

**FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT**



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

DURATION ADDITION TO ELECTRICITY STORAGE (DAYS)

Announcement Type: **Modification 02**
Funding Opportunity No. DE-FOA-0001906
CFDA Number 81.135

Funding Opportunity Announcement (FOA) Issue Date:	Tuesday, May 1, 2018
Submission Deadline for Mandatory Notice of Intent:	5 PM ET, Friday, June 15, 2018
Deadline for Questions to ARPA-E-CO@hq.doe.gov:	5 PM ET, Friday, June 22, 2018
Submission Deadline for Full Applications:	5 PM ET, Monday, July 2, 2018
Submission Deadline for Replies to Reviewer Comments:	5 PM ET, Thursday, August 16, 2018
Expected Date for Selection Notifications:	September 2018
Total Amount to Be Awarded	Approximately \$30 million, subject to the availability of appropriated funds.
Anticipated Awards	ARPA-E may issue one, multiple, or no awards under this FOA. Awards may vary between \$500,000 and \$10 million.

- For eligibility criteria, see Section III.A of the FOA.
- For cost share requirements under this FOA, see Section III.B of the FOA.
- To apply to this FOA, Applicants must register with and submit application materials through ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/Registration.aspx>). For detailed guidance on using ARPA-E eXCHANGE, see Section IV.H.1 of the FOA.
- Applicants are responsible for meeting each submission deadline. Applicants are strongly encouraged to submit their applications at least 48 hours in advance of the submission deadline.
- For detailed guidance on compliance and responsiveness criteria, see Sections III.C.1 through III.C.4 of the FOA.

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

MODIFICATIONS

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

Mod. No.	Date	Description of Modifications
01	05/02/2018	<ul style="list-style-type: none">Revised references to correctly identify Figure 3 within Section I.B of the FOA.
02	05/21/18	<ul style="list-style-type: none">Corrected the levelized cost of storage (LCOS) equation (Equation [1]) within Section I.B.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 OF CONTENTS

REQUIRED DOCUMENTS CHECKLIST - 5 -

I. FUNDING OPPORTUNITY DESCRIPTION - 7 -

A. AGENCY OVERVIEW - 7 -

B. PROGRAM OVERVIEW - 8 -

 1. *INTRODUCTION AND OBJECTIVES* - 8 -

 2. *PROJECT CONTENT, FUNDING LEVELS, AND PROGRAM SCHEDULE* - 9 -

 3. *TECHNICAL CATEGORIES AND PROGRAM METRICS* - 10 -

 4. *TECHNICAL APPENDIX* - 16 -

II. AWARD INFORMATION - 25 -

A. AWARD OVERVIEW - 25 -

B. ARPA-E FUNDING AGREEMENTS - 26 -

 1. *COOPERATIVE AGREEMENTS* - 26 -

 2. *FUNDING AGREEMENTS WITH FFRDCs/DOE LABS, GOGOs, AND FEDERAL INSTRUMENTALITIES* - 26 -

 3. *TECHNOLOGY INVESTMENT AGREEMENTS* - 27 -

C. STATEMENT OF SUBSTANTIAL INVOLVEMENT - 27 -

III. ELIGIBILITY INFORMATION - 28 -

A. ELIGIBLE APPLICANTS - 28 -

 1. *INDIVIDUALS* - 28 -

 2. *DOMESTIC ENTITIES* - 29 -

 3. *FOREIGN ENTITIES* - 29 -

 4. *CONSORTIUM ENTITIES* - 30 -

B. COST SHARING - 30 -

 1. *BASE COST SHARE REQUIREMENT* - 30 -

 2. *INCREASED COST SHARE REQUIREMENT* - 31 -

 3. *REDUCED COST SHARE REQUIREMENT* - 31 -

 4. *LEGAL RESPONSIBILITY* - 32 -

 5. *COST SHARE ALLOCATION* - 32 -

 6. *COST SHARE TYPES AND ALLOWABILITY* - 32 -

 7. *COST SHARE CONTRIBUTIONS BY FFRDCs AND GOGOs* - 33 -

 8. *COST SHARE VERIFICATION* - 34 -

C. OTHER - 34 -

 1. *COMPLIANT CRITERIA* - 34 -

 2. *RESPONSIVENESS CRITERIA* - 35 -

 3. *SUBMISSIONS SPECIFICALLY NOT OF INTEREST* - 36 -

 4. *LIMITATION ON NUMBER OF SUBMISSIONS* - 36 -

IV. APPLICATION AND SUBMISSION INFORMATION - 37 -

A. APPLICATION PROCESS OVERVIEW - 37 -

 1. *REGISTRATION IN ARPA-E eXCHANGE* - 37 -

 2. *NOTICES OF INTENT* - 37 -

 3. *FULL APPLICATIONS* - 37 -

 4. *REPLY TO REVIEWER COMMENTS* - 37 -

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).

5.	<i>PRE-SELECTION CLARIFICATIONS AND “DOWN-SELECT” PROCESS</i>	- 38 -
6.	<i>SELECTION FOR AWARD NEGOTIATIONS</i>	- 38 -
B.	<i>APPLICATION FORMS</i>	- 39 -
C.	<i>CONTENT OF NOTICES OF INTENT</i>	- 39 -
D.	<i>CONTENT AND FORM OF FULL APPLICATIONS</i>	- 40 -
1.	<i>FIRST COMPONENT: TECHNICAL VOLUME</i>	- 41 -
2.	<i>SECOND COMPONENT: SF-424</i>	- 49 -
3.	<i>THIRD COMPONENT: BUDGET JUSTIFICATION WORKBOOK/SF-424A</i>	- 49 -
4.	<i>FOURTH COMPONENT: SUMMARY FOR PUBLIC RELEASE</i>	- 51 -
5.	<i>FIFTH COMPONENT: SUMMARY SLIDE</i>	- 51 -
6.	<i>SIXTH COMPONENT: BUSINESS ASSURANCES & DISCLOSURES FORM</i>	- 52 -
7.	<i>SEVENTH COMPONENT: U.S. MANUFACTURING PLAN</i>	- 53 -
E.	<i>CONTENT AND FORM OF REPLIES TO REVIEWER COMMENTS</i>	- 54 -
F.	<i>INTERGOVERNMENTAL REVIEW</i>	- 55 -
G.	<i>FUNDING RESTRICTIONS</i>	- 55 -
1.	<i>ALLOWABLE COSTS</i>	- 55 -
2.	<i>PRE-AWARD COSTS</i>	- 55 -
3.	<i>PATENT COSTS</i>	- 56 -
4.	<i>CONSTRUCTION</i>	- 56 -
5.	<i>FOREIGN TRAVEL</i>	- 56 -
6.	<i>PERFORMANCE OF WORK IN THE UNITED STATES</i>	- 56 -
7.	<i>PURCHASE OF NEW EQUIPMENT</i>	- 57 -
8.	<i>TECHNOLOGY TRANSFER AND OUTREACH</i>	- 57 -
9.	<i>LOBBYING</i>	- 58 -
10.	<i>CONFERENCE SPENDING</i>	- 59 -
11.	<i>INDEPENDENT RESEARCH AND DEVELOPMENT COSTS</i>	- 59 -
H.	<i>OTHER SUBMISSION REQUIREMENTS</i>	- 60 -
1.	<i>USE OF ARPA-E eXCHANGE</i>	- 60 -
V.	<i>APPLICATION REVIEW INFORMATION</i>	- 61 -
A.	<i>CRITERIA</i>	- 61 -
1.	<i>CRITERIA FOR FULL APPLICATIONS</i>	- 61 -
2.	<i>CRITERIA FOR REPLIES TO REVIEWER COMMENTS</i>	- 63 -
B.	<i>REVIEW AND SELECTION PROCESS</i>	- 63 -
1.	<i>PROGRAM POLICY FACTORS</i>	- 63 -
2.	<i>ARPA-E REVIEWERS</i>	- 64 -
3.	<i>ARPA-E SUPPORT CONTRACTOR</i>	- 65 -
C.	<i>ANTICIPATED ANNOUNCEMENT AND AWARD DATES</i>	- 65 -
VI.	<i>AWARD ADMINISTRATION INFORMATION</i>	- 65 -
A.	<i>AWARD NOTICES</i>	- 65 -
1.	<i>REJECTED SUBMISSIONS</i>	- 65 -
2.	<i>FULL APPLICATION NOTIFICATIONS</i>	- 65 -
B.	<i>ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS</i>	- 66 -
1.	<i>DUNS NUMBER AND SAM, FSRS, AND FEDCONNECT REGISTRATIONS</i>	- 67 -
2.	<i>NATIONAL POLICY ASSURANCES</i>	- 67 -

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).

3.	<i>PROOF OF COST SHARE COMMITMENT AND ALLOWABILITY</i>	- 68 -
4.	<i>COST SHARE PAYMENTS</i>	- 68 -
5.	<i>ENVIRONMENTAL IMPACT QUESTIONNAIRE</i>	- 68 -
6.	<i>TECHNOLOGY-TO-MARKET PLAN</i>	- 69 -
7.	<i>INTELLECTUAL PROPERTY AND DATA MANAGEMENT PLANS</i>	- 69 -
8.	<i>U.S. MANUFACTURING REQUIREMENT</i>	- 70 -
9.	<i>CORPORATE FELONY CONVICTIONS AND FEDERAL TAX LIABILITY</i>	- 71 -
10.	<i>APPLICANT RISK ANALYSIS</i>	- 72 -
11.	<i>RECIPIENT INTEGRITY AND PERFORMANCE MATTERS</i>	- 72 -
12.	<i>NONDISCLOSURE AND CONFIDENTIALITY AGREEMENTS REPRESENTATIONS</i>	- 72 -
C.	REPORTING	- 73 -
VII.	AGENCY CONTACTS	- 73 -
A.	COMMUNICATIONS WITH ARPA-E	- 73 -
B.	DEBRIEFINGS	- 74 -
VIII.	OTHER INFORMATION	- 75 -
A.	FOAs AND FOA MODIFICATIONS	- 75 -
B.	OBLIGATION OF PUBLIC FUNDS	- 75 -
C.	REQUIREMENT FOR FULL AND COMPLETE DISCLOSURE	- 75 -
D.	RETENTION OF SUBMISSIONS	- 76 -
E.	MARKING OF CONFIDENTIAL INFORMATION	- 76 -
F.	TITLE TO SUBJECT INVENTIONS	- 76 -
G.	GOVERNMENT RIGHTS IN SUBJECT INVENTIONS	- 77 -
1.	<i>GOVERNMENT USE LICENSE</i>	- 78 -
2.	<i>MARCH-IN RIGHTS</i>	- 78 -
3.	<i>U.S. MANUFACTURING REQUIREMENT</i>	- 78 -
H.	RIGHTS IN TECHNICAL DATA	- 79 -
I.	PROTECTED PERSONALLY IDENTIFIABLE INFORMATION	- 79 -
J.	COMPLIANCE AUDIT REQUIREMENT	- 80 -
IX.	GLOSSARY	- 81 -

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).

REQUIRED DOCUMENTS CHECKLIST

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

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

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

SUBMISSION	COMPONENTS	OPTIONAL/ MANDATORY	FOA SECTION	DEADLINE
Notice of Intent	<ul style="list-style-type: none"> • Each Applicant must enter the following information into ARPA-E eXCHANGE by the stated deadline: <ul style="list-style-type: none"> ○ Project Title; ○ Lead Organization; ○ % of effort contributed by the Lead Organization; and ○ The Project Team, including Principal Investigator for the Prime Recipient, Team Members, and Key Participants 	Mandatory	IV.C	5 PM ET, Friday, June 15, 2018
Full Application	<ul style="list-style-type: none"> • Each Applicant must submit a Technical Volume in Adobe PDF format by the stated deadline. Applicants may use the Technical Volume template available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov). The Technical Volume must include the following: <ul style="list-style-type: none"> ○ Executive Summary (1 page max.) ○ Sections 1-5 (12 pages max.) <ul style="list-style-type: none"> • 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 PQS limited to 3 pages in length, no cumulative page limit) • The Technical Volume must be accompanied by: <ul style="list-style-type: none"> ○ 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) – Applicants may use the Summary Slide template available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov); and ○ Completed and signed Business Assurances & Disclosures Form (no page limit, Adobe PDF format). ○ U.S. Manufacturing Plan (1 page limit, Adobe PDF format) 	Mandatory	IV.D	5 PM ET, Monday, July 2, 2018

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Reply to Reviewer Comments	<ul style="list-style-type: none">• Each Applicant may submit a Reply to Reviewer Comments in Adobe PDF format. This submission is optional. Applicants may use the Reply to Reviewer Comments template available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov). The Reply may include:<ul style="list-style-type: none">○ Up to 3 pages of text; and○ Up to 2 pages of images.	Optional	IV.E	5 PM ET, Thursday, August 16, 2018
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I. FUNDING OPPORTUNITY DESCRIPTION

A. AGENCY OVERVIEW

The Advanced Research Projects Agency – Energy (ARPA-E), an organization within the Department of Energy (DOE), is chartered by Congress in the America COMPETES Act of 2007 (P.L. 110-69), as amended by the America COMPETES Reauthorization Act of 2010 (P.L. 111-358) to:

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

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

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

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

ARPA-E funds technology with the potential to be disruptive in the marketplace. The mere creation of a new learning curve does not ensure market penetration. Rather, the ultimate value of a technology is determined by the marketplace, and impactful technologies ultimately

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become disruptive – that is, they are widely adopted and displace existing technologies from the marketplace or create entirely new markets. ARPA-E understands that definitive proof of market disruption takes time, particularly for energy technologies. Therefore, ARPA-E funds the development of technologies that, if technically successful, have the clear disruptive potential, e.g., by demonstrating capability for manufacturing at competitive cost and deployment at scale.

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

B. PROGRAM OVERVIEW

1. INTRODUCTION AND OBJECTIVES

The Duration Addition to electricity Storage (DAYS) program will pursue new long-duration electricity storage (LDES) technologies with discharge durations that range from 10 to approximately 100 hours at rated power. Such “long” durations are beyond the requirements for intra-day (“daily”) energy time shift and many other stationary electricity storage applications common on the grid today. ARPA-E believes durations at rated power of 10 to 100 hours are relevant for needs that go beyond daily cycling but are short of seasonal energy time-shift applications. Long-duration storage applications present new forms of technical challenges associated with exceptionally low lifetime cost requirements (including both capital and operating expenses), particularly for the energy storage media and related components.

¹ OMB Circular A-11

(https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/assets/a11_current_year/a11_2017.pdf), Section 84, pgs. 3-4.

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However, the lower number of cumulative cycles, acceptability of slow ramp rates, and other relaxed performance requirements that are associated with long durations and infrequent cycling provide opportunities for design tradeoffs that may be leveraged to reduce costs and realize economically-viable LDES systems.

The primary objective of the DAYS program is the development of LDES systems that deliver electricity at a levelized cost of storage (LCOS) of 5 cents/kWh-cycle *across the full range of storage durations (i.e. 10 to approximately 100 hours)*. This requirement results in a target lifetime cost that decreases with increasing storage duration, a marked divergence from many existing storage cost targets that focus on a single duration and thus a single cost metric. The LCOS target of 5 cents/kWh-cycle likely requires system round-trip efficiencies greater than 50%.

For this focused program, ARPA-E expects chemical, electrochemical, thermal, and mechanical technical approaches to potentially address this problem statement. The DAYS program requires that all proposed storage systems be charged by electricity alone and produce electricity as the sole output.

If successful, the DAYS program will provide new forms of stationary electricity storage systems that enhance grid resiliency, provide low-cost capacity, support the transmission and distribution infrastructure, enable a greater share of low-cost, intermittent sources of wind and solar in the future generation mix, along with other benefits.

2. PROJECT CONTENT, FUNDING LEVELS, AND PROGRAM SCHEDULE

ARPA-E expects projects funded through the DAYS FOA to focus on the development of sub-scale components, full-scale components, and/or sub-scale systems. Because the program is open to several technology classes, there are a range of scales for the demonstration of proof of concept and proof of performance for both components and systems. For this program, ARPA-E is open to smaller projects seeking to develop transformational advances in one or more components used in a complete system, with proof of concept demonstrated at the sub-scale component level. ARPA-E is also open to larger projects, seeking proof of concept for full-scale components, and/or a complete sub-scale system. Awards issued through the DAYS FOA will range from \$500,000 to \$10 million.

Regardless of whether a project focuses at the component or system level, the performance results need to be augmented with full-scale system performance and cost modeling to assess the ability of the approach to meet or exceed the program metrics once a full-scale system is built. In other words, techno-economic analysis will be required for all projects.

At ARPA-E's discretion, subject to the availability of appropriated funds, a second phase to the DAYS program is envisioned, with a goal of building one or more prototype systems that are placed in field use. Prospective recipients for any future second phase may be selected by

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ARPA-E for award negotiations based upon the technical and other success of any project(s) sponsored under this Funding Opportunity Announcement, as demonstrated in the Final Scientific/Technical Report. ARPA-E may also publish a Phase II Funding Opportunity Announcement, open to all eligible entities. ARPA-E expects to finalize and publicize its plans for a second phase to the DAYS program in 2021.

3. TECHNICAL CATEGORIES AND PROGRAM METRICS

The DAYS program includes two technical categories, which are described in more detail in Figure 2 and Figure 3 below, along with their associated text:

- Daily-plus cycling (Category 1): LDES systems that provide daily cycling, in addition to longer-duration, less frequent cycling.
- Non-daily cycling (Category 2): LDES systems that do *not* provide daily cycling and only provide less frequent cycling.

Because this program is open to a range of different storage technology classes (including thermal, mechanical, electrochemical, chemical, and others), the technical performance targets in Table 1 of this section are necessarily high level and primarily economic. To ensure ARPA-E has sufficiently granular technical information to make informed selection decisions, the specific technical information that is required for reviewers to assess the potential for an approach to meet the metrics in Table 1 is required from Applicants in Section 1 of the Technical Volume.

Table 1. Technical performance metrics for the DAYS program.

ID	Metric name	Value	Description and rationale
1	Duration at rated power	10 to approximately 100 hours	These durations of interest are intermediate between daily cycling and seasonal cycling.
2	Levelized cost of storage (LCOS)	5 cents/kWh-cycle	Target per-cycle storage cost accounting for capital, operating (including system inefficiency), maintenance, and all other costs. A discount rate of 10% and a system lifetime of 20 years are assumed. See equation [1] and the associated discussion below for more information on LCOS.
3	Electricity purchase price	2.5 cents/kWh	An electricity purchase price allows applicants to balance operating costs with other costs (including capital expenses), with a fixed LCOS. 2.5 cents/kWh is an expected unsubsidized cost of electricity for future

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			utility-scale wind and solar installations available through power purchase agreements or similar contracts, and is also a favorable wholesale electricity price in deregulated markets.*
4	Siting requirements	No geographic constraints	The technologies in this program need to be suitable for siting throughout the entire United States. Technologies may make use of below ground storage (e.g., a sub-surface tank), but may not rely on site-specific geologic structures.
5	Energy form for charge and discharge	Only electricity in / only electricity out	This program will only consider storage systems that are charged solely by electricity and produce electricity on discharge. In other words, the program is not interested in systems such as concentrating solar power that have photons as an input.
6	Minimum final, full-scale system size	100 kW based on peak electrical output	The minimum size is chosen to reflect the program focus on systems for commercial and utility applications.
7	Duty cycle	Applicants must use the duty cycles shown in Figure 2B, which result in the cost-duration curves shown in Figure 3.	The duty cycle is required to establish system cost targets as a function of duration. ARPA-E has proposed two duty cycles that define the two program categories.

*With a purchase price of 2.5 cents/kWh and an LCOS of 5 cents/kWh-cycle, if the round-trip efficiency is 33% there is *no* money left for capital and other costs, while with a round-trip efficiency of 50% there is 2.5 cents/kWh-cycle available for capital and all other costs. Thus, while these metrics allow Applicants to trade off capital and operating expenses, 33% is a hard lower bound on round-trip efficiency, and ARPA-E generally expects technologies funded in this program to have a round-trip efficiency of greater than 50%. Another key consideration is that as the discharge efficiency drops, the effective cost of the stored energy increases because a larger fraction of the stored energy is lost during the conversion process. Thus, the impact of efficiency is twofold.

Examples of technical approaches of interest for LDES systems with Daily-plus (Category 1) and Non-daily (Category 2) duty cycles include but are not limited to:

- Electricity storage systems that are not obvious extensions of systems currently being designed for durations of 8 to 10 h at rated power. In particular, high-risk technical approaches that are highly differentiated in their cost-performance design tradeoffs relative to current commercial and R&D electricity storage systems, for which proof of concept is required, are of interest.

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- Approaches with the potential to achieve the technical performance metrics for durations up to the upper range of interest for the DAYS program, i.e. approximately 100 hours.
- Systems with an electricity storage capital cost that is a declining function of storage duration. Figure 6 in the technical appendix below provides a conceptual visualization of this approach. For example, physical, chemical, or electrochemical transformation of active materials during system operation to enable storage at higher energy density relative to that required for optimized power stack operation are of interest.
- Technical approaches that exploit the reduced performance requirements associated with less frequent cycling, while maintaining excellent calendar life.
- Approaches to significantly reduce energy and balance-of-plant costs through innovative system architectures, energy dense storage media, inherently safe bulk storage systems, and other approaches.
- Innovative approaches to leverage extremely low cost energy storage materials, and potentially even negative cost energy storage media.
- Methods to provide cost-effective thermal insulation that is required by the long dwell times associated with infrequent cycling and a need to retain system efficiency.
- Approaches that exploit the low ramp rates required for infrequent cycling that can likely be predicted well in advance, regarding both power and energy components.
- Storage systems that can leverage an existing power block (such as a turbine, or a flow battery stack) to dramatically limit the need for additional power-related costs.
- Development of energy-related subsystems that augment the duration of existing daily-cycling storage systems, but that are differentiated from the daily-cycling storage medium in physical state, composition, concentration, or other characteristic.

In the remainder of this section, additional context specifically relevant to the performance metrics in Table 1 is provided. First, a key quantity for the program is the levelized cost of storage (LCOS). The LCOS is the amount paid to a storage system for each cycle that is accomplished and can be thought of as a cost adder for each unit of energy that passes through the system. For purposes of this FOA, LCOS is defined as:

$$LCOS = \left[\left(\frac{1}{\eta_{RTE}} - 1 \right) P_e \sum_{t=1}^T \frac{1}{(1+r)^t} + \sum_{t=1}^T \frac{O\&M(t)}{(1+r)^t} + \left(\frac{C_E}{\eta_D} + \frac{C_P}{d} \right) \right] * \left[\sum_{t=1}^T \frac{n_e(t)}{(1+r)^t} \right]^{-1} \quad [1]$$

$$LCOS = \left[\left(\frac{1}{\eta_{RTE}} - 1 \right) P_c \sum_{t=1}^T \frac{n_c(t)}{(1+r)^t} + \sum_{t=1}^T \frac{O\&M(t)}{(1+r)^t} + \left(\frac{C_E}{\eta_D} + \frac{C_P}{d} \right) \right] * \left[\sum_{t=1}^T \frac{n_c(t)}{(1+r)^t} \right]^{-1} \quad [1]$$

where η_{RTE} and η_D are the AC system round-trip and discharge efficiencies at rated power, respectively, P_c is the input electricity price during charging, r is the discount rate, T is system lifetime in years, $O\&M(t)$ is the combination of fixed and variable operations and maintenance costs over time interval t in \$/kWh (including periodic replacement of any system components), C_E is the capital cost for (usable) energy-specific components and associated balance of plant

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(\$/kWh), C_p is the capital cost for power-specific components and associated balance of plant at rated power (\$/kW), d is the storage duration at rated power (h), and $n_c(t)$ is the total number of equivalent full charge-discharge cycles the system performs over time interval t . Calculations throughout this FOA assume a fixed input electricity price of 2.5 cents/kWh, 10% discount rate, and 20-year system lifetime. As indicated by the breakdown of system capital costs into power- and energy-related components, ARPA-E expects the majority of technical approaches that can achieve the program goals to have fully decoupled energy and power. Figure 1 provides a visual depiction of the LCOS and example relative cost contributions associated with system inefficiency, operations and maintenance, and capital expenditure.

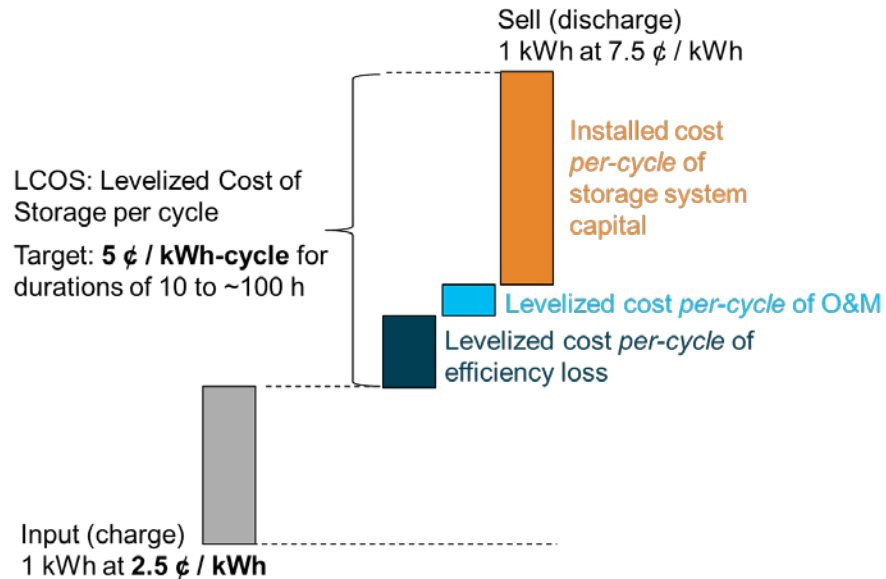


Figure 1. Illustration of economic targets for the program and one possible breakdown of LCOS. The fixed purchase price of electricity (2.5 cents/kWh) and the cost adder (i.e., the LCOS) for each kWh that is transacted through the storage asset (5 cents/kWh-cycle) are provided.

The principal target metric of the DAYS program is an LCOS of 5 cents/kWh-cycle. This aggressive metric is consistent with previous targets for daily cycling applications², with the key difference here being that the target LCOS *remains fixed across the entire range of durations under consideration*. In other words, the LCOS for a system with a 100-hour duration would be identical to that of a system with a 10-hour duration. The rationale for this choice is that it facilitates integration of increasing durations of electrical energy storage at a fixed per-cycle cost, thereby allowing storage systems to serve long-duration applications in which they have traditionally been cost prohibitive. As shown in Figure 2A, the implication of a fixed LCOS is that the total cost of the storage system over its lifetime, expressed on a per-unit-energy basis, must decrease as the frequency of storage system cycling decreases. This follows from the fact that the full energy stored by a long-duration storage system is accessed relatively infrequently, resulting in fewer total cycles and thus less total revenue per unit energy. The green shaded

² energy.gov/sites/prod/files/2013/12/f5/Grid%20Energy%20Storage%20December%202013.pdf

region in Figure 2A highlights the cycling frequencies and system lifetime costs of interest for the DAYS program.

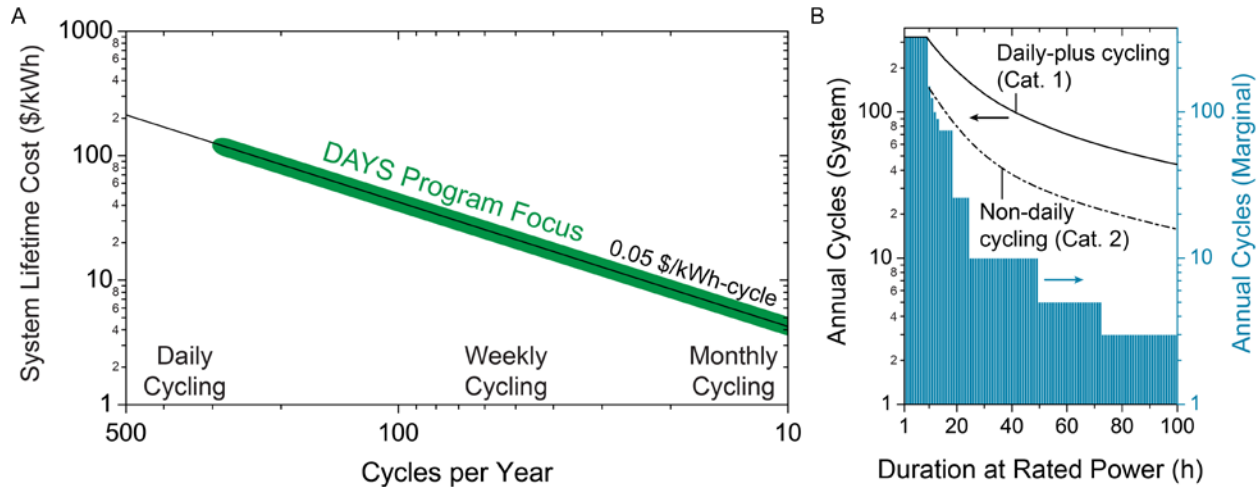


Figure 2. (A) Graphical representation of the decreasing system lifetime cost requirement as a function of the cycling frequency. The green highlighted region indicates the annual system cycle counts and lifetime costs of interest for the DAYS program. (B) Assumed duty cycle used to correlate cycle frequency and storage duration. Blue bars indicate the number of cycles each marginal hour of the storage system performs per year. The black lines represent the total cycle count for a system that cycles daily and beyond daily (solid line, Category 1) and a system that is only operated beyond daily (dashed line, Category 2).

Storage systems are typically designed and rated according to their energy-to-power ratio, in units of hours. Thus, it is important in the context of the DAYS program to also examine target costs as a function of duration. Converting from cycles per year to storage duration requires specification of a duty cycle for the system. The duty cycle ultimately derives from both the application(s) served and the system design. Relevant aspects of a duty cycle include the rate of charge and discharge (which often may be a fraction of the rated power), the depth of discharge during cycling, the dwell time spent at different states of charge, the operating temperature of the system, and other factors. ARPA-E is fully aware that there are numerous types of duty cycles, which in turn have implications for system economics. However, for the sake of this program, the duty cycle shown in Figure 2B will be used. This duty cycle is meant to be representative of a possible wind or solar firming application that maximizes use of the power block for a 100-hour system when the system cycles both daily and at less frequent intervals. The blue bars in Figure 2B indicate the number of cycles each marginal hour of the storage system performs per year, and sharply decrease at longer durations. The black lines are the total system cycle count, equal to the energy throughput for a given system per year normalized to the energy storage content at rated power. The solid line is relevant for Category 1 storage systems that include daily cycling as well as a diminishing number of cycles at longer durations. The dashed line is derived by excluding daily cycles (*i.e.*, the first ten hours) when calculating total system cycle count and reflects the lower annual cycles for Category 2 systems. While the duty cycle is not rigorously derived from one or a set of specific use cases, it points to a new design space for stationary electricity storage.

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Figure 3 uses the duty cycle shown in Figure 2B and quantifies the implication of a fixed LCOS across duration; *it is the key figure for the DAYS program*. Several points are important to call to attention. *First*, note that the system lifetime cost on the y-axis here is *not* the capital cost, but is derived from equation [1], and therefore *includes* capital costs, costs associated with system inefficiency, as well as other costs. Capital cost requirements are therefore *lower* than the values shown in this figure, and Applicants can explore tradeoffs between the costs associated with system inefficiency and capital costs, along with the other costs shown in equation [1]. *Second*, the gray box in the upper left corner shows the current costs and durations for new commercial installations (predominantly Li-ion). The durations are far shorter, and the costs higher, than the focus of the DAYS program. *Third*, system lifetime cost as a function of duration for two important baseline technologies – pumped-storage hydropower (PSH) and future Li-ion – are shown.³ At shorter durations, the value of Li-ion is clearly demonstrated, with costs below those of PSH up to durations of approximately 4-6 hours. The cost structure of Li-ion (with power costs coming from an inverter) is advantageous at durations of approximately 5 hours and less. However, Figure 3 shows that the cost structure of future Li-ion is fundamentally different than that of PSH at longer durations, as a result of a higher installed energy cost (optimistically assumed to be ~150 \$/kWh for future Li-ion vs. ~2 \$/kWh for PSH). *Fourth*, the figure shows the cost goal for daily cycling (Category 1) of the DAYS program. As described previously, Category 1 is for systems that accomplish *both* daily cycling (and therefore receive the high revenue streams associated with frequent use) *and* cycling at longer durations (and hence lower frequency). Clearly, the cost structure of Li-ion is fundamentally unable to achieve the Category 1 cost goal, while the cost structure of PSH meets and even exceeds the goal across the full range of durations of interest. Unfortunately, as discussed in the Technical Appendix, PSH projects have essentially ceased because of siting limitations and the uncertainty and cost of financing very large projects. And *fifth*, Figure 3 shows the cost goal for non-daily cycling (Category 2). Category 2 is for systems that are not required to provide daily cycling. They therefore miss out on the significant daily revenue stream, but also have less stringent performance requirements (e.g. cycle life and round-trip efficiency), which opens a new cost-performance design space for stationary storage systems. The cost targets for Category 2 begin at the 10 h duration mark in Figure 3, which reflects the fact that the values were derived by summing the revenues only beyond 10 hours (i.e. excluding daily cycling) according to the duty cycle in Figure 2B. However, Category 2 systems and subsystems do have a “first hour” of energy storage with respect to their operation. More information on system cost analysis is included in the Technical Appendix below.

³ Lifetime cost is calculated using LCOS according to equation [1] and the duty cycle in Figure 2B. Relevant assumptions for PSH are: $\eta_{RTE} = 85\%$, $\eta_D = 92\%$, $P_C = 0.025$ \$/kWh, fixed $O\&M = 2.50$ \$/kW-y, no replacements over 20 year project, $C_E = 2$ \$/kWh, $C_P = 1000$ \$/kW. And for future Li-ion batteries: $\eta_{RTE} = 81\%$, $\eta_D = 90\%$, $P_C = 0.025$ \$/kWh, fixed $O\&M = 5.00$ \$/kW-y, replacement cost of 150 \$/kWh, and a cycle life of 5000 cycles.

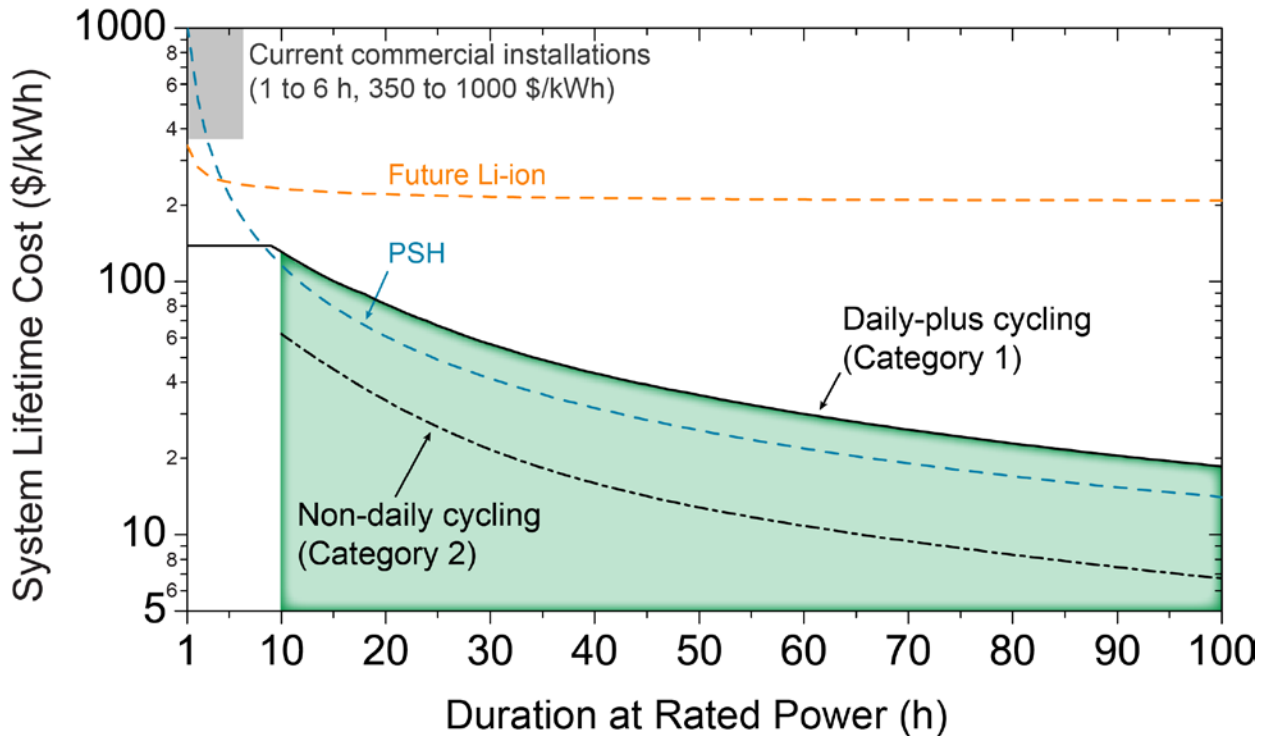


Figure 3. The key figure that defines the opportunity pursued in the DAYS program. The Category 1 and 2 goals correspond to a fixed LCOS of 5 cents/kWh-cycle across all durations and result in a falling system lifetime cost as the duration increases. Current commercial practice and the scaling of both Li-ion and PSH are indicated for comparison against program goals.

Finally, ARPA-E has specified an input electricity price of 2.5 cents/kWh for this program. With a fixed value for both the purchase price of electricity and the LCOS, Applicants can explore tradeoffs between the costs of system inefficiency, capital costs, and other costs. The choice of 2.5 cents/kWh reflects an estimate of future power purchase agreement (PPA) prices available to electric utilities and other buyers of wholesale electricity. Customers paying distribution expenses will always pay far more than 2.5 cents/kWh, so this goal is reflective of prices only accessible to large-scale and transmission-connected entities.

4. TECHNICAL APPENDIX

This section provides background and context on stationary storage and ARPA-E’s interest in LDES systems, as well as technical context relevant for potential Applicants to the DAYS program.

General background on electricity storage and its applications on the grid

Stationary electrical energy storage is widely recognized to play an important role in the present United States electricity system, and has the potential to play a significantly larger role

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in the future.⁴ Pumped-storage hydropower is by far the largest source of electricity storage on the grid today, consisting of about 22 GW of capacity and several hundred GWh of stored energy.⁵ A typical discharge time for a PSH facility is 6 to 10 hours, which primarily fulfills daily energy time shift applications. There have been few new PSH installations in the U.S. in the past 25 years as a result of the difficulty of permitting new sites and financing large projects, preventing the grid from accessing more of the types of services offered by PSH. Recently, battery and other electricity storage technology installations have grown, but are still a small fraction as compared to PSH (<5% on a power-capacity basis and even lower on an energy basis).

The services provided by stationary electricity storage, both by large, centralized, transmission-connected assets, as well as smaller, distributed assets, have been carefully described in a number of reports.⁶ Those services include frequency regulation, peaking capacity, energy time shift (which can benefit numerous types of generation assets, including both baseload and intermittent), transmission and distribution system upgrade deferral, black start capacity, backup power, demand charge reduction, and others. Indeed, the benefits offered by electricity storage are widely recognized; the limited rate of current deployment is due to high costs, siting challenges (e.g., for PSH), and unfavorable market structures, rather than a lack of technical benefits.

At present, there is substantial commercial excitement and activity around stationary storage, largely driven on the technology side by the scale up of Li-ion batteries resulting from growing opportunities in the automotive sector. Because of their increasing economies of scale, as well as their ubiquity in a growing number of applications, Li-ion batteries are an important benchmark for stationary storage technologies, including those envisioned to provide long-duration storage services. Recent reports suggest that tens of gigawatts of Li-ion capacity will be put in service over the next fifteen years, in some cases serving as a lower cost alternative to simple-cycle natural gas peaker plants.⁷ Other storage technologies, including flow and non-flow batteries and a host of other technology classes, are also being scaled up to serve market applications primarily associated with daily energy time shift. However, due to the high marginal costs of scaling the quantity of stored energy, Li-ion batteries and many other competing technologies are severely limited in their ability to economically scale to durations beyond 10 hours. Much of the Li-ion storage capacity that is expected to be added in the coming 15 years will have a duration at rated power of 2 to 6 hours.

Rationale for work on long-duration electricity storage

The vast majority of commercial electricity storage deployments, as well as research into new forms of stationary electricity storage, focus on systems with durations of under ten hours at

⁴ <http://www.sandia.gov/ess/publications/SAND2010-0815.pdf>

⁵ <https://www.eia.gov/todayinenergy/detail.php?id=31372>

⁶ <http://www.sandia.gov/ess/publications/SAND2010-0815.pdf>

⁷ Manghani, Ravi, "Will Energy Storage Replace Peaker Plants?," March, 2018, gtmresearch.

Lubersbane, Andy, "Following the Grid Storage Current: Technology, cost, economics," April 8, 2016, IHS Energy.

rated power. This focus is well placed given the clear diurnal pattern of electricity load throughout the year. Several other applications, such as transmission and distribution upgrade deferral and demand charge management, also show strong daily patterns.

However, there are several electricity storage applications that would benefit from durations substantially longer than ten hours. Backup power is one example in which tens of hours of electrical energy storage would provide critical services during an extended grid outage associated with a storm or other event. Extended backup power is typically served today with natural gas or diesel generators designed to solely provide backup capacity.

Another important application for LDES is the integration of large amounts of intermittent wind and solar in a future (ca. post-2030) regional electricity grid. Onshore wind and solar photovoltaics (PV) are now the cheapest forms of new electricity generation in the United States. In favorable locations, the future unsubsidized levelized cost of energy (LCOE) of these technologies will be at or below 2.5 cents/kWh.⁸ These low prices for wind and solar create a substantial opportunity for the United States, through the reduction in electricity bills and through an increase in the ability to maintain low natural gas prices for use in the chemical industry or for export. However, wind and solar, with their characteristic intermittency, do not provide dispatchable power output. Strategies to mitigate inherent fluctuations in variable renewable generation must therefore be implemented on a large scale if these resources are to be used extensively on the grid while maintaining resiliency and reliability of the network. Widely accepted approaches to manage variability and uncertainty and increase the penetration of wind and solar generation include energy storage, transmission expansion, curtailment, and load flexibility. Each method has unique advantages and limitations, with cost being the longstanding challenge for stationary electricity storage, particularly as systems are scaled to increasingly greater amounts of stored energy and longer durations. The relative importance of storage versus other approaches will depend on the costs of storage, geographic region (where resources such as transmission capacity differ), policy, and other factors.

Numerous modeling studies have demonstrated that electricity storage systems with up to approximately eight hours of duration can significantly increase the amount of energy from wind and solar that can be utilized on a large regional grid (e.g., CAISO or ERCOT).⁹ Most studies of high wind and solar penetrations consider levels up to about 50% on an annual energy basis, and often include simplifying assumptions such as large-scale geographic averaging, lossless and limitless transmission, and perfect generation forecasting. Despite these idealities, it is clear that increasing the duration of electricity storage will allow greater penetration of low-cost wind and solar resources. As a corollary, achieving high levels of variable renewable penetration requires multi-day electrical energy storage and even seasonal energy arbitrage in extreme cases.¹⁰ However, additional modeling work is needed to accurately quantify the

⁸ https://emp.lbl.gov/sites/default/files/2016_wind_technologies_market_report_final_optimized.pdf
https://www.energy.gov/sites/prod/files/2016/12/f34/SunShot%202030%20Fact%20Sheet-12_16.pdf

⁹ <https://www.nrel.gov/docs/fy16osti/66595.pdf>, <https://doi.org/10.1016/j.enpol.2011.01.019>,
DOI: 10.1038/nclimate3045

¹⁰ DOI: 10.1039/c7ee03029k

impact of LDES on wind and solar penetration at the regional level, and should include realistic handling of grid power flow constraints, network stability, contingency requirements, opportunity costs of curtailed energy, limits to load flexibility, and other parameters necessary to capture the full complexity of delivering power within a large electricity system.

An alternate opportunity for LDES systems is firming of individual wind and/or solar installations. Highly dispatchable variable renewable generator-plus-storage assets, enabled by substantial quantities of stored electricity and proper sizing of power components, would provide significantly more value to the grid compared to today's co-located systems that are typically limited to storage durations of 4 to 6 hours or less.¹¹ This application is likely to be more near-term relative to operation as standalone, transmission connected LDES assets. Depending on the location (e.g., Maine vs. Arizona), asset type (e.g., solar vs. wind), and desired output shape (e.g., peaker vs. baseload), storage systems with tens to approximately 100 hours of duration can in many cases deliver the desired output across greater than 90% of the hours in given year (assuming rated power of storage is commensurate with the desired output power).¹² Long-duration storage thus has the potential to grant wind and solar PV resources a character similar to baseload and dispatchable fossil fuel generators.¹³

In summary, ARPA-E sees some applications that for the right performance and cost would be interested in long-duration storage products immediately (e.g., backup power, off-grid applications, dispatchable solar or wind installations), while other applications (e.g., large-scale, grid-tied LDES systems) may not see significant market demand until further into the future.

The economics and operation of long-duration electricity storage systems

The range of possible storage applications, each with its own unique value proposition, complicates stationary electricity storage economics. Moreover, it is possible to "stack" multiple storage services, resulting in a new duty cycle that superposes the contributions of several individual applications. In deregulated markets, the locational marginal price of wholesale electricity also varies over time, and it is necessary to forecast future market prices when deciding when to buy and sell in the case of energy arbitrage.

While ARPA-E is fully aware of the variety of value streams available to storage, the metrics in this program are based on a single levelized cost of storage (LCOS) target, as defined in Section B.3 equation [1] above. This equation represents high level economic considerations for storage costs. Applicants should carefully consider how the underlying physical properties and characteristics of their proposed approach influence each of the relevant parameters in equation [1]. Where appropriate, Applicants are encouraged to consult established

¹¹ <https://www.pv-tech.org/news/aes-and-kiuc-break-ground-on-hawaiis-largest-solar-plus-storage-system>

¹² https://arpa-e.energy.gov/sites/default/files/1c_Ferrara_2017_1207%20ARPA-E%20Workshop%20TE%20Presentation%20With%20Back-Up.pdf

¹³ In terms of effective load carrying capacity (i.e. the derating of the power of a generator relative to a perfect generator in a given system) and the ability to provide power reliably within a predetermined generation profile.

technoeconomic analyses available for various storage classes, including redox flow batteries, various types of thermal storage, and mechanical systems, to ground system-specific assumptions for cost and performance.¹⁴

To provide a concrete example of the implication of achieving an LCOS of 5 cents/kWh-cycle across durations up to 100 hours, if half of the electricity produced by a wind or solar plant at 2.5 cents/kWh LCOE passed through a co-located storage device with an LCOS of 5 cents/kWh-cycle (i.e. discharge price of 7.5 cents/kWh-cycle), the overall cost of electricity from the combined generator plus storage system would be 5 cents/kWh, a price expected to be competitive with electricity generated by future combined cycle natural gas plants.¹⁵ With 90% flowing through the storage asset, the combined LCOE would still be competitive at 7 cents/kWh. With a fixed LCOS across durations up to 100 hours, these costs would result in new classes of generation assets with dispatchability over time scales of days, even without the input of additional wind or solar energy.

The opportunity defined in Figure 3 can be broken down in terms of the design space for power and energy system lifetime costs, as shown in Figure 4. Note that the power and energy costs are on a system-lifetime basis, and therefore include the installed capital cost, operation (which includes the cost of electricity lost in system inefficiency) and maintenance associated with these components, and any other costs. The curves in Figure 4 were derived from the relation

$$\lambda_P = (\lambda_T - \lambda_E) d \quad [2]$$

where λ_T is the total system lifetime cost per unit energy obtained from Figure 3, λ_E is the lifetime cost of energy (\$/kWh), λ_P is the lifetime cost of power (\$/kW), and d is the storage duration at rated power (h). It is important to note that stationary storage cost reporting is convoluted by the fact that total system cost can be conveyed on either a per-unit-energy or per-unit-power basis by simple rearrangement of equation [2], whereas power and energy subsystem costs are always reported using their respective units. For purposes of this program, Applicants must report all system-level costs in \$/kWh. As in Figure 3, solid curves in Figure 4 correspond to daily-plus cycling (Category 1), while dashed curves correspond to non-daily cycling (Category 2). Three system durations are shown for each category: 10 h, 50 h, and 100 h. The importance of energy costs for LDES systems is readily apparent, with the cost contours trending toward verticality as duration at rated power increases. In the extreme limits of duration, the system cost asymptotes at the marginal system lifetime energy cost, λ_E (i.e. the cost required to add one additional unit of energy).¹⁶ In addition, the cost breakdown for non-daily cycling (Category 2) shows low required system lifetime power costs as well, with an upper limit of around 600 \$/kW. Because of this constraint on power costs, the idea of

¹⁴ For example, DOI: 10.1039/C4EE02158D; DOI: 10.1016/j.jpowsour.2016.08.129; energy.gov/sites/prod/files/2014/08/f18/fcto_2014_electrolytic_h2_wkshp_coella1.pdf; DOI: 10.1016/j.apenergy.2016.10.045; nrel.gov/docs/fy17osti/67464.pdf; osti.gov/servlets/purl/981926; caes.pnnl.gov/pdf/PNNL-22235.pdf

¹⁵ https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf

¹⁶ DOI: 10.1016/j.joule.2017.08.007

leveraging an existing power block (for example, an existing turbine, or an existing flow battery stack), and adding on energy storage, such that the power costs are (nearly) “free,” is one potential technical approach to meet the challenging non-daily cycling (Category 2) targets.

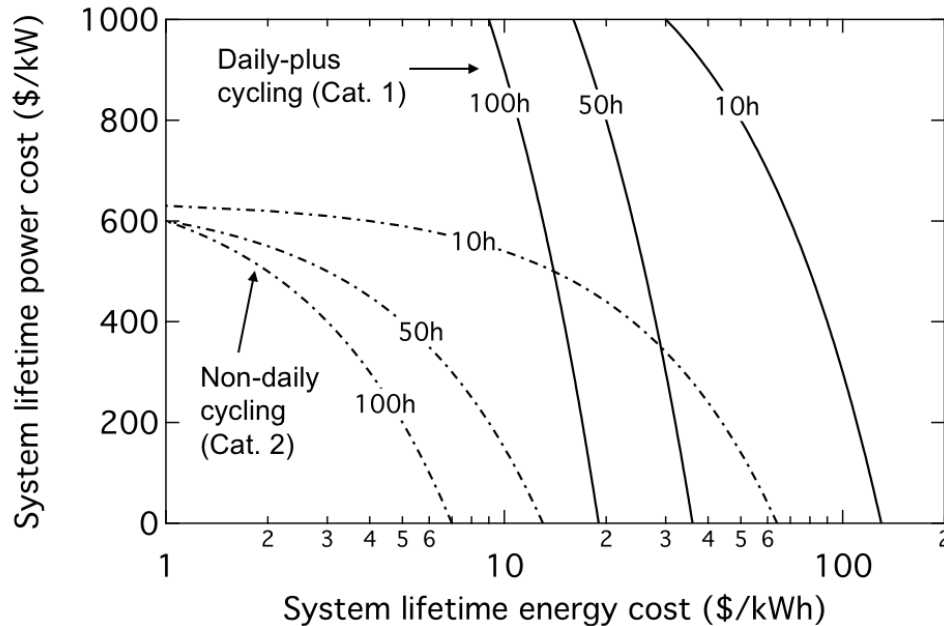


Figure 4. Breakdown of system lifetime energy and power costs for systems of various durations at a fixed LCOS of 5 cents/kWh-cycle. Cost contours for storage assets cycled both daily (Category 1) and non-daily (Category 2) are provided. Contours are derived from the full system costs shown in Figure 3 for the indicated durations. Note that costs associated with system inefficiency are proportional to energy throughput and are therefore considered part of the system lifetime energy costs.

Given the outsized impact of energy-related costs on total system costs for both categories, it is important to note that those expenses are inclusive of the energy storage medium, the container used to hold the energy storage medium, any additional balance-of-plant (BOP) costs, installation, and maintenance throughout the system lifetime. Figure 5 provides important context for two of the key cost drivers for the energy portion of a system: the capital cost of the energy storage media and capital cost of the containment. Figure 5A shows example storage media capital costs for four major classes of storage media, while Figure 5B shows containment capital costs as a function of energy density. Looking in more detail first at Figure 5A, note that capital costs are expressed on both a \$/kWh and a \$/L basis, and diagonal lines correspond to fixed energy densities (kWh/L). While there is not a hard cutoff on storage media capital costs, based on the system lifetime energy costs in Figure 4, capital costs in the range of approximately 5 to 20 \$/kWh, depending on duration at rated power, are of interest. Figure 5A shows that a number of energy storage media can potentially meet this criterion, including some that are nearly free (e.g., rocks), common chemicals (e.g., hydrogen, ammonia, and liquid air), and some materials already used for energy storage (e.g., molten salts and an Fe-based active material used in some flow batteries, FeCl_2). For two common flow battery reactants – FeCl_2 and VOSO_4 – values of the energy density are shown for both the concentration typically

used to flow through the stacks (~1.5M) *and* the approximate energy density when the aqueous solvent and supporting salt are removed. Removing the aqueous solvent and supporting salt is one way to increase the energy density by roughly an order of magnitude, reducing tank, BOP, and installation costs, although the cost of the energy storage media itself (on a \$/kWh basis) stays roughly fixed, because the cost of the aqueous solvent and supporting salts are nearly negligible. Figure 5B shows the cost of containment as a function of energy density for several relevant containment vessels. Again, there is not a hard cutoff on containment capital costs, but values up to approximately 20 \$/kWh are of interest. Figure 5B shows the critical importance of the energy density to the containment cost, and emphasizes the importance of achieving an energy density (for all required reactants) of at least 0.1 kWh/L. For the containment of high-temperature materials requiring calcium aluminates or other materials with high strength at high temperatures, an energy density approaching or exceeding 1 kWh/L is preferable. It is also important to note that some storage approaches require secondary containment, for example if a hazardous liquid is being stored, and that must also be included in the containment cost. Overall, ARPA-E intends Figure 5 to provide Applicants with quantitative context for the design tradeoffs among capital cost, energy density, and discharge efficiency (which impacts sizing and quantity of energy-related materials and components). As a final comment, energy density is a key property because it directly influences not only the cost of containment, but also the cost of shipping, site preparation, installation, piping between containment vessels, etc.

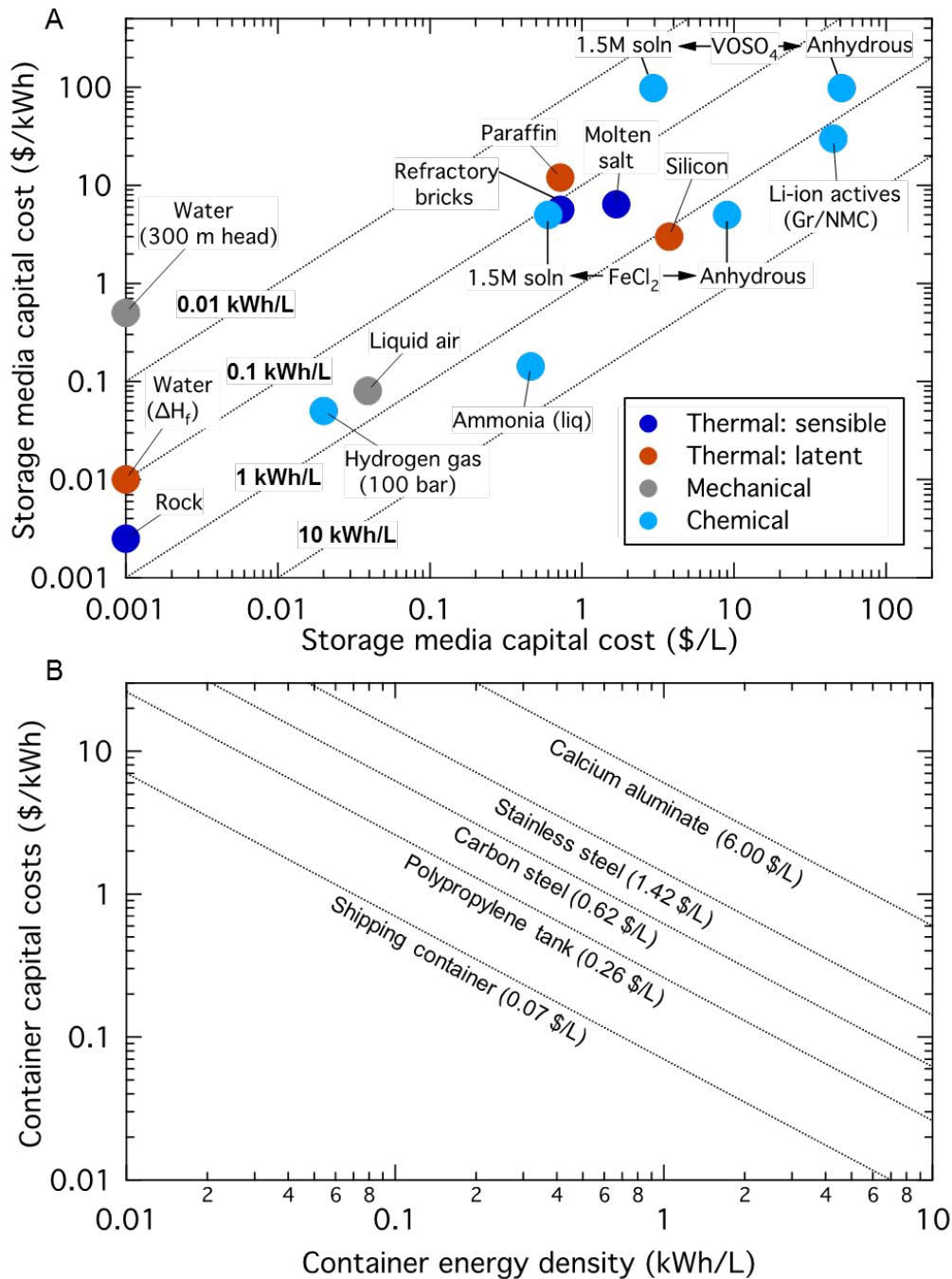


Figure 5. Overview of the capital costs for two of the key energy-related components of system lifetime energy cost. Panel A shows approximate capital costs of energy storage media, while Panel B shows capital costs of a variety of container types. The sum of these two costs should still be significantly below the system lifetime energy costs shown in Figure 4 (for a particular category and system duration) to provide budget for installation, maintenance, and other costs. Note that all of the capital costs in Figure 5 *do not* account for the discharge efficiency in the energy basis; for example, the value for molten salt is the sensible heat in the salts within its working range, not the electrical energy emerging from the power cycle.

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Finally, as discussed in the list of suggestions provided in section B.3 above, one area of technical interest is the development of approaches in which the attributes of the storage units, including storage media and/or containment vessels, depend on the frequency of cycling and thus duration. Figure 6 provides a graphical depiction of such an approach, showing three energy storage attributes that change as a function of duration: energy density (which increases as a function of duration to reduce the cost of containment, installation, etc.), thermal insulation (which is required to increase as a function of duration because of the longer dwell times between cycles coupled with the need to maintain a sufficient round-trip efficiency that meets the 5 cents/kWh-cycle LCOS target), and cycle life (which can fall with increasing duration because fewer cycles are accumulated). The idea is that the increased energy density and reduced cycle life can be used to reduce the lifetime system energy cost, even while the need to increase the amount of thermal insulation adds to costs as the duration increases. The concept presented in Figure 6 may have applications to thermal, chemical, and mechanical systems, and explorations of these concepts is an area of interest for the program.

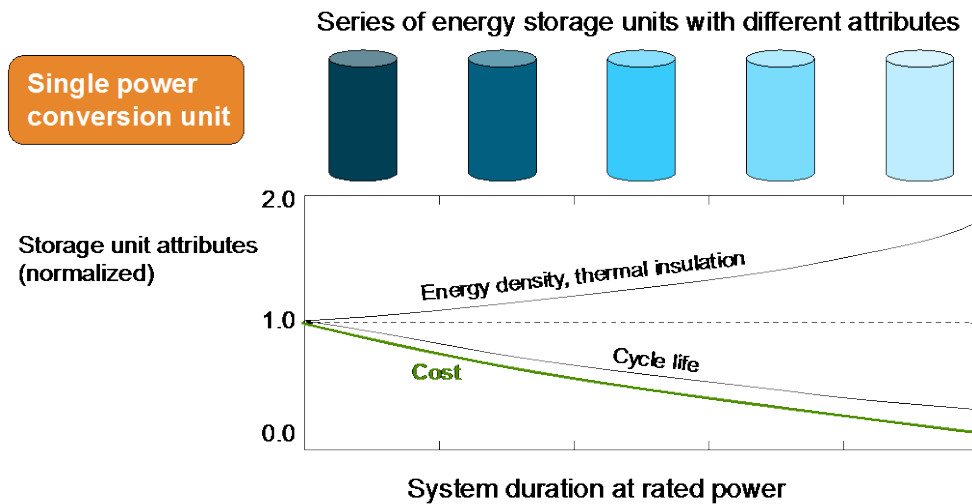


Figure 6. Schematic of a long-duration storage system with a series of energy storage units with different attributes, all sharing a single power conversion unit.

II. AWARD INFORMATION

A. AWARD OVERVIEW

ARPA-E expects to make a maximum of \$30 million available for awards under this FOA, subject to the availability of appropriated funds. ARPA-E anticipates making approximately 10 to 15 awards under this FOA. ARPA-E may, at its discretion, issue one, multiple, or no awards.

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

The period of performance for funding agreements may range from 18 to 36 months. ARPA-E expects the start date for funding agreements to be January 2019, or as negotiated.

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

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

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

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

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

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

B. ARPA-E FUNDING AGREEMENTS

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

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."¹⁷ Accordingly, ARPA-E has substantial involvement in the direction of every Cooperative Agreement, as described in Section II.C below.

1. COOPERATIVE AGREEMENTS

ARPA-E generally uses Cooperative Agreements to provide financial and other support to Prime Recipients.¹⁸

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

2. 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 the rest of 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.

¹⁷ U.S. Congress, Conference Report to accompany the 21st Century Competitiveness Act of 2007, H. Rpt. 110-289 at 171-172 (Aug. 1, 2007).

¹⁸ The Prime Recipient is the signatory to the funding agreement with ARPA-E.

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 rest of 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 a FFRDC or GOGO will have similar terms and conditions as ARPA-E's Model Cooperative Agreement (<http://arpa-e.energy.gov/arpa-e-site-page/award-guidance>).

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.

3. TECHNOLOGY INVESTMENT AGREEMENTS

ARPA-E may use its "other transactions" authority under the America COMPETES Reauthorization Act of 2010 or DOE's "other transactions" authority under the Energy Policy Act of 2005 to enter into Technology Investment Agreements (TIAs) with Prime Recipients. ARPA-E may negotiate a TIA when it determines that the use of a standard cooperative agreement, grant, or contract is not feasible or appropriate for a project.

A TIA is more flexible than a traditional financial assistance agreement. In using a TIA, ARPA-E may modify standard Government terms and conditions. See 10 C.F.R. § 603.105 for a description of a TIA.

In general, TIAs require a cost share of 50%. See Section III.B.2 of the FOA.

C. STATEMENT OF SUBSTANTIAL INVOLVEMENT

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

- Awardees 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

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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.
- 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. §§ 200.338 and 200.339.
- 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 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,¹⁹ as the lead for a Project Team,²⁰ or as a member of a Project Team. However, ARPA-E will only award funding to an entity formed by the Applicant.

¹⁹ A Standalone Applicant is an Applicant that applies for funding on its own, not as part of a Project Team.

²⁰ The term “Project Team” is used to mean any entity with multiple players working collaboratively and could encompass anything from an existing organization to an ad hoc teaming arrangement. A Project Team consists of the Prime Recipient, Subrecipients, and others performing or otherwise supporting work under an ARPA-E funding agreement.

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2. DOMESTIC ENTITIES

For-profit entities, educational institutions, and nonprofits²¹ 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

U.S. incorporated subsidiaries of foreign entities, whether for-profit or otherwise, are eligible to apply for funding under this FOA as a Standalone Applicant, as the lead organization for a Project Team, or as a member of a Project Team, subject to the requirements in 2 Code of the Federal Regulation (CFR) 910.124, which includes requirements that the entity's participation in this FOA's Program be in the economic interest of the U.S. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate.

Entities not incorporated in the U.S., whether for-profit or otherwise, are not eligible to apply for funding, but may be proposed by an Applicant as a member of a Project Team.

All work under an ARPA-E award must be performed in the U.S. The Applicants 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/>. Please refer to the Business Assurances & Disclosures Form for guidance on the content and form of the request.

Also, refer to Section VIII.G.3, which addresses U.S. manufacturing requirements for inventions arising from research projects funded by this Program.

²¹ 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.

4. CONSORTIUM ENTITIES

Consortia, which may include domestic and foreign entities, must designate one member of the consortium as the consortium representative to the Project Team. The consortium representative must be incorporated in the United States. The eligibility of the consortium will be determined by reference to the eligibility of the consortium representative under Section III.A 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 SHARING²²

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.B.1 of the FOA). Under a Cooperative Agreement or Grant, the Prime Recipient must provide at least 20% of the Total Project Cost²³ as cost share, except as provided in Sections III.B.2 or III.B.3 below.²⁴

²² Please refer to Section VI.B.3-4 of the FOA for guidance on cost share payments and reporting.

²³ 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.

²⁴ Energy Policy Act of 2005, Pub.L. 109-58, sec. 988.

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).

2. INCREASED COST SHARE REQUIREMENT

Large businesses 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).

Under a Technology Investment Agreement, the Prime Recipient must provide at least 50% of the Total Project Cost as cost share. ARPA-E may reduce this minimum cost share requirement, as appropriate.

3. REDUCED COST SHARE REQUIREMENT

ARPA-E has reduced the minimum 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.
- Small businesses – or consortia of small businesses – will provide 0% cost share from the outset of the project through the first 12 months of the project (hereinafter the “Cost Share Grace Period”).²⁵ 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%, but less than 100%, of the total work under the funding agreement (as measured by the Total Project Cost) the Project Team 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.²⁶
- Project Teams composed exclusively of domestic educational institutions, domestic nonprofits, and/or FFRDCs are required to provide at least 5% of the Total Project Cost as cost share.

²⁵ Small businesses are generally defined as 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>). Applicants that are small businesses will be required to certify in the Business Assurances & Disclosures Form that their organization meets the SBA’s definition of a small business under at least one NAICS code.

²⁶ See the information provided in previous footnote.

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- 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 minimum cost share requirements described in Sections III.B.1 and III.B.2 of the FOA.

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 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.G.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 not 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;
- Federal funding or property (e.g., Federal grants, equipment owned by the Federal Government); or
- Expenditures that were reimbursed under a separate Federal program.

In addition, Project Teams may not use independent research and development (IR&D) funds²⁷ to meet their cost share obligations under cooperative agreements. However, Project Teams may use IR&D funds to meet their cost share obligations under Technology investment 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

²⁷ As defined in Federal Acquisition Regulation Subsection 31.205-18.

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.

C. OTHER

1. COMPLIANT CRITERIA

Notices of Intent are deemed compliant if:

- The Applicant entered all required information and clicked the "Create Submission" button in ARPA-E eXCHANGE by the deadline stated in the FOA.

ARPA-E may not review or consider noncompliant Notices of Intent, including Notices of Intent submitted through other means, Notices of Intent submitted after the applicable deadline, and incomplete Notices of Intent. ARPA-E will not extend the submission deadline for Applicants that fail to submit required information and documents due to server/connection congestion.

Full Applications are deemed compliant if:

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

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

Replies to Reviewer Comments are deemed compliant if:

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

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

2. RESPONSIVENESS CRITERIA

ARPA-E performs a preliminary technical review of Full Applications.

The following types of submissions may be deemed nonresponsive and may not be reviewed or considered:

- Submissions that fall outside the technical performance metrics specified in Section I.B.3 of the FOA.
- Submissions that have been submitted in response to other currently issued ARPA-E FOAs.
- Submissions that are not scientifically distinct from applications submitted in response to other currently issued ARPA-E FOAs.
- Submissions for basic research aimed solely at discovery and/or fundamental knowledge generation.
- Submissions for large-scale demonstration projects of existing technologies.
- Submissions for proposed technologies that represent incremental improvements to existing technologies.
- Submissions for proposed technologies that are not based on sound scientific principles (e.g., violates a law of thermodynamics).

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).

- 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 scientifically distinct from existing funded activities supported elsewhere, including within the Department of Energy.
- 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.

3. SUBMISSIONS SPECIFICALLY NOT OF INTEREST

Submissions that propose the following may be deemed nonresponsive and may not be merit reviewed or considered:

- Approaches seeking incremental improvements to Li-ion batteries, including incremental improvements to Li-ion battery materials and architectures.
- Approaches seeking incremental improvements to other storage technologies already under development, including electrochemical (e.g., flow batteries), chemical (e.g., hydrogen), mechanical (e.g., compressed air), and other storage technology classes.
- Demonstration projects that do not include a significant degree of technical risk.
- Approaches for which the capital cost of the energy storage media and the containment, as shown in Figure 5 of Section I.B.4, will prevent reaching the LCOS cost target.
- Technologies that are not suitable for siting throughout the entire United States. Technologies may make use of below ground storage (e.g., a sub-surface tank), but technologies that rely on site-specific geologic structures are specifically not of interest.
- Technologies that are not charged solely by electricity, and produce electricity as the sole output.

4. LIMITATION ON NUMBER OF SUBMISSIONS

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

IV. APPLICATION AND SUBMISSION INFORMATION

A. APPLICATION PROCESS OVERVIEW

1. REGISTRATION IN ARPA-E eXCHANGE

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

2. NOTICES OF INTENT

Applicants must submit a Notice of Intent by the deadline stated in the FOA. Applicants should submit a Notice of Intent early in the FOA process. Failure to comply with this requirement will render the Applicant's Full Application ineligible for consideration. Section IV.C of the FOA provides instructions on submitting a Notice of Intent.

ARPA-E performs a preliminary review of Notices of Intent to determine whether they are compliant, as described in Section III.C of the FOA. ARPA-E will not review or consider noncompliant Notices of Intent.

3. FULL APPLICATIONS

Applicants must submit a Full Application by the deadline stated in the FOA. Section IV.D of the FOA provides instructions on submitting a Full Application.

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

4. REPLY TO REVIEWER COMMENTS

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

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).

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

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

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

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

6. SELECTION FOR AWARD NEGOTIATIONS

ARPA-E carefully considers all of the information obtained through the application process and makes an independent assessment of each compliant and responsive Full Application based on the criteria and program policy factors in Sections V.A.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 OF NOTICES OF INTENT

The Notice of Intent is mandatory (i.e. in order to submit a Full Application, a compliant Notice of Intent must have been submitted). Each Applicant must enter the following information into ARPA-E eXCHANGE by the deadline stated in the FOA:

- Project Title;
- Lead Organization;
- % of effort contributed by the Lead Organization; and
- The Project Team, including:
 - The Principal Investigator for the Prime Recipient;
 - Team Members (i.e., Subrecipients); and
 - Key Participants (i.e., individuals who contribute in a substantive, measurable way to the execution of the proposed project).

Each Notice of Intent should be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Notice of Intent.

ARPA-E may not review or consider noncompliant Notices of Intent (see Section III.C of the FOA).

D. 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 centerpiece of the Full Application. Provides a detailed description of the proposed R&D project and Project Team. A Technical Volume template is available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov).
SF-424	PDF	Application for Federal Assistance (https://arpa-e-foa.energy.gov). 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 (https://arpa-e-foa.energy.gov)

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).

Summary for Public Release	PDF	Short summary of the proposed R&D project. Intended for public release. A Summary for Public Release template is available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov).
Summary Slide	PPT	A four-panel project slide summarizing different aspects of the proposed R&D project. A Summary Slide template is available on ARPA-E eXCHANGE (https://arpa-e-foa.energy.gov).
Business Assurances & Disclosures Form	PDF	Requires the Applicant to make responsibility disclosures and disclose potential conflicts of interest within the Project Team. Requires the Applicant to describe the additionality and risks associated with the proposed project, disclose applications for funding currently pending with Federal and non-Federal entities, and disclose funding from Federal and non-Federal entities for work in the same technology area as the proposed R&D project. If the Applicant is a FFRDC/DOE Lab, requires the Applicant to provide written authorization from the cognizant Federal agency and, if a DOE/NNSA FFRDC/DOE Lab, a Field Work Proposal. Allows the Applicant to request a waiver or modification of the Performance of Work in the United States requirement and/or the Technology Transfer & Outreach (TT&O) spending requirement. This form is available on ARPA-E eXCHANGE at https://arpa-e-foa.energy.gov . A sample response to the Business Assurances & Disclosures Form is also available on ARPA-E eXCHANGE.
U.S. Manufacturing Plan	PDF	As part of the application, Applicants are required to submit a U.S. Manufacturing Plan. The U.S. Manufacturing Plan represents the Applicant’s measurable commitment to support U.S. manufacturing as a result of its award. See detailed U.S. Manufacturing Plan instructions and examples in the Seventh Component description below.

ARPA-E provides detailed guidance on the content and form of each component below.

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 following content and form requirements, including maximum page lengths specified below. If Applicants exceed the maximum page lengths specified for each section indicated below, ARPA-E will review only the authorized number of pages and disregard any additional pages.

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, ARPA-E and reviewers are under no obligation to review cited sources (e.g., internet websites).

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).

<u>PAGE LIMIT</u>	<u>SECTION</u>	<u>DESCRIPTION</u>
1 page max.	EXECUTIVE SUMMARY	<p>Summarize the objective(s) and technical approach of the proposed effort at a technical level appropriate for scientific and engineering peers. Include a figure of the proposed system and identify the areas for innovation. Place this same figure in the Summary Slide described in Section IV.D of the FOA.</p> <p>INSTRUCTIONS:</p> <ol style="list-style-type: none"> (1) The Project Title should be brief and descriptive of the proposed technology. (2) Enter the category the application is targeted towards (Daily plus – Category 1, or Non-Daily – Category 2), and the targeted system duration at rated power. (3) Provide the Total Project Cost in U.S. dollars and percentage cost share in parentheses, and the project duration in months. (4) The Executive Summary must include a figure that presents the overall system, including its components and working principle (for example, arrows showing flow of materials or energy). Denote the areas of focus in the proposed project with bold text or other notation. (5) The Executive Summary shall not exceed 1 page in length.
Sections 1-5 12 pages max.	Section 1 PROPOSED SYSTEM, INNOVATION, AND STATE OF THE ART	<p>Provide a description of the proposed system, the areas targeted for innovation in that overall system, and any relevant context on the state of the art that is not available in the literature or other public sources.</p> <ul style="list-style-type: none"> • Describe the proposed system, referencing the figure in the Executive Summary, and emphasizing how the approach handles the design tradeoffs inherent in achieving the program metrics. • Fill out and provide the information requested in the Proposed System Specifications Table below. • Describe how the proposed effort represents a new and innovative solution to the overall program challenge described in the FOA. • Provide any relevant context on the state of the art that is not available in the literature or other public source(s). Relevant information on the state of the art that is available in publications can be referenced. <p>Below is a table of required information for Section 1 of the Technical Volume. Please fill out and insert this table into Section 1 of your application. Please remove all text in the first column other than that underlined and expand the right column to provide the maximum space for your answer. The purpose of this table is for reviewers to have more granular information on the target technical specifications of the proposed system to achieve the high-level metrics in Section I.B.3. of the FOA. ARPA-E</p>

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

		<p>understands that important assumptions lie behind the values requested in this table, especially for costs, and Applicants should be careful to provide information on their key assumptions for reviewer consideration. In addition, information in this table (or elsewhere in Section 1) should identify and address any of the applicable common key drivers of system cost, and methods to mitigate those costs. Common key cost drivers include: low energy density, expensive materials (e.g., platinum-group metal catalysts), the presence of corrosive, toxic, and/or flammable storage media or other system materials, high temperatures that increase containment costs, elevated pressures that increase containment costs, the need for expensive site preparation such as excavation, and others.</p> <p>INSTRUCTIONS:</p> <p>(1) This section may include one or more additional figures that focus in more detail on the proposed innovations or other aspects of the proposed system, as well as tables or other graphics.</p> <p>(2) The suggested length of the Innovation Section is 4 to 5 pages.</p>
	<p>Section 2 PROPOSED WORK AND ANY INITIAL OR RELEVANT RESULTS</p>	<p>Describe the R&D tasks, the key technical risks, and any initial or related results that support the approach. This Section should justify the proposed approach as being appropriate to achieve the project’s objective(s).</p> <ul style="list-style-type: none"> • State the size of the power (in units of W or kW) and/or energy (in units of Wh or kWh) of any component(s) and/or system(s) to be physically built and tested in the project. • Describe the technical approach and how this approach will achieve the proposed project objective(s). • Describe the background, theory, simulation, modeling, experimental data, or other initial results or principles that support achieving the project objective(s). Provide specific examples of supporting data and/or appropriate citations to the scientific and technical literature. • Identify potential technical issues and risks, e.g., the approach requires a never-before-demonstrated fabrication technique or greater-than-previously-demonstrated sub-component performance, etc. • Provide a schedule for the proposed effort by major tasks, including major milestones or Go/No-Go decision points as appropriate. (A Gantt chart is recommended.) • Identify and provide a description for each main task in the proposed effort. • Describe the key technical milestones and how these define the critical path for successful completion of the task. <p>INSTRUCTIONS:</p>

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

		<p>(1) The Proposed Work Section may include figures, tables, and graphics. (2) The suggested length of the Proposed Work Section is 4 to 5 pages.</p>
	<p>Section 3 TEAM ORGANIZATION AND CAPABILITIES</p>	<p>Describe and discuss the organization, capabilities, and management of the team and how these enable successful execution of the proposed effort.</p> <ul style="list-style-type: none"> • Indicate roles and responsibilities of the organizations on the proposed Project Team, e.g., subrecipient, consultant, subcontractor, or lead organization for each of the project tasks. Include relevant organization charts and teaming organization charts, if appropriate. • Identify Key Personnel, describe how their qualifications relate to the proposed effort, and indicate their roles and responsibilities for each of the project tasks. • Identify capabilities of the Applicant or proposed Project Team, e.g., relevant experience, previous or current R&D efforts, or related government or commercial projects, that support the proposed effort. <p>INSTRUCTIONS:</p> <p>(1) This Section may include figures, tables, and graphics. (2) The suggested maximum length of the Team Section is 1 page.</p>
	<p>Section 4 TECHNOLOGY TO MARKET</p>	<p>For ARPA-E to achieve its mission, projects must ultimately find a path to large-scale adoption. ARPA-E asks the Applicant to describe how the proposed technology is expected to transition from the lab to commercial deployment.</p> <ul style="list-style-type: none"> • Describe the product eventually to be sold, and the contribution of your technology to that product. Consider the initial product as well as ultimate products. • Identify prospective organizations that would be interesting in hosting and evaluating your particular long duration energy storage system. Describe why they would be interested, what size they would want (i.e. kW/kWh), and other potential needs/constraints. • Discuss who your first partners might be and describe why they might be interested in your technology. • Discuss the anticipated roles for the proposed research team. Who will lead technical aspects (manufacturing /cost estimation/ patenting) and who will lead commercial strategy? • Describe existing intellectual property in broad scientific terms (as well as patent numbers), if any, and how that would help you protect your anticipated products. • Discuss new intellectual property and data that is anticipated to be created as part of this effort, if any, and how it might reduce risks from competitors.

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).

		<p>INSTRUCTIONS:</p> <p>(1) The Technology to Market Section may include figures, tables, and graphics.</p> <p>(2) The suggested length of the Technology to Market Section is 1 page.</p>																																										
	<p>Section 5 BUDGET</p>	<p>Indicate the budget, in US dollars, and provide a high-level budget summary, demonstrating that the budget is reasonable and appropriate for the proposed effort.</p> <p>Provide in tabular form following the template give below, a breakdown of the project budget by entity and major task in US dollars.</p> <table border="1" data-bbox="638 617 1511 915"> <thead> <tr> <th>Task Name</th> <th>[Prime]</th> <th>[Sub #1]</th> <th>[Sub #2]</th> <th>[Sub #3]</th> <th>[Sub #4]</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>[Task #1]</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>[Task #2]</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>[Task #3]</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Technol ogy-to- Market</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Total</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Replace “Prime” with name of the primary (lead) entity and “Sub #n” with the name of the sub-recipient or sub-contractor entities, if applicable. Task names should clearly correspond to major tasks listed in Section 2.4. Expand or contract the table as needed to add/subtract entities (columns) or tasks (rows).</p> <p>Provide a high-level summary for the project by major budget category, including at least these three:</p> <ul style="list-style-type: none"> • Key Personnel and technical staff to be utilized (e.g., scientists, engineers, technicians, postdocs, graduate students, etc.) • Equipment • Materials and Supplies <p>INSTRUCTIONS:</p> <p>(1) The Budget Section may include figures, tables, and graphics.</p> <p>(2) The suggested maximum length of the Budget Section is 1 page.</p>	Task Name	[Prime]	[Sub #1]	[Sub #2]	[Sub #3]	[Sub #4]	Total	[Task #1]							[Task #2]							[Task #3]							Technol ogy-to- Market							Total						
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<p>No page limit</p>	<p>REFERENCES</p>	<p>Provide a list of references appropriate to Sections 1-5.</p> <p>INSTRUCTIONS:</p> <p>(1) Only bibliographic information may be contained in the references. No additional text or commentary is allowed.</p> <p>(2) There is no page limit for the Bibliographic References Section, which is outside of the overall 12-page limit for Sections 1-5.</p>																																										

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

<p>Each PQS limited to 3 pages in length, no cumulative page limit</p>	<p>PERSONAL QUALIFICATION SUMMARIES</p>	<p>A Personal Qualification Summary (PQS) is required for the PI and all other Key Personnel. Each PQS must include a description of the following only:</p> <ul style="list-style-type: none"> • Education and training • Employment history • Awards and honors • A list of no more than 10 peer-reviewed publications related to the proposed project • A list of no more than 10 other peer-reviewed publications demonstrating capabilities in the broad field • A list of no more than 10 non-peer-reviewed publications and patents demonstrating capabilities in the broad field <p>INSTRUCTIONS:</p> <p>(1) Each Personal Qualification Summary is limited to 3 pages in length and there is no page limit for this Section, which is outside of the 12-page limit for Sections 1-5.</p> <p>(2) Curriculum Vitae should not be submitted.</p>
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<p>The template for the Proposed System Specifications Table to be included in Section 1 of the Technical Volume is below. An application must provide the required information and ARPA-E recommends using this template.</p>	
<p>System Specifications</p>	
<p>Description</p>	<p>Response/Comments (include references where possible)</p>
<p><u>System discharge and charge efficiency:</u> Provide the efficiency of the system at rated power (and optimal engineering design point) for both charge and discharge, on an A/C basis. Also provide an estimate (with key assumptions) for self-discharge rate of all storage media in %/week assuming the system is idle and initially at 100% state of charge.</p>	
<p><u>Target installed capital costs for energy and power components:</u> Provide the target <i>installed capital</i> cost for power-related (\$/kW) and energy-related (\$/kWh) subsystems. If a simple assumption is used for the cost of shipping and installation, please state it.</p>	

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

Energy-Related Specifications	
Description	Response/Comments (include references where possible)
<p><u>Energy storage media:</u> Provide the identity of the energy storage media, their energy densities (kWh/L), their expected capital cost per unit of usable energy (\$/kWh), and other key attributes (e.g., upper and lower temperatures for operation). Exclude efficiency losses during discharge for the energy basis. If multiple storage media are used please number and describe each. Also briefly describe any supporting materials or additives that do not directly store energy but are necessary to for effective utilization of the energy storage media.</p>	
<p><u>Energy storage containment and other key BOP:</u> Provide the material composition of each containment vessel (including secondary containment, if needed) used to contain the energy storage media, the volume of each vessel in liters, and the capital cost of each vessel in \$/L (for $\geq 50,000$ L containers). Provide the identity, characteristics, and expected capital costs for other key BOP items (e.g., include the type, thickness, and cost of thermal insulation, if not included in the vessel values above).</p>	
Power-Related Specifications	
Description	Response/Comments (include references where possible)
<p><u>Core power conversion device:</u></p> <p>For <i>area-based power conversion systems</i> (e.g., electrochemical cells), describe the identities of the</p>	

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

<p>layers, their important attributes (e.g., thickness or loading), the expected power density at the target efficiency (in W/cm²), and the expected areal capital cost of repeat units (in \$/m²).</p> <p><i>For non area-based power conversion systems (e.g., turbines), describe the materials used, the specific power (in kW/kg), whether the same device is used for both discharge and charge, the ramp rate, and other key information.</i></p>	
<p><u>Power conversion BOP:</u></p> <p>For all systems, state whether an inverter is needed.</p> <p><i>For area-based power conversion systems (e.g., electrochemical cells), describe key BOP components and their expected capital cost (in \$/kW). This could include heat exchangers, compressors, unit operations for precipitation or dilution, etc.</i></p> <p><i>For non area-based mechanical power conversion systems (e.g., turbines), describe key BOP components and their expected capital cost (in \$/kW). This could include heat exchangers, compressors, etc.</i></p>	

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

2. 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 are required to complete all required fields in accordance with the instructions.

Prime Recipients and Subrecipients are required to complete SF-LLL (Disclosure of Lobbying Activities), available at <https://www.grants.gov/web/grants/forms/post-award-reporting-forms.html#sortby=1>, 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).
- Assume a project start date of January 2019, or as negotiated.
- 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-

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).

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.G.3 of the FOA for more information on Patent Costs).
- Unless a waiver is granted by ARPA-E, each Project Team must spend at least 5% of the Federal funding (i.e., the portion of the award that does not include the recipient’s cost share) on Technology Transfer & Outreach (TT&O) activities to promote and further the development and deployment of ARPA-E-funded technologies.
- All TT&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 pricing purposes, assume a project start date of January 2019, or as negotiated.
- For more information, please refer to the ARPA-E Budget Justification Guidance document at <https://arpa-e-foa.energy.gov>.

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).

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 <u>shall not exceed 250 words and one paragraph</u> . (2) The Summary for Public Release <u>shall consist only of text</u> —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, <u>this Cover Page and Summary should not contain confidential or proprietary information</u> . See Section VIII.E of the FOA for additional information on marking confidential information.
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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:

- A Technology Summary;
 - The technical category and the hours of duration at rated power of the proposed system.
 - Bullet points that describe novel aspects of the proposed technology and technology approach;
- Proposed Targets;
 - Including any important technical performance metrics for the proposed system and/or key components addressed in the project;

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).

- Including quantitative description of the state of the art;
- Including quantitative descriptions of the proposed targets;
- The figure from the Executive Summary, and any key graphics (illustrations, charts and/or tables) summarizing the technology development;
- 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 potential conflicts of interest within the Project Team;
- 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.”²⁸ 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.

²⁸ America COMPETES Act, Pub. L. No. 110-69, § 5012 (2007), as amended (codified at 42 U.S.C. § 16538).

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

- Request authorization to perform some work overseas; and
- Request a waiver of the TT&O spending requirement.

7. SEVENTH COMPONENT: U.S. MANUFACTURING PLAN

As part of the application, Applicants are required to submit a U.S. Manufacturing Plan that should not exceed one page in length. The U.S. Manufacturing Plan represents the Applicant's measurable commitment to support U.S. manufacturing as a result of its award. U.S. Manufacturing Plans are a Program Policy Factor during the review and selection process. See Section V.B.1 of the FOA.

A U.S. Manufacturing Plan should contain the following or similar preamble: "If selected for funding, the Applicant agrees to the following commitments as a condition of that funding:" and, after the preamble, the plan should include one or more specific and measurable commitments. For example, an Applicant may commit particular types of products to be manufactured in the U.S. **These plans should not include requirements regarding the source of inputs²⁹ used during the manufacturing process.** In addition to or instead of making a commitment tied to a particular product, the Applicant may make other types of commitments still beneficial to U.S. manufacturing. An Applicant may commit to a particular investment in a new or existing U.S. manufacturing facility, keep certain activities based in the U.S. (i.e., final assembly) or support a certain number of jobs in the U.S. related to the technology and manufacturing. For an Applicant which is likely to license the technology to others, especially universities for which licensing may be the exclusive means of commercialization the technology, the U.S. manufacturing plan may indicate the Applicant's plan and commitment to use a licensing strategy **for both exclusive and nonexclusive** licensing that would likely support U.S. manufacturing.

When an Applicant that is a domestic small business, domestic educational institution, or nonprofit organization is selected for an award, the U.S. Manufacturing Plan submitted by the Applicant may become part of the terms and conditions of the award **in addition to the requirements attaching to subject inventions described in VI.B.8 below.** See Section VI.B.8 of the FOA for U.S. Manufacturing Requirements applicable to large businesses. The Applicant/Awardee may request a waiver or modification of the U.S. Manufacturing Plan from

²⁹ For purposes of this FOA, an input refers to something which is used during the manufacturing process which (1) was in existence prior to or first produced outside of an ARPA-E award; (2) does not embody a subject invention, or technology which is developed or improved under an ARPA-E award; and (3) was not produced through the use of a subject invention, or technology which is developed or improved under an ARPA-E award.

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).

DOE upon a showing that the original U.S. Manufacturing Plan is no longer economically feasible.

Class patent waivers usually apply to domestic large businesses as set forth in Section VIII.F of the 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 that any products embodying or produced through the use of an invention conceived or first actually reduced to practice under the award will be substantially manufactured in the United States, unless DOE agrees that the commitments proposed in the U.S. Manufacturing Plan are sufficient. The U.S. Manufacturing Plan submitted by the Applicant may become part of the terms and conditions of the award **in addition to the requirements attaching to subject inventions.**

E. CONTENT AND FORM OF REPLIES TO REVIEWER COMMENTS

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

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).

than five pages in length, ARPA-E will review only the first five pages and disregard any additional pages.

SECTION	PAGE LIMIT	DESCRIPTION
Text	3 pages maximum	<ul style="list-style-type: none">Applicants may respond to one or more reviewer comments or supplement their Full Application.
Images	2 pages maximum	<ul style="list-style-type: none">Applicants may provide graphs, charts, or other data to respond to reviewer comments or supplement their Full Application.

F. INTERGOVERNMENTAL REVIEW

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

G. FUNDING RESTRICTIONS

1. ALLOWABLE COSTS

All expenditures must be allowable, allocable, and reasonable in accordance with the applicable Federal cost principles. ARPA-E has listed the Federal cost principles for different categories of Applicants at <http://arpa-e.energy.gov/arpa-e-site-page/post-award-guidance>.

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. ARPA-E generally does not accept budgets as submitted with the Full Application. Budgets 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.

Pre-award costs expected to exceed \$100,000 or incurred more than 90 days before the date of the Award require the prior written authorization of the ARPA-E Contracting Officer.

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Please refer to <https://arpa-e.energy.gov/?q=site-page/pre-award-costs> for additional guidance on pre-award costs.

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. Because all patent costs are considered to be Technology Transfer & Outreach (TT&O) costs (see Section IV.G.8 of the FOA below), the waiver request is subject to approval by ARPA-E.

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 Contracting Officer 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 – i.e., Prime Recipients must expend 100% of the Total Project Cost 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.

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).

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 an acquisition cost of \$25,000 or more per unit. 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. In order to meet this mandate every Project Team must spend at least 5% of the 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. Project Teams must also seek a waiver from ARPA-E to spend less than the minimum 5% TT&O expenditure requirement.

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;

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- 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 seek a waiver of the TT&O requirement by including an explicit request in the Business Assurances & Disclosures Form. Please refer to the Business Assurances & Disclosures Form for guidance on the content and form of the waiver request. ARPA-E may waive or modify the TT&O requirement, as appropriate.

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

Please refer to the "h. Other" tab contained within the SF-424A and Budget Justification Spreadsheet found at <https://arpa-e.energy.gov/?q=site-page/required-forms-and-templates> for additional guidance on TT&O requirements.

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.grants.gov/web/grants/forms/post-award-reporting-forms.html#sortby=1>) 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.

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).

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.

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H. 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>). Notices of Intent, 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 User 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 submission deadline. Under normal conditions (i.e., at least 48 hours in advance of the submission deadline), Applicants should allow at least 1 hour to submit a Notices of Intent or 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 will not review or consider incomplete applications and applications received after the deadline stated in the FOA. Such applications will 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;

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- 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). ARPA-E also performs a preliminary review of Notices of Intent and 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

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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;
- Whether the proposed technical solution represents a high-risk approach that is differentiated in cost-performance design tradeoffs relative to current commercial and R&D state-of-the-art electricity storage systems;
- 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:

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- 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.

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).

- II. **Relevance to ARPA-E Mission Advancement.** Project contributes to one or more of ARPA-E's key statutory goals:
 - a. Reduction of US dependence on foreign energy sources;
 - b. Stimulation of domestic manufacturing/U.S. Manufacturing Plan;
 - c. Reduction of energy-related emissions;
 - d. Increase in U.S. energy efficiency;
 - e. Enhancement of U.S. economic and energy security; or
 - f. Promotion of U.S. advanced energy technologies competitiveness.

- III. **Synergy of Public and Private Efforts.**
 - a. Avoids duplication and overlap with other publicly or privately funded projects;
 - b. Promotes increased coordination with nongovernmental entities for demonstration of technologies and research applications to facilitate technology transfer; or
 - c. Increases unique research collaborations.

- IV. **Low likelihood of other sources of funding.** High technical and/or financial uncertainty that results in the non-availability of other public, private or internal funding or resources to support the project.

- V. **High-Leveraging of Federal Funds.** Project leverages Federal funds to optimize advancement of programmatic goals by proposing cost share above the required minimum or otherwise accessing scarce or unique resources.

- VI. **High Project Impact Relative to Project Cost.**

2. ARPA-E REVIEWERS

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.

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).

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 contractor 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 in approximately September 2018 and to execute funding agreements in approximately January 2019.

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.

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

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).

the further development of the proposed technology and to provide a brief opportunity to respond to reviewer comments.

a. SUCCESSFUL APPLICANTS

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

Please refer to Section IV.G.2 of the FOA for guidance on pre-award costs. Please also refer to <https://arpa-e.energy.gov/?q=site-page/funding-agreements-project-guidance> for guidance on the award negotiation process.

b. POSTPONED SELECTION DETERMINATIONS

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

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

c. UNSUCCESSFUL APPLICANTS

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

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

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.

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).

1. DUNS NUMBER AND SAM, FSRS, AND FEDCONNECT REGISTRATIONS

Prime Recipients and Subrecipients are required to obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number at <http://fedgov.dnb.com/webform> and to register with the System for Award Management (SAM) at <https://www.sam.gov/portal/public/SAM/>. Prime Recipients and Subrecipients should commence this process as soon as possible in order to expedite the execution of a funding agreement. Obtaining a DUNS number and registering with SAM 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/>.³⁰ 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.

ARPA-E may not execute a funding agreement with the Prime Recipient until it has obtained a DUNS number and completed its SAM and FSRS registrations. In addition, the Prime Recipient may not execute subawards with Subrecipients until they obtain a DUNS number and complete their SAM registration. Prime Recipients and Subrecipients are required to keep their SAM and FSRS data current throughout the duration of the project.

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. Please refer to Attachment 6 of ARPA-E's Model Cooperative Agreement (<https://arpa-e.energy.gov/?q=site-page/funding-agreements>) for information on the National Policy Assurances.

¹⁵ 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 PAYMENTS³¹

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 see Section III.B.3 of the FOA.

Please refer to Attachment 1 Clause 24 (<https://arpa-e.energy.gov/?q=site-page/funding-agreements>) for additional guidance on cost share payment requirements.

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 on ARPA-E eXCHANGE at <https://arpa-e-foa.energy.gov>. The Environmental Impact Questionnaire is due within 21 calendar days of the selection announcement.

¹⁶ Please refer to Section III.B of the FOA for guidance on cost share requirements.

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).

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 (<http://arpa-e.energy.gov/FundingAgreements/Overview.aspx>) 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. The DMP must meet the minimum requirements available at the following website: <https://arpa-e.energy.gov/?q=site-page/project-management-reporting-requirements>.

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).

8. U.S. MANUFACTURING REQUIREMENT

In addition to treatment of the U.S. Manufacturing Plan described above in Section IV.D.7 of the FOA, ARPA-E requires products embodying or produced through the use of subject inventions (i.e., inventions conceived or first actually reduced to practice under ARPA-E funding agreements) to be substantially manufactured in the United States by Project Teams and their licensees, as described below. The Applicant may request a modification or waiver of the U.S. Manufacturing Requirement.

a. SMALL BUSINESSES

Small businesses (including Small Business Concerns) that are Prime Recipients or Subrecipients under ARPA-E funding agreements are required to substantially manufacture the following products in the United States for any use or sale in the United States: (1) products embodying subject inventions, and (2) products produced through the use of subject invention(s).³² This requirement does not apply to products that are manufactured for use or sale outside the U.S. A.

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

b. LARGE BUSINESSES AND FOREIGN ENTITIES

Large businesses and foreign entities that are Prime Recipients or Subrecipients under ARPA-E funding agreements are required to substantially manufacture the following products in the United States: (1) products embodying subject inventions, and (2) products produced through the use of subject invention(s).³³ This requirement applies to products that are manufactured for use or sale in the United States and outside the United States.

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

³² Small businesses are generally defined as domestically incorporated entities that meet the criteria established by the U.S. Small Business Administration's "Table of Small Business Size Standards Matched to North American Industry Classification System Codes" (<http://www.sba.gov/content/small-business-size-standards>).

³³ Large businesses are generally defined as domestically incorporated entities that do not meet the criteria established by the U.S. Small Business Administration's "Table of Small Business Size Standards Matched to North American Industry Classification System Codes" (<http://www.sba.gov/content/small-business-size-standards>).

acquiring a controlling interest in the large business or foreign entity to apply the same U.S. Manufacturing requirements to their licensees.

c. EDUCATIONAL INSTITUTIONS AND NONPROFITS

Domestic educational institutions and nonprofits that are Prime Recipients or Subrecipients under ARPA-E funding agreements must require their exclusive licensees to substantially manufacture the following products in the United States for any use or sale in the United States: (1) articles embodying subject inventions, and (2) articles produced through the use of subject invention(s). This requirement does not apply to articles that are manufactured for use or sale overseas.

Educational institutions and nonprofits must require their assignees to apply the same U.S. Manufacturing requirements to their exclusive licensees.

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

FFRDCs/DOE Labs that are GOCOs and state and local government entities are subject to the same U.S. Manufacturing requirements as domestic educational institutions and nonprofits. GOGOs are subject to the requirements in 37 CFR § 404.5(a)(2).

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.

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).

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 §200.205(c), subparagraphs (1) through (4). 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 with a total amount of Federal share greater than the simplified acquisition threshold (presently \$250,000), 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. 200.205).

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. §200.205.

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*

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).

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 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.

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 (<http://arpa-e.energy.gov/arpa-e-site-page/award-guidance>).

VII. AGENCY CONTACTS

A. COMMUNICATIONS WITH ARPA-E

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

During the “quiet period,” Applicants are required to submit all questions regarding this FOA to ARPA-E-CO@hq.doe.gov. 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.

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).

- 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 Full Application deadline. Responses to questions received before the cutoff will be posted at least one business day in advance of the submission deadline. ARPA-E may re-phrase questions or consolidate similar questions for administrative purposes.
- Responses are published in a document specific to this FOA under “CURRENT FUNDING OPPORTUNITIES – FAQs” on ARPA-E’s website (<http://arpa-e.energy.gov/faq>).

Applicants may submit questions regarding ARPA-E eXCHANGE, ARPA-E’s online application portal, to ExchangeHelp@hq.doe.gov. 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. ARPA-E provides Applicants with reviewer comments on Full Applications before the submission deadline for Replies to Reviewer Comments.

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).

VIII. OTHER INFORMATION

A. FOAs AND FOA MODIFICATIONS

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

B. OBLIGATION OF PUBLIC FUNDS

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

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

C. 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.

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).

D. RETENTION OF SUBMISSIONS

ARPA-E expects to retain copies of all Notices of Intent, 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.

E. MARKING OF CONFIDENTIAL INFORMATION

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

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

The 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.

F. TITLE TO SUBJECT INVENTIONS

Ownership of subject inventions is governed pursuant to the authorities listed below. Typically, either by operation of law or under the authority of a patent waiver, Prime Recipients and

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Subrecipients may elect to retain title to their subject inventions under ARPA-E funding agreements.

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions. If they elect to retain title, they must file a patent application in a timely fashion.
- All other parties: The Federal Non-Nuclear Energy Research and Development Act of 1974, 42 U.S.C. 5908, provides that the Government obtains title to new inventions unless a waiver is granted (*see below*).
- Class Waiver: Under 42 U.S.C. § 5908, title to subject inventions vests in the U.S. Government and large businesses and foreign entities do not have the automatic right to elect to retain title to subject inventions. However, ARPA-E typically issues “class patent waivers” under which large businesses and foreign entities that meet certain stated requirements, such as cost sharing of at least 20%, may elect to retain title to their subject inventions. If a large business or foreign entity elects to retain title to its subject invention, it must file a patent application in a timely fashion. If the class waiver does not apply, a party may request a waiver in accordance with 10 C.F.R. §784.
- GOGOs are subject to the requirements of 37 C.F.R. Part 501.
- Determination of Exceptional Circumstances (DEC): Each Applicant is required to submit a U.S. Manufacturing Plan as part of its Full Application. The U.S. manufacture provision included in Attachment 2 of an award is included as part of the U.S. Manufacturing Plan. If selected, the U.S. Manufacturing Plan may be incorporated into the award terms and conditions for domestic small businesses and nonprofit organizations. DOE has determined that exceptional circumstances exist that warrants the modification of the standard patent rights clause for small businesses and non-profit awardees under Bayh-Dole to the extent necessary to implement and enforce the U.S. Manufacturing Plan. For example, the commitments and enforcement of a U.S. Manufacturing Plan may be tied to subject inventions. Any Bayh-Dole entity (domestic small business or nonprofit organization) affected by this DEC has the right to appeal it. The DEC is dated September 9, 2013 and is available at the following link: <http://energy.gov/gc/downloads/determination-exceptional-circumstances-under-bayh-dole-act-energy-efficiency-renewable>.

G. GOVERNMENT RIGHTS IN SUBJECT INVENTIONS

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

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).

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.

3. U.S. MANUFACTURING REQUIREMENT

ARPA-E requires that awards address whether products embodying or produced through the use of subject inventions (i.e., inventions conceived or first actually reduced to practice under ARPA-E funding agreements) are to be substantially manufactured in the United States by Project Teams and their licensees. The requirement varies depending upon whether an awardee is a small business, University or other type of awardee. The Applicant may request a modification or waiver of the U.S. Manufacturing Requirement.

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).

H. RIGHTS IN TECHNICAL DATA

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

- Background or “Limited Rights Data”: The U.S. Government will not normally require delivery of technical data developed solely at private expense prior to issuance of an award, except as necessary to monitor technical progress and evaluate the potential of proposed technologies to reach specific technical and cost metrics.
- Generated Data: The U.S. Government normally retains very broad rights in technical data produced under Government financial assistance awards, including the right to distribute to the public. However, pursuant to special statutory authority, certain categories of data generated under ARPA-E awards may be protected from public disclosure for up to five years in accordance with provisions that will be set forth in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

I. 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;

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).

- 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).

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 Notice of Intent, Full Application, and Reply to Reviewer Comments.

ARPA-E: is the Advanced Research Projects Agency – Energy, an agency within 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.

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

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

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

Prime Recipient or Awardee: 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 inventive supportive work that is part of an ARPA-E project.

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

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

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.G.8 of the FOA for more information).

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).