A Excel spreadsheet. This form is available on ARPA-E eXCHANGE at https://arpa-e-foa.energy.gov. Prime Recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the Prime Recipient and its Subrecipients and Contractors. The SF-424A form included with the Budget Justification Workbook will "auto-populate" as the Applicant enters information into the Workbook. Applicants should carefully read the "Instructions and Summary" tab provided within the Budget Justification Workbook.

Subrecipient information must be submitted as follows:

- Each Subrecipient incurring greater than or equal to 10% of the Total Project Cost must complete a separate Budget Justification workbook to justify its proposed budget. These worksheets must be inserted as additional sheets within in the Prime Recipient's Budget Justification.
- Subrecipients incurring less than 10% of the Total Project Cost are not required to complete a separate Budget Justification workbook. However, such Subrecipients are required to provide supporting documentation to justify their proposed budgets. At a minimum, the supporting documentation must show which tasks/subtasks are being performed, the purpose/need for the effort, and a sufficient basis for the estimated costs.

ARPA-E provides the following supplemental guidance on completing the Budget Justification Workbook/SF-424A:

- Applicants may request funds under the appropriate object class category tabs as long as the item and amount requested are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions described herein.
- If Patent costs are requested, they must be included in the Applicant's proposed budget (see Section IV.F.3 of the FOA for more information on Patent Costs).

- Applicants may include Technology Transfer & Outreach (TT&O) activities to promote and further the development and deployment of ARPA-E-funded technologies. This is not required and is up to the applicant to decide if appropriate for the proposed work.
- If included, allTT&O costs requested must be included in the Applicant's proposed budget and identified as TT&O costs in the Budget Justification Workbook/SF-424A with the costs being requested under the "Other" budget category. All budgeted activities must relate to achieving specific objectives, technical milestones and deliverables outlined in Section 2.4 Task Descriptions of the Technical Volume.
- For more information, please refer to the ARPA-E Budget Justification Guidance document at https://arpa-e-foa.energy.gov.

4. FOURTH COMPONENT: SUMMARY FOR PUBLIC RELEASE

Applicants are required to provide a 250 word maximum Summary for Public Release. A Summary for Public Release template is available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov). The Summary for Public Release must be submitted in Adobe PDF format. This summary should not include any confidential, proprietary, or privileged information. The summary should be written for a lay audience (e.g., general public, media, Congress) using plain English.

250 Words	**SUMMARY FOR PUBLIC RELEASE**	Briefly describe the proposed effort, summarize its objective(s) and technical approach, describe its ability to achieve the "Program Objectives" (see Section I.B of the FOA), and indicate its potential impact on "ARPA-E Mission Areas" (see Section I.A of the FOA). The summary should be written at technical level suitable for a high-school science student and is designed for public release. **INSTRUCTIONS:** (1) The Summary for Public Release shall not exceed 250 words and one paragraph. (2) The Summary for Public Release shall consist only of text—no graphics, figures, or tables. (3) For applications selected for award negotiations, the Summary may be used as the basis for a public announcement by ARPA-E; therefore, **this Cover Page and Summary should not contain confidential or proprietary information**. See Section VIII.I of the FOA for additional information on marking confidential information.

5. FIFTH COMPONENT: SUMMARY SLIDE

Applicants are required to provide a single PowerPoint slide summarizing the proposed project. The slide must be submitted in Microsoft PowerPoint format. This slide will be used during ARPA-E's evaluation of Full Applications. A summary slide template and a sample summary slide are available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov).

Summary Slides must conform to the content requirements described below:

- Exploratory Topic Name
- A Technology Summary;
    - Bullet points that describe novel aspects of the proposed technology and technology approach;
- A description of the technology's impact;
    - Quantitative description (through text or graphic) of the impact the proposed project will provide to the market and ARPA-E mission areas;
- Proposed Targets;
    - Including any important technical performance metrics and/or impact categories;
    - Including quantitative description of the state of the art;
    - Including quantitative descriptions of the proposed targets;
- Any key graphics (illustrations, charts and/or tables) summarizing technology development and/or impact;
- The project's key idea/takeaway;
- Project title and Principal Investigator information; and
- Requested ARPA-E funds and proposed Applicant cost share.

6. SIXTH COMPONENT: BUSINESS ASSURANCES & DISCLOSURES FORM

Applicants are required to provide the information requested in the Business Assurances & Disclosures Form. The information must be submitted in Adobe PDF format. A fillable Business Assurances & Disclosures Form template is available on ARPA-E eXCHANGE at https://arpa-e-foa.energy.gov. A sample response to the Business Assurances & Disclosures Form is also available on ARPA-E eXCHANGE.

As described in the Business Assurances & Disclosures Form, the Applicant is required to:

- Disclose conditions bearing on responsibility, such as criminal convictions and Federal tax liability;
- Disclose conflicts of interest within the Project Team and provide the Applicant's up-to-date, written, and enforced conflict of interest policy in accordance with DOE Interim COI Policy guidance at https://www.energy.gov/management/financial-assistance-letter-no-fal-2022-02;
- If the Applicant is a FFRDC/DOE Lab, submit written authorization from the cognizant Federal agency; and
- If the Applicant is a DOE/NNSA FFRDC/DOE Lab, submit a Field Work Proposal.

In addition, ARPA-E is required by statute to "accelerat[e] transformational technological advances in areas that industry is by itself not likely to undertake because of technical and

financial uncertainty."[18] In accordance with ARPA-E's statutory mandate, the Applicant is required to:

- Describe the additionality and risks associated with the proposed R&D project;
- Disclose any applications for the same project or related work currently pending with any Federal or non-Federal entities; and
- Disclose all funding for work in the same technology area as the proposed project received from any Federal or non-Federal entity within the last 5 years.

Finally, the Applicant may use the Business Assurances & Disclosures Form to:

- Request authorization to perform some work overseas

D. CONTENT AND FORM OF REPLIES TO REVIEWER COMMENTS

If Applicable to the Exploratory Topic (refer to Table 1), written feedback on Full Applications is made available to Applicants before the submission deadline for Replies to Reviewer Comments. Applicants have a brief opportunity to prepare a short Reply to Reviewer Comments responding to one or more comments or supplementing their Full Application. A fillable Reply to Reviewer Comments template is available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov).

Replies to Reviewer Comments must conform to the following requirements:

- The Reply to Reviewer Comments must be submitted in Adobe PDF format.
- The Reply to Reviewer Comments must be written in English.
- All pages must be formatted to fit on 8-1/2 by 11 inch paper with margins not less than one inch on every side. Use Times New Roman typeface, a black font color, and a font size of 12 points or larger (except in figures and tables).
- The Control Number must be prominently displayed on the upper right corner of the header of every page. Page numbers must be included in the footer of every page.

ARPA-E may not review or consider noncompliant Replies to Reviewer Comments (see Section III.C.1 of the FOA). 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.

Replies to Reviewer Comments must conform to the following content and form requirements, including maximum page lengths, described below. If a Reply to Reviewer Comments is more than three pages in length, ARPA-E may review only the first three pages and disregard any additional pages, or ARPA-E may determine that the submission as a whole is noncompliant.

[18] America COMPETES Act, Pub. L. No. 110-69, § 5012 (2007), as amended (codified at 42 U.S.C. § 16538).

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SECTION	PAGE LIMIT	DESCRIPTION
Text	2 pages maximum	• Applicants may respond to one or more reviewer comments or supplement their Full Application.
Images	1 page maximum	• Applicants may provide graphs, charts, or other data to respond to reviewer comments or supplement their Full Application.

E. INTERGOVERNMENTAL REVIEW

This program is not subject to Executive Order 12372 (Intergovernmental Review of Federal Programs).

F. FUNDING RESTRICTIONS

1. ALLOWABLE COSTS

All expenditures must be allowable, allocable, and reasonable in accordance with the applicable Federal cost principles. Pursuant to 2 C.F.R. § 910.352, the cost principles in the Federal Acquisition Regulations (48 C.F.R. Part 31.2) apply to for-profit entities. The cost principles contained in 2 C.F.R. Part 200, Subpart E apply to all entities other than for-profits.

2. PRE-AWARD COSTS

ARPA-E will not reimburse any pre-award costs incurred by Applicants before they are selected for award negotiations. Please refer to Section VI.A of the FOA for guidance on award notices.

Upon selection for award negotiations, Applicants may incur pre-award costs at their own risk, consistent with the requirements in 2 C.F.R. Part 200, as modified by 2 C.F.R. Part 910, and other Federal laws and regulations. All submitted budgets are subject to change and are typically reworked during award negotiations. ARPA-E is under no obligation to reimburse pre-award costs if, for any reason, the Applicant does not receive an award or the award is made for a lesser amount than the Applicant expected, or if the costs incurred are not allowable, allocable, or reasonable.

3. PATENT COSTS

For Subject Inventions disclosed to DOE under an award, ARPA-E will reimburse the Prime Recipient – in addition to allowable costs associated with Subject Invention disclosures - up to $30,000 of expenditures for filing and prosecution of United States patent applications,

including international applications ("PCT application") submitted to the United States Patent and Trademark Office (USPTO).

The Prime Recipient may request a waiver of the $30,000 cap. Note that, patent costs are considered to be Technology Transfer & Outreach (TT&O) costs (see Section IV.F.8 of the FOA below), and should be requested as such.

4. CONSTRUCTION

ARPA-E generally does not fund projects that involve major construction. Recipients are required to obtain written authorization from the Contracting Officer before incurring any major construction costs.

5. FOREIGN TRAVEL

ARPA-E generally does not fund projects that involve foreign travel. Recipients are required to obtain written authorization from the ARPA-E Program Director before incurring any foreign travel costs and provide trip reports with their reimbursement requests.

6. PERFORMANCE OF WORK IN THE UNITED STATES

ARPA-E strongly encourages interdisciplinary and cross-sectoral collaboration spanning organizational boundaries. Such collaboration enables the achievement of scientific and technological outcomes that were previously viewed as extremely difficult, if not impossible.

ARPA-E requires all work under ARPA-E funding agreements to be performed in the United States. However, Applicants may request a waiver of this requirement where their project would materially benefit from, or otherwise requires, certain work to be performed overseas.

Applicants seeking a waiver of this requirement are required to include an explicit request in the Business Assurances & Disclosures Form, which is part of the Full Application submitted to ARPA-E. Such waivers are granted where there is a demonstrated need, as determined by ARPA-E.

7. PURCHASE OF NEW EQUIPMENT

All equipment purchased under ARPA-E funding agreements must be made or manufactured in the United States, to the maximum extent practicable. This requirement does not apply to used or leased equipment. The Prime Recipients are required to notify the ARPA-E Contracting Officer reasonably in advance of purchasing any equipment that is not made or manufactured in the United States with a total acquisition cost of $250,000 or more. The ARPA-E Contracting Officer will provide consent to purchase or reject within 30 calendar days of receipt of the Recipient's notification.

8. TECHNOLOGY TRANSFER AND OUTREACH

ARPA-E is required to contribute a percentage of appropriated funds to Technology Transfer and Outreach (TT&O) activities. Project Teams have the option of spending a portion of Federal funding (i.e., the portion of the award that does not include the recipient's cost share) provided by ARPA-E on TT&O activities to promote and further the development and deployment of ARPA-E-funded technologies.

All TT&O expenditures are subject to the applicable Federal cost principles (i.e., 2 C.F.R. 200 Subpart E and 48 C.F.R. Subpart 31). Examples of TT&O expenditures are as follows:

- Documented travel and registration for the ARPA-E Energy Innovation Summit and other energy-related conferences and events;
- Documented travel to meet with potential suppliers, partners, or customers;
- Documented work by salaried or contract personnel to develop technology-to-market models or plans;
- Documented costs of acquiring industry-accepted market research reports; and
- Approved patent costs.

ARPA-E will not reimburse recipients for TT&O costs considered to be unallowable in accordance with the applicable cost principles. Examples of unallowable TT&O expenditures include:

- Meals or entertainment;
- Gifts to potential suppliers, partners, or customers;
- TT&O activities that do not relate to the ARPA-E-funded technologies;
- Undocumented TT&O activities; and
- TT&O activities unrelated and/or unallocable to the subject award.

Applicants may choose to not include TT&O activities if appropriate, and do not need a waiver to do so.

For information regarding incorporation of TT&O costs into budget documentation, see Section IV.C.3 of the FOA.

9. LOBBYING

Prime Recipients and Subrecipients may not use any Federal funds, directly or indirectly, to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. § 1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

Prime Recipients and Subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (https://www.gsa.gov/forms-library/disclosure-lobbying-activities) if any non-Federal funds have been paid or will be paid to any person for influencing or attempting to influence any of the following in connection with your application:

- An officer or employee of any Federal agency,
- A Member of Congress,
- An officer or employee of Congress, or
- An employee of a Member of Congress.

10. CONFERENCE SPENDING

Prime Recipients and Subrecipients may not use any Federal funds to:

- Defray the cost to the United States Government of a conference held by any Executive branch department, agency, board, commission, or office which is not directly and programmatically related to the purpose for which their ARPA-E award is made and for which the cost to the United States Government is more than $20,000; or
- To circumvent the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such a conference.

11. INDEPENDENT RESEARCH AND DEVELOPMENT COSTS

ARPA-E does not fund Independent Research and Development (IR&D) as part of an indirect cost rate under its financial assistance awards. IR&D, as defined at FAR 31.205-18(a), includes cost of effort that is not sponsored by an assistance agreement or required in performance of a contract, and that consists of projects falling within the four following areas: (i) basic research, (ii) applied research, (iii) development, and (iv) systems and other concept formulation studies.

ARPA-E's goals are to enhance the economic and energy security of the United States through the development of energy technologies and ensure that the United States maintains a technological lead in developing and deploying advanced energy technologies. ARPA-E accomplishes these goals by providing financial assistance for energy technology projects, and has well recognized and established procedures for supporting research through competitive financial assistance awards based on merit review of proposed projects. Reimbursement for independent research and development costs through the indirect cost mechanism could circumvent this competitive process.

To ensure that all projects receive similar and equal consideration, eligible organizations may compete for direct funding of independent research projects they consider worthy of support by submitting proposals for those projects to ARPA-E. Since proposals for these projects may be submitted for direct funding, costs for independent research and development projects are not allowable as indirect costs under ARPA-E awards. IR&D costs, however, would still be included in the direct cost base that is used to calculate the indirect rate so as to ensure an appropriate allocation of indirect costs to the organization's direct cost centers.

12. PROHIBITION ON CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT

Per 2 C.F.R. § 200.216, recipients and subrecipients are prohibited from obligating or expending grant funds to: (1) procure or obtain; (2) extend or renew a contract to procure or obtain; or (3) enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115–232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities). Refer to 2 C.F.R. § 200.216 for possible additional prohibitions and limitations.

G. OTHER SUBMISSION REQUIREMENTS

1. USE OF ARPA-E eXCHANGE

To apply to this FOA, Applicants must register with ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov/Registration.aspx). Full Applications and Replies to Reviewer Comments must be submitted through ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov/login.aspx). ARPA-E will not review or consider applications 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 Applicant Guide" (https://arpa-e-foa.energy.gov/Manuals.aspx).

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

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 application that the Applicant has submitted to ARPA-E and the corresponding Control Number is displayed on that page. If the Applicant submits more than one application to a particular FOA, a different Control Number is shown for each application.

Applicants are responsible for meeting each submission deadline in ARPA-E eXCHANGE. **Applicants are strongly encouraged to submit their applications at least 48 hours in advance of the Exploratory Topic Submission Deadline.** Under normal conditions (i.e., at least 48 hours in advance of the Close Date), Applicants should allow at least 1 hour to submit a Full Application. In addition, Applicants should allow at least 15 minutes to submit a Reply to Reviewer Comments. Once the application is submitted in ARPA-E eXCHANGE, Applicants may revise or update their application until the expiration of the applicable deadline.

Applicants should not wait until the last minute to begin the submission process. During the final hours before the submission deadline, Applicants may experience server/connection congestion that prevents them from completing the necessary steps in ARPA-E eXCHANGE to submit their applications. **ARPA-E will not extend the submission deadline for Applicants that fail to submit required information and documents due to server/connection congestion.**

ARPA-E may not review or consider incomplete applications and applications received after the Exploratory Topic submission deadline stated in the FOA. Such applications may be deemed noncompliant (see Section III.C.1 of the FOA). The following errors could cause an application to be deemed "incomplete" and thus noncompliant:

- Failing to comply with the form and content requirements in Section IV of the FOA;
- Failing to enter required information in ARPA-E eXCHANGE;
- Failing to upload required document(s) to ARPA-E eXCHANGE;
- Failing to click the "Submit" button in ARPA-E eXCHANGE by the deadline stated in the FOA;
- Uploading the wrong document(s) or application(s) to ARPA-E eXCHANGE; and
- Uploading the same document twice, but labeling it as different documents. (In the latter scenario, the Applicant failed to submit a required document.)

ARPA-E urges Applicants to carefully review their applications and to allow sufficient time for the submission of required information and documents.

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). If applicable, 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 select a Full Application for award negotiations.

1. 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%

2. 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 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 U.S. dependence on foreign energy sources;
   b. Stimulation of U.S. manufacturing; and/or software development
   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.**

VII. **Qualified Opportunity Zone (QOZ).** Whether the entity is located in an urban and economically distressed area including a Qualified Opportunity Zone (QOZ) or the proposed project will occur in a QOZ or otherwise advance the goals of QOZ. The goals include spurring economic development and job creation in distressed communities throughout the United States. For a list or map of QOZs go to: https://www.cdfifund.gov/opportunity-zones.

2. ARPA-E REVIEWERS

By submitting an application to ARPA-E, Applicants consent to ARPA-E's use of Federal employees, contractors, and experts from educational institutions, nonprofits, industry, and governmental and intergovernmental entities as 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 Full Applications, and Replies to Reviewer Comments. In addition, ARPA-E trains its reviewers in proper evaluation techniques and procedures.

Applicants are not permitted to nominate reviewers for their applications. 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.

3. ARPA-E SUPPORT CONTRACTOR

ARPA-E utilizes contractors to assist with the evaluation of applications 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 applications to ARPA-E.

By submitting an application 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 contractors to prepare the application. ARPA-E will not consider any applications that are submitted by or prepared with the assistance of its support contractors.

C. ANTICIPATED ANNOUNCEMENT AND AWARD DATES

ARPA-E expects to announce selections for negotiations for each Exploratory Topic in the month indicated in Table 1. ARPA-E anticipates that it will execute a funding agreement approximately 120 after notifying an Applicant that its application has been selected for negotiations.

VI. AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES

1. REJECTED SUBMISSIONS

Noncompliant and nonresponsive Full Applications are rejected by the Contracting Officer and are not merit reviewed or considered for award. 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 Full Application was rejected.

2. 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.

If authorized per Table 1, 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.F.2 of the FOA for guidance on pre-award costs.

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.F.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

The following administrative and national policy requirements apply to Prime Recipients. The Prime Recipient is the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to disputes and claims arising out of any agreement between the Prime Recipient and a FFRDC contractor. Prime Recipients are required to flow down these requirements to their Subrecipients through subawards or related agreements.

- If a subaward is made to a DOE/NNSA National Laboratory, all Disputes and Claims will be resolved in accordance with the terms and conditions of the DOE/NNSA National Laboratory's management and operating (M&O) contract, as applicable, in consultation between DOE and the prime awardee.
- If a subaward is made to another Federal agency or its FFRDC contractor, all Disputes and Claims will be resolved in accordance with the terms and conditions of the interagency agreement in consultation between DOE and the prime awardee.

1. Unique Entity Identifier and SAM, FSRS, and FedConnect Registrations

Prime Recipients must register with the System for Award Management (SAM) at www.sam.gov/SAM prior to submitting an application, at which time the system will assign (if newly registered)a Unique Entity Identifier (UEI). As of April 4, 2022, the UEI replaces the old Dun and Bradstreet Data Universal Numbering System (DUNS) number requirement.

Prime Recipients must:

- Maintain an active SAM registration with current information, including information on a its immediate and highest-level owner and subsidiaries, as well as on all predecessors that have been awarded a Federal contract or financial assistance award within the last three years, if applicable, at all times during which it has an active Federal award or an application or plan under consideration by a Federal awarding agency;
- Remain registered in the SAM database after the initial registration;
- Update its information in the SAM database as soon as it changes;
- Review its information in the SAM database on an annual basis from the date of initial registration or subsequent updates to ensure it is current, accurate and complete; andNot make a subaward to any entity unless the entity has provided its UEI.

Subrecipients are not required to register in SAM, but must obtain a UEI.

Prime Recipients and Subrecipients should commence this process as soon as possible in order to expedite the execution of a funding agreement. Registering with SAM and obtaining the UEI could take several weeks.

Prime Recipients are also required to register with the Federal Funding Accountability and Transparency Act Subaward Reporting System (FSRS) at https://www.fsrs.gov/.[19] Prime Recipients are required to report to FSRS the names and total compensation of each of the Prime Recipient's five most highly compensated executives and the names and total compensation of each Subrecipient's five most highly compensated executives. Please refer to https://www.fsrs.gov/ for guidance on reporting requirements. Prime Recipients are required to keep the FSRS data current throughout the duration of the project.

ARPA-E may not execute a funding agreement with the Prime Recipient until it has obtained a UEI and completed its SAM and FSRS registrations.

Finally, Prime Recipients are required to register with FedConnect in order to receive notification that their funding agreement has been executed by the Contracting Officer and to obtain a copy of the executed funding agreement. Please refer to https://www.fedconnect.net/FedConnect/ for registration instructions.

2. NATIONAL POLICY ASSURANCES

Project Teams, including Prime Recipients and Subrecipients, are required to comply with the National Policy Assurances attached to their funding agreement in accordance with 2 C.F.R. § 200.300. Refer to Attachment 6 of ARPA-E's Model Cooperative Agreement https://arpa-e.energy.gov/technologies/project-guidance/pre-award-guidance/funding-agreements) for information on the National Policy Assurances.

[19] The Federal Funding Accountability and Transparency Act, P.L. 109-282, 31 U.S.C. 6101 note.

3. PROOF OF COST SHARE COMMITMENT AND ALLOWABILITY

Upon selection for award negotiations, the Prime Recipient must confirm in writing that the proposed cost share contribution is allowable in accordance with applicable Federal cost principles.

The Prime Recipient is also required to provide cost share commitment letters from Subrecipients or third parties that are providing cost share, whether cash or in-kind. Each Subrecipient or third party that is contributing cost share must provide a letter on appropriate letterhead that is signed by an authorized corporate representative.

4. COST SHARE PAYMENTS[20]

All proposed cost share contributions must be reviewed in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

The Prime Recipient is required to pay the "Cost Share" amount as a percentage of the total project costs in each invoice period for the duration of the period of performance. Small Businesses should refer to Section III.B.3 of the FOA.

ARPA-E may deny reimbursement requests, in whole or in part, or modify or terminate funding agreements where Prime Recipients (or Project Teams) fail to comply with ARPA-E's cost share payment requirements.

5. ENVIRONMENTAL IMPACT QUESTIONNAIRE

By law, ARPA-E is required to evaluate the potential environmental impact of projects that it is considering for funding. In particular, ARPA-E must determine before funding a project whether the project qualifies for a categorical exclusion under 10 C.F.R. § 1021.410 or whether it requires further environmental review (i.e., an environmental assessment or an environmental impact statement).

To facilitate and expedite ARPA-E's environmental review, Prime Recipients are required to complete an Environmental Impact Questionnaire during award negotiations. This form is available at https://arpa-e.energy.gov/technologies/project-guidance/pre-award-guidance/required-forms-and-templates. Each Prime Recipient must wait to complete the Environmental Impact Questionnaire (EIQ) until after ARPA-E has notified them that Attachment 3 Statement of Program Objectives is in final form. The completed EIQ is then due back to ARPA-E within 14 calendar days.

[20] Please refer to Section III.B of the FOA for guidance on cost share requirements.

6. TECHNOLOGY-TO-MARKET PLAN

During award negotiations, Prime Recipients are required to negotiate and submit an initial Technology-to-Market Plan to the ARPA-E Program Director, and obtain the ARPA-E Program Director's approval prior to the execution of the award. Prime Recipients must show how budgeted Technology Transfer and Outreach (TT&O) costs relate to furthering elements of the Technology-to-Market Plan. During the period of performance, Prime Recipients are required to provide regular updates on the initial Technology-to-Market plan and report on implementation of Technology-to-Market activities. Prime Recipients may be required to perform other actions to further the commercialization of their respective technologies.

ARPA-E may waive or modify this requirement, as appropriate.

7. INTELLECTUAL PROPERTY AND DATA MANAGEMENT PLANS

ARPA-E requires every Project Team to negotiate and establish an Intellectual Property Management Plan for the management and disposition of intellectual property arising from the project. The Prime Recipient must submit a completed and signed Intellectual Property Management plan to ARPA-E within six weeks of the effective date of the ARPA-E funding agreement. All Intellectual Property Management Plans are subject to the terms and conditions of the ARPA-E funding agreement and its intellectual property provisions, and applicable Federal laws, regulations, and policies, all of which take precedence over the terms of Intellectual Property Management Plans.

ARPA-E has developed a template for Intellectual Property Management Plans https://arpa-e.energy.gov/technologies/project-guidance/post-award-guidance/project-management-reporting-requirements so as to facilitate and expedite negotiations between Project Team members. ARPA-E does not mandate the use of this template. ARPA-E and DOE do not make any warranty (express or implied) or assume any liability or responsibility for the accuracy, completeness, or usefulness of the template. ARPA-E and DOE strongly encourage Project Teams to consult independent legal counsel before using the template.

Awardees are also required, post-award, to submit a Data Management Plan (DMP) that addresses how data generated in the course of the work performed under an ARPA-E award will be preserved and, as appropriate, shared publicly. The Prime Recipient must submit a completed and signed DMP - as part of the Team's Intellectual Property Management Plan - to ARPA-E within six weeks of the effective date of the ARPA-E funding agreement.

8. U.S. COMPETITIVENESS

A primary objective of DOE's multi-billion dollar research, development and demonstration investments – including ARPA-E awards - is advancement of new energy technologies, manufacturing capabilities, and supply chains for and by U.S. industry and labor. Therefore, in

exchange for receiving taxpayer dollars to support an applicant's project, the applicant must agree to the following U.S. Competitiveness Provision as part of an award under this FOA.

U.S. Competitiveness

The Contractor (Prime Recipient in ARPA-E awards) agrees that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States unless the Contractor can show to the satisfaction of DOE that it is not commercially feasible. In the event DOE agrees to foreign manufacture, there will be a requirement that the Government's support of the technology be recognized in some appropriate manner, e.g., alternative binding commitments to provide an overall net benefit to the U.S. economy. The Contractor agrees that it will not license, assign or otherwise transfer any subject invention to any entity, at any tier, unless that entity agrees to these same requirements. Should the Contractor or other such entity receiving rights in the invention(s): (1) undergo a change in ownership amounting to a controlling interest, or (2) sell, assign, or otherwise transfer title or exclusive rights in the invention(s), then the assignment, license, or other transfer of rights in the subject invention(s) is/are suspended until approved in writing by DOE. The Contractor and any successor assignee will convey to DOE, upon written request from DOE, title to any subject invention, upon a breach of this paragraph. The Contractor will include this paragraph in all subawards/contracts, regardless of tier, for experimental, developmental or research work.

A subject invention is any invention of the contractor conceived or first actually reduced to practice in the performance of work under an award. An invention is any invention or discovery which is or may be patentable. The contractor includes any awardee, recipient, sub-awardee, or sub-recipient.

As noted in the U.S. Competitiveness Provision, at any time in which an entity cannot meet the requirements of the U.S. Competitiveness Provision, the entity may request a modification or waiver of the U.S. Competitiveness Provision. For example, the entity may propose modifying the language of the U.S. Competitiveness Provision in order to change the scope of the requirements or to provide more specifics on the application of the requirements for a particular technology. As another example, the entity may request that the U.S. Competitiveness Provision be waived in lieu of a net benefits statement or U.S. manufacturing plan. The statement or plan would contain specific and enforceable commitments that would be beneficial to the U.S. economy and competitiveness. Commitments could include manufacturing specific products in the U.S., making a specific investment in a new or existing U.S. manufacturing facility, keeping certain activities based in the U.S. or supporting a certain number of jobs in the U.S. related to the technology. If DOE, in its sole discretion, determines that the proposed modification or waiver promotes commercialization and provides substantial U.S. economic benefits, DOE may grant the request and, if granted, modify the award terms and conditions for the requesting entity accordingly.

The U.S. Competitiveness Provision is implemented by DOE pursuant to a Determination of Exceptional Circumstances (DEC) under the Bayh-Dole Act and DOE Patent Waivers. See Section VIII.A, "Title to Subject Inventions", of this FOA for more information on the DEC and DOE Patent Waiver.

9. CORPORATE FELONY CONVICTIONS AND FEDERAL TAX LIABILITY

In submitting an application in response to this FOA, the Applicant represents that:

- It is not a corporation that has been convicted of a felony criminal violation under any Federal law within the preceding 24 months; and
- It is not a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

For purposes of these representations the following definitions apply: A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

10. APPLICANT RISK ANALYSIS

If selected for award negotiations, ARPA-E may evaluate the risks posed by the Applicant using the criteria set forth at 2 CFR §200.206(b)(ii). . ARPA-E may require special award terms and conditions depending upon results of the risk analysis.

11. RECIPIENT INTEGRITY AND PERFORMANCE MATTERS

Prior to making a Federal award ARPA-E is required to review and consider any information about Applicants that is contained in the Office of Management and Budget's designated integrity and performance system accessible through SAM (currently the Federal Awardee Performance and Integrity Information System or FAPIIS) (41 U.S.C. § 2313 and 2 C.F.R. 200. 206).

Applicants may review information in FAPIIS and comment on any information about itself that a Federal awarding agency previously entered into FAPIIS.

ARPA-E will consider any written comments provided by Applicants during award negotiations, in addition to the other information in FAPIIS, in making a judgment about an Applicant's integrity, business ethics, and record of performance under Federal awards when reviewing potential risk posed by Applicants as described in 2 C.F.R. §200.206.

12. NONDISCLOSURE AND CONFIDENTIALITY AGREEMENTS REPRESENTATIONS

In submitting an application in response to this FOA the Applicant represents that:

(1) **It does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contractors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

(2) **It does not and will not** use any Federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:

a. *"These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling."*

b. The limitation above shall not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

c. Notwithstanding the provision listed in paragraph (a), a nondisclosure confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States Government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States Government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosure to congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

13. INTERIM CONFLICT OF INTEREST POLICY FOR FINANCIAL ASSISTANCE

The DOE interim Conflict of Interest Policy for Financial Assistance (COI Policy) can be found at https://www.energy.gov/management/financial-assistance-letter-no-fal-2022-02. This policy is applicable to all non-Federal entities applying for, or that receive, DOE funding by means of a financial assistance award (e.g., a grant, cooperative agreement, or technology investment agreement) and, through the implementation of this policy by the entity, to each Investigator who is planning to participate in, or is participating in, the project funded wholly or in part under the DOE financial assistance award. DOE's interim COI Policy establishes standards that provide a reasonable expectation that the design, conduct, and reporting of projects funded wholly or in part under DOE financial assistance awards will be free from bias resulting from financial conflicts of interest or organizational conflicts of interest. The applicant is subject to the requirements of the interim COI Policy and within each application for financial assistance, the applicant must certify that it is, or will be by the time of receiving any financial assistance award, compliant with all requirements in the interim COI Policy. For applicants to any ARPA-E Funding Opportunity Announcement, this certification, disclosure of any managed or unmanaged conflicts of interest, and a copy of (or link to) the applicant's own conflict of interest policy must be included with the information provided in the Business Assurances & Disclosures Form. The applicant must also flow down the requirements of the interim COI Policy to any subrecipient non-Federal entities.

C. REPORTING

Recipients are required to submit periodic, detailed reports on technical, financial, and other aspects of the project, as described in Attachment 4 to ARPA-E's Model Cooperative Agreement https://arpa-e.energy.gov/technologies/project-guidance/pre-award-guidance/funding-agreements).

VII. AGENCY CONTACTS

A. COMMUNICATIONS WITH ARPA-E

Upon the issuance of a Exploratory Topic, 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. 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. 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 the Exploratory Topic submission deadline. Responses to questions received before this cutoff will be posted no later than three business days 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. 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.

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. If authorized per Table 1, ARPA-E provides Applicants with reviewer comments on Full Applications before the submission deadline for Replies to Reviewer Comments.

VIII. OTHER INFORMATION

A. TITLE TO SUBJECT INVENTIONS

Ownership of subject inventions is governed pursuant to the authorities listed below.

- 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;
- All other parties: The federal Non-Nuclear Energy Act of 1974, 42. U.S.C. 5908, provides that the government obtains title to new subject inventions unless a waiver is granted (see below):
- Class Patent Waiver for Domestic Large Businesses: DOE has issued a class patent waiver that applies to this FOA. Under this class patent waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class patent waiver, a domestic large business must agree to the U.S. Competitiveness Provision in accordance with Section VI.B.8. of this FOA.
- Advance and Identified Waivers: For applicants that do not fall under the class patent waiver or the Bayh-Dole Act, those applicants may request a patent waiver that will cover subject inventions that may be made under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to DOE within the time frames set forth in the award's intellectual property terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- DEC: On June 07, 2021, DOE approved a DETERMINATION OF EXCEPTIONAL CIRCUMSTANCES (DEC) UNDER THE BAYH-DOLE ACT TO FURTHER PROMOTE DOMESTIC MANUFACTURE OF DOE SCIENCE AND ENERGY TECHNOLOGIES. In accordance with this DEC, all awards, including sub-awards, under this FOA made to a Bayh-Dole entity (domestic small businesses and nonprofit organizations) shall include the U.S. Competitiveness Provision in accordance with Section VI.B.8 of this FOA. A copy of the DEC may be found on the DoE website. Pursuant to 37 CFR § 401.4, any Bayh-Dole entity affected by this DEC has the right to appeal it by providing written notice to DOE within 30 working days from the time it receives a copy of the determination.

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 ten years (or more, if approved by ARPA-E) 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

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, including Exploratory Topic announcements, are also posted to these websites. You can receive an email when a modification or a new Exploratory Topic 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 receive timely notice of any modifications or other announcements. More information is available at https://www.fedconnect.net.

F. 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.

G. REQUIREMENT FOR FULL AND COMPLETE DISCLOSURE

Applicants are required to make a full and complete disclosure of the information requested in the Business Assurances & Disclosures Form. Disclosure of the requested information is mandatory. Any failure to make a full and complete disclosure of the requested information may result in:

- The rejection of a Full Application, and/or Reply to Reviewer Comments;
- The termination of award negotiations;
- The modification, suspension, and/or termination of a funding agreement;
- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of Federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

H. RETENTION OF SUBMISSIONS

ARPA-E expects to retain copies of all Full Applications, Replies to Reviewer Comments, and other submissions. No submissions will be returned. By applying to ARPA-E for funding, Applicants consent to ARPA-E's retention of their submissions.

I. MARKING OF CONFIDENTIAL INFORMATION

ARPA-E will use data and other information contained in Full Applications, and Replies to Reviewer Comments strictly for evaluation purposes.

Full Applications, Replies to Reviewer Comments, and other submission containing confidential, proprietary, or privileged information should 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 cover sheet of the Full Application, Reply to Reviewer Comments or other submission 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 header and 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.

J. COMPLIANCE AUDIT REQUIREMENT

A prime recipient organized as a for-profit entity expending $750,000 or more of DOE funds in the entity's fiscal year (including funds expended as a Subrecipient) must have an annual compliance audit performed at the completion of its fiscal year. For additional information, refer to Subpart F of: (i) 2 C.F.R. Part 200, and (ii) 2 C.F.R. Part 910.

If an educational institution, non-profit organization, or state/local government is either a Prime Recipient or a Subrecipient, and has expended $750,000 or more of Federal funds in the entity's fiscal year, the entity must have an annual compliance audit performed at the completion of its fiscal year. For additional information refer to Subpart F of 2 C.F.R. Part 200.

IX. GLOSSARY

Applicant: The entity that submits the application to ARPA-E. In the case of a Project Team, the Applicant is the lead organization listed on the application.

Application: The entire submission received by ARPA-E, including the Preliminary Application, Full Application, Reply to Reviewer Comments, and Small Business Grant Application (if applicable).

ARPA-E: Is the Advanced Research Projects Agency – Energy, an agency of the U.S. Department of Energy.

Cost Sharing: Is the portion of project costs from non-Federal sources that are borne by the Prime Recipient (or non-Federal third parties on behalf of the Prime Recipient), rather than by the Federal Government.

Deliverable: A deliverable is the quantifiable goods or services that will be provided upon the successful completion of a project task or sub-task.

DOE: U.S. Department of Energy.

DOE/NNSA: U.S. Department of Energy/National Nuclear Security Administration

FFRDCs: Federally Funded Research and Development Centers.

FOA: Funding Opportunity Announcement.

For-Profit Organizations (Other than Small Businesses) (or *large businesses*): Means entities organized for-profit other than small businesses as defined elsewhere in this Glossary.

GOCOs: U.S. Government Owned, Contractor Operated laboratories.

GOGOs: U.S. Government Owned, Government Operated laboratories.

Institutions of Higher Education (or *educational institutions*): Has the meaning set forth at 20 U.S.C. 1001.

Milestone: A milestone is the tangible, observable measurement that will be provided upon the successful completion of a project task or sub-task.

Nonprofit Organizations (or *nonprofits*): Has the meaning set forth at 2 C.F.R. § 200.70.

Prime Recipient: The signatory to the funding agreement with ARPA-E.

PI: Principal Investigator.

Project Team: A Project Team consists of the Prime Recipient, Subrecipients, and others performing or otherwise supporting work under an ARPA-E funding agreement

Small Business: Small businesses are domestically incorporated entities that meet the criteria established by the U.S. Small Business Administration's (SBA) "Table of Small Business Size Standards Matched to North American Industry Classification System Codes" (NAICS) (http://www.sba.gov/content/small-business-size-standards).

Standalone Applicant: An Applicant that applies for funding on its own, not as part of a Project Team.

Subject Invention: Any invention conceived or first actually reduced to practice under an ARPA-E funding agreement.

Exploratory Topic: A technical area of research that is detailed in a "Special Program Announcement" at the end of this FOA as an Appendix and visible on ARPA-E eXCHANGE as a supporting FOA document. Each Exploratory Topic will have its own deadline. Once the topic deadline has passed the notice will be taken down and ARPA-E will no longer be accepting applications in that area. ARPA-E will only review applications that are scientifically aligned with the Exploratory Topic(s) open at the time the application is submitted.

Task: A task is an operation or segment of the work plan that requires both effort and resources. Each task (or sub-task) is connected to the overall objective of the project, via the achievement of a milestone or a deliverable.

Total Project Cost: The sum of the Prime Recipient share and the Federal Government share of total allowable costs. The Federal Government share generally includes costs incurred by GOGOs, FFRDCs, and GOCOs.

TT&O: Technology Transfer and Outreach. (See Section IV.F.8 of the FOA for more information).

I. APPENDIX A: Low-Energy Nuclear Reactions

Special Program Announcement for
Exploratory Topics (DE-FOA-0002784)
Low-Energy Nuclear Reactions

Topic Issue Date	September 13, 2022
Deadline for Questions to ARPA-E-CO@hq.doe.gov	5 PM ET, Friday, November 4, 2022
Submission Deadline for Full Applications	9:30 AM ET, Tuesday, November 15, 2022
Submission Deadline for Replies to Reviewer Comments:	5:00 PM ET, Tuesday, December 20, 2022
Expected Date for Selection Notifications	February 2023
Anticipated Date of Awards	May 2023
Total Amount to be Awarded	Approximately $10,000,000 subject to the availability of appropriated funds, to be shared between FOAs DE-FOA-0002784 and DE-FOA-0002785 for this Exploratory Topic
Anticipated Awards	ARPA-E may issue one, multiple, or no awards under this FOA. Awards may vary between approximately $1,000,000–$2,500,000 for Category A and $500,000–$1,500,000 for Category B.
Maximum Period of Performance	30 Months

1. Introduction

This announcement describes an Exploratory Topic (ET) on Low-Energy Nuclear Reactions (LENR).[21] ARPA-E invites Full Applications for financial assistance in pursuit of hypotheses-driven approaches toward producing publishable evidence of LENR that is convincing to the wider scientific community. A goal of this Exploratory Topic is to establish clear practices to rigorously answer the question, "should this field move forward given that LENR could be a potentially transformative carbon-free energy source, or does it conclusively not show promise?". Program objectives, technical categories, and performance metrics are described further in Section 2.

ARPA-E acknowledges the complex, controversial history of LENR beginning with the announcement by Martin Fleischmann and Stanley Pons (FP) in 1989 that they had achieved

[21] We define LENR as a hypothetical energy-producing process (or class of processes) with system energy outputs characteristic of nuclear physics (>>1 keV/amu/reaction) and energy inputs characteristic of chemistry (~eV/atom). See further materials from the ARPA-E LENR workshop: https://arpa-e.energy.gov/events/low-energy-nuclear-reactions-workshop.

deuterium-deuterium (D-D) "cold fusion" in an electrochemical cell.[22] Multiple books[23] recount the history of "cold fusion" (now known as LENR). DOE reviews in 1989 and 2004 both concluded that the evidence did not support the claim of D-D fusion, but that research proposals on deuterated heavy metals should be evaluated under the standard peer-review process.[24] However, few such proposals were submitted, and none were funded by DOE.

Despite LENR being largely dismissed by the scientific research community by 1990, many groups from around the world (including the U.S., Japan, Russia, China, and the EU) continued to conduct varied LENR experiments and report evidence of excess heat and nuclear reactions (including neutrons, tritium, ^{3}He, ^{4}He, transmutation products, and isotopic shifts) in hundreds of reports/papers.[25] However, repeatability of the key evidence over multiple trials of seemingly the same experiment remains elusive to this day. This may be due to limitations in experimental or diagnostic techniques, a lack of awareness and/or control of the key triggers and independent variables of LENR experiments, and/or other reasons. Furthermore, results were typically not reported with the level of scientific rigor required by top-tier research journals. As a result, LENR as a field remains in a stalemate with uncertain prospects for scientific advances and impact.

Based on its claimed characteristics to date, LENR may support a form of nuclear energy with potentially low capital cost, high specific power and energy, and little-to-no radioactive byproducts. If LENR can be irrefutably demonstrated and scaled, it could potentially become a disruptive technology with myriad energy, defense, transportation, and space applications, all with strong implications for U.S. technological leadership. For energy applications, LENR could potentially contribute to decarbonizing sectors such as industrial heat and transportation (~50% of U.S. and global CO_2-equivalent emissions).

Within the past decade, there has been renewed interest in supporting LENR research activities in the U.S., with prominent sponsorship (e.g., Google, DARPA, NASA), that has advanced LENR-relevant state-of-the-art capabilities and methodologies.[26] Some of the teams are reporting preliminary evidence[27] of LENR that are possibly consistent with past observations but that do not yet meet the program metrics presented below in Section 2, the fulfillment of which could help break the stalemate surrounding LENR.

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[22] M. Fleischmann and S. Pons, "Electrochemically induced nuclear fusion of deuterium," *J. Electroanal. Chem. Int. Electrochem.* **261**, 201 (1989); https://doi.org/10.1016/0022-0728(89)80006-3.

[23] See, e.g., J. R. Huizenga, *Cold Fusion: The Scientific Fiasco of the Century* (University of Rochester Press, Rochester, NY, 1993); E. Storms, *The Science of Low Energy Nuclear Reaction* (World Scientific, Singapore, 2007); S. B. Krivit, *Hacking the Atom* (Pacific Oaks Press, San Rafael, CA, 2016); and S. B. Krivit, *Fusion Fiasco* (Pacific Oaks Press, San Rafael, CA, 2016).

[24] For the 1989 and 2004 DOE review reports, see https://www.lenr-canr.org/acrobat/ERABreportofth.pdf and https://www.lenr-canr.org/acrobat/DOEreportofth.pdf, respectively. For a summary presentation of the reviews, see https://arpa-e.energy.gov/sites/default/files/2021LENR_workshop_Greco.pdf.

[25] See, e.g., https://lenr-canr.org and the bibliographies of the Storms and Krivit books in footnote 4.

[26] See, e.g., C. P. Berlinguette et al., "Revisiting the cold case of cold fusion," *Nature* **570**, 45 (2019); https://doi.org/10.1038/s41586-019-1256-6.

[27] See talks from the ARPA-E LENR workshop: https://arpa-e.energy.gov/events/low-energy-nuclear-reactions-workshop.

This ARPA-E Exploratory Topic aims to build on the recent progress with strong emphases on testing/confirming specific hypotheses (rather than focusing only on replication), identifying and verifying control of experimental variables and triggers, supporting more comprehensive diagnostics and analysis, improving access to broader expertise and capabilities on research teams, and insisting on peer review and publication in top-tier scientific journals.

2. Topic Description

This Exploratory Topic invites Full Applications to advance LENR research by identifying and testing well-articulated hypotheses on how to activate/control LENR and their accompanying empirical signatures. A key goal of the ET is to obtain convincing empirical evidence of nuclear reactions[28] in an LENR experiment and publication of the evidence in a top-tier peer-reviewed research journal (see Section 2A for specific suggested criteria for what constitutes "convincing empirical evidence"). ARPA-E is seeking Full Applications that successfully address the highest-priority elements described in the sub-sections immediately below and in greater detail in the Technical Volume (TV) template, which is available for download at the ARPA-E: Funding Opportunity Exchange website (https://arpa-e-foa.energy.gov/).

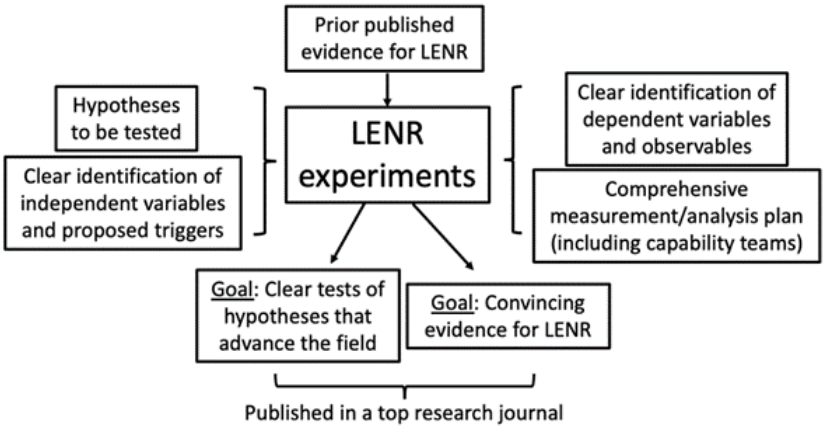
Additional overarching goals of this Exploratory Topic are to bring together new perspectives and participants, modern state-of-the-art scientific and technical capabilities, and the experiences of long-time LENR practitioners..

Applicants must select only one of the following technical categories, discussed further below:

A. LENR experiments
B. Capability teams.

A. Technical Category A: LENR experiments

The figure below summarizes Category A logic and goals.



[28] ARPA-E is agnostic at this time regarding the existence of LENR as a physical phenomenon (as defined in footnote 21), the underlying mechanism(s) of LENR, and the specific nuclear process(es) involved, if any (e.g., fusion, neutron capture, alpha or beta decay, neutronization, etc.).

For Category A, Applicants must comprehensively address the following:

- Select and justify LENR experimental platform(s) and design (i.e., methods for H and/or D loading and LENR activation/trigger; materials structure/composition; control experiments; background/contaminant characterization, etc.) with a clearly articulated connection to prior published research claiming evidence of LENR
- Articulate specific hypothesis or hypotheses to be tested, including justification at a phenomenological level of the importance and relevance of the hypothesis or hypotheses
- Identify key independent and dependent variables and their desired quantitative ranges that the proposed research will emphasize and rigorously characterize
- Propose a comprehensive diagnostic and analysis plan that minimizes the probability of inconclusive outcomes (whether the results are positive or negative); the expectation is a strong focus on detection of both prompt and secondary/delayed nuclear-reaction products, specifying the particle(s) and prompt energy ranges anticipated (and why)
- Account for uncertainties in both background and signal in the statistical analysis with all assumptions explicitly defined and justified; the correlation among all measurements should be analyzed in a single comprehensive statistical framework with all assumptions explicitly defined in mathematical terms. If multiple simultaneous measurements are made, a unified statistical framework is required with clear identification of correlated or orthogonal measurements
- Demonstrate access to the needed broad discipline expertise and the embodied knowledge of long-time LENR researchers, corresponding to the chosen experimental approach, hypotheses to be tested, and statistical analysis methodologies
- Commit to the standard peer-review process and demonstrate a willingness to submit findings to leading research journals;
- As stated in section IV.F.3, ARPA-E, for Subject Inventions disclosed to DOE under an award, ARPA-E will reimburse the Prime Recipient – in addition to allowable costs associated with Subject Invention disclosures - up to $30,000 of expenditures for filing and prosecution of United States patent applications,
- Technology-to-Market (T2M) considerations, including
    - Plausibility of proposed LENR approach to realize net energy gain and scalability to devices with useful levels of power
    - Potential first markets for a commercial system
    - Other barriers, such as obtaining IP protection, consideration for publication by top-tier journals, etc.
- Serious evaluation and mitigation/control of potential hazards (mechanical, electrical, radiological, and otherwise) associated with the proposed LENR experiments, and plans for protecting human health and property.

Please refer to the Technical Volume template (available for download at the ARPA-E: Funding Opportunity Exchange website (https://arpa-e-foa.energy.gov/)), which provides further guidance for preparing your Full Application.

To constitute convincing empirical evidence for LENR, each Applicant must describe how they will meet the following:

- Conduct experiments that demonstrably satisfy the definition of LENR given in footnote 21
- Achieve statistically significant diagnostic evidence of nuclear reactions above background and relative to control experiments, at a level greater than 99.7% (3s) statistical confidence level
- Carefully identify and eliminate "prosaic" explanations, e.g., rogue chemical reactions resulting in excess heat, material and/or environmental contaminants, natural radiation background, etc.
- Publish results in a top-tier research journal.

B. Technical Category B: Capability Teams

Applicants seeking to contribute an expert/specialist capability that could assist multiple Category-A LENR experimental teams in fulfilling program objectives should consider selecting Category B. Capabilities of interest include but are not limited to

- Diagnostic instruments expertise (e.g., detection of nuclear-reaction products, pre- and post-experimental materials elemental/isotopic analysis, etc.)
- Relevant analyses expertise, including statistical analysis and Bayesian inference techniques of "multi-messenger" datasets in low-count, high-background environments[29]
- Relevant computational codes/expertise to aid in experimental design and data interpretation
- Precision materials fabrication, handling, characterization.

The primary objectives for Category B is to bring state-of-the-art instruments and capabilities to the program and to Category-A projects that may not otherwise have access to the resources and/or expertise to quickly achieve an equivalent capability. A goal is to avoid expending time and resources in establishing capabilities/expertise that already exist elsewhere. Capability teams bring a neutral, independent perspective that will bolster the credibility of any reported evidence for LENR. ARPA-E has experience with Capability Teams in other programs.[30]

ARPA-E strongly encourages interactions between potential Category-A and Category-B Applicants throughout the application process, so that Submissions are coordinated and complementary to the extent possible. However, Category-A and Category-B Submissions will be evaluated independently.

[29] See, e.g., J. L. Alvarez, "Poisson-based detection limit and signal confidence intervals for few total counts," Health Phys. **93**, 120 (2007); https://doi.org/10.1097/01.hp.0000261331.73389.bd.
[30] See, e.g., https://arpa-e.energy.gov/news-and-media/blog-posts/fusing-further-advancement-introducing-arpa-e-fusion-capability-teams.

Category-A Applicants are especially encouraged to partner with Category-B Applicants on capabilities requiring lengthy/nuanced experience and/or expensive instruments/diagnostics. It is acceptable for Category-A Applicants to either include a team member to fulfill the needed capability or to state that they expect to work with a known Category-B Applicant. The latter is encouraged to improve efficiency and avoid unnecessary expenses in duplicating Category-B capabilibities . If the proposed capabilities are clearly articulated/justified, including appropriate quantitative technical requirements, ARPA-E will identify and encourage collaborations between Category-A and B teams during technical milestone negotiations.

ARPA-E prohibits the same person or persons being on both a Category-A and Category-B Applicant team. In order to ensure objectivity in the measurements taken by Category-B teams, Category A and Category B teams interested in partnering should ensure that there are no actual or apparent conflicts of interest within or between the the teams.

Per Section VI.B.7 of the FOA, every Project Team must negotiate and establish an Intellectual Property Management Plan for the management and disposition of intellectual property arising from the project. Every project that involves a Category-A awardee partnering with a Category-B awardee will be required to have a similar plan for the management and disposition of intellectual property arising from such a collaboration. Such a Plan will need to at least address the limtations, if any, on the use and disclosure of any data exchanged between the parties and the rights of the collaborating parties to any newly arising technology for commercialization purposes. If a Category-B awardee is partnering with more than one Category-A awardee, then both the ARPA-E award to the Category-B awardee and the Plan between the collaborating parties shall include a prohibition on the Category-B awardee sharing any data provided to it or produced by it to any other Category-A awardee without the express written permission of the partnering Category-A awardee.

C. Criteria and Metrics

Category A: LENR Experiments

Table 1 summarizes the key criteria/metrics for Category A: LENR Experiments. Applicants should clearly and concisely articulate how their Submission meets each of the criteria.

Table 1. Summary of criteria/metrics for Category A: LENR experiments.

Criteria	Metrics
Maximum input energy or voltage	• ≤ 500 eV per directly energized particle, or ≤ 500 V applied voltage anywhere in the experiment

Proposed LENR experimental platform	• Past evidence of nuclear reactions (preferred) and/or excess heat in a peer-reviewed journal paper (cite papers, show/discuss key data) • Preferably, related corroboration of key results by at least one independent group (cite papers, show/discuss key data) • Recognition and discussion of potential hazards to property and human safety, and demonstrated commitment and ability to develop a hazard mitigation/control plan
Hypotheses to be tested	• Phenomenological justification of the significance/relevance of the chosen hypothesis (hypotheses) with respect to LENR • Clear statement of independent and dependent variables to be characterized and their allowable measurement uncertainties, as well as a statement of uncontrolled/uncontrollable variables (e.g., average loading fraction may be a controllable variable, but the loading process introduces uncontrollable and possibly uncharacterized morphological changes to the sample)

Detection of nuclear-reaction products	• Justification of particles and energy ranges to be measured, and desired temporal/spatial resolutions
	• Plan for achieving statistically significant diagnostic evidence of nuclear reactions above background and relative to control experiments, at a level greater than 99.7% (3s) statistical confidence level, including
	  ○ Real-time detection of prompt/secondary nuclear-reaction products, including multiple detectors and positioning, etc., as appropriate, and/or pre- and post-experiment materials elemental/isotopic analysis
	  ○ Background/contaminant characterization with sufficient sensitivity, resolution, and time correlation to achieve the required statistical confidence
	• Inclusion of or access to state-of-the-art detectors and expertise

Calorimetry	• Calorimetry cannot be the only nor primary diagnostic, but it can be part of the diagnostic suite, provided that labor and hardware expenditures associated with calorimetry are ≤10% of the total project cost of a Category-A application • Category-A teams are encouraged to work with a Category-B Capability Team that has demonstrated capability in calorimetry • A comprehensive energy-balance model that accounts for all possible sources and sinks must be available or developed as part of the proposed work • State quantitative requirements on calorimetry detection thresholds and resolution based upon analysis of experimental uncertainty
Control experiments	• Identify and justify the control experiments needed to support a clear test of the hypotheses under consideration, and to build confidence in empirical evidence for LENR if it is observed • Describe how control experiments are not introducing new or uncontrolled variables, or how these are accounted for in reaching conclusions

Controlling impurities and contaminants	• Plan for pre- and post-experimental sample characterization for all materials, electrolytes, and/or gases • Articulation of required characterization resolution/uncertainties based on hypotheses being tested
Teaming	• Team composition includes first-hand knowledge of a past LENR experiment that is directly related to the selected experimental platform and hypotheses • PI of this Submission has a demonstrated track record of publishing in top-tier journals

Category B: Capability Teams

Several capabilities are needed for LENR experiments to fulfill the program objectives. Classes of anticipated capabilities and their desired attributes are summarized in Table 2. Category-B Applicants should clearly state the capability or capabilities they are providing (with quantitative targets wherever possible) and the class or classes of LENR experimental platforms that they envision supporting..

Table 2. Summary of criteria/attributes for Category B: Capability Teams.

Capability	Desired attributes and quantitative targets
Detection of prompt and secondary nuclear-reaction products	• Description of particles (e.g., ^{3}He, ^{4}He, tritium, neutrons, transmutation/decay products) and energy ranges that can be measured • State achievable temporal, spatial, and energy resolutions, as well as detection sensitivities and thresholds • Type of selected detectors and their strengths/weaknesses in the context of common LENR experimental platforms • Plans for placing detectors in a suitable position relative to the presumed source, including within challenging liquid or high-temperature/pressure environments
Materials fabrication and pre/post-experimental structural and elemental analysis	• Ability to fabricate materials samples with controlled microstructure (specify feature sizes, morphology, defect uniformity, etc.) • Materials handling protocols to control the introduction of contaminants • Elemental/isotopic detection thresholds and resolution • Structural and/or morphological analysis/imaging resolution, including direct measurement of H/D-loading capable of resolving spatiotemporal variations
Mass balance and spectroscopy	• Ability to provide an inventory of all species present in an LENR experiment, with mass or fractional molar resolutions adequate to differentiate from control experiments and the environmental background

Calorimetry	• Budget devoted to calorimetry should be ≤25% of total project cost[31] • Previous calorimetry data/results and calibrations by team appear in peer-reviewed publications • Achieved detection thresholds, resolutions, uncertainties of relevance to leading LENR experimental platforms • Validated energy balance model of calorimeter and all sensors with uncertainty analysis
Modeling/computation	• Relevant capabilities /codes to support the experimental design of promising classes of LENR experiments and control experiments • Relevant capabilities/codes to support diagnostic design, specification of diagnostic requirements, and data/scientific interpretations

3. Submissions Specifically Not of Interest

Submissions that propose the following may be deemed non-responsive and may not be merit-reviewed:

- Experiments with input energies >500 eV per directly energized particle, or >500 V of applied voltage anywhere in the experiment
- No clear hypotheses to be tested
- No articulated connection to prior published evidence for LENR and of how this work builds on the earlier work
- Calorimetry as the only or primary diagnostic
- Lack of a plan for obtaining direct empirical evidence of nuclear reactions
- Purely theoretical or computational studies
- Research plans requiring substantial diagnostic or code development beyond their adaptation to specific experiments.

4. Content and Form of Full Applications

The content and form of Applicants' Technical Volumes shall follow the instructions and be consistent with the template titled Technical Volume: Appendix A, LENR. All other instructions set forth at FOA Section IV.C remain unchanged.

Templates for preparing Full Applications under this Exploratory Topic may be found on ARPA-E Exchange at https://arpa-e-foa.energy.gov/.

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[31] Note that the limit for calorimetry is ≤10% of total project cost for Category-A applications that include calorimetry, but calorimetry can be up to ≤25% of the budget for a Category-B application.