

FUNDING OPPORTUNITY ANNOUNCEMENT



Advanced Research Projects Agency – Energy (ARPA-E) U.S. DEPARTMENT OF ENERGY

Support Grants For Participation in ARPA-E Grid Optimization (GO) Competition Challenge 3

Announcement Type: Initial Announcement
Funding Opportunity No. DE-FOA-0002690
CFDA Number 81.135

Funding Opportunity Announcement (FOA) Issue Date:	February 16, 2022
Deadline for Questions to ARPA-E-CO@hq.doe.gov:	5 PM ET, March 25, 2022
Submission Deadline for Full Applications:	9:30 AM ET, April 5, 2022
Expected Date for Selection Notifications:	May 2022
Total Amount to Be Awarded	Up to \$4 million, subject to the availability of appropriated funds.
Anticipated Awards	ARPA-E may issue one, multiple, or no awards under this FOA. ARPA-E will provide up to \$400,000 per award.

- For eligibility criteria, see Section III.A 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.F.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 cost share requirements under this FOA, see Section III.B 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).

- For detailed guidance on compliance and responsiveness criteria, see Sections III.B.1 through III.B.4 of the FOA.

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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 Full Applications see Section IV.C of the FOA.

SUBMISSION	COMPONENTS	OPTIONAL/ MANDATORY	FOA SECTION	DEADLINE
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 1-3 (5 pages max.) <ul style="list-style-type: none"> • 1. Innovation, Impact, and Proposed Work • 2. Team Organization and Capabilities • 3. Budget ○ Bibliographic References (no page limit) ○ Personal Qualification Summaries (each PQS limited to 2 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); and ○ Completed and signed Business Assurances & Disclosures Form (no page limit, Adobe PDF format). ○ Commercialization Plan (3 page limit, Adobe PDF format) 	Mandatory	IV.C	9:30 AM ET, April 5, 2022

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

- “(A) to enhance the economic and energy security of the United States through the development of energy technologies that—
- (i) reduce imports of energy from foreign sources;
 - (ii) reduce energy-related emissions, including greenhouse gases;
 - (iii) improve the energy efficiency of all economic sectors;
 - (iv) provide transformative solutions to improve the management, clean-up, and disposal of radioactive waste and spent nuclear fuel; and
 - (v) improve the resilience, reliability, and security of infrastructure to produce, deliver, and store energy; and
- (B) to ensure that the United States maintains a technological lead in developing and deploying advanced energy technologies.”

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

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

ARPA-E funds transformational research. Existing energy technologies generally progress on established “learning curves” where refinements to a technology and the economies of scale that accrue as manufacturing and distribution develop drive 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 or the applied technology offices within DOE. By contrast, ARPA-E supports transformative research that has the potential to create fundamentally new learning curves. ARPA-E technology projects typically start with cost/performance estimates well above the level of an incumbent technology. Given the high risk inherent in these projects, many will fail to progress, but some may succeed in generating a new learning curve with a projected cost/performance metric that is significantly lower than that of the incumbent technology.

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

ARPA-E funds applied research and development. The Office of Management and Budget defines “applied research” as an “original investigation undertaken in order to acquire new knowledge...directed primarily towards a specific practical aim or objective” and defines “experimental development” as “creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes.”¹ Applicants interested in receiving financial assistance for basic research (defined by the Office of Management and Budget as “experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts”)² should contact the DOE’s Office of Science (<http://science.energy.gov/>). Office of Science national scientific user facilities (<http://science.energy.gov/user-facilities/>) are open to all researchers, including ARPA-E Applicants and awardees. These facilities provide advanced tools of modern science including accelerators, colliders, supercomputers, light sources and neutron sources, as well as facilities for studying the nanoworld, the environment, and the atmosphere. Projects focused on early-stage R&D for the improvement of technology along defined roadmaps may be more appropriate for support through the DOE applied energy offices including: the Office of Energy Efficiency and Renewable Energy (<http://www.eere.energy.gov/>), the Office of Fossil Energy and Carbon Management (<https://www.energy.gov/fecm/office-fossil-energy-and-carbon-management>), the Office of Nuclear Energy (<http://www.energy.gov/ne/office-nuclear-energy>), and the Office of Electricity (<https://www.energy.gov/oe/office-electricity>).

B. PROGRAM OVERVIEW

The purpose of this FOA is to fund research and development of solution techniques that will be used by awardees to compete in Challenge 3 of the Grid Optimization (GO) Competition. The GO Competition is a series of prize challenges to accelerate the development and comprehensive evaluation of grid software solutions.³ The GO Competition, Challenge 3, is an algorithm competition focused on the optimal power flow (OPF) problem for the electric power

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

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

³ See <https://gocompetition.energy.gov/>.

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sector that includes AC power flow, optimal topology, bid-in demand, unit commitment, and N-1 reliability. Awardees under this FOA will be required to participate in Challenge 3. As described in detail in Appendix A to this FOA and on the GO Competition website (<https://gocompetition.energy.gov/>), Challenge 3 is anticipated to launch in the Spring of 2022. Participation in the GO Competition Challenge 3 will be open to anyone that satisfies the applicable requirements in the Rules Document on the GO Competition website (<https://gocompetition.energy.gov/competition-rules>), not just those awarded under ARPA-E DE-FOA-0002690.

The purpose of this FOA is to provide grants: (i) to further incentivize and identify innovative research for solution methods applicable to Challenge 3, and (ii) to enable broader diversity in team domain expertise, i.e., to encourage teams to participate that do not traditionally focus on the particular problems that are targeted but otherwise have innovative approaches for this class of optimization problems. While Challenge 3 focuses on a power systems problem, the Challenge and this FOA target a much broader audience (e.g., those specialized in operations research, applied mathematics, optimization methods and algorithms, controls, etc.).

Existing grid software was designed for a power grid centered on conventional generation and transmission technologies. Recent years have seen major developments in new types of resources, including distributed energy resources (DER), intermittent resources (wind and solar), storage, and active consumer participation. Such emerging technologies have unique characteristics distinct from conventional resources. Emerging technologies face a prohibitive barrier within large-scale grid operations as the existing software support systems do not acknowledge these unique characteristics with the same level of accuracy and efficiency with which they capture conventional resources. As a consequence, this existing software paradigm does not allow for these assets to be used to their full potential. Furthermore, the ever-increasing emphasis on grid resilience demands innovative management of a more diverse resource portfolio, which existing grid software is not equipped to handle without overly simplifying assumptions. Simply put, in order to improve market efficiency (market surplus) including reliability and resiliency, the power industry must significantly advance grid software. Innovation is needed regarding the underlying simulation, optimization, and control methods in order to enable increased grid flexibility, reliability, and resilience while also substantially reducing the costs of integrating emerging technologies and resources into the electric power system.

To this end, ARPA-E has set a goal: to support the development of new and innovative grid software to achieve a modern grid. ARPA-E is targeting key areas for innovation in grid software including, but not limited to, optimal utilization of conventional and emerging grid technologies, management of dynamic operations of the grid (including extreme event response and restoration), and management of millions of emerging distributed energy resources.

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This broader effort began with the launch of the Grid Optimization (GO) Competition. If successful, the GO Competition will accelerate the development of transformational and disruptive methods for solving problems related to the electric power grid and to provide a transparent, fair, and comprehensive evaluation of new solution methods. The GO Competition is aimed at overhauling and modernizing grid software and is structured as multiple challenges, the third of which is expected to begin in the spring of 2022.

Each challenge in the GO Competition includes trial events and culminates in a Final Event to evaluate the performance, speed, and efficiency of each Entrant's approach on standardized, realistic datasets in a controlled environment. Like prior Challenges, winners will be announced after each event in Challenge 3, and awards will be presented after the final event. Individual and organizations can participate as "Open Entrants" and can register and submit their programs (i.e., algorithmic approaches) or "Proposal Entrants." Proposal Entrants are the organizations and teams that are each selected and ultimately awarded a grant under this FOA to develop their algorithmic approach for submission to Challenge 3. The GO Competition incentivizes entrepreneurial efforts that align with ARPA-E's mission to innovate in grid software. The algorithms and software solutions submitted to the GO Competition will supplement ARPA-E efforts to break down barriers to empower widespread, fast adoption of emerging grid technologies with the goal of saving billions of dollars in an energy sector with revenues reaching close to \$400B per year.⁴ This FOA provides details for potential Proposal Entrants (also referred to as "awardees" in this FOA) to apply for grants to prepare for and participate in the GO Competition Challenge 3 (see Appendix A for more information).

C. TECHNICAL AREAS OF FOCUS FOR APPLICANTS TO THIS FOA

For this FOA, ARPA-E seeks innovative approaches that provide fast, robust, economically efficient solution techniques for the dynamic, non-convex, mixed-integer optimization problem established for Challenge 3. In this FOA, ARPA-E is seeking submissions that describe novel techniques to solve this security-constrained optimal power flow problem; such a description includes, but is not limited to, alternative formulations of the problem, approximations, heuristic approaches, decomposition techniques, etc. Critical issues to discuss in the application submitted to this FOA include, but are not limited to:

- Technical details regarding the proposed approach and its applicability to dynamic, large-scale, non-convex, mixed integer non-linear programs (MINLP). In particular, relate the proposed effort to the problem of OPF and the specific formulation for Challenge 3, including temporal constraints, unit commitment, topology optimization, and reserves modeling.
- Quantitative comparisons of the proposed algorithmic approach to other state of the art OPF approaches and/or other generalized non-convex MIP approaches as well as provide initial evidence that the proposed approach is promising.
- Handling of the non-convexities in the network flow problem.

⁴ Energy Information Administration, "Revenue from Sales of Electricity to Ultimate Customers," https://www.eia.gov/electricity/annual/html/epa_02_03.html

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- Proposed approaches in terms of the GO Competition scoring criteria (<https://gocompetition.energy.gov/challenges/challenge-3/scoring>). All Entrants should aspire to find the best objective function value, satisfying constraints, algorithm runtime and robustness/ability to find feasible points.
- How the proposed solution differs from state-of-the-art approaches, including citations of any pertinent literature.

In addition to the above, applicants may also:

- Provide additional evidence that their approach is fundamentally suited for future grid management challenges, not specifically included in the GO Competition Challenge 3 formulation including, but not limited to: (1) the integration of high penetrations of renewable generation, DERs and active consumer participation, (2) the improving cost effectiveness of distributed energy resources (including storage), (3) the increasing use of topology optimization using line switching and flexible Alternating Current (AC) transmission system (FACTS) devices, (4) the determination and inclusion of proxy stability constraints, (5) identification of system response to extreme events, and (6) grid restoration and resilience. These challenges introduce potentially millions more decision variables including integer variables and added non-convexities in the network flow problem. These challenges also bring forward the need for transformational approaches.
- Tailor their approach to specific “difficult” aspects of the non-convex MINLP OPF problem. Applicants should detail and justify these decisions and their tradeoffs.
- While publication of algorithmic approaches will not be required of FOA awardees (Proposal Entrants), ARPA-E encourages awardees to submit open-access journal articles or conference papers where they describe their approach.

FOA Applicants should note that ARPA-E is open to exact solution methods, approximations, or heuristics as long as they are targeted to system efficiency. Applicants should describe their approach for the mathematical problem presented in the complete formulation presented on the GO Competition Challenge 3 website (<https://gocompetition.energy.gov/challenges/challenge-3/formulation>). Applicants should also consult (<https://gocompetition.energy.gov/challenges/challenge-3/scoring>), which describes the scoring mechanisms that will be used to choose the GO Competition Challenge 3 winners.

D. POST AWARD – PARTICIPATION IN THE GO COMPETITION CHALLENGE 3

Awardees⁵ under this FOA will be required to compete in the GO Competition Challenge 3. Awardees under this FOA must also complete the following in addition to those requirements applicable to all GO Competition Challenge 3 Entrants:

⁵ Awardees are the applicants to this FOA that are selected for and ultimately receive a grant after successfully completing award negotiations.

- **Task 1:** Register for the GO Competition Challenge 3 on the competition website (<https://gocompetition.energy.gov/>); awardees under this FOA will not be permitted to participate anonymously.
- **Task 2:** Participate in Competitive Event 1 according to the rules of the GO Competition Platform; their results will be displayed on the leaderboards.
- **Task 3:** Participate in Competitive Event 2 according to the rules of the GO Competition Platform; their results will be displayed on the leaderboards.
- **Task 4:** Participate in Competitive Event 3 according to the rules of the GO Competition Platform; their results will be displayed on the leaderboards.
- **Task 5:** Participate in the Challenge 3 Final Event (Competitive Event 4) according to the rules of the GO Competition Platform; their results will be displayed on the leaderboards.

Awardees that qualify for a prize in Challenge 3 will receive their prize as additional grant funding from ARPA-E to further develop their algorithm. Receipt of this funding: (i) requires submission of a brief application, (ii) is subject to ARPA-E's standard grant terms and conditions (including cost sharing requirements, if any), and (iii) is contingent upon the successful conclusion of award negotiations. ARPA-E reserves the right to discontinue negotiations without the award of a grant in the event the parties cannot agree on the terms of the prospective grant.

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II. AWARD INFORMATION

A. AWARD OVERVIEW

ARPA-E expects to make \$4 million available for new awards under this FOA, subject to the availability of appropriated funds. ARPA-E will provide up to \$400,000 per award.

B. ARPA-E FUNDING AGREEMENTS

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

1. GRANTS

A Grant is a legal instrument that is used to provide Federal financial assistance or other things of value to carry out a public purpose of support or stimulation authorized by Federal statute. ARPA-E anticipates awarding cost-reimbursable Grants, except as set forth in the following subsection, for research funded under this FOA. . ARPA-E may, at its sole discretion, issue fixed-amount Grants for the awards issued under this FOA, in lieu of cost-reimbursable Grants.

Awardees will be required, *inter alia*, to submit a Final Technical Report to ARPA-E and to obtain prior approval of the ARPA-E Contracting Officer for changes in principal investigator, project partner, or scope of project effort. The Final Technical Report should include the algorithm formulation, including the strategy to utilize the GO Competition multi-core Computing Platform, and potential future research.

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 lead entity for 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

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).

Lab and the rest of the Project Team.

When a FFRDC/DOE Lab is a *member* of a Project Team, ARPA-E executes a funding agreement directly with the FFRDC/DOE Lab and a single, separate Cooperative Agreement with the Prime Recipient, the lead entity for 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 an FFRDC or GOGO will have similar terms and conditions as ARPA-E's Model Cooperative Agreement (<https://arpa-e.energy.gov/technologies/project-guidance/pre-award-guidance/funding-agreements>).

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

III. ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

This FOA is open to U.S. universities, national laboratories, industry, and individuals, subject to the additional eligibility requirements are below. However, the following **are not eligible for funding under this FOA**:

- Federal employees;
- ARPA-E support contractors, their employees and their spouses, dependents, and other household members;
- Any individual funded by ARPA-E to support or facilitate the design and development of Challenge 3 or to create or validate datasets to be used in Challenge 3 of the GO Competition;^{6,7}
- Any individual, along with their spouses, dependents, and household members, working for/supporting the GO Competition Administrator;⁸
- Any DOE Federal employee, prior ARPA-E employee, or support contractor, along with their spouses, dependents, and household members, that assisted, are assisting, or will assist in the design or operation of Challenge 3 of the GO Competition, in creation of the GO Competition software platform for Challenge 3, or in the evaluation of the Entrant submitted approaches for Challenge 3;⁹
- Any individual or organization that is on the Specially Designated Nationals list.¹⁰

1. INDIVIDUALS

U.S. citizens or permanent residents may apply for funding in their individual capacity as a Standalone Applicant,¹¹ as the lead for a Project Team,¹² or as a member of a Project Team. However, ARPA-E will only award funding to an entity formed by the Applicant.

⁶ This group includes, but is not limited to, individuals working on behalf of ARPA-E through contracts at the National Renewable Energy Laboratory, the Pacific Northwest National Laboratory, Texas A&M University, and the University of Wisconsin and includes any individual that has worked on the .

⁷ If such individuals wish to test their algorithmic approaches on the GO Competition Challenge 3 platform, they may do so only after the GO Competition Challenge 3 has ended and all publicly available datasets have been released to the public. These individuals cannot submit their algorithmic approach at any time before the end of the GO Competition Challenge 3.

⁸ The Pacific Northwest National Laboratory (PNNL) is acting as the GO Competition Administrator, the host team of the competition. Additionally, there are sub-contractors that are supporting PNNL and ARPA-E in regards to the GO Competition Challenge 3 (Arizona State University, National Renewable Energy Laboratory, Texas A&M University, the University of Wisconsin-Madison).

⁹ This group includes, but is not limited to, specific individuals working on behalf of ARPA-E through contracts at Arizona State University, the Pacific Northwest National Laboratory, the University of Wisconsin, and Quantitative Scientific Solutions.

¹⁰ <https://www.treasury.gov/resource-center/sanctions/SDN-List/Pages/default.aspx>

¹¹ A Standalone Applicant is an Applicant that applies for funding on its own, not as part of a Applicant Team.

¹² The term "Applicant 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. An Applicant Team consists of the Prime Recipient, Subrecipients, and others performing or otherwise supporting work under an ARPA-E funding agreement.

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. DOMESTIC ENTITIES

For-profit entities¹³, educational institutions¹⁴, and nonprofits¹⁵ that are incorporated in the United States, including U.S. territories, are eligible to apply for funding as a Standalone Applicant, as the lead organization for a Project Team, or as a member of a Project Team.

FFRDCs/DOE Labs are eligible to apply for funding as the lead organization for a Project Team or as a member of a Project Team that includes institutions of higher education, companies, research foundations, or trade and industry research collaborations, but not as a Standalone Applicant.

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

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

3. FOREIGN ENTITIES

Foreign entities, whether for-profit or otherwise, are eligible to apply for funding as Standalone Applicants, as the lead organization for a Project Team, or as a member of a Project Team. Foreign entities must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed or to be formed) under the laws of a State or territory of the United States to receive funding. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate. All work under the ARPA-E award must be performed in the United States. The Applicant may request a waiver of this requirement in the Business Assurances & Disclosures Form, which is submitted with the Full Application and can be found at <https://arpa-e-foa.energy.gov/> (see "View Template Application Documents"). Refer to the Business Assurances & Disclosures Form for guidance on the content and form of the request.

4. CONSORTIUM ENTITIES

Consortia, which may include domestic and foreign entities, must designate one member of the consortium as the consortium representative to the Project Team. The consortium representative must be incorporated in the United States. The eligibility of the consortium will

¹³ For-Profit Organizations (Other than Small Businesses) (or *large businesses*): Means entities organized for-profit other than small businesses as defined elsewhere in this Glossary.

¹⁴ Institutions of Higher Education (or educational institutions): Has the meaning set forth at 20 U.S.C. 1001.

¹⁵ 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.

be determined by reference to the eligibility of the consortium representative under Section III.A of the FOA. Each consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium entity must provide a written description of its internal governance structure and its internal rules to the Contracting Officer (ARPA-E-CO@hq.doe.gov).

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

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

B. **COST SHARING**¹⁶

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 of the FOA). Under a Cooperative Agreement or Grant, the Prime Recipient must provide at least 20% of the Total Project Cost¹⁷ as cost share, except as provided in Sections III.B.2 or III.B.3 below.¹⁸

2. **INCREASED COST SHARE REQUIREMENT**

Large businesses¹⁹ 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).

3. **REDUCED COST SHARE REQUIREMENT**

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

¹⁶ Please refer to Section VI.B.3-4 of the FOA for guidance on cost share payments and reporting.

¹⁷ 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.

¹⁸ Energy Policy Act of 2005, Pub.L. 109-58, sec. 988(c)

¹⁹ The term "For-Profit Organizations (Other than Small Businesses)" or "large business" is defined in Section IX.

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).

- A domestic educational institution or domestic nonprofit applying as a Standalone Applicant is required to provide at least 5% of the Total Project Cost as cost share.
- Project Teams composed exclusively of domestic educational institutions, domestic nonprofits, and/or FFRDCs/DOE Labs/Federal agencies and instrumentalities (other than DOE) are required to provide at least 5% of the Total Project Cost as cost share. Small businesses – or consortia of small businesses – may provide 0% cost share from the outset of the project through the first 12 months of the project (hereinafter the “Cost Share Grace Period”).²⁰ If the project is continued beyond the Cost Share Grace Period, then at least 10% of the Total Project Cost (including the costs incurred during the Cost Share Grace Period) will be required as cost share over the remaining period of performance.
- Project Teams where a small business is the lead organization and small businesses perform greater than or equal to 80% of the total work under the funding agreement (as measured by the Total Project Cost) are entitled to the same cost share reduction and Cost Share Grace Period as provided above to Standalone small businesses or consortia of small businesses.
- Project Teams where domestic educational institutions, domestic nonprofits, small businesses, and/or FFRDCs perform greater than or equal to 80% of the total work under the funding agreement (as measured by the Total Project Cost) are required to provide at least 10% of the Total Project Cost as cost share. However, any entity (such as a large business) receiving patent rights under a class waiver, or other patent waiver, that is part of a Project Team receiving this reduction must continue to meet the statutory minimum cost share requirement (20%) for its portion of the Total Project Cost.
- Projects that do not meet any of the above criteria are subject to the base cost share requirements described in Sections III.B.1 and III.B.2 of the FOA.

4. LEGAL RESPONSIBILITY

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

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

²⁰The term “small business” is defined in Section IX.

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.E 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;
- Appropriated Federal funding or property (e.g., Federal grants, equipment owned by the Federal Government); or
- Expenditures that were reimbursed under a separate Federal program.

In addition, Project Teams may not use independent research and development (IR&D) funds²¹ to meet their cost share obligations under Cooperative Agreements. However, Project Teams may use IR&D funds to meet their cost share obligations under “other transaction” agreements.

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

Cost share contributions must be specified in the project budget, verifiable from the Prime Recipient’s records, and necessary and reasonable for proper and efficient accomplishment of the project. Every cost share contribution must be reviewed and approved in advance by the

²¹ As defined in Federal Acquisition Regulation SubSection 31.205-18.

Contracting Officer and incorporated into the project budget before the expenditures are incurred.

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

7. COST SHARE CONTRIBUTIONS BY FFRDCs AND GOGOs

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

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

8. COST SHARE VERIFICATION

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

C. OTHER

1. COMPLIANT CRITERIA

Full Applications are deemed compliant if:

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

2. RESPONSIVENESS CRITERIA

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

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

- Submissions that fall outside the technical parameters specified in this FOA.
- Submissions that have been submitted in response to currently issued ARPA-E FOAs.
- Submissions that are not scientifically distinct from applications submitted in response to currently issued ARPA-E FOAs.
- Submissions for basic research aimed solely at discovery and/or fundamental knowledge generation.
- Submissions for large-scale demonstration projects of existing technologies.
- Submissions for proposed technologies that represent incremental improvements to existing technologies.
- Submissions for proposed technologies that are not based on sound scientific principles (e.g., violates a law of thermodynamics).
- Submissions for proposed technologies that are not transformational, as described in Section I.A of the FOA.
- Submissions for proposed technologies that do not have the potential to become disruptive in nature, as described in Section I.A of the FOA. Technologies must be scalable such that they could be disruptive with sufficient technical progress.
- Submissions that are not distinct in scientific approach or objective from activities currently supported by or actively under consideration for funding by any other office within Department of Energy.
- Submissions that are not distinct in scientific approach or objective from activities currently supported by or actively under consideration for funding by other government agencies or the private sector.
- Submissions that do not propose a R&D plan that allows ARPA-E to evaluate the submission under the applicable merit review criteria provided in Section V.A of the FOA.

3. SUBMISSIONS SPECIFICALLY NOT OF INTEREST

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

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).

- Approaches that ignore the non-convexities in this network flow problem (i.e., approaches that ignore voltage, reactive power, and other aspects within ACOPF problems that cause non-convexities).
- Approaches that ignore the temporal constraints in this multi-period market dispatch network flow problem (i.e., approaches that ignore ramping constraints, minimum up or down times, and storage).

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.

As established by the Rules document for the GO Competition Challenge 3, <https://gocompetition.energy.gov/competition-rules>, individuals cannot be members of multiple Entrant Teams. A person can be on no more than one Entrant Team (Proposal Entrant Team or Open Entrant Team; see the Rules document in <https://gocompetition.energy.gov/competition-rules> for more information). If an individual person is listed on multiple applications to this FOA, ARPA-E will select **no more than** one of those applications for award negotiations.

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

2. FULL APPLICATIONS

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

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

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

Once ARPA-E completes its review of Full Applications, 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.

4. 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

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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 SF-424A. Applicants may use the templates available on ARPA-E eXCHANGE, including the template for the Technical Volume of the Full Application and the template for the Business Assurances & Disclosures Form. A sample response to the Business Assurances & Disclosures Form is available on ARPA-E eXCHANGE.

C. CONTENT AND FORM OF FULL APPLICATIONS

Full Applications must conform to the following formatting requirements:

- Each document must be submitted in the file format prescribed below.
- The Full Application must be written in English.
- All pages must be formatted to fit on 8-1/2 by 11 inch paper with margins not less than one inch on every side. Single space all text and use Times New Roman typeface, a black font color, and a font size of 12 point or larger (except in figures and tables).
- The ARPA-E assigned Control Number, the Lead Organization Name, and the Principal Investigator's Last Name must be prominently displayed on the upper right corner of the header of every page. Page numbers must be included in the footer of every page.

Full Applications found to be noncompliant or nonresponsive may not be merit reviewed or considered for award (see Section III.B 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.

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).

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

Full Applications must conform to the content requirements described below.

Component	Required Format	Description and Information
Technical Volume	PDF	The technical volume is the centerpiece of the Full Application. Provides a detailed description of the proposed R&D project and Project Team.
SF-424	PDF	Application for Federal Assistance. Applicants are responsible for ensuring that the proposed costs listed in eXCHANGE match those listed on forms SF-424 and SF-424A. Inconsistent submissions may impact ARPA-E’s final award determination.
SF-424A	XLS	Budget Information – Non-Construction Programs
Business Assurances & Disclosures Form	PDF	Applicants should provide comprehensive responses to the questions on this form. Requires the Applicant to make responsibility disclosures and disclose 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. This form 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. A sample response to the Business Assurances & Disclosures Form is also available on ARPA-E eXCHANGE.
Commercialization Plan	PDF	As part of the application, Applicants are required to submit a Commercialization Plan. The Commercialization Plan represents the Applicant’s measurable commitment to support U.S. manufacturing or provide other benefits to the U.S. economy as a result of its award.

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 content and form requirements included within the template, including maximum page lengths. If Applicants exceed the maximum page lengths specified for each section, ARPA-E will review only the authorized number of pages and disregard any additional pages, or ARPA-E may determine that the submission as a whole is noncompliant per Section III.C of the FOA..

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).

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).

2. SECOND COMPONENT: SF-424

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

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

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

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

- Each Project Team should submit only one SF-424 (i.e., a Subrecipient should not submit a separate SF-424).
- The list of certifications and assurances in Block 21 can be found at <http://energy.gov/management/downloads/certifications-and-assurances-use-sf-424>.
- The dates and dollar amounts on the SF-424 are for the entire period of performance (from the project start date to the project end date), not a portion thereof.
- Applicants are responsible for ensuring that the proposed costs listed in eXCHANGE match those listed on forms SF-424 and SF-424A. Inconsistent submissions may impact ARPA-E's final award determination.

3. THIRD COMPONENT: SF-424A

Applicants are required to complete the SF-424A Excel spreadsheet. This form is available on ARPA-E eXCHANGE 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: 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 Applicant 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.”²² 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 current funding for work in the same technology area as the proposed project received from any Federal or non-Federal entity.

Finally, the Applicant may use the Business Assurances & Disclosures Form to request authorization to perform some work overseas.

²² America COMPETES Act, Pub. L. No. 110-69, § 5012 (2007), as amended (codified at 42 U.S.C. § 16538).

5. FIFTH COMPONENT: COMMERCIALIZATION PLAN

As part of the application, Applicants are required to submit a Commercialization Plan that should not exceed three pages in length. A template Commercialization Plan is available on ARPA-E eXCHANGE at <https://arpa-e-foa.energy.gov>. The Commercialization Plan represents the Applicant's measurable commitment to support U.S. manufacturing of subject inventions and distribution of any data, namely software and data sets, resulting from its award in a manner that benefits the U.S. economy. Commercialization Plans are a Program Policy Factor during the review and selection process. See Section V.B.1 of the FOA.

A Commercialization Plan must contain a commitment to the U.S. manufacturing requirements stated in Section VI.B.8 below. A Commercialization Plan must also include a plan for how data will be commercialized and which Intellectual Property rights will be asserted. Additionally, the Commercialization Plan should include a description of specific economic or other benefits to the U.S. economy related to the commercial use by the Applicant of the technology being funded by ARPA-E. For example, an Applicant may commit particular types of products to be manufactured in the United States or include restrictions on licensing of software to use in the United States. (These plans should not include requirements regarding the source of inputs 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 beneficial to U.S. manufacturing or utilization of software. For example, an Applicant may commit to the creation of new and/or high-tech U.S.-based jobs such as those associated with maintaining the software, offering services related to the use of the software, or further domestic development of the software by the Applicant or third parties. ARPA-E is open to considering modification of the license retained by the government in copyright to support acceptable Plans. Assertion of copyright is automatically allowed for domestic educational institutions and nonprofits; for-profit entities must request authorization from ARPA-E to assert copyright.

When an Applicant is selected for an award, the Commercialization Plan submitted by the Applicant will become part of the terms and conditions of the award. It is important to note that the Commercialization Plan is in support of and not a replacement for the U.S. Manufacturing Requirement described in Section VI.B.6. The Applicant/Awardee may request a waiver or modification of the Commercialization Plan from DOE/ARPA-E upon a showing that the original Commercialization Plan is no longer economically feasible.

Class patent waivers usually apply to domestic large businesses as set forth in Section VIII.A 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 a waiver is granted by DOE/ARPA-E. The

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).

Commercialization Plan submitted by the Applicant will become part of the terms and conditions of the award in addition to the requirements attaching to subject inventions.

D. INTERGOVERNMENTAL REVIEW

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

E. FUNDING RESTRICTIONS LIMITATIONS

1. ALLOWABLE COSTS

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

2. PRE-AWARD COSTS

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

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

3. FOREIGN TRAVEL

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

4. 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.

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ARPA-E requires all work under ARPA-E funding agreements to be performed in the United States – i.e., Prime Recipients must perform all work 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.

5. 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/forms/post-award-reporting-forms.html>) if any non-Federal funds have been paid or will be paid to any person for influencing or attempting to influence 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.

6. 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.

7. INDEPENDENT RESEARCH AND DEVELOPMENT

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.

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

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

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).

F. OTHER SUBMISSION REQUIREMENTS

1. USE OF ARPA-E eXCHANGE

To apply to this FOA, Applicants must register with ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/Registration.aspx>). Full Applications must be submitted through ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/login.aspx>). ARPA-E will not review or consider applications submitted through other means (e.g., fax, hand delivery, email, postal mail). For detailed guidance on using ARPA-E eXCHANGE, please refer to the “ARPA-E eXCHANGE Applicant Guide” (<https://arpa-e-foa.energy.gov/Manuals.aspx>).

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

Once logged in to ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/login.aspx>), Applicants may access their submissions by clicking the “My Submissions” link in the navigation on the left side of the page. Every application that the Applicant has submitted to ARPA-E and the corresponding Control Number is displayed on that page. If the Applicant submits more than one application to a particular FOA, a different Control Number is shown for each application.

Applicants are responsible for meeting each submission deadline in ARPA-E eXCHANGE. **Applicants are strongly encouraged to submit their applications at least 48 hours in advance of the 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 Full Application. In addition, Applicants should allow at least 15 minutes to submit a Reply to Reviewer Comments. Once the application is submitted in ARPA-E eXCHANGE, Applicants may revise or update their application until the expiration of the applicable deadline.

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

ARPA-E may not review or consider incomplete applications and applications received after the deadline stated in the FOA. Such applications may be deemed noncompliant (see Section III.B.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.

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).

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.B of the FOA).

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* (35%) - This criterion involves consideration of the following:

- Thorough understanding of the current state-of-the-art and presentation of an innovative technical approach to significantly improve performance over the current state-of-the-art;
- Awareness of competing commercial and emerging technologies and identification of how the proposed concept/technology provides significant improvement over these other solutions; and
- A reasonable and effective strategy for transitioning the proposed technology to commercial deployment.

(2) *Overall Scientific and Technical Merit* (35%) - This criterion involves consideration of the following:

Whether the proposed approach is unique and innovative;

- Feasibility of the proposed work based upon preliminary data or other background information and sound scientific and engineering practices and principles; and
- A sound technical approach to accomplish the proposed R&D objectives.

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

The PI (Applicant Team Leader) and Applicant 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.

The above criteria will be weighted as follows:

Impact of the Proposed Technology	35%
Overall Scientific and Technical Merit	35%
Qualifications, Experience, and Capabilities of the Proposed Applicant Team	30%

B. REVIEW AND SELECTION PROCESS

1. PROGRAM POLICY FACTORS

In addition to the above criteria, ARPA-E may consider the following program policy factors in determining which Full Applications to select for award negotiations:

- I. **ARPA-E Portfolio Balance.** Project balances ARPA-E portfolio in one or more of the following areas:
 - a. Diversity of technical personnel in the proposed Project Team;
 - b. Technological diversity;
 - c. Organizational diversity;
 - d. Geographic diversity;
 - e. Technical or commercialization risk; or
 - f. Stage of technology development.

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

- III. **Synergy of Public and Private Efforts.**
 - a. Avoids duplication and overlap with other publicly or privately funded projects;

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- b. Promotes increased coordination with nongovernmental entities for demonstration of technologies and research applications to facilitate technology transfer; or
 - c. Increases unique research collaborations.
- IV. **Low likelihood of other sources of funding.** High technical and/or financial uncertainty that results in the non-availability of other public, private or internal funding or resources to support the project.
- V. **High-Leveraging of Federal Funds.** Project leverages Federal funds to optimize advancement of programmatic goals by proposing cost share above the required minimum or otherwise accessing scarce or unique resources.
- VI. **High Project Impact Relative to Project Cost.**
- VII. **Qualified Opportunity Zone (QOZ).** Whether the entity is located in an urban and economically distressed area including a Qualified Opportunity Zone (QOZ) or the proposed project will occur in a QOZ or otherwise advance the goals of QOZ. The goals include spurring economic development and job creation in distressed communities throughout the United States. For a list or map of QOZs go to: <https://www.cdfifund.gov/opportunity-zones>.

2. ARPA-E REVIEWERS

By submitting an application to ARPA-E, Applicants consent to ARPA-E's use of Federal employees, contractors, and experts from educational institutions, nonprofits, industry, and governmental and intergovernmental entities as reviewers. ARPA-E selects reviewers based on their knowledge and understanding of the relevant field and application, their experience and skills, and their ability to provide constructive feedback on applications.

ARPA-E requires all reviewers to complete a Conflict-of-Interest Certification and Nondisclosure Agreement through which they disclose their knowledge of any actual or apparent conflicts and agree to safeguard confidential information contained in Full Applications. 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.

Reviewers for this FOA will not be eligible to participate in Challenge 3 of the GO Competition.

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 May 2022 and to award funding agreements in approximately July 2022.

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.

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.

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.

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).

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.

Applicants that are not selected for award negotiations under this FOA may still participate as an Open Entrant in the GO Competition Challenge 3. See the GO Competition website Rules Document (<https://gocompetition.energy.gov/competition-rules>) regarding competing in Challenge 3 and eligibility for an award.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

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

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

1. 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 www.sam.gov/SAM and obtain a Unique Entity Identifier.

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.

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).

Prime Recipients are also required to register with the Federal Funding Accountability and Transparency Act Subaward Reporting System (FSRS) at <https://www.fsrs.gov/>.²³ 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 complete their SAM registrations. 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 Grant (<https://arpa-e.energy.gov/?q=site-page/funding-agreements>) for information on the National Policy Assurances.

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.

²³ The Federal Funding Accountability and Transparency Act, P.L. 109-282, 31 U.S.C. 6101 note.

4. COST SHARE PAYMENTS²⁴

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

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

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

5. INTELLECTUAL PROPERTY AND DATA MANAGEMENT PLANS

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

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

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

6. U.S. COMPETITIVENESS

A primary objective of DOE’s multi-billion dollar research, development and demonstration

²⁴ Please refer to Section III.B of the FOA for guidance on cost share requirements.

investments – including ARPA-E awards - is advancement of new energy technologies, manufacturing capabilities, and supply chains for and by U.S. industry and labor. Therefore, in exchange for receiving taxpayer dollars to support an applicant's project, the applicant must agree to the following U.S. Competitiveness Provision as part of an award under this FOA.

U.S. Competitiveness

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

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

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

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U.S. economic benefits, DOE may grant the request and, if granted, modify the award terms and conditions for the requesting entity accordingly.

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

7. 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.

8. APPLICANT RISK ANALYSIS

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

9. RECIPIENT INTEGRITY AND PERFORMANCE MATTERS

Prior to making a Federal award, ARPA-E is required to review and consider any information about Applicants that is contained in the Office of Management and Budget's designated integrity and performance system accessible through SAM (currently the Federal Awardee Performance and Integrity Information System or FAPIIS) (41 U.S.C. § 2313 and 2 C.F.R. 200.206).

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

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

10. NONDISCLOSURE AND CONFIDENTIALITY AGREEMENTS REPRESENTATIONS

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

- (1) **It does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contractors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.
- (2) **It does not and will not** use any Federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:
 - a. *“These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling.”*
 - b. The limitation above shall not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.
 - c. Notwithstanding 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

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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 Grant (<https://arpa-e.energy.gov/?q=site-page/funding-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).

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.

- ARPA-E will post responses on a weekly basis to any questions that are received that have not already been addressed at the link above. ARPA-E may re-phrase questions or consolidate similar questions for administrative purposes.
- ARPA-E will cease to accept questions approximately 10 business days in advance of each submission deadline. Responses to questions received before the cutoff will be posted no later than three business days in advance of the submission deadline. ARPA-E may re-phrase questions or consolidate similar questions for administrative purposes.
- Responses are published in a document specific to this FOA under “CURRENT FUNDING OPPORTUNITIES – FAQs” on ARPA-E’s website (<http://arpa-e.energy.gov/faq>).

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

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

During the “quiet period,” only the Contracting Officer may authorize communications between ARPA-E personnel and Applicants. The Contracting Officer may communicate with Applicants as necessary and appropriate. As described in Section IV.A of the FOA, the Contracting Officer may arrange pre-selection meetings and/or site visits during the “quiet period.”

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).

B. DEBRIEFINGS

ARPA-E does not offer or provide debriefings.

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. TITLE TO SUBJECT INVENTIONS

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

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions;
- All other parties: The federal Non-Nuclear Energy Act of 1974, 42 U.S.C. 5908, provides that the government obtains title to new subject inventions unless a waiver is granted (see below):
 - Class Patent Waiver for Domestic Large Businesses: DOE has issued a class patent waiver that applies to this FOA. Under this class patent waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class patent waiver, a domestic large business must agree to the U.S. Competitiveness Provision in accordance with Section VI.B.8. of this FOA.
 - Advance and Identified Waivers: For applicants that do not fall under the class patent waiver or the Bayh-Dole Act, those applicants may request a patent waiver that will cover subject inventions that may be made under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to DOE within the time frames set forth in the award's intellectual property terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- DEC: On June 07, 2021, DOE approved a DETERMINATION OF EXCEPTIONAL CIRCUMSTANCES (DEC) UNDER THE BAYH-DOLE ACT TO FURTHER PROMOTE DOMESTIC MANUFACTURE OF DOE SCIENCE AND ENERGY TECHNOLOGIES. In accordance with this DEC, all awards, including sub-awards, under this FOA made to a Bayh-Dole entity (domestic small businesses and nonprofit organizations) shall include the U.S. Competitiveness Provision in accordance with Section VI.B.6 of this FOA. A copy of the DEC may be found on the DoE website. Pursuant to 37 CFR § 401.4, any Bayh-Dole entity affected by this DEC has the right to appeal it by providing written notice to DOE within 30 working days from the time it receives a copy of the determination.

B. GOVERNMENT RIGHTS IN SUBJECT INVENTIONS

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

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.

C. RIGHTS IN TECHNICAL DATA

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

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

that will be set forth in the award. Authorization of further enhanced rights to promote dissemination of software may also be available. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

D. PROTECTED PERSONALLY IDENTIFIABLE INFORMATION

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

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

E. FOAs AND FOA MODIFICATIONS

FOAs are posted on ARPA-E eXCHANGE (<https://arpa-e-foa.energy.gov/>), Grants.gov (<http://www.grants.gov/>), and FedConnect (<https://www.fedconnect.net/FedConnect/>). Any modifications to the FOA 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

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

F. OBLIGATION OF PUBLIC FUNDS

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

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

G. REQUIREMENT FOR FULL AND COMPLETE DISCLOSURE

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

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

H. RETENTION OF SUBMISSIONS

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

I. MARKING OF CONFIDENTIAL INFORMATION

ARPA-E will use data and other information contained in Full Applications strictly for evaluation purposes.

Full Applications and other submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking

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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 or other submission must be marked as follows and identify the specific pages containing confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

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

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

J. COMPLIANCE AUDIT REQUIREMENT

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

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

IX. GLOSSARY

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

Application: The entire submission received by ARPA-E, including the Full Application.

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

Challenge: A focused effort on a particular grid software problem.

GO Competition: ARPA-E’s broader pursuit to innovate and modernize grid software systems.

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: 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 funding agreement.

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

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

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.



APPENDIX A: ARPA-E GO COMPETITION CHALLENGE 3: OVERVIEW AND PROGRAM INFORMATION

1. BACKGROUND

Since the dawn of the age of electrification, electric power system engineers and operators have been required to manage the real-time matching of instantaneous electricity generation and consumption – especially in the absence of cost effective and ubiquitous electricity storage. Achieving a continuous match between supply and demand requires utilities, grid operators, and other stakeholders to use a variety of sophisticated energy management systems (EMS), market management systems (MMS), dynamic security assessment (DSA) tools, and other decision support tools. These systems employ optimization models and algorithms, control systems, and/or simulations that cover a wide spectrum of applications that vary in type, structure, complexity, and timescale. Decision stages include long-term analysis (e.g., investment planning), midterm analysis (maintenance scheduling, outage coordination, and various reliability and stability assessments), operational planning stages (e.g., day-ahead security constrained unit commitment), and real-time operations and situational awareness.

A number of emerging trends will substantially alter the planning, operations, control, and reliability standards of electric grids over the next several decades. These trends include the high penetration of stochastic resources whose output is uncertain (such as wind and solar), changing electricity demand patterns, and the improving cost effectiveness of distributed energy resources (including storage). Operational protocols and software support systems have long since treated power plants as the primary source of operational flexibility necessary to ensure a reliable and efficient operation. Instead, there is a paradigm shift where flexible resources are being replaced by stochastic resources (wind and solar) while distributed energy resources (including consumption) are emerging to provide flexibility. Innovative grid software is necessary to plan and adapt to growing penetrations of stochastic resources for which availability is both more variable than conventional generators and highly probabilistic. The expected growth in system complexity will require the development of substantially improved grid software to assist grid operators to ensure not just a continuous supply of reliable electricity but to achieve a sustainable, clean, and affordable electric power economy, a necessity for any advanced society.

Many new optimization methods have been proposed in the research community in recent years and many claims have been made regarding the possible practical benefits that these new algorithms might offer utilities and power grid operations in general. However, today, it is extremely difficult to compare relative strengths and weaknesses of different proposed

approaches. The vast majority of reports only test new algorithms on either relatively small-scale power network models, which often must be heavily modified to satisfy the modeling requirements specific to individual algorithms, or on proprietary datasets that inherently cannot be released for wide-spread performance testing. Computational experiments are also typically conducted on a variety of systems, ranging from laptops to large-scale clusters with thousands of nodes. Even small changes in how specific constraints are modeled or which constraints are considered can have significant implications for algorithm selection and performance as well as solution quality. Electrification was chosen as the greatest achievement of the 20th century by the National Academy of Engineering based on technical achievements for one of the most complex engineered systems that then forms a backbone for any modern society. A new paradigm for the testing and evaluation of emerging software solutions is needed to accelerate the adoption of transformational technologies for this critical and complex engineered system.

In response, ARPA-E has announced the GO Competition. The goal of the GO Competition is to accelerate the development of transformational and disruptive methods for solving the most pressing power system problems. The GO Competition will be staged as a series of challenges in power systems to address emerging needs and new technologies on the grid. Challenge 3 will extend the security-constrained optimal power flow problem presented in Challenges 1 and 2 into a market dispatch problem which will include time series data for weather, intermittent generation, unit commitment constraints (including combined cycle plant configurations), and consumption. Challenge 3 will introduce new models to the GO Competition for emerging technologies such as storage, consumer participation (bid-in and price-responsive demand), distributed energy resources, and renewables. Challenge 3 will evaluate transformational OPF tools for three types of real-world applications: real-time dispatch in a five minute market, day-ahead dispatch in an hourly market, and advisory planning models which consider the potential for extreme weather events. Security constraints will remain an integral component of the GO Competition problem for Challenge 3 and all three applications will also consider reserve requirements. With this competition, ARPA-E aims to provide fair and transparent comparisons of industrially-relevant algorithm performance on high-fidelity, open-access, large-scale power system models and a platform for the identification of transformational and disruptive methods for solving power system optimization problems.

2. OPPORTUNITIES IN GRID SOFTWARE AND OPTIMIZATION METHODS

The OPF problem is the central optimization challenge underlying a large suite of grid planning and operational tools. Simply stated, the OPF problem is that of finding the optimal secure dispatch and control settings for power generation, flexible customer demand, energy storage,

and grid control equipment that maximize the operating efficiency of the system.^{25, 26, 27} In order to be deployable, the recommended settings must satisfy all physical constraints of electric power infrastructure and applicable operating standards. These standards include, but are not limited to, minimum and maximum voltages at each node (bus), minimum and maximum power generation from each generator, thermal transmission constraints, stability constraints, and constraints to ensure the reliability of the system while responding to unexpected events and outages (i.e., contingencies). For a more complete history and formal problem formulation, we refer the reader to a paper authored by the Federal Energy Regulatory Commission (FERC).²⁸

Improved OPF algorithms can yield significant benefits. Recent studies have suggested that enhanced OPF algorithms can offer as much as 5-10% reductions in total U.S. electricity cost by improving our management of grid resources in order to reduce network and operational limitations, corresponding to a savings of up to \$40B annually.^{29, 30} In addition to monetary savings, improved optimization algorithms are likely to help ensure reliable system operation as power flows become more dynamic.³¹ To fully realize the potential benefits of renewable generation, recently developed electric transmission power flow controllers, distribution automation technologies, distributed energy resources, energy storage, and consumption software support tools will require more complex nonconvex grid operation optimization algorithms. Furthermore, as the number of controllable resources connected to both transmission and distribution systems grow substantially, along with the reliance on stochastic resources, it is important to examine approaches that will handle the increasing complexities driven by the size, non-convexities, and uncertainties associated with power grid management. Advances in optimization methods and decision support tools are paramount to overcome these complicating factors and to reduce the reliance on operator intuition and the reliance on conventional technologies. In this context, the importance of new OPF methods was recently recognized by the National Academies.³²

²⁵ J. Carpentier, "Contribution to the economic dispatch problem," *Bulletin de la Société Française des Électriciens*, ser. 8, vol. 3, pp. 431-447, 1962.

²⁶ H. W. Dommel and W. F. Tinney, "Optimal power flow solutions," *IEEE Transactions on Power Apparatus and Systems*, vol. 87, no. 10, pp 1866-1876, October 1968.

²⁷ There are a variety of specific applications for OPF. The specific objective function and the constraints can vary widely. In many applications, where demand is considered fixed, the objective is considered to be minimization of total generation cost.

²⁸ M. B. Cain, R. P. O'Neill, and A. Castillo, "History of optimal power flow and formulations," Federal Energy Regulatory Commission, Washington, DC, August 2013, <http://www.ferc.gov/industries/electric/indus-act/market-planning/opf-papers/acopf-1-history-formulation-testing.pdf>.

²⁹ M. Ilic, "Modeling of hardware and systems related transmission limits: the use of AC OPF for relaxing transmission limits to enhance reliability and efficiency," *Presentation at FERC Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software*, Washington, DC, June 2013, <http://www.ferc.gov/CalendarFiles/20140411131533-T2-B%20-%20Ilic.pdf>.

³⁰ M. B. Cain, R. P. O'Neill, and A. Castillo, "History of optimal power flow and formulations," Federal Energy Regulatory Commission, Washington, DC, August 2013, <http://www.ferc.gov/industries/electric/indus-act/market-planning/opf-papers/acopf-1-history-formulation-testing.pdf>.

³¹ GE Energy, "Western wind and solar integration study," National Renewable Energy Laboratory, Technical Report No. NREL/SR-550-47434, May 2010, <http://www.nrel.gov/docs/fy10osti/47434.pdf>.

³² National Academies of Sciences, Engineering, and Medicine. *Analytic Research Foundations for the Next-Generation Electric Grid*. Washington, DC: The National Academies Press, 2016. doi: 10.17226/21919.

The core OPF solution methods predominantly used in industry today were designed in an era when computers were far less capable and more costly and general purpose optimization solvers were in their infancy. Grid operators, power system software vendors, and the research community were required to make a range of simplifying assumptions, most commonly a set of linearizing assumptions that ignore voltage and reactive power, referred to as a direct current optimal power flow (DCOPF). While many proprietary variations on OPF models, approximations, and solution techniques have been developed over the past decades by industry vendors, the most commonly used optimization software packages, including production cost models, security-constrained unit commitment (SCUC), and security-constrained economic dispatch (SCED) tools rely on linear OPF assumptions such as the assumptions found in a classical DCOPF problem. Despite improvements in formulations, approximation techniques, and solvers, there are no tools currently in widespread use in industry that use the full AC power flow equations (without linearizing assumptions) and simultaneously co-optimize both real and reactive power generation.

The SCOPF tools in use today often result in conservative solutions that must be iteratively checked for physical feasibility before implementation. The development and demonstration at scale of OPF solution methods providing physically feasible solutions and capable of optimizing both real and reactive power generation and demand within the time limits required for practical application remains a difficult problem. Achieving these capabilities are expected to become critical in the future as electric power systems evolve to include more widely distributed and stochastic resources, especially as OPF becomes more important in the context of electric distribution systems.

Since the turn of the millennium, the performance of the most powerful supercomputers has increased by almost four orders of magnitude while the cost per computational step has dropped by approximately the same factor.^{33,34,35} Improvements in optimization and search methods have evolved similarly, especially those related to mixed integer programming (MIP) and heuristic-based optimization methods. The relative speed of commercial general-purpose solvers, such as CPLEX and GUROBI, has also increased by over three orders of magnitude on fixed hardware.^{36,37} Cloud computing, which can be used to leverage many of these gains, has also started to gain more widespread interest within the power system engineering community.³⁸

In tandem, many new approaches to solve OPF problems have been proposed in the literature in recent years; it appears increasingly likely that scalable and more accurate approaches to

³³ P. Panciatici et al., "Advanced optimization methods for power systems," *Proceedings of the 18th Power System Computation Conference*, Wroclaw, Poland, August 2014, pp. 1-18, doi: 10.1109/PSCC.2014.7038504.

³⁴ <http://www.top500.org/>

³⁵ <https://intelligence.org/2014/05/12/exponential-and-non-exponential/>

³⁶ <http://www.gurobi.com>

³⁷ T. Koch et al., "MIPLIB 2010," *Mathematical Programming Computation*, vol. 3, no. 2, pp. 103-163, June 2011, doi: 10.1007/s12532-011-0025-9

³⁸ J. Goldis et al., "Use of cloud computing in power market simulations," Presentation at FERC Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software, Washington, DC, June 2014.

solve the OPF problem may be within reach. For example, recent research has moved from linear to convex approximations for the OPF problem. Fast and accurate convex relaxations have been formulated where the global optimum can be found efficiently using quadratic convex, semi-definite, and second order cone programming approaches.^{39,40,41,42,43} Furthermore, it has been shown that there are situations when a convex relaxation of the OPF problem can still find the global optimum to the original non-convex mathematical program.^{44,45} Distributed and parallelizable OPF algorithms have also been proposed, for example, using the alternating direction method of multipliers (ADMM), suggesting that OPF solution algorithms can be designed that leverage more advanced computational hardware.^{46,47,48} These same algorithms could enable the real-time coordination and optimization of large numbers of distributed energy resources. Advances in general optimization methods, as well as those from other fields, may lend insights to solve OPF problems. For example, work in machine learning has focused on efficiently finding solutions to non-convex optimization problems. Methodologies developed, such as new variations on stochastic gradient descent, may help efficiently find solutions to the non-convex OPF problem.^{49,50,51} OPF problems that solve both pre-contingency and post-contingency states may also benefit from recent research into decomposition methods or stochastic optimization algorithms that seek to exploit a similar two-stage problem structure.^{52,53} Finally, many unique methodologies using techniques such as genetic algorithms, neural networks, fuzzy algorithms,

³⁹ S. Low, "Convex relaxation of optimal power flow, Part I: Formulations and equivalence," *IEEE Transactions on Control of Network Systems*, vol. 1, no. 1, pp. 15-27, March 2014, doi: 10.1109/TCNS.2014.2309732.

⁴⁰ S. Low, "Convex relaxation of optimal power flow, Part II: Exactness," *IEEE Transactions on Control of Network Systems*, vol. 1, no. 2, pp. 177-189, May 2014, doi: 10.1109/TCNS.2014.2323634.

⁴¹ R. Madani, S. Sojoudi, and J. Lavaei, "Convex relaxation for optimal power flow problem: Mesh networks," *IEEE Transactions on Power Systems*, vol. 30, no. 1, pp. 199-211, May 2014, doi: 10.1109/TPWRS.2014.2322051.

⁴² D. Molzahn et al., "Implementation of a large-scale optimal power flow solver based on semidefinite programming," *IEEE Transactions on Power Systems*, vol. 28, no. 4, pp. 3987-3998, April 2013, doi: 10.1109/TPWRS.2013.2258044.

⁴³ C. Coffrin, H. Hijazi, and P. Van Hentenryck, "Strengthening the SDP relaxation of AC power flows with convex envelopes, bound tightening, and valid inequalities," *IEEE Transactions on Power Systems*, vol. 32, no. 5, pp. 3549-3558, September 2017, doi: 10.1109/TPWRS.2016.2634586.

⁴⁴ J. Lavaei and S. Low, "Zero duality gap in optimal power flow problem," *IEEE Transactions on Power Systems*, vol. 27, no. 1, pp. 92-107, August 2011, doi: 10.1109/TPWRS.2011.2160974.

⁴⁵ L. Gan et al., "Exact convex relaxation of optimal power flow in radial networks," *IEEE Transactions on Automatic Control*, vol. 60, no. 1, pp. 72-87, June 2014, doi: 10.1109/TAC.2014.2332712.

⁴⁶ A. Sun, D.T. Phan, and S. Ghosh, "Fully decentralized AC optimal power flow algorithms," *IEEE Power and Energy Society General Meeting*, Vancouver, BC, Canada, July 2013, doi: 10.1109/PESMG.2013.6672864.

⁴⁷ S. Magnússon, P. Weeraddana, and C. Fischione, "A distributed approach for the optimal power flow problem based on ADMM and sequential convex approximations," *arXiv preprint arXiv: 1401.4621*, January 2014.

⁴⁸ B. H. Kim and R. Baldick, "A comparison of distributed optimal power flow algorithms." *IEEE Transactions on Power Systems*, vol. 15, no. 2, pp. 599-604, May 2000, doi: 10.1109/59.867147.

⁴⁹ P. Jain and P. Kar, "Non-convex optimization for machine learning," *Foundations and Trends in Machine Learning*, vol. 10, no. 3-4, pp. 142-336, December 2017, doi: 10.1561/22000000058.

⁵⁰ R. Ge et al., "Escaping from saddle points – online stochastic gradient for tensor decomposition," *JMLR: Workshop and Conference Proceedings*, vol. 40, pp. 1-46, 2015.

⁵¹ Z. Allen-Zhu and E. Hazan, "Variance reduction for faster non-convex optimization," *Proceedings of the 33rd International Conference on Machine Learning*, vol. 48, pp. 699-707, June 2016.

⁵² F. Capitanescu et al., "State-of-the-art, challenges, and future trends in security constrained optimal power flow," *Electric Power Systems Research*, vol. 81, pp. 1731-1741, 2011.

⁵³ F. Capitanescu, "Critical review of recent advances and further developments needed in AC optimal power flow," *Electric Power Systems Research*, vol. 136, pp. 57-68, 2016.

and holomorphic embedding have also emerged claiming, in many cases, to revolutionize solution methods for OPF.^{54,55}

The end-result has been numerous research projects and papers on improved grid optimization strategies and many new algorithms that may be able to significantly impact grid operation and control. However, most of these advances have not yet moved past the early research stage. One critical roadblock to their adoption has been the lack of publicly available, large-scale, and high-fidelity power system network models on which to test new solution methods and/or perform valid comparisons. Most recent grid operation optimization advances still have not been validated on realistic, large-scale test models and their operational limits also remain largely unexplored.⁵⁶

3. THE GO COMPETITION CHALLENGE 3: OPF

ARPA-E intends to launch GO Competition Challenge 3 in the Spring of 2022; Challenge 3 will focus on a multi-period OPF market dispatch problem for three main applications (real-time dispatch, day-ahead markets, and advisory planning).⁵⁷ It is important to note that a necessary first step for any meaningful OPF competition must be the development of many small, medium, and large-scale, realistic power system network descriptions and operating scenarios defining a variety of challenging operating conditions (reflecting both the existing electric power system and that in the future). The primary objective of the ARPA-E GRID DATA (Generating Realistic Information for the Development of Distribution And Transmission Algorithms) program⁵⁸, launched in early 2016, was the development of these datasets, an example of which is depicted in Figure 1. The projects supported under the GRID DATA program are providing many of the power system datasets to be used in the upcoming GO Competition Challenge 3.

⁵⁴ X. F. Wang, Y. Song, and M. Irving, *Modern power systems analysis*, New York, NY: Springer Science & Business Media, 2008.

⁵⁵ A. Trias, "The holomorphic embedding load flow method," *IEEE Power and Energy Society General Meeting*, San Diego, CA, July 2012, doi: 10.1109/PESGM.2012.6344759.

⁵⁶ ARPA-E "Generating Realistic Information for Development of Distribution and Transmission Algorithms (GRID DATA)," Funding Opportunity Announcement Number DE-FOA-0001357, June 2015, <https://arpa-e.energy.gov/?q=pdfs/grid-data-de-foa-0001357>.

⁵⁷ See <https://gocompetition.energy.gov/>.

⁵⁸ <http://arpa-e.energy.gov/?q=arpa-e-programs/grid-data>.

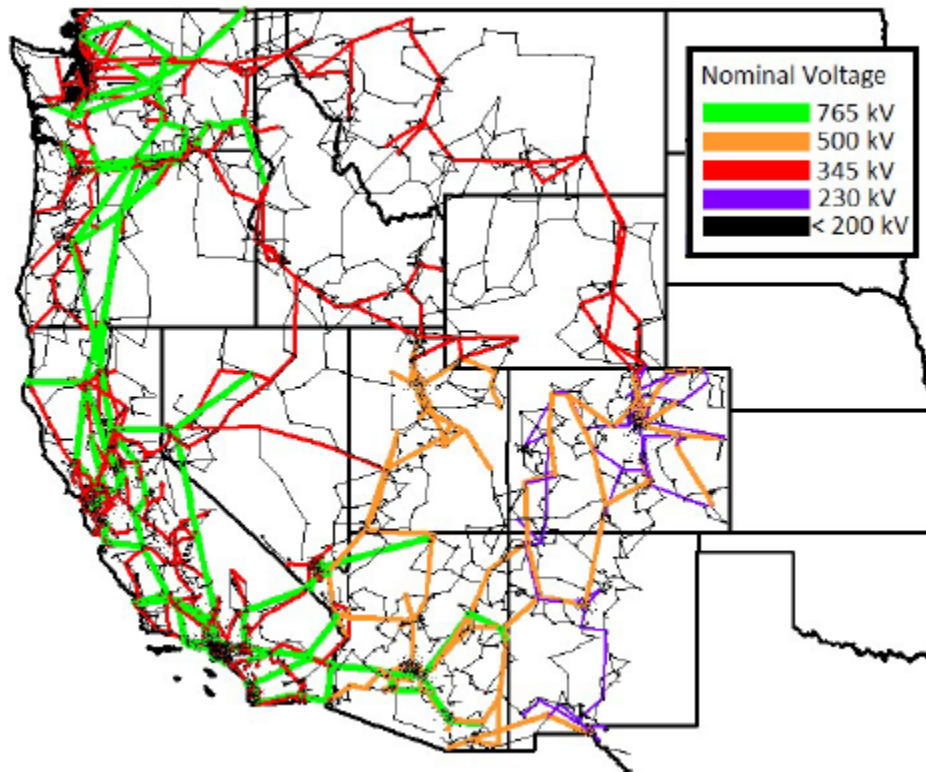


Figure 1. 10,000 Node Synthetic Network Model on the Footprint of the Western United States.⁵⁹

Datasets containing power system network models with corresponding scenarios including time series data for weather, intermittent generation, consumption, reserves, and contingencies will be released at the start of the GO Competition Challenge 3, which will allow Entrants to test their OPF algorithms prior to submitting the algorithms in Competitive Events 1, 2, and 3 and the Final Event (Event 4). Events 3 and 4 will award monetary prizes to the top ranked competitors based on their official score. The Events are described in more detail regarding algorithm submission, scoring, and the release of datasets used for these events in Section 3.B and Section 3.C within this appendix, Appendix A. Additionally, a specific problem formulation will be provided (<https://gocompetition.energy.gov/challenges/challenge-3/formulation>) along with a descriptive scoring criteria (<https://gocompetition.energy.gov/challenges/challenge-3/scoring>) on the GO Competition website. The provided problem formulation and modeling approach described will be used for solution evaluation. Entrants will be permitted to use any approximation or reformulation of the official problem formulations, alternative modeling conventions, and/or solution methods within their own software; however, the resulting solution will be evaluated with the official formulation. Indeed, we anticipate Entrants will use a variety of model formulations (to enhance computational efficiency and/or promote finding a solution) and will use a mix of formal optimization solution methods and unique heuristics. For

⁵⁹ A. B. Birchfield, T. Xu, K. M. Gegner, K. S. Shetye, and T. J. Overbye, "Grid structural characteristics as validation criteria for synthetic networks," *IEEE Transactions on Power Systems*, vol. 32, no. 4, pp. 3258-3265, July 2017.

example, Entrants may choose to mathematically decompose the problem in various ways. Regardless of the method and model formulation used within each Entrant’s software, all Entrants will be required to provide their solution (variable setpoints) in a form that is compatible with the selected, published competition problem formulation.

Entrants will interact with the competition via a hosted computational platform with a web front-end portal (<https://gocompetition.energy.gov/>). Algorithms will be submitted for formal evaluation (and scoring) by the official competition platform throughout all challenges of the competition. Submissions can either be source code that must be compiled, linked, and executed, interpreted and executed, or a binary execution file. Each submission will be run on the controlled, secure evaluation platform with no external communications. The competition evaluation platform will provide access to several popular licensed solvers (please refer to the competition website for an up-to-date list of supported solvers). Solutions requiring licensed software not provided by the platform will have to be self-contained.

Public leaderboards will be maintained during the competition on the web portal as described below. Entrants can participate as individuals or in teams. Refer to the Rules Document posted on the GO Competition website (<https://gocompetition.energy.gov/competition-rules>) for more information.

A. Challenge 3: Spring 2022-Spring 2023

Challenge 3 will focus on the OPF problem and utilize multiple unique datasets. Each dataset will consist of a collection of power system network models of different sizes with associated operating scenarios (for more details on the distinction between power system network models and operating scenarios, see details on scoring: <https://gocompetition.energy.gov/challenges/challenge-3/scoring>).

It is expected that many datasets will be open source and include models generated by the ARPA-E GRID DATA program. Datasets will be released on the GO Competition website throughout Challenge 3. System models and datasets made publicly available in the GO Competition will not contain or constitute Critical Energy Infrastructure Information (CEII).⁶⁰ Any datasets or system models used in the GO Competition that do contain CEII will be maintained according to all applicable requirements and established industry best practices.

At the start of the competition, representative datasets will be provided to all Entrants to aid in the development of their algorithms. The specific datasets for each event will be released after the judging process for each event is completed, subject to restrictions related to protecting

⁶⁰ See 18 C.F.R. § 388.113(c)(1). The term “CEII” means “specific engineering, vulnerability, or detailed design information about proposed or existing critical infrastructure that: (i) relates details about the production, generation, transportation, transmission, or distribution of energy; (ii) could be useful to a person in planning an attack on critical infrastructure; (iii) is exempt from mandatory disclosure under the Freedom of Information Act, 5 U.S.C. Part 552; and (iv) Does not simply give the general location of the critical infrastructure.”

CEII. Note that the Final Event may include datasets that are not from the ARPA-E GRID DATA program and that will not be publicly released after the judging is finalized for Challenge 3; these datasets may be proprietary industry cases that cannot be released. Proprietary datasets will be stored at a secure location by the GO Competition Administrator;⁶¹ algorithm performance against actual datasets will contextualize and validate the GO Competition Challenge 3 results for the research and industry communities.

The “Challenge 3 Original Dataset (C3OD)” will be released at the start of Challenge 3 in order to allow Entrants to start developing solution methods and test their approach on the GO Competition platform. Entrants will be able to download the datasets in order to test algorithms within their own development environment. Entrants can also submit software to be scored against the C3OD dataset using the official competition platform at any time.

Scores will be generated after each Competitive Event for each Entrant’s algorithm and will be displayed on a set of competition leaderboards, accessible via the competition website. Open Entrants may choose to remain anonymous on the leaderboards or may choose to display their Entrant name associated with their scores. However, Entrants that choose to remain anonymous are ineligible for awards under this competition. For more information on scoring, see <https://gocompetition.energy.gov/challenges/challenge-3/scoring>.

B. Competitive Events 1 and 2 (Spring 2022, Summer 2022)

Two trial Competitive Events will be conducted to allow the Entrants to view their performance on datasets that have not been publicly released. Approximately three and five months into Challenge 3, the two dry-run “trial” rounds will be held utilizing new power system datasets, Challenge 3 Dataset 1 (C3D1) and Challenge 3 Dataset 2 (C3D2). The datasets will be similar to those in C3OD, but they will not be publically released until after the conclusion of each trial event. Entrants are expected to update their submitted approach throughout Challenge 3 and, in particular, before each of the Competitive Events. The datasets used throughout the GO Competition Challenge 3 may increase in size and complexity.

Prior to each Competitive Event, there will be a deadline for Entrants to submit their OPF software approach before the judging is conducted; these deadlines will be posted at the start of the GO Competition Challenge 3 in the spring of 2022. Following each deadline, the software from all Entrants will be run and scored against C3D1 and C3D2 respectively. After each Competitive Event, scores for each Entrant submission will be displayed on a set of competition leaderboards. The objective of the first two events is to give Entrants experience in using the portal for the competition and to troubleshoot any potential algorithm submission and evaluation problems in the context of a specified deadline.

⁶¹ The Pacific Northwest National Laboratory (PNNL) is acting as the GO Competition Administrator, the host team of the competition. Additionally, there are sub-contractors that are supporting PNNL and ARPA-E in regards to the GO Competition Challenge 3 (Arizona State University, National Renewable Energy Laboratory, Texas A&M University, the University of Wisconsin-Madison).

The datasets used for scoring for each competitive trial event (C3D1 and C3D2) will be released to the public as soon as scoring and evaluation of all algorithms has been completed. C3D1 and C3D2 and will remain available for scoring runs using the official competition platform throughout the remainder of the competition and Entrants will have the ability to submit new software/algorithms (to be tested against datasets from C3D1 and/or C3D2 at any time).

C. Competitive Event 3 and the Challenge 3 Final Event (Event 4) (Fall 2022, Winter 2022)

At the conclusion of Challenge 3, Competitive Events 3 and 4 (The Final Event) will occur, which will include the official scoring that will determine the final placement of the Entrants for purposes of determining prizes. GO Competition formulations, scoring, and rules will be similar to those in the previous competitive events, with a new Challenge 3 Dataset 3 (C3D3) and Final Dataset (C3FD) used for evaluation and scoring. The deadline for Entrants to submit their OPF solution software will be announced at the start of the GO Competition Challenge 3. Following the deadline, the software from all Entrants will be run and scored against the C3D3 and C3FD respectively. Scores for each Entrant submission will be displayed on a series of competition leaderboards.

Competition winners will be determined based on the final scores (see <https://gocompetition.energy.gov/challenges/challenge-3/scoring>) subject to the winning criteria specified in the GO Competition Rules Document (see <https://gocompetition.energy.gov/competition-rules>). The datasets that are used for the third Competitive Event (C3D3) and the Final Event (C3FD), will be made publicly available only after the scoring is finalized for each event and the winners are announced.

D. Beyond Challenge 3

After the Final Event, the top performers from Challenge 3 may be invited to continue in a Challenge 3 Pilot Phase. This potential pilot will be designed to increase the Technology to Market focus for this Competition. Participation in a potential pilot will be by invitation only.

E. Competition Timeline: Challenge 3

The proposed Challenge 3 competition timeline is available online on the GO Competition website (see <https://gocompetition.energy.gov/challenges/challenge-3/timeline>).

ARPA-E intends for the competition platform to be capable of hosting a wide range of power system algorithm research competitions. Once the processes are established and the award competition model has been validated, private sector entities or other government agencies will have the option of commissioning and sponsoring additional award competitions, contributing to a new era of innovation in electric power systems research.

4. GO COMPETITION DETAILS AND WEBSITE

The definitive (and evolving) source of all details related to the GO Competition including details regarding participation eligibility requirements, the standardized evaluation platform, Challenge 3 modeling details, and scoring metrics can be found at the GO Competition website, <https://gocompetition.energy.gov/>. The official OPF formulation can be found on the GO Competition website along with other information pertaining to the hardware platform and available software. While frequent changes are not expected, ARPA-E reserves the right to change any of these details. Potential Entrants should visit the GO Competition website for updates and should provide contact information during the registration process so that they can be notified when there are changes.

5. OPEN ENTRANTS AND PROPOSAL ENTRANTS

ARPA-E is providing two parallel paths for participating in the GO Competition Challenge 3: a *Proposal Entrant Path* and an *Open Entrant Path*. Each Entrant's score and ranking throughout the competition will be based on the same technical evaluation criteria and scoring mechanisms for all Entrants, irrespective of path.

Proposal Entrants for Challenge 3 will be competitively selected on the basis of proposals submitted to this FOA. It is anticipated that up to 10 teams selected under this FOA will receive grants of up to \$400,000.

Teams who do not apply as Proposal Entrants, or are not selected under this FOA, may participate as Open Entrants. Open Entrants registration materials will be made available on the competition website prior to Challenge 3 and a deadline for registration will be established. Neither ARPA-E nor the GO Competition Administrator will gain rights to software developed by Open Entrants as a result of participation in the competition and Open Entrants will not be required to publicly disclose their solution methods.

Competition and award money eligibility requirements are detailed in the GO Competition Rules Document in <https://gocompetition.energy.gov/competition-rules>, for both Proposal Entrants and Open Entrants. ARPA-E reserves the right to disqualify an Entrant at any time when their actions are deemed to violate the rules of the competition, including but not limited to, the violation of relevant laws or regulations in the course of participation in the competition. ARPA-E does not authorize or consent to competition participants infringing on any U.S. patent or copyright while participating in the competition. No illegal activities may be undertaken for the purpose of participation in the competition.

6. SCORING AND AWARD (PRIZE MONEY AND GRANTS)

Following the Challenge 3 GO Competition Final Event, ARPA-E will determine the top five winning teams in three separate scoring divisions in Competitive Event 3 and six separate

scoring divisions in Competitive Event 4 (The Final Event), see Figures 2, 3 and 4. Scoring divisions are defined based on scoring method and time in which algorithms must return a solution. Divisions 1, 2, and 3 will reward teams a robust performance across all scenarios, the total score for each division will be an accumulation of all of the individual scenario scores in the division. Divisions 4, 5, and 6 (Final Event only) will rank teams by the number of best solutions found for each scenario. Details on scoring divisions and scoring methodology can be found in (<https://gocompetition.energy.gov/challenges/challenge-3/scoring>). Subject to the availability of appropriated funds, the planned award amounts vary by rank for each Eligible Entrant (see the Rules document describing eligibility for receiving awards through the GO Competition Challenge 3 from the GO Competition website: <https://gocompetition.energy.gov/competition-rules>). Eligible Entrants can receive one award in each division in each prize event (the total award amount is additive). Awards to Open Entrants will be prize money. Awards to Proposal Entrants will be additional grant funding from ARPA-E to further develop their algorithm. Receipt of this funding: (i) requires submission of a brief application, and (ii) is subject to ARPA-E's standard grant terms and conditions (including cost sharing requirements, if applicable). ARPA-E reserves the right to discontinue negotiations without the award of a grant in the event the parties can not agree on the terms of the prospective grant. Please see the eligibility requirements as outlined in (<https://gocompetition.energy.gov/competition-rules>). Open Entrants will not be restricted in how they utilize the funds. However, Open Entrants will be encouraged to use those funds to continue to develop their algorithms and participate in future GO Challenges.



Figure 2: Competitive Event 3 Scoring Divisions; Prizes are Only for Award-Eligible Entrants.



Figure 3: Final Event Scoring Divisions 1, 2, and 3; Prizes are Only for Award-Eligible Entrants.



Figure 4: Final Event Scoring Divisions 4, 5, and 6; Prizes are Only for Award-Eligible Entrants.

ARPA-E expects to actively publicize the results of the GO Competition. In addition, award winners from Challenge 3 (prize money recipients and grant recipients) will be encouraged to participate in related events such as an industry outreach event and the annual ARPA-E Energy Innovation Summit.