

**U.S. Department of Energy (DOE)
Office of Energy Efficiency and Renewable Energy (EERE)**

Advancing U.S. Thin-Film Solar Photovoltaics

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FOA Issue Date:	9/12/23 ~2pm Eastern
Informational Webinar:	9/26/23 1:00 p.m. ET
Submission Deadline for Concept Papers:	10/24/23 5:00 p.m. ET
Expected Date for Concept Paper Encourage/Discourage Decision	11/16/23
Submission Deadline for Full Applications:	12/18/23 5:00 p.m. ET
Expected Dates for Applicant Interviews:	2/5/24-2/13/24
Expected Date for EERE Selection Notifications:	March 2024
Expected Timeframe for Award Negotiations:	March – July 2024

- Applicants must submit a Concept Paper by 5:00 p.m. ET on the due date listed above to be eligible to submit a Full Application.
- To apply to this FOA, applicants must register with and submit application materials through EERE eXCHANGE at <https://eere-eXCHANGE.energy.gov>, EERE’s online application portal.
- Applicants must designate primary and backup points-of-contact in EERE eXCHANGE with whom EERE will communicate to conduct award negotiations. If an application is selected for award negotiations, it is not a commitment to issue an award. It is imperative that the applicant/selectee be responsive during award negotiations and meet negotiation deadlines. Failure to do so may result in cancelation of further award negotiations and rescission of the selection.
- **Unique Entity Identifier (UEI) and System for Award Management (SAM)** - Each applicant (unless the applicant is excepted from those requirements under 2 CFR 25.110) is required to: (1) register in the SAM at <https://www.sam.gov> before submitting an application; (2) provide a valid UEI number in the application; and (3) maintain an active SAM registration with current information when the applicant has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable UEI and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, DOE

will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

NOTE: Due to the high number of UEI requests and SAM registrations, entity legal business name and address validations are taking longer than expected to process. Entities should start the UEI and SAM registration process as soon as possible. If entities have technical difficulties with the UEI validation or SAM registration process they should use the [HELP](#) feature on [SAM.gov](#). SAM.gov will address service tickets in the order in which they are received and asks that entities not create multiple service tickets for the same request or technical issue. Additional entity validation resources can be found here: [GSAFSD Tier 0 Knowledge Base - Validating your Entity](#).

MODIFICATIONS

All modifications to the FOA are HIGHLIGHTED in the body of the FOA

Mod. No.	Date	Description of Modification
0001	10/04/2023	To revise the deadlines for expected E/D decision and full application deadline
0002	11/13/2023	Defines prime recipient as representing the “majority of the work performed (over 50%) at I A i and III A i, and revises the deadline for expected E/D decision and Applicant interviews.

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I. Funding Opportunity Description

A. Background and Context

i. Program Purpose

The U.S. Department of Energy Solar Energy Technologies Office (SETO) works to accelerate the development and deployment of solar technologies to support an equitable transition to a decarbonized electricity system by 2035 and a net-zero energy sector by 2050. Achieving these goals will support the nationwide effort to address the climate crisis and ensure that all Americans benefit from the transition to a clean energy economy. The office supports solar energy research, development, demonstration, and technical assistance in five areas— photovoltaics, concentrating solar-thermal power, systems integration, manufacturing and competitiveness, and soft costs—to improve the affordability, reliability, and domestic benefit of solar technologies on the electric grid.

The Advancing U.S. Thin-Film Solar Photovoltaics FOA will focus on accelerating the capabilities of two thin-film photovoltaic (PV) technologies: metal-halide perovskite PV and cadmium telluride (CdTe) PV. It will fund innovative industrial research and development (R&D) projects for perovskite PV and industrial research, development, and demonstration (RD&D) projects for CdTe PV. “Industrial” R&D and RD&D refers to projects that are led by industry with the primary intent of improving commercial viability and/or market share of the technologies being studied. This FOA promotes American leadership in thin-film PV technology in both the domestic manufacturing of thin-film PV modules and the deployment of these technologies at the gigawatt (GW) scale. With this goal in mind, **only for-profit entities and teams led by for-profit entities may apply to this FOA** (see Section III.A for details on eligibility criteria), **the scope of work performed by the prime recipient must represent the majority of the work performed (over 50%), as measured by the total project costs**, and all work must be performed in the United States (see Section IV.I.iii. and Appendix C).

R&D has helped lower manufacturing costs, increase efficiency and performance, and improve the reliability of solar technologies. Over the past 40 years, SETO awardees achieved over a third of the solar cell efficiency world records recorded by the National Renewable Energy Laboratory (NREL)¹ and created hundreds of companies that are pushing the boundaries of innovation, bringing new products and services to the market. SETO currently supports over 500 solar RD&D projects across the country. Over the past 15 years, the SETO

¹ NREL. Best Research Cell Efficiency Chart. National Renewable Energy Laboratory. <https://www.nrel.gov/pv/cell-efficiency.html>, accessed June 22, 2023.

Manufacturing and Competitiveness² team—which focuses on technology commercialization—has invested over \$370 million in the U.S. innovation community, leading to nearly \$12 billion in follow-on private funding. These investments have helped secure American leadership in solar innovation and increased energy affordability across the country.³

This FOA will address, in part, SETO’s fiscal year 2023 congressional direction on RD&D projects for perovskite PV and CdTe PV technologies.

Building a clean and equitable energy economy and addressing the climate crisis is a DOE priority. This FOA will advance DOE goals to achieve carbon-pollution-free electricity by 2035 and “deliver an equitable, clean energy future, and put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050.”⁴ DOE is committed to pushing the frontiers of science and engineering, catalyzing clean energy jobs through research, development, demonstration, and deployment and ensuring environmental justice and inclusion of underserved communities. These activities support the broader government-wide approach to domestic manufacturing by securing the country’s critical supply chains.⁵

ii. **Topics Summary**

This FOA seeks applications to address two topics:

Topic 1: Promoting Research & Development toward Industrial Manufacturing of Early-Stage Perovskite Tandem Photovoltaics (PRIMES Perovskite Tandem PV)

Topic 1 will provide up to \$20 million for hybrid tandem perovskite PV research and development projects at for-profit companies that achieve specific efficiency, long-term reliability, manufacturability, and economic viability thresholds. SETO will not fund projects that focus only on manufacturing scale-up, but SETO will fund projects that may enable pilot-scale manufacturing in the future. Successful projects will focus on hybrid tandem devices that combine perovskite PV with another PV material, such as crystalline silicon (c-Si) or CdTe.

² EERE. Manufacturing and Competitiveness Team. 2023. www.energy.gov/eere/solar/manufacturing-and-competitiveness-team, accessed June 22, 2023.

³ Pecora, E.F., and Trinastic, J. P. *Location-dependent Public-private Interaction in Catalyzing Solar Technology Commercialization*, DOE/EE-2569, 1863491, 8845; Mar 1, 2022. DOI: 10.2172/1863491.

⁴ Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad,” FR 2021-02177; January 27, 2021.

⁵ Executive Order 14017, “America’s Supply Chains,” <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains/>.

Topic 2: Improving the Market Potential of Advanced Cadmium Telluride Photovoltaics (IMPAC_{dTe} PV)

Topic 2 will provide up to \$16 million for research, development, and demonstration projects in the CdTe PV materials, equipment, installation, recycling, and performance monitoring sectors, with a focus on three areas:

- Supporting the PV deployment sector's ability to adapt to a growing number of CdTe modules in PV systems;
- Increasing the scale of the domestic CdTe PV supply chain;
- Improving CdTe PV technology to maintain competitiveness with c-Si PV.

Projects supporting the PV deployment sector's ability to adapt to a growing number of CdTe modules will advance tools that assess quality and field performance at time of installation and throughout a system's lifetime. Many of the current tools for assessing PV reliability were designed for c-Si PV arrays. These tools could be optimized to gather data for CdTe PV systems or replaced with approaches designed for CdTe PV arrays. Projects may also develop innovations that enhance the system-level performance, reliability, and field metrology of CdTe PV installations.

Projects that support the domestic CdTe PV manufacturing supply chain and improve CdTe PV technology competitiveness will enhance throughput, performance, energy intensity, and production costs for unit processes, integrated manufacturing, and recycling. They will also maintain the quality, reliability, and viability of the domestic CdTe PV industry and supply chain. Further, projects that develop new end-of-life management systems for CdTe should enable material recovery at an economically viable scale.

iii. Background

DOE expects U.S. electricity demand will rapidly increase as buildings, transportation, and industry get electrified.⁶ While solar energy and other clean energy resources can meet much of this demand, DOE estimates domestic deployment of solar PV will need to grow from 110 GW_{ac}⁷ of capacity today to 1,000 GW_{ac} by 2035 to cost-effectively achieve the Biden administration's decarbonization goals. Continued cost reductions and innovation in the solar PV supply chain will facilitate this growth.

⁶ Ardani, K.; Denholm, P.; Mai, T.; Margolis, R.; O'Shaughnessy, E.; Silverman, T.; Zuboy, J. *Solar Futures Study*. Solar Energy Technologies Office, U.S. Department of Energy. Sept. 8, 2021. <https://www.energy.gov/eere/solar/solar-futures-study>, accessed June 22, 2023.

⁷ U.S. Energy Information Administration. *Electric Power Monthly Table 6.1 A*. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=table_6_01_a, accessed March 20, 2023.

The dominant PV technology installed worldwide uses crystalline silicon. Global c-Si module production was 233 GW_{dc} in 2021.⁸ The only other technology with gigawatt-scale production is thin-film CdTe PV, at approximately 9 GW_{dc} in 2022. SETO has released funding opportunities that support innovation in the domestic c-Si supply chain,⁹ a white paper on the opportunities to secure this supply chain,¹⁰ and a report on the challenges within the existing supply chain.¹¹

Alternative PV technologies, such as thin-film PV, must be able to compete with the scale, bankability, durability, and development timelines of c-Si PV. Given the rapid progress of and large investment in c-Si PV R&D, this is a challenge. Even if alternative technologies provide unique market values, their cost-competitiveness will be contingent on scaling rapidly to gigawatt-level manufacturing to compete with the economies of scale the c-Si PV supply chain has now and will have in the future.

This FOA focuses on two promising thin-film PV technologies: metal-halide perovskite PV and CdTe PV. While these two technologies face different, major challenges based on their relative technological maturity to become competitive or stay competitive with c-Si PV, they share some common fundamental advantages. Thin-film PV technologies use direct bandgap semiconductors that have much thinner photoactive layers than c-Si and have potential advantages, such as less-energy-intensive manufacturing, lower manufacturing capital expenditures, simpler supply chains, and greater lifetime energy yield.¹²

Perovskite PV technology is still developing but has seen improvements in efficiency at an unprecedented rate for an emerging PV technology, achieving power conversion efficiencies (PCEs) of over 25% for a single-junction device in just over 10 years after its first reported use as a PV material. In addition, perovskite PV's ease of processing and high-performance potential make it deserving of further investigation, particularly its potential in tandem PV devices. However, fundamental durability and manufacturing challenges need solutions before perovskite PV can break into the market for grid-connected energy production.¹³ If proven to be scalable, durable, and cost-competitive, perovskite

⁸ International Energy Agency Photovoltaic Power Systems Programme. *Snapshot of Global PV Markets*, https://iea-pvps.org/wp-content/uploads/2023/04/IEA_PVPS_Snapshot_2023.pdf.

⁹ Funding Notice: Bipartisan Infrastructure Law Silicon Solar Manufacturing and Dual-use Photovoltaics Incubator <https://www.energy.gov/eere/solar/articles/funding-notice-bipartisan-infrastructure-law-silicon-solar-manufacturing-and>, accessed July 7, 2023.

¹⁰ *Building a Bridge to a More Robust and Secure Solar Energy Supply Chain*, <https://www.energy.gov/eere/solar/building-bridge-more-robust-and-secure-solar-energy-supply-chain>.

¹¹ *Solar Photovoltaics: Supply Chain Deep Dive Assessment*, www.energy.gov/eere/solar/solar-photovoltaics-supply-chain-review-report.

¹² Wikoff, H.M., et al., "Embodied Energy and Carbon from the Manufacture of Cadmium Telluride and Silicon Photovoltaics," *Joule* 2022, 6 (7), 1710-1725. <https://doi.org/10.1016/j.joule.2022.06.006>.

¹³ "Substantially" is defined here as >500 MWac per year.

PV could substantially contribute to long-term decarbonization and deployment goals.

In this FOA, SETO outlines several critical timebound milestones to align the domestic perovskite PV industry on the critical path to commercialization. Funding will support companies in meeting these technology milestones by the end of 2026 to merit future funding for pilot manufacturing projects.

CdTe thin-film PV modules represent approximately 30% of all PV installed in the United States in 2022. CdTe PV also represents a major fraction of the domestic PV manufacturing capacity and is experiencing rapid near-term expansion. The United States has been a leader in the development of CdTe PV and other thin-film PV technologies and is home to the largest thin-film PV manufacturer in the world (First Solar). Still, thin-film PV technologies have yet to take off globally—less than 3% of the global PV market uses CdTe modules,^{14,15,16,17} and thin-film PV module efficiencies have lagged those of their c-Si competitors.

America's innovators have the potential to harness these thin-film technologies to develop new value streams and products that can supply domestic and global markets. Investments from this FOA will help accelerate the growth of the solar industry, identify emerging opportunities, and drive down costs for our domestic energy market, positioning the United States on the leading edge of solar industry advances.

This FOA is designed to help new thin-film PV products get closer to the market by addressing key technological barriers and reducing financial risk, thereby enabling solar companies to attract private investment and speed up commercialization. SETO supports the transformation of R&D into products that can be manufactured in the United States.

iv. Teaming Partner List

The United States has strong R&D capabilities across its universities and national laboratories and is rebuilding its manufacturing capabilities. Private, for-profit manufacturing entities—the target applicants for this FOA—would benefit greatly from developing strong partnerships within this ecosystem. As such,

¹⁴ David Feldman et. al. *Spring 2023 Solar Industry Update*, NREL/PR-7A40-86215, 1974994, 86988; May 18, 2023, DOI: 10.2172/1974994.

¹⁵ David Feldman et. al. *Summer 2022 Solar Industry Update*, NREL/PR-7A40-83718, 1883384, 84491; August 18, 2022, <https://www.nrel.gov/docs/fy22osti/83718.pdf>.

¹⁶ Wood MacKenzie US-Solar Market Insight (2022) <https://www.woodmac.com/industry/power-and-renewables/us-solar-market-insight/>. Accessed March 20, 2023.

¹⁷ SEIA U.S. Solar Market Insight <https://www.seia.org/us-solar-market-insight>. Accessed July 7, 2023.

applicants are strongly encouraged to form teams for projects under this FOA. Applicants are encouraged to partner with academia, national laboratories, other industry members, supply chain partners, equipment developers, and institutions representing a diversity of individuals, such as, but not limited to, tribal communities; minority-serving institutions (MSI), including historically Black colleges and universities (HBCU) and other minority institutions (OMI);¹⁸ minority business enterprises; minority-, woman-, and veteran-owned businesses; and entities located in an energy community, underserved community, or through linkages with Opportunity Zones.^{19,20} Applicants are particularly encouraged to partner with a diverse set of organizations to advance demonstration and field testing activities.

DOE is compiling a Teaming Partner List to facilitate the formation of project teams for this FOA. The Teaming Partner List allows organizations that may wish to participate on a project to express their interest to other applicants and explore potential partnerships.

The Teaming Partner List will be available on EERE eXCHANGE and regularly updated to reflect new teaming partners who provide their organization's information.

SUBMISSION INSTRUCTIONS: View the Teaming Partner List by visiting the EERE eXCHANGE homepage and clicking on "Teaming Partners" within the left-hand navigation pane. This page allows users to view published Teaming Partner Lists. To join the Teaming Partner List, submit a request within eXCHANGE. Select the appropriate Teaming Partner List from the drop-down menu and fill in the following information: Investigator Name, Organization Name, Organization Type, Topic, Background and Capabilities, Website, Contact Address, Contact Email, and Contact Phone.

DISCLAIMER: By submitting a request to be included on the Teaming Partner List, the requesting organization consents to the publication of the above-referenced information. By facilitating the Teaming Partner List, DOE is not endorsing, sponsoring, or otherwise evaluating the qualifications of the individuals and organizations that are identifying themselves for placement on this Teaming

¹⁸ MSIs, HBCUs, and OMIs are educational entities recognized by the Office of Civil Rights (OCR) and the U.S. Department of Education, and they are identified on the OCR's Department of Education U.S. accredited postsecondary minorities' institution list. See <https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html>

¹⁹ Energy communities are regions with high dependence on coal, oil, natural gas, and power plant jobs. See <https://energycommunities.gov/priority-energy-communities/>.

²⁰ Opportunity Zones were added to the Internal Revenue Code by section 13823 of the Tax Cuts and Jobs Act of 2017, codified at 26 U.S.C. 1400Z-1. The list of designated Qualified Opportunity Zones can be found in IRS Notices [2018-48 \(PDF\)](#) and [2019-42 \(PDF\)](#). A visual map of the census tracts designated as Qualified Opportunity Zones may be found at [Opportunity Zones Resources](#). See [frequently asked questions](#) about Qualified Opportunity Zones.

Partner List. DOE will not pay for the provision of any information, nor will it compensate any applicants or requesting organizations for the development of such information.

B. Topics

i. **Topic 1: Promoting Research & Development toward Industrial Manufacturing of Early-Stage Perovskite Tandem Photovoltaics (PRIMES Perovskite Tandem PV)**

The goal of this topic is to put domestically manufactured perovskite hybrid tandem PV on the path to substantial market acceptance by 2030. This FOA outlines SETO's approach to supporting this goal starting in fiscal year 2023 (FY23). Projects will focus on hybrid tandem devices that combine perovskite PV with another PV material (e.g., c-Si, CdTe, CIGS). Quantifiable targets that reflect technology progression and changing market dynamics are provided in this FOA to set expectations of the progress needed to enable commercialization for perovskite PV, with key interim milestones to be met by the end of calendar year 2026.

a. **Background on Perovskite PV and SETO Support**

The perovskite PV R&D community has demonstrated some of the fastest efficiency improvements ever seen for an emerging PV technology. At the lab scale, perovskite PV technology has achieved power conversion efficiencies (PCEs) over 25% in single-junction cells and over 33% in tandem cells with silicon.²¹ These PCE results combined with the high-throughput potential of perovskite module manufacturing demonstrate the promise of perovskite semiconductors in next-generation solar modules. SETO has identified and communicated the importance of four major technoeconomic challenges facing perovskite PV: durability, efficiency at scale, manufacturing, and validation and bankability (see Figure 1, below).

SETO defined these four categories in its FY 2020 Perovskite FOA²² and detailed them in a 2022 article in *ACS Energy Letters*.²³ In brief, SETO categorizes the challenges as such:

²¹NREL. Best Research Cell Efficiency Chart. National Renewable Energy Laboratory. <https://www.nrel.gov/pv/cell-efficiency.html> (accessed June 22, 2023).

²²U.S. Solar Energy Technologies Office, Solar Energy Technologies Office Fiscal Year 2020 Perovskite Funding Program, DE-FOA-0002357, 81.087, <https://eere-exchange.energy.gov/Default.aspx?foald=4f6953d0-ac25-44f6-b99a-ce04f8e119d6>.

²³Siegler, et. al. "The Path to Perovskite Commercialization: A Perspective from the United States Solar Energy Technologies Office." *ACS Energy Letters* 2022, 7 (5), 1728-1734. <https://doi.org/10.1021/acseenergylett.2c00698>.

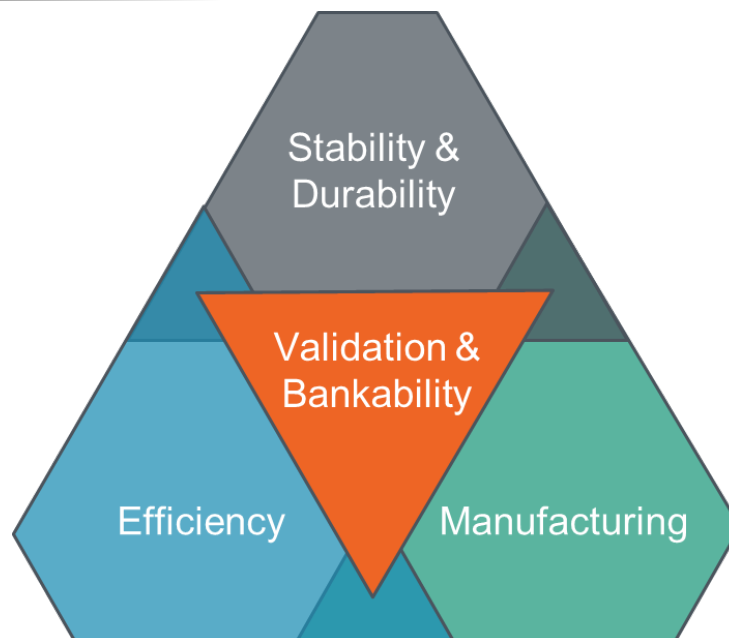


Figure 1. Technoeconomic challenges of perovskites

Durability refers to the ability of perovskite demonstration modules to maintain power and safety ratings over extended duration in fielded outdoor conditions across a variety of climate zones. To achieve SETO's \$0.02/kWh levelized cost of energy (LCOE) target for utility-scale solar systems, technologies of any variety must be able to survive in the field for 20 years or more.²⁴ To demonstrate advancements in durability, minimodules must demonstrate outdoor fielded performance and pass rigorous robustness and accelerated lifetime tests.

Efficiency at scale addresses the major concerns reproducing the high efficiencies achieved on small lab-scale devices (0.1-1 cm²) to larger area minimodules (100-1000 cm²), which are likely a necessary intermediate step to full-size modules. Challenges in demonstration of large-area device performance range from scientific (module fabrication and scribing, uniformity, sheet resistance within layers, etc.) to systemic (record PCEs being set on non-scalable processes, such as solvent-antisolvent engineered spin coating recipes, process optimization tailored only for ≤ 0.1 cm² node sizes, etc.).

Manufacturing refers to the science and engineering of scaled manufacturing methods for minimodule production as well as quality and statistical validation. Effective manufacturing-focused R&D validates innovations and process improvements with statistical process control using statistically relevant sampling sets from high-throughput capable equipment. It also accelerates cycles of learning with systematic experimental approaches such as design of

²⁴ Woodhouse, M., et. al., *Research and Development Priorities to Advance Solar Photovoltaic Lifecycle Costs and Performance*. NREL/TP-7A40-80505, 1826113, 43707, October 1, 2021, DOI: 10.2172/1826113.

experiments and/or machine learning-aided approaches, such as Gaussian Process Regression, and aims for process insensitivity across a range of process variable conditions. Manufacturing R&D must have a high focus on quality control and quality assurance, with the ability to easily identify quality issues in both inputs (issues in chemical precursors, deposition conditions, etc.) and outputs (product quality).

Validation & Bankability is the ability for financial entities to secure investor financing at commercially viable interest rates. For grid-tied electricity generation projects, this requires projects to employ reliable system components (including modules) that have minimal technical risk. Technical risk is reduced significantly with third-party validation of claimed product performance by entities such as the joint Sandia-NREL Perovskite PV Accelerator for Commercializing Technologies (PACT) center.

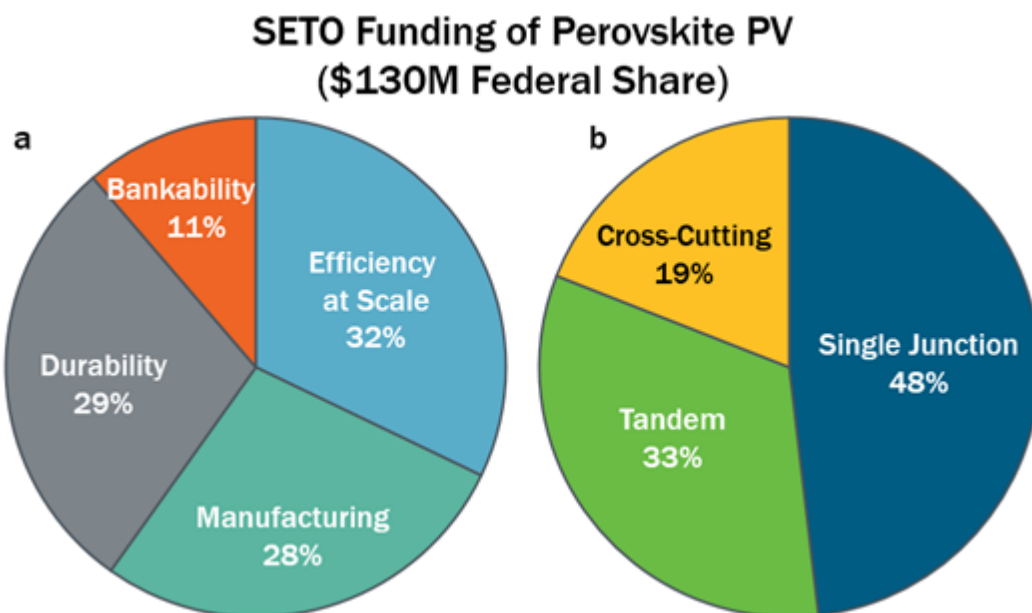


Figure 2. (a) SETO’s historical funding (FY 2013-2022) across categories of efficiency, durability, manufacturing, and bankability on a cumulative scale of funding obligations, not accounting for projects that finished under budget or cancelled mid-award. Relative breakdowns denote total federal share funding obligated to each effort. Each project was assigned a fractional effort in these four categories based on budgets assigned to project tasks in quarterly reporting documents. (b) SETO’s funding of perovskite PV for single junction, tandem, and cross-cutting projects. Projects were categorized as tandem or cross-cutting only if tandems were explicitly stated in the scope of the work. Breakdown is of the total federal share obligated to each category, with entire project budgets allocated to one of the three categories based on project descriptions. SETO has not funded work on multijunction devices exceeding two junctions for perovskite PV.

SETO has invested substantially to address these four risk categories through previous funding programs.²⁵ SETO’s historic funding (FY 2013-2022) across these four categories is shown in Figure 2, above.

While naming and categorizing work within one of these areas allows increased focus on the key problems in each area, all four of these technoeconomic challenges must be solved together for perovskite PV to realize commercial relevance.

With this goal in mind, SETO set preliminary integrated targets for perovskite PV that would indicate a stronger readiness for manufacturing development. In 2021, SETO developed a performance target matrix to align the U.S. industry on several R&D metrics, integrating feedback from the domestic perovskite R&D community.²⁶ These target metrics were used to develop the 2026 milestones for this FOA (Table 1).

Table 1: Perovskite Tandem Performance Targets Matrix

Configuration	Aperture Area PCE ²	Total Module Area ³	Durability	Sample Population Requirements
Single Junction ¹	18% PCE	≥500 cm ² with at least 4 inter-connected cells	Pass IEC 61215 Module Quality Test (MQT) 10, 11, 13 and 21 and ISOS-L-2 at specified durations with <10% relative performance loss per test ⁴	>1 kW total, at least 20 modules for outdoor testing ⁶
Perovskite-only Tandems ¹	24% PCE		6 months continuous outdoor testing with <3% relative degradation overall and <1% degradation in the final 3-month span ⁵	
Hybrid Tandems	27% PCE			

¹While the 2021 SETO request for information set PCE targets for single-junction and perovskite-only tandem devices, these configurations are not of interest for this FOA.

²Average of tested devices, measured after at least 10 kWh/m² outdoor or AM1.5 exposure

³Aperture/total module area > 75%

⁴Validation Center (or other independent laboratory) will assign devices to each test from available sample population. Test overview:

²⁵ Previous funding programs can be found at: <https://www.energy.gov/eere/solar/perovskite-solar-cells>.

²⁶ U.S. Solar Energy Technologies Office, *Performance Targets for Perovskite Photovoltaic Research, Development, and Demonstration Programs*, DOE/EE-2564, 1861006, 8844; Feb 01, 2022, DOI: 10.2172/1861006.

MQT 10 – UV preconditioning test: 15kWh/m², 60°C

MQT 11 – Thermal cycling test: 50 cycles, -40°C to +85°C

MQT 13 – Damp heat test: 1000 h at +85°C, 85% RH

MQT 21 – Potential induced degradation test: IEC TS 62804-1 +85°C, 85% RH at maximum system voltage for 96 hours

ISOS-L-2 – Light-soaking: 1000 h, 1 sun AM1.5, +75°C, ambient environment

⁵ Conducted by the Validation Center; result is an average of top-performing 90% of fielded devices (10% dropout acceptable).

⁶ Devices will be assigned to accelerated or outdoor testing by the Validation Center or other independent laboratory (not by the fabricator).

b. Perovskite PV Current Outlook

Since the release of SETO FY 2020 Perovskite FOA, significant progress has been made in these research areas. Silicon-perovskite tandem PVs have demonstrated the highest PCE of any tandem device at 1 sun with >33% PCE for 1 cm² devices. There also have been impressive demonstrations of improvements on cell-level perovskite technologies performing well in tests under the International Electrotechnical Commission (IEC) standard for PV modules: IEC 61215's MQT 12 (humidity-freeze) and MQT 13 (damp-heat) tests.²⁷ There have been further demonstrations of stability enhancement at or just under conditions of the International Summit on Organic PV Stability (ISOS) protocol ISOS-L-2^{28,29} and demonstration of >16% PCE of a 1 cm² perovskite-silicon cell after 1 year outdoors.³⁰

The continued R&D progress and promise of perovskite PV is accelerating the push to bring this technology to the market. Several companies have announced plans to build or begin operating >100 MW pilot manufacturing lines in the next 1-4 years, but the implementation of these lines has been delayed multiple times. SETO believes significant R&D challenges need to be overcome to enable perovskite PV to reach commercial relevance.

As of September 2023, SETO does not have data showing that any entity has met the metrics in Table 1, and there have been no public reports of outdoor fielded performance of single-junction or tandem minimodule perovskite PV devices >25 cm² in size maintaining ≥15% PCE after 10 weeks of testing. Based on the available data, SETO believes perovskite PV is on a trajectory to potentially enter the market for grid-connected energy production after 2030. SETO seeks to

²⁷ Shi, L., et. al., Gas chromatography–mass spectrometry analyses of encapsulated stable perovskite solar cells, *Science*, **2020**, 368 (6497), eaba2412 DOI: 10.1126/science.aba2412.

²⁸ Gu, H., et. al. Design optimization of bifacial perovskite minimodules for improved efficiency and stability, *Nature Energy*, **2023**, Preprint, DOI: 10.1038/s41560-023-01254-3.

²⁹ Li, C. et. al., Rational design of Lewis base molecules for stable and efficient inverted perovskite solar cells, *Science*, **2023**, 379 (6633), 690-694, DOI: 10.1126/science.ade3970.

³⁰ Babics, M., et. al., One-year outdoor operation of monolithic perovskite/silicon tandem solar cells, *Cell Rep. Phys. Sci.*, **2023**, 4 (2), 101280, DOI: 10.1016/j.xcrp.2023.101280.

accelerate this timeline by supporting, through this topic, the achievement of the performance target matrix (Table 1) by the end of 2026.

c. Focus of This Topic in Supporting Perovskite PV

To support the industry in reaching this 2026 goal, this topic is focused on the R&D needed to realize the full potential of perovskite PV and accelerate progress toward manufacturing efforts. This funding will support significant industrial R&D hosted at for-profit companies. While advances in academic lab-scale 0.1-1 cm² devices have been substantial over the past decade, proving durability, efficiency, and reproducibility at even modest scales of >100 cm² has proven to be a significant barrier. Therefore, applicants must use industrially relevant processing equipment and large sample sizes to understand process variability at high confidence. Projects must also use structured experimentation methodology at a statistically meaningful scale and couple that with statistical analysis, which is consistent with standard industrial R&D processes.

This topic targets hybrid tandem technologies comprised of halide perovskite PV as a semitransparent top module and a non-perovskite bottom PV cell or module (e.g., c-Si, CdTe). Projects on single-junction devices that are not compatible with tandem configuration and/or projects on all-perovskite tandems are not of interest for this topic. As incumbent technologies like c-Si PV continue to improve in efficiency, the window of opportunity for a new single-junction absorber technology is shrinking, regardless of the cost of the absorber layer. While SETO supports single-junction and all-perovskite tandem technology R&D through other funding opportunities and intends to continue this support, SETO is prioritizing hybrid tandem perovskite technology for this FOA, owing to the following advantages:

- **Ability to leverage existing supply chains:** Existing supply chains for c-Si and CdTe manufacturing are mature, with the tools and materials necessary for fabrication of the bottom absorber layer and associated carrier-selective contacts already being deployed at gigawatt scale.
- **Ability to leverage existing manufacturing infrastructure:** Existing manufacturing infrastructure provides capital assets and manufacturing acumen that can be leveraged for perovskite devices. Metrology, process design, quality inspection, and other capabilities necessary for production of the top and bottom absorber layer, contact layer, and metallization would already be in place and could be quickly optimized.
- **In two-terminal tandem architectures, a uniform surface of the bottom cell will de-risk higher quality top layer deposition:** Mass-produced bottom cells would provide a more mechanically stable, compositionally uniform substrate for a perovskite top layer than bottom layer absorbers that have not yet reached mass

production. This may significantly reduce manufacturing and quality-driven performance and durability challenges associated with non-uniformities that are likely to be more prominent in a less mature, low bandgap PV technology (e.g., multi-phase crystallinity, orientational nonuniformity, surface energy variance, and phase impurity or nonuniformity).

Integrating a perovskite layer onto an inorganic bottom cell presents many challenges, such as the development of an effective carrier collection layer between the cells, the top cell electrode and interconnection, current matching of the two cells, and top cell passivation. Developing just the perovskite top cell device is also a challenge. These challenges increase with the addition of a perovskite bottom cell and the low level of technological readiness currently exhibited by low-bandgap perovskite absorbers.

SETO seeks to accelerate the achievement of the targets for hybrid tandem devices identified in Table 1 by the end of 2026. This R&D is critical to reach the next stages of commercialization, is inherently more resource-intensive, and is best led by industry. As such, lead applicants must be for-profit entities.

However, SETO encourages teaming with universities, national laboratories, and other supply chain or ecosystem partners (See Section I.A.iv. for Teaming List). Personnel from national labs looking to participate in this funding opportunity as a subrecipient must consider their potential conflict of interest obligations before partnering on projects.

This funding program will provide resources to experienced teams that have promising perovskite PV device results to work toward achieving these performance targets on statistically significant sample sizes and on areas consistent with industry-led R&D (100-1000 cm² aperture area). This will serve as a first step toward pilot-scale production.

d. Applications Specifically Not of Interest

- All-perovskite tandem technology development.
- Single-junction perovskite technology development that is not compatible with hybrid tandem final configurations.
- R&D projects that do not use processing equipment and large sample sizes that are relevant to the PV panel manufacturing industry.
- R&D projects that do not use structured experimentation methodology at statistically meaningful scale coupled with statistical analysis, consistent with standard industrial R&D processes.
- Projects solely focused on ramping up manufacturing processes to >1 m² PV device areas.

e. Expected Outcomes of a Successful Project

SETO expects that applicants who successfully complete projects under this topic **will achieve, or be on the path to achieving, the performance target matrix (Table 1) for hybrid tandem perovskite PV by the end of 2026**. These targets are critical to pilot manufacturing of perovskite PV, and reaching them on this timeline is necessary for domestic manufacturers to compete with the incumbents and international competitors. SETO understands the substantial risk involved in achieving these targets and that additional support beyond the scope of this FOA may be needed. Future needs will be assessed in alignment with these goals and pending future appropriations.

f. Equipment Readiness Assessment Requirement

SETO is aware of ongoing supply chain disruptions and the long procurement timelines across many industries. To evaluate applicants' ability to make timely use of available federal funding, SETO requires an equipment readiness risk assessment as a part of the application. This assessment must include the following:

1. An explanation of the throughput capacity of existing equipment already on site.
2. Procurement plans for capacity-expanding tools (including metrology), the stage of the supplier selection process, and the expected cost and delivery timeline of said equipment.
3. Risk mitigation pathways to achieve project deliverables if equipment delivery is delayed.
4. The availability and/or lead time for equipment to be used for the project.
5. An inventory of prototype, made-in-house, or individually customized tools required for the project with detailed sourcing plan and mitigation strategies.

g. Competitive Baseline Project Guidelines at Different Funding Levels (Tabular Format Available in Appendix G)

Teams may propose multiple levels of funding in a single application. Applicants can request anywhere from \$3 million to \$20 million—and must describe how they would adjust the project's scope of work to accommodate different levels of funding (if applying for more than \$7 million, see Section X.i.h for instructions).

The guidelines below describe what an applicant should be able to do at the time of application to demonstrate competitive baseline capabilities for a given funding level. These guidelines are not meant to serve as scopes of work for a project; rather, they are the minimum baseline from which an applicant proposes and develops their project. Applicants may apply for any funding amount between \$3 million and \$20 million, not just the levels mentioned in the

guidelines below. SETO anticipates that some teams may excel in one or more of the criteria identified below but underperform in others. The guidelines below can also be found in Appendix G in a tabular format.

Competitive Baseline Project Guidelines for \$5 Million Federal Award

- I. Team has demonstrated **either**:³¹
 - A. Single-junction perovskite small area cells ($\geq 0.1 \text{ cm}^2$ aperture area³²) with a PCE $\geq 18\%$ on devices with $\geq 1.5 \text{ eV}$ bandgap
 - or**
 - B. Tandem-perovskite small area cells ($\geq 0.1 \text{ cm}^2$ aperture area) with a PCE $\geq 23\%$.
- II. Team has demonstrated combined heat and light stress testing:³³
 - A. ≥ 5 cells held at Maximum Power Point or higher voltage and subjected to $\geq 60 \text{ }^\circ\text{C}$ for ≥ 1000 hours at ~ 1 sun illumination³⁴
 - and**
 - B. The drop in efficiency must be $\leq 20\%$ relative at 1000 hours.
- III. Team has a minimum cell fabrication capability of 100 devices/week and have a plan to scale throughput to ≥ 100 modules per week at $\geq 100 \text{ cm}^2$ aperture area in the project period.³⁵

Competitive Baseline Project Guidelines for \$10 Million Federal Award

- I. The for-profit lead applicant of the project team has established and documented all of the following:
 - A. Experience in industrial R&D and manufacturing (preferably in the PV sector).
 - B. Clearly defined roles, responsibilities, and decision-making processes.
 - C. Business systems for supplier selection for capital equipment and critical raw materials.
 - D. Experience in statistical experimental design and statistical procedures for qualifying processes and tools.
- II. The for-profit lead applicant of the project team has demonstrated ISO 17025 Certified Test Laboratory (CTL) verified performance of both:

³¹ Data must be provided to show this performance can be readily reproduced with a mean PCE across a minimum of 20 cells using >4 substrates produced across ≥ 2 days.

³² To be defined as "aperture area" an opaque mask must be used to define the optically active area.

³³ Cell starting performance and size for degradation testing must be greater than or equal to cell performance requirement.

³⁴ Cells should be appropriately preconditioned using heat/light stabilization or dark soaking. At least 10 cells should be from a single batch of production. Cells may be encapsulated or unencapsulated in controlled environment.

³⁵ The production capability listed is considered the peak capability, and it is understood that teams will not typically operate at this level for multiple weeks.

- A. Single-junction perovskite cells ($\geq 1 \text{ cm}^2$ aperture area³⁶) with a PCE $\geq 18\%$ on devices with $\geq 1.5 \text{ eV}$ band gap **or** tandem-perovskite cells with a PCE $\geq 24\%$,³⁷
and
 - B. Single-junction perovskite minimodules of $\geq 25 \text{ cm}^2$ aperture area with PCE $\geq 15\%$ **or** tandem-perovskite minimodules of $\geq 25 \text{ cm}^2$ with PCE $> 20\%$.³⁸
- III. Team has demonstrated combined heat- and light-stress testing on encapsulated minimodules:³⁹
- A. ≥ 5 devices held at Maximum Power Point or higher voltage and subjected to $\geq 60^\circ\text{C}$ for ≥ 1000 hours at ~ 1 sun illumination.⁴⁰
 - B. The drop in efficiency must be $\leq 10\%$ relative at 1000 hours.
- IV. Team has samples on-sun at outdoor testing facilities (preferably with samples at PACT⁴¹).
- V. Team has a minimum cell fabrication capability of 100 minimodules/week (which should be from ≥ 25 substrates of $\geq 100 \text{ cm}^2$ area each) and have a plan to scale to ≥ 100 modules per week at $\geq 500 \text{ cm}^2$ aperture area in the project period.⁴²

Competitive Baseline Project Guidelines for \$20 million Federal Award

- I. In addition to the \$10 million federal award requirements, the for-profit lead applicant of the project team has established and documented all of the following:
 - A. Management team and senior leadership with significant experience bringing products from R&D to production in a manufacturing environment (preferably in the PV sector).
 - B. Modern project and program management practices informed through Theory of Constraints.⁴³
 - C. Well-developed business systems for supplier selection, change control, risk assessment and mitigation, and data management, with full traceability from incoming material to outgoing product.

³⁶ To be defined as “aperture area” an opaque mask must be used to define the optically active area.

³⁷ Data must be provided to show that this performance can be readily reproduced with a mean PCE across a minimum of 20 cells using ≥ 4 substrates produced across ≥ 2 days.

³⁸ Data must be provided to show this performance can be readily reproduced with a mean PCE across a minimum of 10 separate devices produced across ≥ 2 days.

³⁹ Minimodule starting performance for degradation testing must be greater than or equal to minimodule performance requirement.

⁴⁰ Devices should be appropriately preconditioned using heat/light stabilization or dark soaking. At least 10 minimodules should be from a single batch of production.

⁴¹ See <https://pv pact.sandia.gov/> for details on PACT facilities.

⁴² The production capability listed is considered the peak capability, and it is understood that teams will not typically operate at this level for multiple weeks.

⁴³ Gupta, M., et. al., Integrating Theory of Constraints, Lean, and Six Sigma: a Framework Development and Its Application, *Prod. Plan. and Control*, **2022**, DOI: 10.1080/09537287.2022.2071351

- D. Quality systems, including statistical process control, statistical design of experiments, and statistically informed raw and intermediate materials specifications.
- II. The for-profit lead applicant of the project team has demonstrated ISO 17025 CTL verified PCE of $\geq 27\%$, consistent with the Performance Target Matrix for hybrid tandem perovskite minimodules, on $\geq 25 \text{ cm}^2$ minimodules.⁴⁴
- III. Team has passed at least 4 of the 5 accelerated stress tests in the Performance Target Matrix (i.e., MQT 10, MQT 11, MQT 13, MQT 21, ISOS-L-2).⁴⁵
- IV. Team has demonstrated ≥ 3 months of outdoor field testing with $< 3\%$ relative degradation of PCE (with minimodules on test at PACT⁴⁶ for ≥ 10 weeks) with $\geq 10 \text{ W}$ of samples (≥ 20 minimodules).⁴⁷
- V. Team has a minimum cell-fabrication capability of 500 minimodules/week (which should be from ≥ 100 substrates of $\geq 100 \text{ cm}^2$ area each) and have a plan to scale to 1-shift operation capable of producing ≥ 2000 modules per week at $\geq 500 \text{ cm}^2$ aperture area.⁴⁸

Data Sharing Directions

Successful applications will include information that convinces reviewers that the applicant’s current baseline capabilities have met or exceeded the competitive baseline project guidelines of the desired funding level. Please provide technical data using Table 2, below. Applicants may share data that is not listed in Table 2 in any preferred format. Manufacturing capabilities, such as in-line metrology or manufacturing equipment, must be described using pictures of installed equipment and date-stamped equipment output statistics or in-line data. Written descriptions or graphical depictions of other relevant equipment resources and data management capabilities are also encouraged.

Table 2: Suggested Format for Funding Level Qualification Information

Bottom Cell Type ¹	Device Aperture Area (A, cm ²)	Initial Stabilized ² PCE	Prescribed ³ Post-Operational Test PCE at 1000h	PCE Certified ⁴ by ISO/IEC 17025 CTL? (yes/no)	On-sun Outdoor Operational Testing (yes/no)	Outdoor Test Facility ⁵ Description
	0.1≤A<1.0					
	1.0≤A<25					

⁴⁴ Data must be provided to show this performance can be readily reproduced with a mean PCE across a minimum of 20 separate samples produced across ≥ 7 days.

⁴⁵ Minimodule starting performance for degradation testing must be greater than or equal to minimodule performance requirement.

⁴⁶ See <https://pvfact.sandia.gov/> for details on PACT facilities.

⁴⁷ Minimodule starting performance for degradation testing must be greater than or equal to minimodule performance requirement.

⁴⁸ The production capability listed is considered the peak capability, and it is understood that teams will not typically operate at this level for multiple weeks.

	25≤A<100					
	A≥100					

- [1] Choose among: 2T Silicon, 4T Silicon, CdTe, CIGS, Other
- [2] After “burn-in,” “wake up,” or other preconditioning procedures that address metastable phenomena
- [3] Simultaneously applied 1-sun, maximum power point, ≥60°C ambient temperature
- [4] Choose among: Initial PCE only, Yes (pre and post PCE), No
- [5] Choose among: PACT, national lab (but not PACT), Other ISO 17025 CTL, Other test facility

h. Required Approach to Scope and Budget Development

Applicants requesting more than \$7 million in federal funds in this topic will be required to propose one R&D program scoped at two discrete funding levels. Applications should propose:

1. The proposed ideal level of funding (within FOA project funding limits) to maximize impact and best accelerate commercialization timelines.
2. The proposed minimum level of funding, which must be at least \$4 million less than the ideal level funding, and the associated reduction in scope that would still achieve worthwhile positive results.

Applicants should address this within their submission materials by detailing their full plans at the ideal level of funding and then identifying specific tasks, activities, and milestones that would be reduced, removed, or otherwise modified between the ideal level of funding and minimum level of funding. The application must explain the impact of the ideal versus minimum funding on technology development trajectory.

For example, if an applicant is requesting \$15 million, the submission should fully encompass what the team would accomplish for \$15 million. The team would then need to include what they could accomplish for another discrete lower level of funding, which is of their choosing but can be no more than \$11 million for this example. The team would identify which tasks, milestones, and budget items in their application would be reduced or removed at the reduced funding level. The applicant would also provide an explanation of the relative impact the high and low levels of funding would have on their project goals. For more details on application requirements see Section IV.

Based on the proposals received, the competitive review process, and available funds, SETO may not award proposals that cannot demonstrate a technically meritorious project plan at a lower funding level.

ii. Topic 2: Improving the Market Potential of Advanced Cadmium Telluride Photovoltaics (IMPAC_dT_e PV)

The goal of this topic is to support the CdTe photovoltaics industry as an increasingly valuable part of the U.S. economy and the renewable energy transition. There are three main areas of interest for projects in this topic:

- Supporting the PV deployment sector's ability to adapt to a growing number of CdTe modules in PV systems.
- Increasing the scale of the domestic CdTe PV supply chain.
- Improving CdTe PV technology to maintain competitiveness with c-Si PV.

a. SETO Support of CdTe PV Technology

Over the past decade, SETO has provided approximately \$117 million in federal funding for CdTe PV innovation. As the technology and its supply chain has matured, SETO has supported CdTe PV research and development for the long-term competitiveness of the technology.

CdTe PV has the theoretical potential to achieve performance values well beyond current record cell and module efficiencies. In pursuit of this opportunity, research on cell, module, and material improvements remains an important part of SETO's CdTe funding portfolio. Universities, companies, and national labs participating in SETO CdTe Accelerator Consortium are working to improve cell efficiency while also guiding and supporting the broader research community.⁴⁹ SETO's current CdTe funding allocation by recipient category is shown in Figure 3, below.

SETO has dedicated more of its portfolio to efficiency improvements than to increasing the durability of CdTe PV modules. CdTe materials research is working to keep pace with the increasing efficiency values of c-Si cells and modules by addressing the challenges with defects, junction formation, and contact formation when making CdTe cells. CdTe PV in production performs well in accelerated and long-term reliability testing compared to other alternative technologies like perovskite PV. SETO's reliability programs and fleet-tracking efforts observe installed PV systems and continuously watch for indications of potential problems with long-term performance as CdTe technologies evolve.

b. Opportunities and Challenges for CdTe PV

CdTe PV is the leading U.S.-made PV technology and the only thin-film technology meaningfully competing with c-Si PV, supported by the most complete domestic supply chain of any PV technology. CdTe PV represents

⁴⁹ See <https://www.energy.gov/eere/solar/cadmium-telluride-accelerator-consortium>.

SETO Funding of CdTe PV (\$49M Federal Share)

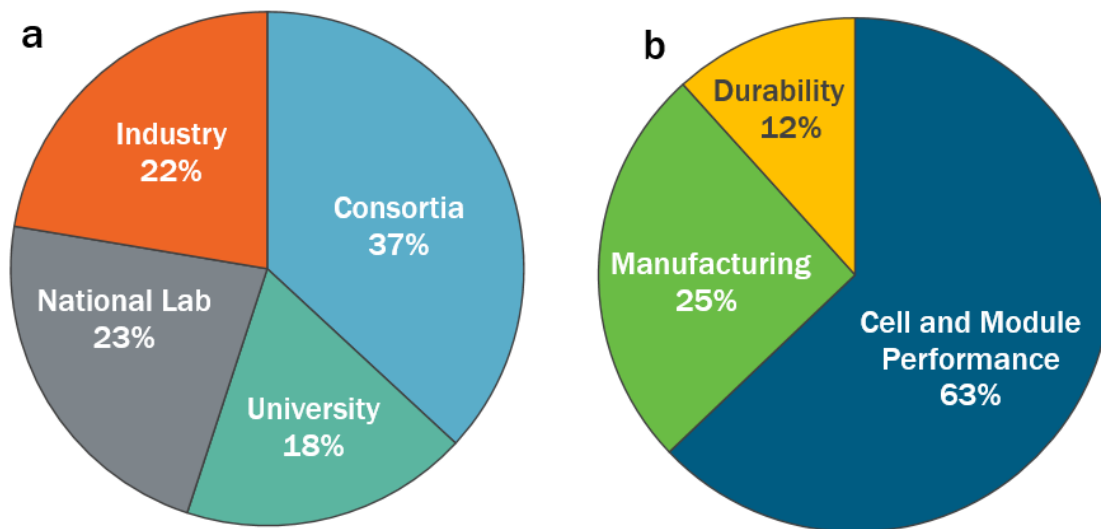


Figure 3. (a) Recipient types and (b) approximate funding breakdowns of different types of work being conducted within SETO’s current CdTe project portfolio. Relative breakdowns denote total federal funding dedicated to each effort. Including recipient cost share would significantly increase the weight of the industry projects in these charts.

approximately 30% of PV modules deployed in the United States and about half of the utility-scale PV modules.

Based on the expected impacts of the Inflation Reduction Act and announced manufacturing capacity expansions, the United States is in a unique position in the global PV ecosystem with two significantly different PV technologies being deployed at scale (c-Si and CdTe). As the U.S. c-Si PV manufacturing industry develops and other technologies, such as perovskite PV, mature, CdTe PV must continue to innovate to maintain its competitive position. At the same time, the U.S. PV system installation, inspection, operations, and maintenance industry needs to adapt to the unique aspects of CdTe PV systems.

Attractive attributes of CdTe PV technology include low embodied energy, fast production processing, low sensitivity to temperature, and established bankability. In contrast to c-Si modules, which have discrete solar cells arranged in strings, CdTe modules are monolithically integrated and directly deposited on flat sheets of glass in a single facility. The streamlined manufacturing process of CdTe PV offers advantages over today’s c-Si PV: an 18.5% efficient CdTe module has about 36% of the embodied energy compared to a single-crystal c-Si module. CdTe PV manufacturing also has the potential for reduced capital expenditures because its fabrication requires fewer unit processes compared to c-Si PV. In addition, today’s U.S.-manufactured CdTe PV modules have a domestic value

content of 60% to 90%, whereas most components of U.S.-manufactured c-Si PV modules are imported.⁵⁰

CdTe PV manufacturing faces several challenges as it expands, including:

1. Limited tellurium (Te) availability
2. Handling of modules at end of life
3. Competition from crystalline silicon c-Si PV
4. Cost of non-CdTe module components
5. Management of large-scale deployment

Improvements in these areas coupled with demonstrated fielded reliability can strengthen the competitive position of CdTe PV technology in the United States.

1) Limited Tellurium Availability

Approximately 30%–40% of the atoms in the absorber layer of a CdTe PV module are Te, which has limited supply and makes up 10%–15% of module costs. As the CdTe PV market expands, the availability of Te could pose a risk to CdTe PV manufacturing and deployment, but likely not before 2035, according to DOE's Critical Materials Assessment.⁵¹ In 2023, CdTe module manufacturing⁵² used about 40% of global Te supply; this percentage will grow as CdTe manufacturing capacity expands. SETO seeks to support research and development projects that increase the supply of Te. For example, improving methods to optimize Te recovery from electrorefining residues and tailings or end-of-life recycling. Ultimately, these projects will enable significant increases in manufacturing.

The current estimate of global Te production is 500 metric tons/year, which is approximately enough for 15-30 GW/year of CdTe module production worldwide.⁵³ The U.S. Geological Survey estimates global economically recoverable Te reserves to be 24,000 metric tons, assuming a 50% recovery rate.⁵⁴ China produces 61% of the world's Te. Japan, the United States, Russia, Canada, and Sweden are the next-largest producers of Te.⁵⁵

⁵⁰ Capacity expansions across the domestic silicon supply chain are underway.

⁵¹ U.S. Department of Energy. Critical Materials Assessment. July 2023. energy.gov/sites/default/files/2023-07/doe-critical-material-assessment_07312023.pdf.

⁵² U.S. Geological Survey. Mineral Commodity Summaries. January 2023. <https://pubs.usgs.gov/periodicals/mcs2023/mcs2023-tellurium.pdf>.

⁵³ Basic Te availability 1Tw CdTe gives $>1.6 \times 10^7$ kg of Te needed (at 1 micron CdTe thickness and 20% PCE) while per the USGS, the estimated global Te reserves is 2.4×10^7 kg. <https://www.sciencedirect.com/book/9780128023297/solar-photovoltaic-cells>.

⁵⁴ Goldfarb, R.J., et al., Tellurium, chap. R of Schulz, K.J., DeYoung, J.H., Jr., Seal, R.R., II, and Bradley, D.C., eds., Critical mineral resources of the United States—Economic and environmental geology and prospects for future supply: U.S. Geological Survey Professional Paper, **2017**, 1802, p. R1–R27, <https://doi.org/10.3133/pp1802R>.

⁵⁵ Nassar, N. T., et. al., Global tellurium supply potential from electrolytic copper refining, *Resources, Conservation and Recycling*, **2022**, 184 (106434), DOI: 10.1016/j.resconrec.2022.10643.

Globally, approximately 90% of Te recovery is as a byproduct of copper electrorefining, and about 10% is as a byproduct from gold mining. The refining process techniques optimize for copper and gold, but not tellurium. Optimization of Te recovery from electrorefining residue could increase Te supply. Te recovery from copper and gold tailings also offers an opportunity to increase Te supply, but this process is not as well understood.

CdTe module recycling can also contribute to the Te supply chain, as end-of-life CdTe modules contain approximately 0.02% Te. CdTe modules are recycled at moderate scale—recyclers process about 25,000 tons of spent modules annually^{56,57}—but since modules last about 20 years, the availability of recycled Te will not solve immediate Te demand. There may be opportunities for further innovation in recycling CdTe modules to recover Te.^{58,59}

2) Handling of Modules at End of life

Reclamation and recycling of CdTe PV materials may extend the availability of tellurium. Other materials used in modules, such as silver, aluminum, and glass, are also potentially recyclable.³⁹ Innovations in CdTe PV recycling processes and their automation can reduce waste and cost and improve materials availability.

3) Competition from Crystalline Silicon PV

The PV performance of CdTe at the R&D scale is lower than c-Si. The PCE of CdTe R&D cells inched up 0.2% in 8 years, from 22.1% in 2016 to 22.3% in May 2023. Record commercial CdTe module PCE rose 2.5%, from 17% in 2016 to 19.5% in 2023. At the same time, c-Si R&D cell PCE climbed 1.2%, from 25.6% to 26.8%, and record commercial c-Si module PCE grew 0.3%, from 24.4% to 24.7%.^{60,61} This increased efficiency lowers costs and spurs demand for c-Si PV.

There are opportunities to improve CdTe PV cell, module design, and manufacturing that can increase PCE. For example, improvements in window transparency, dopant activation, minority carrier lifetime, charge carrier selectivity, and band bending may improve PV performance, while thinner glass can reduce light absorption, cycle time, and total embodied energy. Improvements in the degradation rate of CdTe PV that extend its useful life also

⁵⁶ McNulty, B.A., et al., Byproduct critical metal supply and demand and implications for the energy transition: A case study of tellurium supply and CdTe PV demand, **2022**, 112838, DOI: 10.1016/j.rser.2022.112838.

⁵⁷ Module weight from: <https://www.firstsolar.com/-/media/First-Solar/Technical-Documents/Series-6-Datasheets/Series-6-Datasheet.ashx>.

⁵⁸ Ravikumar, D., et. al., Environmentally improved CdTe photovoltaic recycling through novel technologies and facility location strategies, *Prog. In Photov.*, 2020, 28 (9), 887-898, DOI: 10.1002/pip.3279 <https://iopscience.iop.org/article/10.1088/1757-899X/782/2/022024/pdf>.

⁶⁰ Green, M.A., et. al., Solar cell efficiency tables (version 48), *Prog. in Photov.*, 2016, 24 (7), 905-913. DOI: doi.org/10.1002/pip.2788.

⁶¹ Green, MA, Dunlop, ED, Yoshita, M, et al. Solar cell efficiency tables (version 62). *Prog Photovolt Res Appl.* 2023; 1- 13. doi:10.1002/pip.3726.

exist. Improvements in manufacturing efficiency include innovations in equipment, metrology, and automation could increase manufacturing scale and deployment.

4) Reduction of Cost of Non-CdTe Module Components

The highest-performing CdTe modules deposit the CdTe layer onto low-iron float glass with a fluorinated tin oxide (FTO) transparent conductive oxide (TCO) layer. The combined cost of the front and rear glass sheets can make up 15%–20% of the total module cost and the largest fraction of the embodied energy of a completed CdTe module. Innovations to further reduce the embodied energy of module components and to enable larger-volume manufacturing of CdTe PV modules and their components across the supply chain will support increased deployment of this technology. The entire set of materials comprising CdTe PV and the process used to integrate them impact the cost and lifetime performance of the technology. Improvements to this lifetime performance can decrease the levelized cost of energy (LCOE) of this technology. However, long-term field validation needs such improvements to quantify the value for improvements in CdTe PV products.

5) CdTe Fleet Monitoring

With increasing CdTe PV deployment, innovations in plant and fleet monitoring and diagnostic methods can improve the reliability and reduce the cost of this technology at scale. New approaches specifically for CdTe PV systems and adaptation of techniques used on c-Si PV systems to CdTe systems can help maximize value and enable even larger scale deployment.

c. Focus of this Topic in Supporting CdTe Photovoltaics

SETO seeks projects that can lead to improvements in performance, cost reduction, and/or energy intensity reduction in one or more steps in the CdTe supply chain, from manufacturing to deployment, decommissioning, and recycling. SETO additionally encourages projects that will increase Te supply, as constrained tellurium availability can limit the ability of the CdTe supply chain to scale up and stay cost competitive with c-Si PV technology.

Lead applicants for this topic must be for-profit entities, although collaborations with universities, national laboratories, and other companies are encouraged. Lead applicants must manage projects using modern business systems, including:

- A. Risk assessment/mitigation, data management, and traceable change control.
- B. Statistical design of experiments and, for processes at scale, statistical process control.
- C. Clearly defined Responsible, Accountable, Consulted, Informed (RACI) roles matrix for the project team.

The projects selected will employ state-of-the-art quality systems, project/program management, and reliability testing to ensure value for the industry, stakeholders, and consumers.

This topic is divided into two main categories: R&D and demonstration. Applications proposing less than \$3 million in federal funding are expected to consist primarily of R&D activities and may have lower cost-share requirements (20%). Projects requesting \$3 million to \$15 million in federal funding are expected to occur at the demonstration scale and carry 50% cost share. It is possible for entities to propose a blend of these activities.

R&D-focused projects should address one or more of the following goals:

- Monitoring fielded performance/energy yield of CdTe PV systems through innovations in metrology and instrumentation.
- Improving metrology for CdTe-related processes and materials.
- Reducing the cost and resource intensity of domestically produced CdTe PV modules.
- Improving manufacturing throughput and or reducing manufacturing cost for CdTe raw materials, intermediates, or modules.
- Innovating CdTe technology across the supply chain, including processing, measurement, and Quality Assurance (QA)/Quality Control (QC).
- Increasing the fielded lifetime and/or energy yield of CdTe PV modules and reducing the life-cycle costs of CdTe PV systems.
- Expanding the domestic supply chain for CdTe PV material production, particularly by increasing the availability of tellurium for module manufacturers and reclaiming materials from end-of-life modules.
- Improving the viability of tandem-module architectures where CdTe is one of the active layers.
- Innovation in economically viable CdTe module recycling.

Applicants proposing demonstration activities must have ready access to the facilities necessary to carry out work at this scale and must have experience executing previous efforts with similar demands and complexity. Demonstration projects may address any of the goals for R&D projects and must include one or more of the following activities:

- Demonstration of new CdTe hardware component(s) or novel system architectures in robust, commercially relevant pilot tests.
- Demonstration of methods and instrumentation to facilitate monitoring of fielded performance of CdTe PV at scale.
- Demonstration of high-volume or high-throughput manufacturing processes for CdTe supply-chain components, processes, tools, metrology, and input materials that reduce cost, energy requirements,

and greenhouse gas emissions, and that can be manufactured competitively in the United States.

- Demonstration of improved tellurium resource recovery from metal refining operations at scale.
- Production of a sufficiently large number of CdTe modules for statistically robust field testing and validation.
- Demonstration of economically viable recycling and reclamation of CdTe modules and materials used to manufacture CdTe modules at scale.

d. Applications Specifically Not of Interest

- Proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics).
- Proposals concerning only buffer materials, such as cadmium sulfide (CdS), cadmium selenide (CdSe), or zinc sulfide (ZnS).
- Non-vacuum deposition techniques such as chemical bath, electrolytic, and spray deposition.

C. Community Benefits Plan

DOE is committed to investing in R&D innovations that deliver benefits to the American public and lead to commercialization of technologies and products that foster sustainable, resilient, and equitable access to clean energy. Further, DOE is committed to supporting the development of more diverse, equitable, inclusive, and accessible workplaces to help maintain the nation's leadership in science and technology.

To support the goal of building a clean and equitable energy economy, projects funded under this FOA are expected to (1) advance diversity, equity, inclusion, and accessibility (DEIA); (2) contribute to energy equity; and (3) invest in America's workforce. To ensure these objectives are met, applications must include a Community Benefits Plan (CBP) that addresses the three objectives stated above. See Section IV.E.xviii. and Appendix F for the more information on the Community Benefits Plan content requirements.

D. Authorizing Statutes

The programmatic authorizing statute is Advanced Solar Manufacturing Initiative – Division Z Section 3004(b)(3) of the Energy Act of 2020, (42 U.S.C. 3 16238(b)(3)).

Awards made under this announcement will fall under the purview of 2 CFR Part 200 as amended by 2 CFR Part 910.

II. Award Information

A. Award Overview

i. Estimated Funding

EERE expects to make approximately \$36,000,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 2-15 awards under this FOA. EERE may issue one, multiple, or no awards. Individual awards may vary between \$1,000,000 and \$20,000,000 federal share.

EERE may issue awards in one, multiple, or none of the following topics:

Topic Number	Topic Title	Anticipated Number of Awards	Anticipated Minimum Award Size for Any One Individual Award (Fed Share)	Anticipated Maximum Award Size for Any One Individual Award (Fed Share)	Approximate Total Federal Funding Available for All Awards	Anticipated Period of Performance (months)
1	Promoting Research & Development toward Industrial Manufacturing of Early-Stage Perovskite Tandem Photovoltaics (PRIMES Perovskite Tandem PV)	1-5	\$3M	\$20M	\$20M	18-36
2	Improving the Market Potential of Cadmium Telluride Photovoltaics (IMPAC _d T _e PV)	1-10	\$1M	\$15M Projects requesting \$3M or more must include demonstration activities.	\$16M	12-36

EERE may establish more than one budget period for each award and fund only the initial budget period(s). Funding for all budget periods, including the initial budget period, is not guaranteed.

ii. Period of Performance

EERE anticipates making awards that will run from 12 to 36 months, comprised of one or more budget periods. Project continuation will be contingent upon

several elements, including satisfactory performance and Go/No-Go decision. For a complete list and more information on the Go/No-Go review, see Section VI.B.xv.

iii. New Applications Only

EERE will accept only new applications under this FOA. EERE will not consider applications for renewals of existing EERE-funded awards through this FOA.

B. EERE Funding Agreements

Through cooperative agreements and other similar agreements, EERE provides financial and other support to projects that have the potential to realize the FOA objectives. EERE does not use such agreements to acquire property or services for the direct benefit or use of the U.S. government.

i. Cooperative Agreements

EERE generally uses cooperative agreements to provide financial and other support to prime recipients.

Through cooperative agreements, EERE provides financial or other support to accomplish a public purpose of support or stimulation authorized by federal statute. Under cooperative agreements, the government and prime recipients share responsibility for the direction of projects.

EERE has substantial involvement in all projects funded via cooperative agreement. See Section VI.B.ix. of the FOA for more information on what substantial involvement may involve.

ii. Funding Agreements with Federally Funded Research and Development Center (FFRDCs)⁶²

In most cases, FFRDCs are funded independently of the remainder of the project team. The FFRDC then executes an agreement with any non-FFRDC project team members to arrange work structure, project execution, and any other matters. Regardless of these arrangements, the entity that applied as the prime recipient for the project will remain the prime recipient for the project. See Section III.E.i.

⁶² Federally Funded Research and Development Centers (FFRDC) - FFRDCs are public-private partnerships that conduct research for the U.S. government. A listing of FFRDCs can be found at <http://www.nsf.gov/statistics/ffrdclist/>.

III. Eligibility Information

To be considered for substantive evaluation, an applicant's submission must meet the criteria set forth below. If the application does not meet these eligibility requirements, it will be considered ineligible and removed from further evaluation.

A. Eligible Applicants

i. Domestic Entities

The proposed **prime recipient** must be a domestic, for-profit entity for which the scope of work performed by the prime recipient must represent the majority of the work performed (over 50%), as measured by the total project costs. The proposed prime recipient and subrecipient(s) must be domestic entities.

The following types of domestic entities are eligible to participate as a subrecipient of this FOA:

1. Institutions of higher education
2. For-profit entities
3. Nonprofit entities
4. State and local governmental entities, and Indian tribes

To qualify as a domestic entity, the entity must be organized, chartered or incorporated (or otherwise formed) under the laws of a particular state or territory of the United States; have majority domestic ownership and control; and have a physical place of business in the United States.

DOE/NNSA FFRDCs are eligible to apply for funding as a subrecipient but are not eligible to apply as a prime recipient for Topic 1, and Topic 2.

Non-DOE/NNSA FFRDCs are eligible to participate as a subrecipient but are not eligible to apply as a prime recipient.

Federal agencies and instrumentalities (other than DOE) are eligible to participate as a subrecipient but are not eligible to apply as a prime recipient.

Entities banned from doing business with the U.S. government such as entities debarred, suspended, or otherwise excluded from or ineligible for participating in federal programs are not eligible.

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.

ii. Foreign Entities

In limited circumstances, EERE may approve a waiver to allow a foreign entity to participate as a prime recipient or subrecipient. A foreign entity may submit a Full Application to this FOA, but the Full Application must be accompanied by an explicit written waiver request. Likewise, if the applicant seeks to include a foreign entity as a subrecipient, the applicant must submit a separate explicit written waiver request in the Full Application for each proposed foreign subrecipient.

Appendix C lists the information that must be included in a foreign entity waiver request. The applicant does not have the right to appeal EERE's decision concerning a waiver request.

B. Cost Sharing

Applicants are bound by the cost share proposed in their Full Applications if selected for award negotiations.

Topic 1: Cost Share 20%

The cost share must be at least 20% of the total project costs⁶³ for research and development projects.⁶⁴ The cost share must come from non-federal sources unless otherwise allowed by law.

Topic 2: Cost Share 20% or 50%

The cost share must be at least 20% of the total project costs⁶⁵ for research and development activities and 50% of the total project costs for demonstration and commercial application projects.⁶⁶ The cost share must come from non-federal sources unless otherwise allowed by law. The applicant may propose a blend of R&D activities and demonstration activities and a pro—rata cost share approach would then apply to the total project costs.

For proposals submitted under Topic 2, the contracting officer shall review the proposal at both the overall project and task level. The CO will make the final determination as to how each proposal and task is classified for purposes of cost sharing under Section 988 of EPACT 2005.

⁶³ Total project costs is the sum of the government share, including FFRDC costs if applicable, and the recipient share of project costs.

⁶⁴ Energy Policy Act of 2005, Pub. L. 109-58, sec. 988. Also see 2 CFR 200.306 and 2 CFR 910.130 for additional cost sharing requirements.

⁶⁵ Total project costs is the sum of the government share, including FFRDC costs if applicable, and the recipient share of project costs.

⁶⁶ Energy Policy Act of 2005, Pub. L. 109-58, sec. 988. Also see 2 CFR 200.306 and 2 CFR 910.130 for additional cost sharing requirements.

To help applicants calculate proper cost share amounts, EERE has included a cost share information sheet and sample cost share calculation as Appendices A and B to this FOA.

i. Legal Responsibility

Although the cost share requirement applies to the project as a whole, including work performed by members of the project team other than the prime recipient, the prime recipient is legally responsible for paying the entire cost share. If the funding agreement is terminated prior to the end of the project period, 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 obligation assumed by project team members in subawards or related agreements.

ii. Cost Share Allocation

Each project team is free to determine how best to allocate the cost share requirement among the team members. The amount contributed by individual project team members may vary, as long as the cost share requirement for the entire project is met.

iii. Cost Share Types and Allowability

Every cost share contribution must be allowable under the applicable federal cost principles, as described in Section IV.I.i. of the FOA. In addition, cost share must be verifiable upon submission of the Full Application. Cost share may be provided in the form of cash or cash equivalents, or in-kind contributions. Cost share must come from non-federal sources (unless otherwise allowed by law), such as project participants, state or local governments, or other third-party financing. Federal financing, such as DOE Loan Guarantee, cannot be leveraged by applicants to provide the required cost share or otherwise support the same scope that is proposed under a project.

Cost share may be provided by the prime recipient, subrecipients, or third parties (entities that do not have a role in performing the scope of work). Vendors/contractors may not provide cost share. Any partial donation of goods or services is considered a discount and is not allowable.

Cash contributions include but are not limited to personnel costs, fringe costs, supply and equipment costs, indirect costs, and other direct costs.

In-kind contributions are those where a value of the contribution can be readily determined, verified, and justified but where no actual cash is transacted in

securing the good or service comprising the contribution. Allowable in-kind contributions include, but are not limited to, the donation of volunteer time, or the donation of space, or use of equipment.

Project teams may use funding or property received from state or local governments to meet the cost share requirement, so long as the federal government did not provide the funding to the state or local government.

The recipient may not use any of the following sources to meet its cost share obligations:

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

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. As all sources of cost share are considered part of total project cost, the cost share dollars will be scrutinized under the same federal regulations as federal dollars to the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

Applicants are encouraged to refer to 2 CFR 200.306 as amended by 2 CFR 910.130 for additional cost sharing requirements.

iv. Cost Share Contributions by FFRDCs

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 another non-federal source.

v. Cost Share Verification

Applicants are required to provide written assurance of their proposed cost share contributions in their Full Applications.

Upon selection for award negotiations, applicants are required to provide additional information and documentation regarding their cost share contributions. Please refer to Appendix A of the FOA.

vi. Cost Share Payment

DOE requires prime recipients to contribute the cost share amount incrementally over the life of the award. Specifically, the prime recipient's cost share for each billing period must always reflect the overall cost share ratio negotiated by the parties (i.e., the total amount of cost sharing on each invoice when considered cumulatively with previous invoices must reflect, at a minimum, the cost sharing percentage negotiated). As FFRDC funding will be provided directly to the FFRDC(s) by DOE, prime recipients will be required to provide project cost share at a percentage commensurate with the FFRDC costs, on a budget period basis, resulting in a higher interim invoicing cost share ratio than the total award ratio.

In limited circumstances, and where it is in the government's interest, the Contracting Officer may approve a request by the prime recipient to meet its cost share requirements on a less frequent basis, such as monthly or quarterly. Regardless of the interval requested, the prime recipient must be up-to-date on cost share at each interval. Such requests must be sent to the Contracting Officer during award negotiations and include the following information: (1) a detailed justification for the request; (2) a proposed schedule of payments, including amounts and dates; (3) a written commitment to meet that schedule; and (4) such evidence as necessary to demonstrate that the prime recipient has complied with its cost share obligations to date. The Contracting Officer must approve all such requests before they go into effect.

C. Application Compliance Criteria

All applicant submissions must:

- Comply with the applicable content and form requirements listed in Section IV. of the FOA.
- Include all required documents.
- Be uploaded and submitted to EERE eXCHANGE <https://eere-eXCHANGE.energy.gov>.
- Be submitted by the deadline stated in the FOA.

EERE will not review or consider submissions submitted through means other than EERE eXCHANGE, submissions submitted after the applicable deadline, or incomplete submissions.

Applicants are strongly encouraged to submit their Concept Papers and Full Applications at least 48 hours in advance of the submission deadline. Under normal conditions (i.e., at least 48 hours before the submission deadline), applicants should

allow at least one hour to submit a Concept Paper or Full Application. Once the Concept Paper or Full Application is submitted in EERE eXCHANGE, applicants may revise or update that submission until the expiration of the applicable deadline. If changes are made to any of these documents, the applicant must resubmit the Concept Paper or Full Application before the applicable deadline. EERE will not extend the submission deadline for applicants that fail to submit required information by the applicable deadline due to server/connection congestion.

D. Application Responsiveness Criteria

All Applications deemed to be “Specifically Not of Interest” (as described in Section B.i.d and B.ii.d) are deemed nonresponsive and are not reviewed or considered.

E. Other Eligibility Requirements

i. Requirements for DOE/NNSA and Non-DOE/NNSA FFRDCs Included as a Subrecipient

DOE/NNSA and non-DOE/NNSA FFRDCs may be proposed as a subrecipient on another entity’s application subject to the following guidelines:

a. Authorization for non-DOE/NNSA FFRDCs

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with its authority under its award.

b. Authorization for DOE/NNSA FFRDCs

The cognizant Contracting Officer for the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization:

Authorization is granted for the Laboratory to participate in the proposed project. The work proposed for the Laboratory is consistent with or complementary to the missions of the Laboratory, and will not adversely impact execution of the DOE assigned programs at the Laboratory.

c. Funding, Cost Share, and Subaward with FFRDCs

The value of and funding for the FFRDC portion of the work will not normally be included in the award. DOE/NNSA FFRDCs participating as a subrecipient on a project will be funded directly through the DOE field work proposal (WP) process. Non-DOE/NNSA FFRDCs participating as a subrecipient will be funded through an interagency agreement with the sponsoring agency. Although the FFRDC portion of the work is excluded from the award, the applicant’s cost share requirement will be based on the total cost of the

project, including the applicant's, the subrecipient's, and the FFRDC's portions of the project.

Unless instructed otherwise by the DOE Contracting Officer for the DOE award, all FFRDCs are required to enter into a Cooperative Research and Development Agreement⁶⁷ (CRADA) or, if the role of the DOE/NNSA FFRDC is limited to technical assistance and intellectual property is not anticipated to be generated from the DOE/NNSA FFRDC's work, a Technical Assistance Agreement (TAA), with at least the prime recipient before any project work begins. Any questions regarding the use of a CRADA or TAA should be directed to the cognizant DOE field intellectual property (IP) counsel.

The CRADA or TAA is used to ensure accountability for project work and provide the appropriate management of IP, e.g., data protection and background IP. The CRADA or TAA must be agreed upon by all parties and submitted to DOE or other sponsoring agency, when applicable, for approval, or submitted to DOE for notice under the Master Scope of Work process, when applicable, using any DOE or other sponsoring agency approved CRADA or TAA template without substantive changes by the time the award is made to the prime recipient.

d. Responsibility

The prime recipient will be 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 the FFRDC.

e. Limit on FFRDC Effort

The FFRDC effort, in aggregate, shall not exceed 20% of the total estimated cost of the project, including the applicant's and the FFRDC's portions of the effort.

F. Limitation on Number of Concept Papers and Full Applications Eligible for Review

There are no limits on the number of Concept Papers and Full Applications an applicant may submit for this FOA, provided that each application describes a unique, scientifically distinct project and an eligible Concept Paper was submitted for each Full Application.

⁶⁷ A cooperative research and development agreement is a contractual agreement between a national laboratory contractor and a private company or university to work together on research and development. For more information, see <https://www.energy.gov/gc/downloads/doe-cooperative-research-and-development-agreements>

G. Questions Regarding Eligibility

DOE will not make eligibility determinations for potential applicants prior to the date that applications to this FOA must be submitted. The decision whether to apply in response to this FOA lies solely with the applicant.

IV. Application and Submission Information

A. Application Process

The application process for a single submission includes two distinct phases: Concept Paper and Full Application. **Only applicants who have submitted an eligible Concept Paper will be eligible to submit a Full Application.**

All submissions must conform to the form and content requirements described below, including maximum page lengths.

- Each must be submitted in Adobe PDF format unless stated otherwise.
- Each must be written in English.
- All pages must be formatted to fit on 8.5" x 11" paper with margins not less than one inch on every side. Use Calibri typeface, a black font color, and a font size of 12-point or larger (except in figures or tables, which may be 10-point font). A symbol font may be used to insert Greek letters or special characters, but the font size requirement still applies. References must be included as footnotes or endnotes in a font size of 10 or larger. Footnotes and endnotes are counted toward the maximum page requirement.
- A **control number** will be issued when an applicant begins the EERE eXCHANGE application process. The control number must be included with all application documents. Specifically, the control number must be prominently displayed on the upper right corner of the header of every page and included in the file name (i.e., *Control Number_Applicant Name_Full Application*).
- Page numbers must be included in the footer of every page.
- Each submission must not exceed the specified maximum page limit, including cover page, charts, graphs, maps, and photographs when printed using the formatting requirements set forth above and single spaced. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages.

i. Additional Information on EERE eXCHANGE

EERE eXCHANGE is designed to enforce the deadlines specified in this FOA. The "Apply" and "Submit" buttons will automatically disable at the defined submission deadlines.

Applicants who experience technical difficulties with submission PRIOR to the FOA deadline should contact the EERE eXCHANGE helpdesk for assistance (EERE-eXCHANGESupport@hq.doe.gov).

ii. Application Education Services

DOE and the National Renewable Energy Laboratory developed a program under the American-Made Network⁶⁸ to provide Applicant Education Services. The program is designed to increase the accessibility to this FOA by conducting additional outreach beyond EERE's traditional FOA distribution channels and educating potential applicants about FOA opportunities and requirements in virtual events (for example, by providing an understanding of financial assistance best practices, other successful application practices, and providing opportunities to form collaborative teams).

The services are free of charge and provided through three Power Connectors⁶⁹ in the American-Made Network. Applicants are encouraged to reach out to and engage with the following points of contact at ADL Ventures⁷⁰ (matthew.paul@adlventures.com), Entrepreneur Futures Network⁷¹ (admin@entrepreneurfutures.org), and the University of Arizona Center for Innovation⁷² (Amanda.buchanan635@gmail.com) for more details.

Participation is not mandatory and will have no impact on the evaluation of your application by the Department of Energy.

B. Application Forms

The application forms and instructions are available at [EERE Funding Application and Management Forms](#) and on EERE eXCHANGE. To access these materials on EERE eXCHANGE, go to <https://eere-eXCHANGE.energy.gov> and select the appropriate funding opportunity number.

Note: The maximum file size that can be uploaded to the EERE eXCHANGE website is 50MB. Files larger than 50MB cannot be uploaded, and hence cannot be submitted for review. If a file is larger than 50MB but is still within the maximum page limit specified in the FOA, it must be broken into parts and denoted to that effect. For example:

TechnicalVolume_Part_1

TechnicalVolume_Part_2

⁶⁸ More information available at <https://network.americanmadechallenges.org/>

⁶⁹ More information available at <https://americanmadechallenges.org/power-connectors>

⁷⁰ More information about this entities capabilities available at <https://www.adlventures.com/>

⁷¹ More information about this entities capabilities available at <https://entrepreneurfutures.org/>

⁷² More information about this entities capabilities available at <http://uaci.com/>

EERE will not accept late submissions that resulted from technical difficulties due to uploading files that exceed 50MB.

C. Content and Form of the Concept Paper

Each Concept Paper must be limited to a single concept or technology. The Concept Paper must conform to the requirements listed below, including the stated page limits.

Section	Page Limit	Description
Cover Page	1 page maximum	<p>The cover page should include the project title, the specific announcement Topic being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, the project location(s), the requested funding level, and any statements regarding confidentiality.</p> <p>Topic 1 Only: If applying for ≥\$7 million in federal funds, provide the high and low funding level described in the concept paper (See Section I.B.i.h for details).</p>
Technology Description	4 pages maximum	<p>Applicants are required to describe succinctly:</p> <ul style="list-style-type: none"> • The proposed technology, including its basic operating principles and how it is unique and innovative. • The proposed technology’s target level of performance (applicants should provide technical data or other support to show how the proposed target could be met) • The current state of the art, including key shortcomings, limitations, and challenges. • How the proposed technology will overcome the shortcomings, limitations, and challenges • The potential impact of the proposed project. • How the proposed location of the proposed project will support technology development and long-term success. • The key technical risks/issues associated with the proposed technology development plan. • The impact that EERE funding would have on the proposed project. <p>Topic 1 Only: If applying for ≥\$7 million in federal funds, follow the guidance in Section I.B.i.h when describing your proposed project.</p>
Community Benefits Plan	1 page maximum	<p>Applicants are required to succinctly describe their approach to the Community Benefits Plan, addressing the three core elements:</p> <ul style="list-style-type: none"> • Advance diversity, equity, inclusion, and accessibility (DEIA) • Contribute to energy equity • Invest in America’s workforce
Addendum	2 pages maximum	<p>Applicants are required to succinctly describe the qualifications, experience, and capabilities of the proposed project team, including:</p>

		<ul style="list-style-type: none"> • The skills and expertise of the Principal Investigator (PI) and project team to successfully execute the project plan. • Prior experience which demonstrates an ability to perform tasks of similar risk and complexity. • Previous successful examples of working together with proposed teaming partners. • Access to equipment and facilities necessary to accomplish the effort and/or explanation of how necessary equipment and facilities access will be obtained. <ul style="list-style-type: none"> ○ Topic 1 Only: See section I.B.i.f for further details on topics to cover in assessing your equipment readiness for the proposed project. • Applicants may provide graphs, charts, or other data to supplement their Technology Description.
Data Sharing (Topic 1 Only)	1 page maximum	Topic 1 Applicants only: Applicants are required to provide preliminary data they expect to include in a future Full Application that meets (or show progress toward meeting) the competitive baseline project guidelines for the funding level sought (as described in Section I.B.i.g). Applicants should use the suggested tabular format in Section I.B.i.g to report this data.

EERE makes an independent assessment of each Concept Paper based on the criteria in Section V.A.i. of the FOA. EERE will encourage a subset of applicants to submit Full Applications. Other applicants will be discouraged from submitting a Full Application. See Section VI.A.ii.

D. Content and Form of the Full Application

Applicants must complete the following application forms found at [EERE Funding Application and Management Forms](#) and on the EERE eXCHANGE website at <https://eere-eXCHANGE.energy.gov/>.

Applicants will have approximately 30 days from receipt of the Concept Paper Encourage/Discourage notification on EERE eXCHANGE to prepare and submit a Full Application. Regardless of the date the applicant receives the Encourage/Discourage notification, the submission deadline for the Full Application remains the date and time stated on the FOA cover page.

All Full Application documents must be marked with the control number issued to the applicant.

i. Full Application Content Requirements

Each Full Application must be limited to a single concept. Full Applications must conform to the following requirements and must not exceed the stated page limits.

Component	File Format	Page Limit	File Name
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide (Topic 1 Only: 2 slides for projects ≥\$7 million federal)	MS PowerPoint	1-2	ControlNumber_LeadOrganization_Slide
Technical Volume (Topic 1 Only: 17 page limit for projects ≥\$7 million federal)	PDF	15-17	ControlNumber_LeadOrganization_TechnicalVolume
Resumes	PDF	3 pages each	ControlNumber_LeadOrganization_Resumes
Topic 1 Only: Equipment Readiness Assessment	PDF	3	ControlNumber_LeadOrganization_ERP
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_LOCs
Letters of Support	PDF	1 page each	ControlNumber_LeadOrganization_LOSs
SF-424: Application for Federal Assistance	PDF template	n/a	ControlNumber_LeadOrganization_App424
Budget Justification Workbook	MS Excel template	n/a	ControlNumber_LeadOrganization_Budget_Justification
Subrecipient Budget Justification	MS Excel template	n/a	ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 2)	PDF template	n/a	ControlNumber_LeadOrganization_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF	n/a	ControlNumber_LeadOrganization_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF template	n/a	ControlNumber_LeadOrganization_SF-LLL
Current and Pending Support	PDF (template available)	n/a	ControlNumber_LeadOrganization_CPS
Potentially Duplicative Funding Notice (if applicable)	PDF	n/a	ControlNumber_LeadOrganization_PDFN
Foreign Entity Waiver Requests and Foreign Work Waiver Requests (if applicable)	PDF	n/a	ControlNumber_LeadOrganization_Waiver

Community Benefits Plan	PDF	5	ControlNumber_LeadOrganization_CBP
Transparency of Foreign Connections (if applicable)	PDF	n/a	ControlNumber_LeadOrganization_TFC
Locations of Work	XLS	n/a	ControlNumber_LeadOrganization_LOW

Note: The maximum file size that can be uploaded to the EERE eXCHANGE website is 50MB. See Section IV.B.

EERE provides detailed guidance on the content and form of each component below.

ii. Technical Volume

The Technical Volume must conform to the following content and form requirements. This volume must address the technical review criteria as discussed in Section V. of the FOA.

Save the Technical Volume in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_TechnicalVolume”.

Applicants must provide sufficient citations and references to the primary research literature to justify the claims and approaches made in the Technical Volume. However, EERE and reviewers are under no obligation to review cited sources.

The Technical Volume to the Full Application may not be more than 15 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and should include all information in the table below. The applicant should consider the weighting of each of the technical review criteria (see Section V.A.ii. of the FOA) when preparing the Technical Volume.

Technical Volume Content Requirements	
SECTION/PAGE MAXIMUM	DESCRIPTION
Cover Page	The cover page should include the project title, the specific FOA Topic being addressed, both the PI and business points of contact, names of all team member organizations, names of Senior/Key Personnel and their organizations, the project location(s), the requested funding level, and any statements regarding confidentiality.

	<p>Topic 1 Only: If applying for ≥\$7 million in federal funds, provide the high and low funding level being requested (see Section I.B.i.h for more details).</p>
<p>Project Overview (Approximately 10% of the Technical Volume)</p>	<p>The Project Overview should contain the following information:</p> <ul style="list-style-type: none"> • Background: The applicant should discuss the background of its organization, including the history, successes, and current research and development status (i.e., the technical baseline) relevant to the technical topic being addressed in the Full Application. • Project Goal(s): The applicant should explicitly identify the targeted improvements to the baseline technology and the critical success factors in achieving that goal. <ul style="list-style-type: none"> ○ Topic 1 Only: Project goals must specifically consider the 2026 performance targets matrix and timeline (see Section I.B.i.a). ○ Topic 1 Only: If applying for ≥\$7 million in federal funds, explain how the goals differ for the high and low funding level being requested (see Section I.B.i.h for more details). • DOE Impact: The applicant should discuss the impact that DOE funding would have on the proposed project. Applicants should specifically explain how DOE funding, relative to prior, current, or anticipated funding from other public and private sources, is necessary to achieve the project objectives. <ul style="list-style-type: none"> ○ Topic 1 Only: The applicant must discuss the impact of both the high and low level of funding, if applicable (see Section I.B.i.h).
<p>Technical Description, Innovation, and Impact (Approximately 40% of the Technical Volume)</p>	<p>This section should contain a clear, feasible narrative that defines the scope of proposed work and how this work will function to accomplish the Project Goal(s). As part of this, the Technical Description should contain the following information:</p> <ul style="list-style-type: none"> • Relevance and Outcomes: The applicant should provide a detailed description of the technology or focus area, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project. • Feasibility: The applicant should demonstrate the technical feasibility of the proposed technology and capability of achieving the anticipated performance targets, including a description of previous work done and prior results. This section should also address the project’s access to necessary infrastructure (e.g., transportation, water, electricity transmission), including any use of existing infrastructure, as well as to a skilled workforce. <ul style="list-style-type: none"> ○ Topic 1 Only: The applicant must provide data to support current technical capabilities in alignment with Section I.B.i.g. ○ Topic 1 Only: Applicants should reserve the discussion of equipment access and readiness mostly for the Equipment Readiness Assessment. • Innovation and Impacts: The applicant should describe the current state of the art in the applicable field, the specific innovation of the proposed technology or focus area, the advantages of proposed technology over current and emerging technologies, and the overall impact on advancing the state of the art/technical baseline if the project is successful.

	<ul style="list-style-type: none"> ○ To support the impact of the innovation, the applicant should provide a market transformation plan that includes the following: <ul style="list-style-type: none"> ▪ Identification of target markets, competitors, and distribution channels for proposed technology, along with known or perceived barriers to market penetration, including a mitigation plan ▪ Identification of a product development and/or service plan, commercialization timeline, financing, product marketing, and legal/regulatory considerations, including intellectual property, infrastructure requirements, data dissemination, and product distribution ● Topic 1 Only: The applicant must discuss both the high and low level of funding, if applicable, in this section (see Section I.B.i.h for more details).
<p>Workplan (Approximately 25% of the Technical Volume)</p>	<p>The Workplan should detail the approach to completing the objectives and work described in the Project Overview and Technical Description. This should include a summary of the project schedule, the key final (End of Project goals) and intermediate (Go/No-Go decision points) milestones (including milestones in the Community Benefits Plan), and the tasks to accomplish these milestones. The Workplan should essentially explain how an applicant plans to accomplish what they say they want to accomplish and contain the following information:</p> <ul style="list-style-type: none"> ● Project Schedule (Gantt Chart or similar): The applicant should provide a schedule for the entire project, including the length of budget periods, the length of task durations, and the timing of key milestones and Go/No-Go decision points. ● End of Project Goal(s): The applicant should provide a summary of the end of project goal(s). At a minimum, each project must have one SMART end of project goal. <ul style="list-style-type: none"> ○ SMART milestones should be Specific, Measurable, Achievable, Relevant, and Timely, and must demonstrate a technical achievement rather than simply completing a task. The applicant should also provide the means by which the milestone will be verified. ● Go/No-Go Decision Points (see Section VI.B.xv. for more information on the Go/No-Go Review): The applicant should provide a summary of project-wide SMART Go/No-Go decision points at appropriate points in the Workplan. At a minimum, each project must have at least one project-wide Go/No-Go decision point for each budget period (12-18 months) of the project. ● Intermediate Milestones: The applicant can provide, as necessary, additional key SMART milestones between Go/No-Go and End of Project milestones. ● Task Descriptions: The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, accomplish the final project goal(s), and produce all deliverables. The Workplan shall consist of performance periods (approximately annual), separated by Go/No-Go decision points. Performance periods shall have distinct tasks and subtasks, which should be described concisely. <ul style="list-style-type: none"> ○ The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as “we will then complete a proprietary process” is unacceptable). It is the applicant’s responsibility

	<p>to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA.</p> <ul style="list-style-type: none"> ○ Each task must include a high-level budget allocation. <ul style="list-style-type: none"> ▪ Topic 1 Only: Each task must show a budget for the high and low level of funding, if applicable (see Section I.B.i.h for more details). ● Project Management: The applicant should discuss the team’s proposed management plan, including the following: <ul style="list-style-type: none"> ○ The overall approach to and organization for managing the work, including the roles of each project team member, any critical handoffs/ interdependencies among project team members, and how communications will be maintained among project team members (RASIC or similar outlining the roles, accountability, and responsibilities traced to the tasks associated with each milestone). ○ The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices. ○ The approach to project risk management, including a plan for securing a qualified workforce and mitigating risks to project performance including but not limited to community or labor disputes. <ul style="list-style-type: none"> ▪ Topic 1 Only: Applicants should reserve the discussion of equipment access and readiness mostly for the Equipment Readiness Assessment. ○ A description of how project changes will be handled. ○ If applicable, the approach to Quality Assurance/Control. ● Topic 1 Only: The applicant must discuss both the high and low level of funding, if applicable, in this section (see Section I.B.i.h for more details).
<p>Technical Qualifications and Resources (Approximately 25% of the Technical Volume)</p>	<p>The Technical Qualifications and Resources should contain the following information:</p> <ul style="list-style-type: none"> ● A description of the project team’s roles, unique qualifications, and expertise, including those of key subrecipients ● A description of the project team’s existing equipment and facilities, or equipment or facilities already in place on the proposed project site, that will facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project <ul style="list-style-type: none"> ○ Topic 1 Only: Applicants should reserve the discussion of equipment access and readiness mostly for the Equipment Readiness Assessment. ○ Topic 2 Only: If applying for ≥\$3 million in federal funds, describe how the project team's access to facilities and equipment will be sufficient to meet the needs of any proposed demonstration scale activities. ● Relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives <ul style="list-style-type: none"> ○ Topic 2 Only: If applying for ≥\$3 million in federal funds, describe the project team's experience in executing research and development activities at pilot or manufacturing scale.

	<ul style="list-style-type: none"> • The time commitment of the key team members to support the project which is supported by the budget justification. • A description of the technical services to be provided by DOE/NNSA FFRDCs, if applicable. • The skills, certifications, or other credentials of the technical and ongoing operations workforce. • For multi-organizational projects, describe succinctly: <ul style="list-style-type: none"> ○ The roles and the work to be performed by the PI and Senior/Key Personnel at the prime and sub levels ○ Business agreements between the applicant and sub ○ How the various efforts will be integrated and managed ○ Process for making decisions on technical direction ○ Publication arrangements ○ Intellectual property issues ○ Communication plans • Topic 1 Only: The applicant must discuss both the high and low level of funding and any potential impacts it may have on teaming, if applicable, in this section (see Section I.B.i.h for more details).
<p>Addendum (Topic 1 Only) 2 Page Maximum</p>	<p>Topic 1 Only: If applying for ≥\$7 million in federal funds, the applicant must use this addendum to summarize the changes in the project and discuss the changes to the overall impact expected between the high and low level of funding (see Section I.B.i.h for more details).</p>

iii. Summary for Public Release

Applicants must submit a one-page summary of their project that is suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the lead project manager/principal investigator(s), the project title, the requested budget, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (e.g., benefits, outcomes), major participants (for collaborative projects), and the project’s commitments and goals described in the Community Benefits Plan. This document must not include any proprietary or business-sensitive information as DOE may make it available to the public after selections are made. The summary must not exceed one page when printed using standard 8.5” x 11” paper with 1” margins (top, bottom, left, and right) with font not smaller than 12-point.

Topic 1 Only: If applying for ≥\$7 million in federal funds, provide the high and low funding level being requested (See Section I.B.i.h for more details)

Save the Summary for Public Release in a single PDF file using the following convention for the title: “ControlNumber_LeadOrganization_Summary”.

iv. Summary Slide

Applicants to **Topic 2** must provide a single slide summarizing the proposed project. Applicants to **Topic 1** applying for <\$7 million in federal funds must provide a single slide summarizing the proposed project. Applicants to **Topic 1** applying for ≥\$7 million in federal funds must provide two separate slides which summarize the proposed project at the high and low level of funding.

The Summary Slide template is available on EERE eXCHANGE at <https://eere-eXCHANGE.energy.gov/> and must include the following information:

- A technology summary
- A description of the technology's impact
- Proposed project goals
- Any key graphics (illustrations, charts and/or tables)
- The project's key idea/takeaway
- Topline community benefits
- Project title, prime recipient, PI, and Senior/Key Personnel information
- Requested EERE funds and proposed applicant cost share

Save the Summary Slide in a single Microsoft PowerPoint file using the following convention for the title "ControlNumber_LeadOrganization_Slide".

v. Resumes

A resume provides information reviewers can use to evaluate an individual's relevant skills and the experience of the key project personnel. Applicants must submit a resume for each project manager and Senior/Key Personnel. Resumes should include the items below and be no more than three pages, although one page resumes are preferred:

1. Contact information
2. Education: All academic institutions attended, major/area, degree
3. Training: (e.g.,) certification or credential from a Registered Apprenticeship or Labor Management Partnership
4. Professional experience: Beginning with the current position, list professional/academic positions in chronological order with a brief description
5. A list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically. Patents, copyrights, and software systems developed may be provided in addition to or substituted for publications. An abbreviated style such as the Physical Review Letters (PRL) convention for

citations (list only the first author) may be used for publications with more than 10 authors

6. List all current academic, professional, or institutional appointments, foreign or domestic, at the applicant institution or elsewhere, whether or not remuneration is received, and, whether full-time, part-time, or voluntary

Save the resumes in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_Resumes”.

vi. Topic 1 Only: Equipment Readiness Assessment

Applicants should provide an equipment readiness risk assessment to accomplish the goals of the project as described in the Technical Volume. Plans should address all aspects detailed in Section I.B.i.f. Applicants can provide the information in whatever form they feel best communicates the requested details and may supplement written text with graphs, tables, pictures, or other figures. However, all content must be contained within the 3-page limit.

Save the Equipment Readiness Assessment in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_ERP”.

vii. Letters of Commitment

Submit letters of commitment from all subrecipient and third-party cost share providers. If applicable, the letter must state that the third party is committed to providing a specific minimum dollar amount or value of in-kind contributions allocated to cost sharing. The following information for each third party contributing to cost sharing should be identified: (1) the name of the organization; (2) the proposed dollar amount to be provided; and (3) the proposed cost sharing type (cash-or in-kind contributions). Each letter must not exceed one page. Letters of commitment for the project from entities that do not have a substantive role in the project will not be accepted.

Save the letters of commitment in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_LOCs”.

viii. Letters of Support

Submit letters of support from other relevant entities or project partners (e.g., potential off-takers of the proposed innovation or strategic manufacturing partners) to provide support for claims made in the Technical Volume. Letters of

support from partners or others that are critical to the success of the application will lend credibility to claims made in the Technical Volume.

Save the letters of commitment in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_LOSs”.

ix. SF-424: Application for Federal Assistance

Applicants must complete the SF-424 Application for Federal Assistance, which is available at: [EERE Funding Application and Management Forms](#). The list of certifications and assurances in Field 21 can be found at <http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms>, under Certifications and Assurances.

Note: The dates and dollar amounts on the SF-424 are for the complete project period and not just the first project year, first phase or other subset of the project period.

Save the SF-424 in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_424”.

x. Budget Justification Workbook

Applicants must complete the Budget Justification Workbook, available at: [EERE Funding Application and Management Forms](#). Applicants must complete each tab of the Budget Justification Workbook for the project, including all work to be performed by the prime recipient and its subrecipients and contractors. Applicants should include costs associated with required annual audits and incurred cost proposals in their proposed budget documents. The “Instructions and Summary” included with the Budget Justification Workbook will auto-populate as the applicant enters information into the Workbook. Applicants must carefully read the “Instructions and Summary” tab provided within the Budget Justification Workbook.

Topic 1 Only: If applying for \geq \$7 million in federal funds, still only one budget justification workbook should be submitted. The budget sheet should be developed first for the low budget scenario. Then, new line items should be added to each tab in the budget sheet to bring the level of effort up to the high budget scenario. These new line items should be labeled with an “H” and highlighted or otherwise clearly identified to differentiate from the low budget scenario line items.

Example: If an individual contributor on the project was budgeted for 500 hours of work in the low budget scenario and 1000 hours in a high budget scenario,

this would be written on the budget sheet as two line items. The first line item for 500 hours would represent the level of effort in the low-budget scenario, and then a second line item for 500 hours would be needed as well. This second line item would need to be labeled with an “H” to signify that this line item is contributing to the high budget scenario).

This can be repeated across the following tabs – a. Personnel, c. Travel, d. Equipment, e. Supplies, f. Contractual, g. Construction, h. Other, j. Cost Share.

The Instructions and Summary, b. Fringe, and i. Indirect tabs **do not** need to follow this guidance and instead should simply reflect costs for the high budget scenario.

Save the Budget Justification Workbook in a single Microsoft Excel file using the following convention for the title
“ControlNumber_LeadOrganization_Budget_Justification”.

xi. Subrecipient Budget Justification (if applicable)

Applicants must provide a separate budget justification for each subrecipient that is expected to perform work estimated to be more than \$250,000 or 25% of the total work effort, whichever is less. The budget justification must include the same justification information described in the “Budget Justification” section above.

Topic 1 Only: Follow the same directions provide for Budget Justification in Section IV.D.x

Save each subrecipient budget justification in a Microsoft Excel file using the following convention for the title
“ControlNumber_LeadOrganization_Subrecipient_Budget_Justification”.

xii. DOE Work Proposal for FFRDC (if applicable)

If a DOE/NNSA FFRDC is to perform a portion of the work, the applicant must provide a DOE work proposal (WP) in accordance with the requirements in DOE Order 412.1A, Work Authorization System, Attachment 2, available at:
<https://www.directives.doe.gov/directives-documents/400-series/0412.1-BOrder-a-chg1-AdmChg>.

Save the WP in a single PDF file using the following convention for the title
“ControlNumber_LeadOrganization_WP”.

xiii. Authorization for Non-DOE/NNSA or DOE/NNSA FFRDCs (if applicable)

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with the contractor's authority under its award.

Save the Authorization in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FFRDCAuth".

xiv. SF-LLL: Disclosure of Lobbying Activities

Recipients and subrecipients may not use any federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Recipients and subrecipients (listed on tab f. Contractual in the budget justification) must complete the SF-LLL Disclosure of Lobbying Activities, which is available at: [EERE Funding Application and Management Forms](#), to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the 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.

Save the SF-LLL in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_SF-LLL".

xv. Current and Pending Support

Current and pending support is intended to allow the identification of potential duplication, overcommitment, potential conflicts of interest or commitment, and all other sources of support. As part of the application, the principal investigator and all senior/key personnel at the applicant and subrecipient level must provide a list of all sponsored activities, awards, and appointments, whether paid or unpaid; provided as a gift with terms or conditions or provided as a gift without terms or conditions; full-time, part-time, or voluntary; faculty, visiting, adjunct, or honorary; cash or in-kind; foreign or domestic; governmental or private-sector; directly supporting the individual's research or indirectly supporting the individual by supporting students, research staff, space, equipment, or other research expenses. All connections with foreign government-sponsored talent recruitment programs must be identified in current and pending support.

For every activity, list the following items:

- The sponsor of the activity or the source of funding;
- The award or other identifying number;
- The title of the award or activity. If the title of the award or activity is not descriptive, add a brief description of the research being performed that would identify any overlaps or synergies with the proposed research;
- The total cost or value of the award or activity, including direct and indirect costs and cost share. For pending proposals, provide the total amount of requested funding;
- The award period (start date through end date); and
- The person-months of effort per year dedicated to the award or activity.

To identify overlap, duplication of effort, or synergistic efforts, append a description of the other award or activity to the current and pending support.

Details of any obligations, contractual or otherwise, to any program, entity, or organization sponsored by a foreign government must be provided on request to either the applicant institution or DOE. Supporting documents of any identified source of support must be provided to DOE on request, including certified translations of any document.

PIs and senior/key personnel must provide a separate disclosure statement listing the required information above regarding current and pending support. Each individual must sign and date their respective disclosure statement and include the following certification statement:

I, [Full Name and Title], certify to the best of my knowledge and belief that the information contained in this Current and Pending Support Disclosure Statement is true, complete, and accurate. I understand that any false, fictitious, or fraudulent information, misrepresentations, half-truths, or omissions of any material fact, may subject me to criminal, civil or administrative penalties for fraud, false statements, false claims or otherwise. (18 U.S.C. §§ 1001 and 287, and 31 U.S.C. §§ 3729-3733 and 3801-3812). I further understand and agree that (1) the statements and representations made herein are material to DOE's funding decision, and (2) I have a responsibility to update the disclosures during the period of performance of the award should circumstances change which impact the responses provided above.

The information may be provided in the format approved by the NSF, which may be generated by the Science Experts Network Curriculum Vita (SciENCv), a cooperative venture maintained at <https://www.ncbi.nlm.nih.gov/sciencv/>, also available at <https://www.nsf.gov/bfa/dias/policy/nsfapprovedformats/cps.pdf>. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats. If the NSF format is used, the individual must still include a signature, date, and a certification statement using the language included in the paragraph above.

Save the Current and Pending Support in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_CPS".

Definitions:

Current and pending support – (a) All resources made available, or expected to be made available, to an individual in support of the individual's RD&D efforts, regardless of (i) whether the source is foreign or domestic; (ii) whether the resource is made available through the entity applying for an award or directly to the individual; or (iii) whether the resource has monetary value; and (b) includes in-kind contributions requiring a commitment of time and directly supporting the individual's RD&D efforts, such as the provision of office or laboratory space, equipment, supplies, employees, or students. This term has the same meaning as the term Other Support as applied to researchers in NSPM-33: For researchers, Other Support includes all resources made available to a researcher in support of and/or related to all of their professional RD&D efforts, including resources provided directly to the individual or through the organization, and regardless of whether or not they have monetary value (e.g., even if the support received is only in-kind, such as office/laboratory space, equipment, supplies, or employees). This includes resource and/or financial support from all foreign and domestic entities, including but not limited to gifts provided with terms or conditions, financial support for laboratory personnel, and participation of student and visiting researchers supported by other sources of funding.

Foreign Government-Sponsored Talent Recruitment Program – An effort directly or indirectly organized, managed, or funded by a foreign government, or a foreign government instrumentality or entity, to recruit science and technology professionals or students (regardless of citizenship or national origin, or whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to physically relocate to the foreign state for the above purpose. Some

programs allow for or encourage continued employment at United States research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct participants not to disclose their participation to United States entities. Compensation could take many forms including cash, research funding, complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

Senior/key personnel – An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research, development and demonstration (RD&D) project proposed to be carried out with a DOE award.⁷³

xvi. Potentially Duplicative Funding Notice (if applicable)

If the applicant or project team member has other active awards of federal funds, the applicant must determine whether the activities of those awards potentially overlap with the activities set forth in its application to this FOA. If there is a potential overlap, the applicant must notify DOE in writing of the potential overlap and state how it will ensure any project funds (i.e., recipient cost share and federal funds) will not be used for identical cost items under multiple awards. Likewise, for projects that receive funding under this FOA, if a recipient or project team member receives any other award of federal funds for activities that potentially overlap with the activities funded under the DOE award, the recipient must promptly notify DOE in writing of the potential overlap and state whether project funds from any of those other federal awards have been, are being, or are to be used (in whole or in part) for one or more of the identical cost items under the DOE award. If there are identical cost items, the recipient must promptly notify the Contracting Officer in writing of the potential duplication and eliminate any inappropriate duplication of funding.

Save the Potentially Duplicative Funding Notice in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_PDFN.”

xvii. Waiver Requests (if applicable)

Foreign Entity Participation

For projects selected under this FOA, all recipients and subrecipients must qualify as domestic entities. See Section III. To request a waiver of this

⁷³ Typically, these individuals have doctoral or other professional degrees, although individuals at the masters or baccalaureate level may be considered Senior/Key Personnel if their involvement meets this definition. Consultants, graduate students, and those with a postdoctoral role also may be considered Senior/Key Personnel if they meet this definition.

requirement, the applicant must submit an explicit waiver request in the Full Application. Appendix C lists the information that must be included in a waiver request.

Foreign Work Waiver Request

As set forth in Section IV.I.iii., all work for projects selected under this FOA must be performed in the United States. To request a waiver of this requirement, the applicant must submit an explicit waiver request in the Full Application. Appendix C lists the information that must be included in a foreign work waiver request.

Save the Waivers in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_Waiver”.

xviii. Locations of Work

Applicants must complete the Locations of Work Documentation, available on EERE eXCHANGE at <https://eere-eXCHANGE.energy.gov/>. The applicant must complete the supplied template by listing the city, state, and zip code + 4 digits for each location where project work will be performed by the prime recipient or subrecipient(s). Save the completed template as a Microsoft Excel file using the following convention for the title: “Control Number_LeadOrganization_LOW.”

xix. Community Benefits Plan

The Community Benefits Plan must set forth the applicant’s approach to ensuring the Federal investments advance the following three objectives: (1) DEIA; (2) energy equity; and (3) investing in America’s workforce. The below sections set forth the content requirements for the Community Benefits Plan, which addresses each of these objectives. Applicants must address all three sections.

The applicant’s Community Benefits Plan must include at least one Specific, Measurable, Attainable, Realistic, and Timely (SMART) milestone per budget period to measure progress on the proposed actions. The Community Benefits Plan will be evaluated as part of the technical review process. If a project is selected, EERE will incorporate the Community Benefits Plan into the award and the recipient must implement its Community Benefits Plan when carrying out its project. EERE will evaluate the recipient’s progress throughout the life of the award, including as part of the Go/No-Go review process.

The plan should be specific to the proposed project and not a restatement of an organization’s policies. Applicants should describe the future implications or a milestone-based plan for identifying future implications of their research on energy equity, including, but not limited to, benefits for the U.S. workforce. These impacts may be uncertain, occur over a long period of time, and/or have

many factors within and outside the specific proposed research. Applicants are encouraged to describe the influencing factors and the most likely workforce and energy equity implications of the proposed research if the research is successful. While some guidance and example activities are provided in Appendix F, applicants are encouraged to leverage promising practices and develop a plan tailored to their project.

The Community Benefits Plan must not exceed five pages. It must be submitted in PDF format using the following convention name for the title:

“ControlNumber_LeadOrganization_CBP.” This Plan must address the technical review criterion titled, “Community Benefits Plan.” See Section V. of the FOA.

The Community Benefits Plan must address the following three sections:

1) Diversity, Equity, Inclusion, and Accessibility:

To building a clean and equitable energy economy, it is important that there are opportunities for people of all racial, ethnic, socioeconomic and geographic backgrounds, sexual orientation, gender identity, persons with disabilities, and those re-entering the workforce from incarceration. This section of the plan must demonstrate how DEIA is incorporated in the technical project objectives. The plan must identify the specific action the applicant would take that integrates into the research goals and project teams. Submitting an institutional DEIA plan without specific integration into the project will be deemed insufficient.

2) Energy Equity:

This section must articulate the applicant’s consideration of long-term equity implications of the research. It must identify how the specific project integrates equity considerations into the project design to support equitable outcomes if the innovation is successful. Like cost reductions and commercialization plans, the Community Benefits Plan requires description of the equity implications of the innovation.

3) Workforce Implications:

This section must articulate the applicant’s consideration of long-term workforce impacts and opportunities of the research. It must identify how the project is designed and executed to include an understanding of the future workforce needs if the innovation is successful.

See Appendix F for more guidance.

xx. Transparency of Foreign Connections (if applicable)

Applicants must provide the following as it relates to the proposed recipient and subrecipients. Include a separate disclosure for the applicant and each proposed

subrecipient. U.S. National Laboratories, domestic government entities, and institutions of higher education are only required to respond to items 1, 2 and 9, and if applying as to serve as the prime recipient, must provide complete responses for project team members that are not U.S. National Laboratories, domestic government entities, or institutions of higher education.

1. Entity name, website address and mailing address;
2. The identity of all owners, principal investigators, project managers, and senior/key personnel who are a party to any *Foreign Government-Sponsored Talent Recruitment Program* of a foreign country of risk (i.e., China, Iran, North Korea, and Russia);
3. The existence of any joint venture or subsidiary that is based in, funded by, or has a foreign affiliation with any foreign country of risk;
4. Any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity;
5. Percentage, if any, that the proposed recipient or subrecipient has foreign ownership or control;
6. Percentage, if any, that the proposed recipient or subrecipient is wholly or partially owned by an entity in a foreign country of risk;
7. Percentage, if any, of venture capital or institutional investment by an entity that has a general partner or individual holding a leadership role in such entity who has a foreign affiliation with any foreign country of risk;
8. Any technology licensing or intellectual property sales to a foreign country of risk, during the 5-year period preceding submission of the proposal;
9. Any foreign business entity, offshore entity, or entity outside the United States related to the proposed recipient or subrecipient;
10. Complete list of all directors (and board observers), including their full name, citizenship and shareholder affiliation, date of appointment, duration of term, as well as a description of observer rights as applicable;
11. Complete capitalization table for your entity, including all equity interests (including LLC and partnership interests, as well as derivative securities). Include both the number of shares issued to each equity holder, as well as the percentage of that series and all equity on a fully diluted basis. Identify the principal place of incorporation (or organization) for each equity holder. If the equity holder is a natural person, identify the citizenship(s). If the recipient or subrecipient is a publicly traded company, provide the above information for shareholders with an interest greater than 5%;
12. A summary table identifying all rounds of financing, the purchase dates, the investors for each round, and all the associated governance and

information rights obtained by investors during each round of financing;
and

13. An organization chart to illustrate the relationship between your entity and the immediate parent, ultimate parent, and any intermediate parent, as well as any subsidiary or affiliates. Identify where each entity is incorporated.

DOE reserves the right to request additional or clarifying information based on the information submitted.

Save the Transparency of Foreign Connections information in a single PDF file using the following convention for the title
"ControlNumber_LeadOrganization_TFC."

E. Post Selection Information Requests

If selected for award negotiations, EERE reserves the right to require that selected applicants provide additional or clarifying information regarding the application submissions, the project, the project team, the award requirements, and any other matters related to anticipated award. The following is a list of examples of information that may be required:

- Personnel proposed to work on the project and collaborating organizations (See Section VI.B.xx. Participants and Collaborating Organizations);
- Current and Pending Support (See Sections IV.D.xiv. and VI.B.xxi. Current and Pending Support);
- An Intellectual Property Management Plan describing how the project team/consortia members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies in accordance with Section VI.B.xi. Intellectual Property Management Plan;
- A Data Management Plan (if applicable) describing how all research data displayed in publications resulting from the proposed work will be digitally accessible at the time of publications, in accordance with Section VI.B.xxiv.;
- Indirect cost information;
- Other budget information;
- Letters of Commitment from third parties contributing to cost share, if applicable;
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5);
- Information for the DOE Office of Civil Rights to process assurance reviews under 10 CFR 1040;
- Representation of Limited Rights Data and Restricted Software, if applicable; and

- Environmental Questionnaire.

F. Unique Entity Identifier (UEI) and System for Award Management (SAM)

Each applicant (unless the applicant is an individual or federal awarding agency that is excepted from those requirements under 2 CFR 25.110(b) or (c), or has an exception approved by the federal awarding agency under 2 CFR 25.110(d)) is required to: (1) Register in the SAM at <https://www.sam.gov> before submitting an application; (2) provide a valid UEI in the application; and (3) maintain an active SAM registration with current information when the applicant has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable UEI and SAM requirements. If an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, DOE will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

NOTE: Due to the high demand of UEI requests and SAM registrations, entity legal business name and address validations are taking longer than expected to process. Entities should start the UEI and SAM registration process as soon as possible. If entities have technical difficulties with the UEI validation or SAM registration process they should use the [HELP](#) feature on [SAM.gov](https://www.sam.gov). SAM.gov will work entity service tickets in the order in which they are received and asks that entities not create multiple service tickets for the same request or technical issue. Additional entity validation resources can be found here: [GSAFSD Tier 0 Knowledge Base - Validating your Entity](#).

G. Submission Dates and Times

All required submissions must be submitted in EERE eXCHANGE no later than 5 p.m. ET on the dates provided on the cover page of this FOA.

H. Intergovernmental Review

This FOA is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

I. Funding Restrictions

i. Allowable Costs

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

ii. Pre-Award Costs

Applicants selected for award negotiations (selectee) must request prior written approval to charge pre-award costs. Pre-award costs are those incurred prior to the effective date of the federal award directly pursuant to the negotiation and in anticipation of the federal award where such costs are necessary for efficient and timely performance of the scope of work. Such costs are allowable only to the extent that they would have been allowable if incurred after the date of the federal award and **only** with the written approval of the federal awarding agency, through the Contracting Officer.

Pre-award costs cannot be incurred prior to the Selection Official signing the Selection Statement and Analysis.

Pre-award expenditures are made at the selectee's risk. EERE is not obligated to reimburse costs: (1) in the absence of appropriations; (2) if an award is not made; or (3) if an award is made for a lesser amount than the selectee anticipated.

1. National Environmental Policy Act (NEPA) Requirements Related to Pre-Award Costs

EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA. Applicants should carefully consider and should seek legal counsel or other expert advice before taking any action related to the proposed project that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to EERE completing the NEPA review process.

EERE does not guarantee or assume any obligation to reimburse pre-award costs incurred prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that DOE determines may have an adverse effect on the environment or limit the choice of reasonable alternatives prior to receiving such written authorization from the Contracting Officer, the applicant is doing so at risk of not receiving federal funding for its project and such costs may not be recognized as allowable cost share. Nothing contained in the pre-award cost reimbursement regulations or any pre-award costs approval letter from the Contracting Officer overrides the requirement to obtain the written authorization from the Contracting Officer prior to taking any action that may have an adverse effect on the environment or limit the choice of reasonable alternatives. Likewise, if an application is selected for negotiation of award, and the prime recipient elects to undertake activities that are not authorized for federal funding by the Contracting Officer in advance of EERE completing a NEPA review, the prime recipient is doing so at risk of not receiving federal funding and such costs may not be recognized as allowable cost share.

iii. Performance of Work in the United States (Foreign Work Waiver)**1) Requirement**

All work performed under awards issued under this FOA must be performed in the United States. The prime recipient must flow down this requirement to its subrecipients.

2) Failure to Comply

If the prime recipient fails to comply with the Performance of Work in the United States requirement, EERE may deny reimbursement for the work conducted outside the United States and such costs may not be recognized as allowable recipient cost share. The prime recipient is responsible should any work under this award be performed outside the United States, absent a waiver, regardless of whether the work is performed by the prime recipient, subrecipients, contractors or other project partners.

3) Waiver

To seek a foreign work waiver, the applicant must submit a written waiver request to EERE. Appendix C lists the information that must be included in a request for a foreign work waiver.

Save the waiver request(s) in a single PDF file. The applicant does not have the right to appeal EERE's decision concerning a waiver request.

iv. Construction

Recipients are required to obtain written authorization from the Contracting Officer before incurring any major construction costs.

v. Foreign Travel

If international travel is proposed for your project, please note that your organization must comply with the International Air Transportation Fair Competitive Practices Act of 1974 (49 U.S.C. § 40118), commonly referred to as the "Fly America Act," and implementing regulations at 41 CFR 301-10.131 through 301-10.143. The law and regulations require air transport of people or property to, from, between, or within a country other than the United States, the cost of which is supported under this award, to be performed by or under a cost-sharing arrangement with a United States flag carrier, if service is available. Foreign travel costs are allowable only with the written prior approval of the Contracting Officer assigned to the award.

vi. Equipment and Supplies

Property disposition may be required at the end of a project if the current fair market value of property exceeds \$5,000. For-profit entity disposition requirements are set forth at 2 CFR 910.360. Property disposition requirements for other non-federal entities are set forth in 2 CFR 200.310 – 200.316. Continued use of the equipment may also be permitted for authorized purposes. See Section VI.B.xvii and VI.B.xviii for more information on equipment.

vii. Build America Buy America Requirements for Infrastructure Projects

As work under this FOA is expected to be performed by for-profit entities and the scope of work should not involve infrastructure that is publicly owned or serves a public function, it is unlikely that Build America Buy America Act, subtitle IX of BIL (Buy America, or BABA), will apply. However, DOE will review all statements of work and sub-recipients and will make a case by case decision.

Pursuant to the Build America Buy America Act, subtitle IX of BIL (Buy America, or BABA), federally assisted projects that involve infrastructure work, undertaken by applicable recipient types, require that:

- All iron, steel, and manufactured products used in the infrastructure work are produced in the United States; and
- All construction materials used in the infrastructure work are manufactured in the United States.

Whether a given project must apply this requirement is project-specific and dependent on several factors, such as the recipient's entity type, whether the work involves "infrastructure," as defined in Section 70914 of the BIL, and whether the infrastructure in question is publicly owned or serves a public function.

Applicants are strongly encouraged to consult Appendix D of this FOA to determine whether their project may have to apply this requirement, both to make an early determination as to the need of a waiver, as well as to determine what impact, if any, this requirement may have on the proposed project's budget.

Please note that, based on implementation guidance from the Office of Management and Budget issued on April 18, 2022, the Buy America requirements of the BIL do not apply to DOE projects in which the prime recipient is a for-profit entity; the requirements only apply to projects whose prime recipient is a "non-Federal entity," e.g., a State, local government, Indian

tribe, Institution of Higher Education, or nonprofit organization. Subawards should conform to the terms of the prime award from which they flow; in other words, for-profit prime recipients are not required to flow down these Buy America requirements to subrecipients, even if those subrecipients are non-Federal entities as defined above. Conversely, prime recipients which are non-Federal entities must flow the Buy America requirements down to all subrecipients, even if those subrecipients are for-profit entities. Finally, for all applicants—both non-Federal entities and for-profit entities—DOE is including a Program Policy Factor that the Selection Official may consider in determining which Full Applications to select for award negotiations that considers whether the applicant has made a commitment to procure U.S. iron, steel, manufactured products, and construction materials in its project.

The DOE financial assistance agreement will require each recipient to: (1) fulfill the commitments made in its application regarding the procurement of U.S.-produced products and (2) fulfill the commitments made in its application regarding the procurement of other key component metals and domestically manufactured products that are deemed available in sufficient and reasonably available quantities or of a satisfactory quality at the time of award negotiation. Applicants may seek waivers of these requirements in very limited circumstances and for good cause shown. Further details on requesting a waiver can be found in Appendix D and the terms and conditions of an award.

Applicants are strongly encouraged to consult Appendix D for more information.

viii. Lobbying

Recipients and subrecipients may not use any federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Recipients and subrecipients are required to complete and submit SF-LLL, “Disclosure of Lobbying Activities” (<https://www.grants.gov/web/grants/forms/sf-424-individual-family.html>) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the 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.

ix. Risk Assessment

Pursuant to 2 CFR 200.206, DOE will conduct an additional review of the risk posed by applications submitted under this FOA. Such risk assessment will consider:

- 1) Financial stability;**
- 2) Quality of management systems and ability to meet the management standards prescribed in 2 CFR 200 as amended and adopted by 2 CFR 910;**
- 3) History of performance;**
- 4) Audit reports and findings; and**
- 5) The applicant's ability to effectively implement statutory, regulatory, or other requirements imposed on non-federal entities.**

DOE may make use of other publicly available information and the history of an applicant's performance under DOE or other federal agency awards.

Depending on the severity of the findings and whether the findings were resolved, DOE may elect not to fund the applicant.

In addition to this review, DOE must comply with the guidelines on government-wide suspension and debarment in 2 CFR 180, and must require non-federal entities to comply with these provisions. These provisions restrict federal awards, subawards and contracts with certain parties that are debarred, suspended or otherwise excluded from or ineligible for participation in federal programs or activities.

Further, as DOE invests in critical infrastructure and funds critical and emerging technology areas, DOE also considers possible threats to United States research, technology, and economic security from undue foreign government influence when evaluating risk. If high risks are identified and cannot be sufficiently mitigated, DOE may elect to not fund the applicant.

x. Invoice Review and Approval

DOE employs a risk-based approach to determine the level of supporting documentation required for approving invoice payments. Recipients may be required to provide some or all of the following items with their requests for reimbursement:

- Summary of costs by cost categories;
- Timesheets or personnel hours report;
- Invoices/receipts for all travel, equipment, supplies, contractual, and other costs;
- UCC filing proof for equipment acquired with project funds by for-profit recipients and subrecipients;

- Explanation of cost share for invoicing period;
- Analogous information for some subrecipients; and
- Other items as required by DOE.

xi. Prohibition Related to Foreign Government-Sponsored Talent Recruitment Programs

a. Prohibition

Persons participating in a *Foreign Government-Sponsored Talent Recruitment Program of a Foreign Country of Risk* are prohibited from participating in projects selected for federal funding under this FOA. Should an award result from this FOA, the recipient must exercise ongoing due diligence to reasonably ensure that no individuals participating on the DOE-funded project are participating in a *Foreign Government-Sponsored Talent Recruitment Program of a Foreign Country of Risk*. Consequences for violations of this prohibition will be determined according to applicable law, regulations, and policy. Further, the recipient must notify DOE within five (5) business days upon learning that an individual on the project team is or is believed to be participating in a foreign government talent recruitment program of a foreign country of risk. DOE may modify and add requirements related to this prohibition to the extent required by law.

b. Definitions

1. Foreign Government-Sponsored Talent Recruitment Program. An effort directly or indirectly organized, managed, or funded by a foreign government, or a foreign government instrumentality or entity, to recruit science and technology professionals or students (regardless of citizenship or national origin, or whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to relocate physically to the foreign state for the above purpose. Some programs allow for or encourage continued employment at United States research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct participants not to disclose their participation to U.S. entities. Compensation could take many forms including cash, research funding, complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

2. **Foreign Country of Risk.** DOE has designated the following countries as foreign countries of risk: Iran, North Korea, Russia, and China. This list is subject to change.

xii. **Affirmative Action and Pay Transparency Requirements**

All applicants must comply with all applicable federal labor and employment laws, including but not limited to Title VII of the Civil Rights Act of 1964, the Fair Labor Standards Act, the Occupational Safety and Health Act, and the National Labor Relations Act, which protects employees' right to bargain collectively and engage in concerted activities for the purpose of workers' mutual aid or protection.

All federally assisted construction contracts exceeding \$10,000 annually will be subject to the requirements of Executive Order 11246:

(1) Recipients, subrecipients, contractors, and subcontractors are prohibited from discriminating in employment decisions on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin.

(2) Recipients and contractors are required to take affirmative action to ensure that equal opportunity is provided in all aspects of their employment. This includes flowing down the appropriate language to all subrecipients, contractors, and subcontractors.

(3) Recipients, subrecipients, contractors, and subcontractors are prohibited from taking adverse employment actions against applicants and employees for asking about, discussing, or sharing information about their pay or, under certain circumstances, the pay of their co-workers.

DOL's Office of Federal Contractor Compliance Programs (OFCCP) uses a neutral process to schedule compliance evaluations. Consult OFCCP's Technical Assistance Guide⁷⁴ to gain an understanding of the requirements and possible actions the recipients, subrecipients, contractors, and subcontractors must take. Additional guidance may also be found in the National Policy Assurances, produced by DOE.

xiii. **Foreign Collaboration Considerations**

- a. **Consideration of new collaborations with foreign entities and governments.**

The recipient will be required to provide DOE with advanced written notification of any potential collaboration with foreign entities or governments in connection

⁷⁴ See OFCCP's Technical Assistance Guide at:

<https://www.dol.gov/sites/dolgov/files/ofccp/Construction/files/ConstructionTAG.pdf?msclkid=9e397d68c4b111ec9d8e6fecb6c710ec> Also see the National Policy Assurances <http://www.nsf.gov/awards/managing/rtc.jsp>

with its DOE-funded award scope. The recipient will then be required to await further guidance from DOE prior to contacting the proposed foreign entity or government regarding the potential collaboration or negotiating the terms of any potential agreement.

- b. **Existing collaborations with foreign entities and governments.** The recipient will be required to provide DOE with a written list of all existing foreign collaborations in which has entered in connection with its DOE-funded award scope.
- c. **Description of collaborations that should be reported.** In general, a collaboration will involve some provision of a thing of value to, or from, the recipient. A thing of value includes but may not be limited to all resources made available to, or from, the recipient in support of and/or related to the DOE award, regardless of whether or not they have monetary value. Things of value also may include in-kind contributions (such as office/laboratory space, data, equipment, supplies, employees, students). In-kind contributions not intended for direct use on the DOE award but resulting in provision of a thing of value from or to the DOE award must also be reported. Collaborations do not include routine workshops, conferences, use of the recipient's services and facilities by foreign investigators resulting from its standard published process for evaluating requests for access, or the routine use of foreign facilities by awardee staff in accordance with the recipient's standard policies and procedures.

V. Application Review Information

A. Technical Review Criteria

i. Concept Papers

Concept Papers are evaluated based on consideration of the following factors. All sub-criteria are of equal weight.

Concept Paper Criterion: Overall FOA Responsiveness and Viability of the Project (Weight: 100%)

This criterion involves consideration of the following factors:

- The applicant clearly describes the proposed technology, how the technological approach is unique and innovative, and how the technology will advance the current state of the art.
- The applicant has briefly identified risks and challenges of the proposed approach, discussed potential mitigation strategies, and shown the impact that EERE funding and the proposed project would have on advancing the state of the art for thin-film solar PV.

- The applicant team has the qualifications, experience, capabilities, and other resources necessary to complete the proposed project.
- The proposed work, if successfully accomplished, would clearly meet the objectives as stated in the FOA.
- **Topic 1 Only:** The applicant clearly articulates how the proposed work is related to the achievement of the Performance Targets Matrix (Table 1) by the end of calendar year 2026 (See section I.B.i.a).
- **Topic 1 Only:** Sufficient data is provided to show the applicant is capable of meeting the competitive baseline project guidelines relevant to the level of funding requested.

ii. Full Applications

Applications will be evaluated against the technical review criteria shown below. All sub-criteria are of equal weight.

Criterion 1: Technical Merit, Innovation, and Impact

Weighting:

Topic Area 1	Topic Area 2
45%	35%

This criterion involves the following considerations (e.g. each bullet point):

Technical Merit and Innovation

- Extent to which the proposed technology, process, or project is innovative;
- Extent to which the proposed scope of work is clearly described, with a clear, logical, and attainable path towards end of project goals;
- Sufficiency and quality of technical detail to assess the scientific merit of the proposed work, including relevant data, calculations, and discussion of prior work, with analyses that support the viability of the proposed work;
- Sufficiency of statistical power of results, including proposed statistical sample size, sample throughput, sampling strategies, design-of-experiments, and, for processes at scale, statistical process control;
- Extent to which project has buy-in from stakeholders needed to ensure success (including cost-share partners);
- Degree to which relevant manufacturing and supply chain challenges are considered, as applicable, for viable scale-up in this and future demonstrations; and
- Sufficiency of quality management procedures, including supply validation/qualification methodology, instrument qualification procedures, and product quality management.

Impact of Technology Advancement

- Ability of the project to advance technological readiness of thin-film PV for industry adoption;
- Extent to which the project supports the topic area objectives and target specifications and metrics;
- Potential impact of the project on advancing the state of the art;
- Extent to which the technology is replicable and how the proposed work may mitigate risk for future manufacturing demonstrations; and
- Extent to which the project facilitates relationships across new or existing stakeholders to gain technical buy-in and increase potential for future deployments.

Market Transformation Plan

- Identification of target market, competitors (including c-Si companies and solutions), and distribution channels for proposed technology, along with known or perceived barriers to market penetration (including mitigation plan); and
- Comprehensiveness of market transformation plan, including but not limited to product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations (including intellectual property), infrastructure requirements, and product distribution.

Industry Adoption Plan

- Identification of the interest and extent of industry adoption of the technology/process.

Criterion 2: Project Research and Management Plan

Weighting:

Topic Area 1	Topic Area 2
20%	20%

This criterion involves consideration of the following factors, where all sub-criteria (e.g. each bullet point) are of equal weight:

Research Approach and Workplan

- Degree to which the task descriptions are clear, detailed, timely, and reasonable, resulting in a high likelihood that the proposed workplan will succeed in meeting the project goals of the prime recipient;
- Degree to which the approach and critical path to market adoption have been clearly described and thoughtfully considered; and
- Degree to which project milestones align with paths to market adoption.

Identification of Technical Risks

- Discussion and demonstrated understanding of the key technical risk areas of the proposed work and the quality of the mitigation strategies to address them.

Baseline, Metrics, and Deliverables

- Clarity of the baseline, metrics, and milestones;
- Sufficient quality data is provided to assess the current state of development of the applicant team; and
- Strength of the quantifiable metrics, milestones, and mid-point deliverables relative to a clearly defined project baseline that demonstrate meaningful interim progress will be made.

Project Management

- Description of proposed project management systems, including the ability to track tasks, task owners, scope, cost, schedule progress, and changes;
- Summary of the risk assessment methodologies to be applied to this proposed work;
- Reasonableness of budget and spend plan as detailed in the budget justification workbook for proposed project and objectives;
- Adequacy of contingency planning based on quality of cost estimate and identified risks;
- Adequacy, reasonableness, and soundness of the project schedule, as well as periodic Go/No-Go decisions prior to further funds disbursement, interim milestones, and metrics to track process; and
- Adequacy of the identification of risks, including supply chain-induced delays and personnel risks, and timely and appropriate strategies for mitigation and resolution.

Criterion 3: Team and Resources

Weighting:

Topic Area 1	Topic Area 2
20%	30%

This criterion involves consideration of the following factors, where all sub-criteria (e.g. each bullet point) are of equal weight:

Team Capabilities and Commitment

- Qualifications, relevant expertise, and time commitment of the principal investigator(s) and team to successfully address all aspects of the proposed work;
- Diversity of expertise and perspectives of the team and the inclusion of partners that will amplify impact;

- Degree to which the proposed team demonstrates the ability to facilitate and expedite further demonstration, development, and commercial deployment of the proposed technologies; and
- Level of participation by project participants as evidenced by letter(s) of commitment and integration into the workplan.

Resource Availability and Budget

- Sufficiency of the facilities to support the work, particularly the fabrication capabilities of the prime applicant;
- Clear planning as it relates to equipment readiness and adequacy to meet the project deliverables and timelines; and
- Reasonableness of the budget and spend plan for the proposed project and objectives

Criterion 4: Community Benefits Plan

Weighting:

Topic Area 1	Topic Area 2
15%	15%

This criterion involves consideration of the following factors:

Diversity, Equity, Inclusion and Accessibility (DEIA)

- Clear articulation of the project’s goals related to diversity, equity, inclusion, and accessibility;
- Quality of the project’s DEIA goals, as measured by the goals’ depth, breadth, likelihood of success, inclusion of appropriate and relevant SMART milestones, and overall project integration;
- Degree of commitment and ability to track progress toward meeting each of the DEIA goals; and
- Extent of engagement of organizations that represent disadvantaged communities as a core element of their mission, including Minority Serving Institutions (MSIs), Minority Business Entities, and nonprofit or community-based organizations.

Energy Equity

- Clear workplan tasks, staffing, research, and timeline for engaging energy equity stakeholders and/or evaluating the possible near and long-term implications of the project for the benefit of the American public, including, but not limited to public health and public prosperity benefits;
- Approach, methodology, and expertise articulated in the plan for addressing energy equity and justice issues associated with the technology innovation;

and

- Likelihood that the plan will result in improved understanding of distributional public benefits and costs related to the innovation if successful.

Workforce Implications

- Clear and comprehensive workplan tasks, staffing, research, and timeline for engaging workforce stakeholders and/or evaluating the possible near- and long-term implications of the project for the U.S. workforce;
- Approach to document the knowledge, skills, and abilities of the workforce required for successful commercial deployment of innovations resulting from this research; and
- Likelihood that the plan will result in improved understanding of the workforce implications related to the innovation if successful.

B. Standards for Application Evaluation

Applications that are determined to be eligible will be evaluated in accordance with this FOA, by the standards set forth in EERE's Notice of Objective Merit Review Procedure (76 Fed. Reg. 17846, March 31, 2011) and the guidance provided in the "DOE Merit Review Guide for Financial Assistance," effective September 2020, which is available at: <https://energy.gov/management/downloads/merit-review-guide-financial-assistance-and-unsolicited-proposals-current>.

C. Evaluation and Selection Process

i. Overview

The evaluation process consists of multiple phases; each includes an initial eligibility review and a thorough technical review. Rigorous technical reviews of eligible submissions are conducted by reviewers that are experts in the subject matter of the FOA. Ultimately, the Selection Official considers the recommendations of the reviewers, along with other considerations such as program policy factors, in determining which applications to select.

ii. Pre-Selection Interviews

As part of the evaluation and selection process, EERE may invite one or more applicants to participate in pre-selection interviews. Pre-selection interviews are distinct from and more formal than pre-selection clarifications (See Section V.C.iii. of the FOA). The invited applicant(s) will meet with EERE representatives to provide clarification on the contents of the Full Applications and to provide EERE an opportunity to ask questions regarding the proposed project. The information provided by applicants to EERE through pre-selection interviews contributes to EERE's selection decisions.

EERE will arrange to meet with the invited applicants in person at EERE's offices or a mutually agreed upon location. EERE may also arrange site visits at certain applicants' facilities. In the alternative, EERE may invite certain applicants to participate in a one-on-one conference with EERE via webinar, videoconference, or conference call.

EERE will not reimburse applicants for travel and other expenses relating to the pre-selection interviews, nor will these costs be eligible for reimbursement as pre-award costs.

Participation in pre-selection interviews with EERE does not signify that applicants have been selected for award negotiations.

Expected dates for pre-selection interviews are provided on the cover page of this FOA.

iii. Pre-Selection Clarification

EERE may determine that pre-selection clarifications are necessary from one or more applicants. Pre-selection clarifications are distinct from and less formal than pre-selection interviews. These pre-selection clarifications will solely be for the purposes of clarifying the application. The pre-selection clarifications may occur before, during or after the merit review evaluation process. Information provided by an applicant that is not necessary to address the pre-selection clarification question will not be reviewed or considered. Typically, a pre-selection clarification will be carried out through either written responses to EERE's written clarification questions or video or conference calls with EERE representatives.

The information provided by applicants to EERE through pre-selection clarifications is incorporated in their applications and contributes to the merit review evaluation and EERE's selection decisions. If EERE contacts an applicant for pre-selection clarification purposes, it does not signify that the applicant has been selected for negotiation of award or that the applicant is among the top ranked applications.

EERE will not reimburse applicants for expenses relating to the pre-selection clarifications, nor will these costs be eligible for reimbursement as pre-award costs.

iv. Recipient Responsibility and Qualifications

DOE, prior to making a federal award with a total amount of federal share greater than the simplified acquisition threshold, is required to review and

consider any responsibility and qualification information about the applicant that is in the entity information domain in [SAM.gov](https://sam.gov) (see 41 U.S.C. § 2313).

The applicant, at its option, may review information in the entity information domain in [SAM.gov](https://sam.gov) and comment on any information about itself that a federal awarding agency previously entered and is currently in the entity information domain in [SAM.gov](https://sam.gov).

DOE will consider any written comments by the applicant, in addition to the other information in the entity information domain in [SAM.gov](https://sam.gov), in making a judgment about the applicant's integrity, business ethics, and record of performance under federal awards when completing the review of risk posed by applicants as described in 2 CFR 200.206.

v. Selection

The Selection Official may consider the technical merit, the Federal Consensus Board's recommendations, program policy factors, and the amount of funds available in arriving at selections for this FOA.

D. Other Selection Factors

i. Program Policy Factors

In addition to the above criteria, the selection official may consider the following program policy factors in determining which full applications to select for award negotiations:

- Degree to which the proposed project exhibits technological diversity when compared to the existing DOE project portfolio and other projects selected from this FOA
- Degree to which the proposed project, including proposed cost share, optimizes the use of available EERE funding to achieve programmatic objectives
- Level of industry involvement and demonstrated ability to accelerate demonstration and commercialization and to overcome key market barriers
- Degree to which the proposed project is likely to lead to increased high-quality employment and manufacturing in the United States
- Degree to which the proposed project will accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty
- Degree to which the proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications)
- Degree to which the proposed project incorporates applicant or team members from Minority Serving Institutions (e.g., Historically Black Colleges

and Universities (HBCUs)/Other Minority Institutions (OMIs)), Minority Business Enterprises, minority-owned businesses, woman-owned businesses, veteran-owned businesses, or Indian tribes

- Degree to which the proposed project, when compared to the existing DOE project portfolio and other projects to be selected from the subject FOA, contributes to the total portfolio meeting the goals reflected in the Community Benefits Plan criteria
- Degree to which the proposed project will employ procurement of U.S. iron, steel, manufactured products, and construction materials
- Degree to which the proposed project contributes to the diversity of organizations and organization types and sizes selected from this FOA when compared to the existing DOE project portfolio
- The degree to which the proposed project avoids duplication/overlap with other publicly or privately funded work.
- Degree to which the proposed project supports complementary efforts or projects, which, when taken together, will best achieve DOE research goals
- Degree to which the proposed project enables new and expanding market segments
- Degree to which the project's solution or strategy will maximize deployment or replication

E. Anticipated Notice of Selection and Award Negotiation Dates

EERE anticipates notifying applicants selected for negotiation of award and negotiating awards by the dates provided on the cover page of this FOA.

VI. Award Administration Information

A. Award Notices

i. Ineligible Submissions

Ineligible Concept Papers and Full Applications will not be further reviewed or considered for award. The Contracting Officer will send a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE eXCHANGE. The notification letter will state the basis upon which the Concept Paper or the Full Application is ineligible and not considered for further review.

ii. Concept Paper Notifications

EERE will notify applicants of its determination to encourage or discourage the submission of a Full Application. EERE will post these notifications to EERE eXCHANGE. EERE may include general comments provided from reviewers on an applicant's Concept Paper in the encourage/discourage notifications. EERE

anticipates notifying applicants of these encourage or discourage decisions by the dates provided on the cover page of this FOA.

Applicants may submit a Full Application even if they receive a notification discouraging them from doing so. By discouraging the submission of a Full Application, EERE 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. The purpose of the Concept Paper phase is to save applicants the considerable time and expense of preparing a Full Application that is unlikely to be selected for award negotiations.

iii. Full Application Notifications

EERE will notify applicants of its determination via a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE eXCHANGE. The notification letter will inform the applicant whether or not its Full Application was selected for award negotiations. Alternatively, EERE 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 or other factors.

iv. Applicants Selected for Award Negotiations

Successful applicants will receive written notification that they have been selected for award negotiations. Receipt of a notification letter selecting a Full Application for award negotiations does not authorize the applicant to commence performance of the project. If an application is selected for award negotiations, it is not a commitment by EERE to issue an award nor is it a guarantee of federal government funding. Applicants do not receive an award unless and until award negotiations are complete and the Contracting Officer executes the funding agreement, accessible by the prime recipient in FedConnect.

The award negotiation process takes approximately 60 days. Applicants must designate a primary and a backup point-of-contact in EERE eXCHANGE with whom EERE will communicate to conduct award negotiations. The applicant must be responsive during award negotiations (i.e., provide requested documentation) and meet the negotiation deadlines. If the applicant fails to do so or if award negotiations are otherwise unsuccessful, EERE will cancel the award negotiations and rescind the selection. EERE reserves the right to terminate award negotiations at any time for any reason.

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

v. Alternate Selection Determinations

In some instances, an applicant may receive a notification that its application was not selected for award and EERE designated the application to be an alternate, which means EERE may consider the Full Application for federal funding in the future. A notification letter stating the Full Application is designated as an alternate does not authorize the applicant to commence performance of the project. EERE may ultimately determine to select or not select the Full Application for award negotiations.

vi. Unsuccessful Applicants

EERE shall promptly notify in writing each applicant whose application has not been selected for award or whose application cannot be funded because of the unavailability of appropriated funds.

B. Administrative and National Policy Requirements**i. Registration Requirements**

There are several required one-time actions applicants must take before applying to this FOA. Some of these actions may take several weeks, so it is vital applicants build in enough time to complete them. Failure to complete these actions could interfere with application or negotiation deadlines or the ability to receive an award if selected. These requirements are as follows:

1) EERE Funding Opportunity Exchange (eXCHANGE)

Register and create an account on EERE eXCHANGE at <https://eere-eXCHANGE.energy.gov>. This account will allow the user to apply to any open EERE FOAs in EERE eXCHANGE.

To access [EERE eXCHANGE](#), potential applicants must have a [Login.gov](#) account. As part of the eXCHANGE registration process, new users will be directed to create an account in Login.gov. Please note that the email address associated with Login.gov must match the email address associated with the eXCHANGE account. For more information, refer to the eXCHANGE Multi-Factor Authentication (MFA) Quick Guide in the [Manuals section](#) of eXCHANGE.

Each organization or business unit, whether acting as a team or a single entity, should use only one account as the contact point for each submission. Applicants must also designate backup points of contact. **This step is required to apply to this FOA.** The eXCHANGE registration does not have a delay; however, **the remaining registration requirements below could take several weeks to process and are necessary for a potential applicant to receive an award under this FOA.**

2) System for Award Management

Register in SAM (<https://www.sam.gov>). Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called a Marketing Partner ID Number (MPIN) are important steps in SAM registration. Please update your SAM registration annually.

3) FedConnect

Register in FedConnect (<https://www.fedconnect.net>). To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.

4) Grants.gov

Register in Grants.gov (<http://www.grants.gov>) to receive automatic updates when Amendments to this FOA are posted. Please note that Letters of Intent, Concept Papers, and Full Applications will not be accepted through Grants.gov.

5) Electronic Authorization of Applications and Award Documents

Submission of an application and supplemental information under this FOA through electronic systems used by the DOE, including EERE eXCHANGE and FedConnect, constitutes the authorized representative's approval and electronic signature.

ii. Award Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR Part 200 as amended by 2 CFR Part 910.

iii. Foreign National Participation

All applicants selected for an award under this FOA and project participants (including subrecipients and contractors) who anticipate involving foreign nationals in the performance of an award, may be required to provide DOE with specific information about each foreign national to satisfy requirements for foreign national participation. A "foreign national" is defined as any person who is not a United States citizen by birth or naturalization. The volume and type of information collected may depend on various factors associated with the award.

DOE concurrence may be required before a foreign national can participate in the performance of any work under an award.

DOE may elect to deny a foreign national's participation in the award. Likewise, DOE may elect to deny a foreign national's access to a DOE site, information, technologies, equipment, programs, or personnel.

iv. Subaward and Executive Reporting

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR Part 170. Prime recipients must register with the new FFATA Subaward Reporting System database and report the required data on their first tier subrecipients. Prime recipients must report the executive compensation for their own executives as part of their registration profile in SAM.

v. National Policy Requirements

The National Policy Assurances that are incorporated as a term and condition of award are located at: <http://www.nsf.gov/awards/managing/rtc.jsp>.

vi. Environmental Review in Accordance with National Environmental Policy Act (NEPA)

EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA (42 U.S.C. § 4321, *et seq.*). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at <https://www.energy.gov/nepa>.

While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all recipients selected for an award will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their proposed project. If DOE determines certain records must be prepared to complete the NEPA review process (e.g., biological evaluations or environmental assessments), the recipient may be required to prepare the records and the costs to prepare the necessary records may be included as part of the project costs.

vii. Flood Resilience

Applications should indicate whether the proposed project location(s) is within a floodplain, how the floodplain was defined, and how flooding will factor into the project's design. The base floodplain long used for planning has been the 100-year floodplain, which has a 1% chance of flooding in any given year. As directed

by Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input (2015), federal agencies, including DOE, must continue to avoid development in a floodplain to the extent possible. When doing so is not possible, federal agencies are directed to “expand management from the current base flood level to a higher vertical elevation and corresponding horizontal floodplain to address current and future flood risk and ensure that projects funded with taxpayer dollars last as long as intended.” The higher flood elevation is based on one of three approaches: climate-informed science (preferred), freeboard value, or 0.2% annual flood change (500-year floodplain). EO 13690 and related information is available at: <https://www.energy.gov/nepa/articles/eo-13690-establishing-federal-flood-risk-management-standard-and-process-further>.

viii. Applicant Representations and Certifications

1) Lobbying Restrictions

By accepting funds under this award, the prime recipient agrees that none of the funds obligated on the award shall be expended, directly or indirectly, to influence Congressional action on any legislation 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.

2) Corporate Felony Conviction and Federal Tax Liability Representations

In submitting an application to this FOA, the applicant represents that:

- a.** It is **not** a corporation that has been convicted of a felony criminal violation under any federal law within the preceding 24 months; and
- b.** 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, a corporation is any for-profit or nonprofit 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].

3) Nondisclosure and Confidentiality Agreements Representations

In submitting an application to this FOA the applicant represents that:

-
- a. 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.
- b. 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:

“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.”

- (1) The limitation above shall not contravene requirements applicable to Standard Form 312 Classified Information Nondisclosure Agreement (<https://fas.org/sgp/othergov/sf312.pdf>), Form 4414 Sensitive Compartmented Information Disclosure Agreement (<https://fas.org/sgp/othergov/intel/sf4414.pdf>), or any other form issued by a federal department or agency governing the nondisclosure of classified information.
- (2) Notwithstanding the provision listed in paragraph (a), a nondisclosure or 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 U.S. government, may contain provisions appropriate to the 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 during such activity unless specifically authorized to do so by the U.S. government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the U.S. Department of Justice, that are essential to reporting a substantial violation of law.

ix. Statement of Federal Stewardship

EERE will exercise normal federal stewardship in overseeing the project activities performed under EERE awards. Stewardship activities include, but are not limited to, conducting site visits; reviewing performance and financial reports; providing assistance and/or temporary intervention in unusual circumstances to correct deficiencies that develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the project objectives have been accomplished.

x. Statement of Substantial Involvement

EERE has substantial involvement in work performed under awards made as a result of this FOA. EERE does not limit its involvement to the administrative requirements of the award. Instead, EERE has substantial involvement in the direction and redirection of the technical aspects of the project. Substantial involvement includes, but is not limited to, the following:

1. EERE shares responsibility with the recipient for the management, control, direction, and performance of the project.
2. EERE may intervene in the conduct or performance of work under this award for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities.
3. EERE may redirect or discontinue funding the project based on the outcome of EERE's evaluation of the project at the Go/No-Go decision point(s).
4. EERE participates in major project decision-making processes.

xi. Intellectual Property Management Plan (IPMP)

EERE may require an executed IPMP between team members during award negotiations or as a milestone requirement during the award.

The award will set forth the treatment of and obligations related to intellectual property rights between EERE and the individual members. The IPMP should describe how the members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies (see Sections VIII.K.-VIII.N. of this FOA for more details on applicable federal intellectual property laws and regulations). Guidance regarding the contents of IPMP is available from EERE upon request.

The following is a list of examples of items the IPMP may cover:

- The treatment of confidential information between members (e.g., the use of NDAs);

- The treatment of background intellectual property (e.g., any requirements for identifying it or making it available);
- The treatment of inventions made under the award (e.g., any requirements for disclosing to the other members on an application, filing patent applications, paying for patent prosecution, and cross-licensing or other licensing arrangements between the members);
- The treatment of data produced, including software, under the award (e.g., any publication process or other dissemination strategies, copyrighting strategy or arrangement between members);
- Any technology transfer and commercialization requirements or arrangements between the members;
- The treatment of any intellectual property issues that may arise due to a change in membership of the consortia or team; and
- The handling of disputes related to intellectual property between the members.

xii. Subject Invention Utilization Reporting

To ensure that appropriate steps to commercialize subject inventions (*i.e.*, inventions made under DOE awards) are being taken, DOE requires that each prime recipient, subrecipient and contractor holding title to a subject invention submit annual reports for 10 years from the date the subject invention was disclosed to EERE on the utilization of the subject invention and efforts to stimulate such utilization. The reports must include information regarding the status of development, date of first commercial sale or use, gross royalties received by the prime recipient, the subrecipient or contractor and such other data and information as EERE may specify.

xiii. Intellectual Property Provisions

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at <http://energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards>.

xiv. Reporting

Reporting requirements are identified on the Federal Assistance Reporting Checklist, attached to the award agreement.

xv. Go/No-Go Review

Each project selected under this FOA will be subject to a periodic project evaluation referred to as a Go/No-Go Review. A Go/No-Go Review is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success in future phases or periods of performance is evaluated, prior to beginning the execution of future phases. At the Go/No-Go

decision points, DOE will evaluate project performance, project schedule adherence, the extent milestone objectives are met, compliance with reporting requirements, and overall contribution to the program goals and objectives. Federal funding beyond the Go/No-Go decision point (continuation funding) is contingent upon (1) availability of federal funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority; (3) recipient's technical progress compared to the Milestone Summary Table stated in Attachment 1 of the award; (4) recipient's submittal of required reports; (5) recipient's compliance with the terms and conditions of the award; (6) DOE's Go/No-Go decision; (7) the recipient's submission of a continuation application;⁷⁵ and (8) written approval of the continuation application by the Contracting Officer.

As a result of the Go/No-Go Review, DOE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) recommend redirection of work under the project; (3) place a hold on federal funding for the project, pending further supporting data or funding; or (4) discontinue funding the project because of insufficient progress, change in strategic direction, or lack of funding.

The Go/No-Go decision is distinct from a non-compliance determination. In the event a recipient fails to comply with the requirements of an award, DOE may take appropriate action, including but not limited to, redirecting, suspending or terminating the award.

xvi. Conference Spending

The recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the U.S. government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the U.S. government would otherwise

⁷⁵ A continuation application is a non-competitive application for an additional budget period within a previously approved project period. At least ninety (90) days before the end of each budget period, the recipient must submit its continuation application, which includes the following information:

- i. A progress report on the project objectives, including significant findings, conclusions, or developments, and an estimate of any unobligated balances remaining at the end of the budget period. If the remaining unobligated balance is estimated to exceed 20 percent of the funds available for the budget period, explain why the excess funds have not been obligated and how they will be used in the next budget period.
- ii. A detailed budget and supporting justification if there are changes to the negotiated budget, or a budget for the upcoming budget period was not approved at the time of award.
- iii. A description of any planned changes from the SOPO and/or Milestone Summary Table.

exceed \$20,000, thereby circumventing 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 conference.

xvii. Uniform Commercial Code (UCC) Financing Statements

Per 2 CFR 910.360 (Real Property and Equipment) when a piece of equipment is purchased by a for-profit recipient or subrecipient with federal funds, and when the federal share of the financial assistance agreement is more than \$1 million, the recipient or subrecipient must:

Properly record, and consent to the Department's ability to properly record if the recipient fails to do so, UCC financing statement(s) for all equipment in excess of \$5,000 purchased with project funds. These financing statement(s) must be approved in writing by the Contracting Officer prior to the recording, and they shall provide notice that the recipient's title to all equipment (not real property) purchased with federal funds under the financial assistance agreement is conditional pursuant to the terms of this section, and that the government retains an undivided reversionary interest in the equipment. The UCC financing statement(s) must be filed before the Contracting Officer may reimburse the recipient for the federal share of the equipment unless otherwise provided for in the relevant financial assistance agreement. The recipient shall further make any amendments to the financing statements or additional recordings, including appropriate continuation statements, as necessary or as the Contracting Officer may direct.

xviii. Real Property and Equipment

Real property and equipment purchased with project funds (federal share and recipient cost share) are subject to the requirements at 2 CFR 200.310, 200.311, 200.313, and 200.316 (non-federal entities, except for-profit entities) and 2 CFR 910.360 (for-profit entities).

For projects selected for awards under this FOA, the recipients may (1) take disposition action on the real property and equipment; or (2) continue to use the real property and equipment after the conclusion of the award period of performance with Contracting Officer approval. The recipient's written request for Continued Use must identify the property and include: a summary of how the property will be used (must align with the authorized project purposes); a proposed use period, (e.g., perpetuity, until fully depreciated, or a calendar date when the recipient expects to submit disposition instructions); acknowledgement that the recipient shall not sell or encumber the property or permit any encumbrance without prior written DOE approval; current fair

market value of the property; and an estimated useful life or depreciation schedule for equipment.

When the property is no longer needed for authorized project purposes, the recipient must request disposition instructions from DOE. For-profit entity disposition requirements are set forth in 2 CFR 910.360. Property disposition requirements for other non-federal entities are set forth in 2 CFR 200.310 – 200.316.

xix. Implementation of Executive Order 13798, Promoting Free Speech and Religious Liberty

States, local governments, and other public entities may not condition subawards in a manner that would discriminate against or otherwise disadvantage subrecipients based on their religious character.

xx. Participants and Collaborating Organizations

If selected for award negotiations, the selected applicant must submit a list of personnel who are proposed to work on the project, both at the recipient and subrecipient level and a list of proposed collaborating organizations prior to award. Recipients will have an ongoing responsibility to notify DOE of changes to the personnel and collaborating organizations, and submit updated information during the life of the award.

xxi. Current and Pending Support

If selected for award negotiations, within 30 days of the selection notice, the selectee must submit: 1) current and pending support disclosures and resumes for any new PIs or senior/key personnel, and 2) updated disclosures if there have been any changes to the current and pending support submitted with the application. Throughout the life of the award, the recipient has an ongoing responsibility to submit: 1) current and pending support disclosure statements and resumes for any new PI and senior/key personnel, and 2) updated disclosures if there are changes to the current and pending support previously submitted to DOE. Also see Section IV.D.xiv.

xxii. U.S. Manufacturing Commitments

A primary objective of DOE's multi-billion-dollar research, development, and demonstration investments is to cultivate new research and development ecosystems, manufacturing capabilities, and supply chains for and by United States industry and labor. Therefore, in exchange for receiving taxpayer dollars to support an applicant's project, the applicant and its team members must agree to a U.S. Competitiveness provision requiring 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 it can be

shown to the satisfaction of DOE that it is not commercially feasible. Award terms, including the specific U.S. Competitiveness Provision applicable to the various types of recipients and projects, are available at:

<https://www.energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards>.

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

As noted in the U.S. Competitiveness Provision, if 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 United States manufacturing plan. The statement or plan would contain specific and enforceable commitments that would be beneficial to the United States economy and competitiveness. Examples of such commitments could include manufacturing specific products in the United States, making a specific investment in a new or existing United States manufacturing facility, keeping certain activities based in the United States or supporting a certain number of jobs in the United States related to the technology. DOE may, in its sole discretion, determine that the proposed modification or waiver promotes commercialization and provides substantial United States economic benefits, and grant the request. If granted, DOE will modify the award terms and conditions for the requesting entity accordingly.

More information and guidance on the waiver and modification request process can be found in the DOE Financial Assistance Letter on this topic, available at <https://www.energy.gov/management/pf-2022-09-fal-2022-01-implementation-doe-determination-exceptional-circumstances-under>. Additional information on DOE's Commitment to Domestic Manufacturing for DOE-funded R&D is available at <https://www.energy.gov/gc/us-manufacturing>.

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.J. Title to Subject Inventions of this FOA for more information on the DEC and DOE Patent Waivers.

xxiii. Interim Conflict of Interest Policy for Financial Assistance

The DOE interim Conflict of Interest Policy for Financial Assistance (COI Policy)⁷⁶ is applicable to all non-Federal entities applying for, or that receive, DOE funding by means of a financial assistance award (e.g., a grant, cooperative agreement, or technology investment agreement) and, through the implementation of this policy by the entity, to each Investigator who is planning to participate in, or is participating in, the project funded wholly or in part under the DOE financial assistance award. The term “Investigator” means the PI and any other person, regardless of title or position, who is responsible for the purpose, design, conduct, or reporting of a project funded by DOE or proposed for funding by DOE. Recipients must flow down the requirements of the interim COI Policy to any subrecipient non-federal entities. Further, for DOE funded projects, the recipient must include all financial conflicts of interest (FCOI) (i.e., managed and unmanaged/ unmanageable) in its initial and ongoing FCOI reports.

It is understood that non-federal entities and individuals receiving DOE financial assistance awards will need sufficient time to come into full compliance with DOE’s interim COI Policy. To provide some flexibility, DOE allows for a staggered implementation. Specifically, prior to award, applicants selected for award negotiations must: ensure all Investigators complete their significant financial disclosures; review the disclosures; determine whether a FCOI exists; develop and implement a management plan for FCOIs; and provide DOE with an initial FCOI report that includes all FCOIs (i.e., managed and unmanaged/ unmanageable). Recipients will have 180 days from the date of the award to come into full compliance with the other requirements set forth in DOE’s interim COI Policy. Prior to award, the applicant must certify that it is, or will be within 180 days of the award, compliant with all requirements in the COI Policy.

xxiv. Data Management Plan

Each applicant whose Full Application is selected for award negotiations will be required to submit a Data Management Plan (DMP) during the award negotiations phase. A DMP explains how, when appropriate, data generated in the course of the work performed under an EERE award will be shared and preserved to validate the results of the proposed work or how the results could be validated if the data is not shared or preserved. The DMP must provide a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publications.

xxv. Fraud, Waste, and Abuse

The mission of the DOE Office of Inspector General (OIG) is to strengthen the integrity, economy, and efficiency of the Department’s programs and operations

⁷⁶ DOE’s interim COI Policy can be found at [PF 2022-17 FAL 2022-02 Department of Energy Interim Conflict of Interest Policy Requirements for Financial Assistance](#).

including deterring and detecting fraud, waste, abuse, and mismanagement. The OIG accomplishes this mission primarily through investigations, audits, and inspections of DOE activities to include grants, cooperative agreements, loans, and contracts.

The OIG maintains a hotline for reporting allegations of fraud, waste, abuse, or mismanagement. To report such allegations, please visit <https://www.energy.gov/ig/ig-hotline>.

Additionally, recipients of DOE awards must be cognizant of the requirements of [2 CFR 200.113 Mandatory disclosures](#), which states:

The non-Federal entity or applicant for a Federal award must disclose, in a timely manner, in writing to the Federal awarding agency or pass-through entity all violations of Federal criminal law involving fraud, bribery, or gratuity violations potentially affecting the Federal award. Non-Federal entities that have received a Federal award including the term and condition outlined in appendix XII of 2 CFR Part 200 are required to report certain civil, criminal, or administrative proceedings to SAM.gov. Failure to make required disclosures can result in any of the remedies described in [2 CFR 200.339](#). (See also [2 CFR part 180](#), [31 U.S.C. § 3321](#), and [41 U.S.C. § 2313](#).) [[85 FR 49539](#), Aug. 13, 2020]

Applicants and subrecipients (if applicable) are encouraged to allocate sufficient costs in the project budget to cover the costs associated for personnel and data infrastructure needs to support performance management and program evaluation needs, including but not limited to independent program and project audits to mitigate risks for fraud, waste, and abuse.

xxvi. Human Subjects Research

Research involving human subjects, biospecimens, or identifiable private information conducted with DOE funding is subject to the requirements of DOE Order 443.1C, Protection of Human Research Subjects, 45 CFR Part 46, Protection of Human Subjects (subpart A which is referred to as the “Common Rule”), and 10 CFR Part 745, Protection of Human Subjects. Additional information on the DOE Human Subjects Research Program can be found at: [HUMAN SUBJECTS Human Subjects Pr... | U.S. DOE Office of Science \(SC\) \(osti.gov\)](#).

VII. Questions/Agency Contacts

Upon the issuance of a FOA, EERE personnel are prohibited from communicating (in writing or otherwise) with applicants regarding the FOA except through the established question and answer process described below. Questions regarding this FOA must be submitted to thinfilmFOA@ee.doe.gov no later than three (3) business days prior to the application due date and time. Please note, feedback on individual concepts will not be provided through Q&A.

All questions and answers related to this FOA will be posted on EERE eXCHANGE at: <https://eere-eXCHANGE.energy.gov>. **You must first select the FOA Number to view the questions and answers specific to this FOA.** EERE will attempt to respond to a question within three (3) business days, unless a similar question and answer has already been posted on the website.

Questions related to the registration process and use of the EERE eXCHANGE website should be submitted to EERE-eXCHANGESupport@hq.doe.gov.

VIII. Other Information

A. FOA Modifications

Amendments to this FOA will be posted on EERE eXCHANGE and the Grants.gov system. However, you will only receive an email when an amendment or a FOA is posted on these sites if you register for email notifications for this FOA in Grants.gov. EERE recommends that you register as soon after the release of the FOA as possible to ensure you receive timely notice of any amendments or other FOAs.

B. Government Right to Reject or Negotiate

EERE reserves the right, without qualification, to reject any or all applications received in response to this FOA and to select any application, in whole or in part, as a basis for negotiation and/or award.

C. Commitment of Public Funds

The Contracting Officer is the only individual who can make awards or commit the government to the expenditure of public funds. A commitment by anyone other than the Contracting Officer, either express or implied, is invalid.

D. Treatment of Application Information

Applicants should not include trade secrets or business-sensitive, proprietary, or otherwise confidential information in their application unless such information is necessary to convey an understanding of the proposed project or to comply with a

requirement in the FOA. Applicants are advised to not include any critically sensitive proprietary detail.

If an application includes trade secrets or business-sensitive, proprietary, or otherwise confidential information, it is furnished to the federal government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, EERE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for merit review of the application or as otherwise authorized by law. This restriction does not limit the federal government's right to use the information if it is obtained from another source.

If an applicant chooses to submit trade secrets or business-sensitive, proprietary, or otherwise confidential information, the applicant must provide **two copies** of the submission (e.g., Concept Paper, Full Application). The first copy should be marked "non-confidential," with the information believed to be confidential deleted. The second copy should be marked "confidential" and must clearly and conspicuously identify the trade secrets or business-sensitive, proprietary, or otherwise confidential information and must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The federal government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose as authorized by law.

The cover sheet of the Full Application, and other applicant submission must be marked as follows and identify the specific pages containing trade secrets or business-sensitive, proprietary, or otherwise confidential information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets or business-sensitive, proprietary, or otherwise confidential 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 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. [End of Notice]

In addition, (1) the header and footer of every page that contains trade secrets or business-sensitive, proprietary, or otherwise confidential information must be marked as follows: "Contains Trade Secrets or Business-Sensitive, Proprietary, or Otherwise Confidential Information Exempt from Public Disclosure," and (2) every line or

paragraph containing such information must be clearly marked with double brackets or highlighting. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

E. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation, the Go/No-Go Reviews and Peer Reviews, the government may seek the advice of qualified non-federal personnel as reviewers. The government may also use non-federal personnel to conduct routine, nondiscretionary administrative activities, including EERE contractors. The applicant, by submitting its application, consents to the use of non-federal reviewers/administrators. Non-federal reviewers must sign conflict of interest (COI) and non-disclosure acknowledgements (NDA) prior to reviewing an application. Non-federal personnel conducting administrative activities must sign an NDA.

F. Notice Regarding Eligible/Ineligible Activities

Eligible activities under this FOA include those that describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

G. Notice of Right to Conduct a Review of Financial Capability

EERE reserves the right to conduct an independent third-party review of financial capability for applicants that are selected for negotiation of award (including personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

H. Requirement for Full and Complete Disclosure

Applicants are required to make a full and complete disclosure of all information requested. Any failure to make a full and complete disclosure of the requested information may result in:

- The cancellation of award negotiations;
- The modification, suspension, and/or cancellation 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.

I. Retention of Submissions

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

J. 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 inventions unless a waiver is granted (see below);
- Class Patent Waiver: DOE has issued a class waiver that applies to this FOA. Under this class 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. To avail itself of the class waiver, a domestic large business must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States.
- Advance and Identified Waivers: Applicants not covered by a Class Patent Waiver or the Bayh-Dole Act may request a patent waiver that will cover subject inventions that may be invented 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 EERE within the timeframes set forth in the award's intellectual property data 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 subawards and contracts, under this FOA shall include the U.S. Competitiveness Provision in accordance with the U.S. Manufacturing Commitments provision of this FOA. A copy of the DEC can be found at <https://www.energy.gov/gc/determination-exceptional-circumstances-decs>. Pursuant to 37 CFR 401.4, any nonprofit organization or small business firm as defined by 35 U.S.C. § 201 affected by any 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.
- DOE may issue and publish further DEC's on the website above prior to the issuance of awards under this FOA. DOE may require additional submissions or requirements as authorized by any applicable DEC.

K. Government Rights in Subject Inventions

Where prime recipients, subrecipients and contractors retain title to subject inventions, the U.S. government retains certain rights.

1) Government Use License

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

2) March-In Rights

The U.S. government retains march-in rights with respect to all subject inventions. Through “march-in rights,” the government may require a prime recipient or subrecipient who has elected to retain title to a subject invention (or their assignees or exclusive licensees), to grant a license for use of the invention to a third party. In addition, the government may grant licenses for use of the subject invention when a prime recipient, subrecipient, contractor or their assignees and exclusive licensees refuse to do so.

DOE may exercise its march-in rights only 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 satisfied manner;
- The owner has not met public use requirements specified by federal statutes in a reasonably satisfied manner; or
- The United States manufacturing requirement has not been met.

Any determination that march-in rights are warranted must follow a fact-finding process in which the recipient has certain rights to present evidence and witnesses, confront witnesses and appear with counsel and appeal any adverse decision. To date, DOE has never exercised its march-in rights to any subject inventions.

L. 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.

“Limited Rights Data”: The U.S. government will not normally require delivery of confidential or trade secret-type 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.

Government Rights in Technical Data Produced Under Awards: The U.S. government normally retains unlimited 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 EERE awards may be protected from public disclosure for up to five years after the data is generated (“Protected Data”). For awards permitting Protected Data, the protected data must be marked as set forth in the award’s intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

For this FOA, selectees and recipients may request an extended period of protection (more than 5 years and not to exceed 30 years) if reasonably required for commercialization for specific categories of data for all Topics first produced under the resulting awards in accordance with 15 U.S.C. § 3710a(c)(7)(B)(ii) and the Energy Policy Acts of 1992 and 2005, or 42 U.S.C. § 7256(g)(5) for OTAs, if applicable. Further direction will be provided during the negotiation process upon request.

M. Copyright

The prime recipient, subrecipients and contractors may assert copyright in copyrightable works, such as software, first produced under the award without EERE approval. When copyright is asserted, the government retains a paid-up nonexclusive, irrevocable worldwide license to reproduce, prepare derivative works, distribute copies to the public, and to perform publicly and display publicly the copyrighted work. This license extends to contractors and others doing work on behalf of the government.

N. Export Control

The United States government regulates the transfer of information, commodities, technology, and software considered to be strategically important to the United States to protect national security, foreign policy, and economic interests without imposing undue regulatory burdens on legitimate international trade. There is a network of federal agencies and regulations that govern exports that are collectively referred to as “Export Controls.” All recipients and subrecipients are responsible for ensuring compliance with all applicable United States Export Control laws and regulations relating to any work performed under a resulting award.

The recipient must immediately report to DOE any export control violations related to the project funded under the DOE award, at the recipient or subrecipient level, and provide the corrective action(s) to prevent future violations.

O. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment

As set forth in 2 CFR 200.216, recipients and subrecipients are prohibited from obligating or expending project funds (federal funds and recipient cost share) to procure or obtain; extend or renew a contract to procure or obtain; or enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that use *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 Section 889 of Public Law 115-232, *covered telecommunications equipment* is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

See Public Law 115-232, Section 889, 2 CFR 200.216, and 2 CFR 200.471 for additional information.

P. Personally Identifiable Information (PII)

All information provided by the applicant must to the greatest extent possible exclude PII. "PII" refers to information that can be used to distinguish or trace an individual's identity, such as their name, Social Security Number, or biometric records, alone or combined with other personal or identifying information linked or linkable to a specific individual, such as date and place of birth or mother's maiden name. (See OMB Memorandum M-17-12 dated January 3, 2017.)

By way of example, applicants must screen resumes to ensure that they do not contain PII such as personal addresses, personal landline/cell phone numbers, and personal emails. **Under no circumstances should Social Security Numbers (SSNs) be included in the application.** Federal agencies are prohibited from the collecting, using, and displaying unnecessary SSNs. (See the Federal Information Security Modernization Act of 2014 (Pub. L. No. 113-283, Dec 18, 2014; 44 U.S.C. § 3551).

Q. Annual Independent Audits

If a for-profit entity is a prime recipient and has expended \$750,000 or more of DOE awards during the entity's fiscal year, an annual compliance audit performed by an independent auditor is required. For additional information, please refer to 2 CFR 910.501 and Subpart F.

If an educational institution, nonprofit organization, or state/local government is a prime recipient or subrecipient and has expended \$750,000 or more of federal awards

during the non-federal entity's fiscal year, a Single or Program-Specific Audit is required. For additional information, please refer to 2 CFR 200.501 and Subpart F.

Applicants and subrecipients (if applicable) should propose sufficient costs in the project budget to cover the costs associated with the audit. EERE will share in the cost of the audit at its applicable cost share ratio.

R. Informational Webinar

EERE will conduct one informational webinar during the FOA process. It will be held after the initial FOA release but before the due date for Concept Papers.

Attendance is not mandatory and will not positively or negatively impact the overall review of any applicant submissions. The webinar will be open to all applicants who wish to participate. Applicants should refrain from asking questions or communicating information that would reveal confidential and/or proprietary information specific to their project. The webinar date is listed on the cover page of the FOA.

APPENDIX A – COST SHARE INFORMATION

Cost Sharing or Cost Matching

The terms “cost sharing” and “cost matching” are often used synonymously. Even the DOE Financial Assistance Regulations, 2 CFR 200.306, use both terms in the titles specific to regulations applicable to cost sharing. EERE almost always uses “cost sharing,” as it conveys the concept that non-federal share is calculated as a percentage of the Total Project Cost. An exception is the State Energy Program Regulation, 10 CFR 420.12, State Matching Contribution. Here “cost matching” for the non-federal share is calculated as a percentage of the federal funds only, rather than the Total Project Cost.

How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. FFRDC costs must be included in Total Project Costs. The following is an example of how to calculate cost sharing amounts for a project with \$1 million in federal funds with a minimum 20% non-federal cost sharing requirement:

- Formula: Federal share (\$) divided by federal share (%) = Total Project Cost
Example: \$1,000,000 divided by 80% = \$1,250,000
- Formula: Total Project Cost (\$) minus federal share (\$) = Non-federal share (\$)
Example: \$1,250,000 minus \$1,000,000 = \$250,000
- Formula: Non-federal share (\$) divided by Total Project Cost (\$) = Non-federal share (%)
Example: \$250,000 divided by \$1,250,000 = 20%

What Qualifies for Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or two sentences, in general, if a cost is allowable under the cost principles applicable to the organization incurring the cost and is eligible for reimbursement under an EERE grant or cooperative agreement, it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the federal government under another award unless authorized by federal statute to be used for cost sharing.

The rules associated with what is allowable as cost share are specific to the type of organization that is receiving funds under the grant or cooperative agreement, though they are generally the same for all types of entities. The specific rules applicable to:

- FAR Part 31 for For-Profit entities, (48 CFR Part 31); and

- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

In addition to the above regulations, other factors may come into play such as timing of donations and length of the project period. For example, the value of 10 years of donated maintenance on a project that has a project period of five years would not be fully allowable as cost share. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted as cost share.

Additionally, EERE generally does not allow pre-award costs for either cost share or reimbursement when these costs precede the signing of the appropriation bill that funds the award. In the case of a competitive award, EERE generally does not allow pre-award costs prior to the signing of the Selection Statement by the EERE Selection Official.

General Cost Sharing Rules on a DOE Award

- 1. Cash Cost Share** encompasses all contributions to the project made by the recipient or subrecipient(s) for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, or equipment for their company with organizational resources. If the cost of the item or service is reimbursed, it is cash cost share. All cost share items must be necessary to the performance of the project.
- 2. In-Kind Cost Share** encompasses all contributions to the project made by the recipient or subrecipient(s) that do not involve a payment or reimbursement and represent donated items or services. In-Kind cost share items include volunteer personnel hours, donated existing equipment, and donated existing supplies. The cash value and calculations thereof for all In-Kind cost share items must be justified and explained in the Cost Share section of the project Budget Justification. All cost share items must be necessary to the performance of the project. Consult your DOE contact if you have questions before filling out the In-Kind cost share section of the Budget Justification.
- 3. Funds from other federal sources** may **not** be counted as cost share. This prohibition includes FFRDC subrecipients. Non-federal sources include any source not originally derived from federal funds. Cost sharing commitment letters from subrecipients must be provided with the original application.
- 4. Fee or profit**, including foregone fee or profit, are not allowable as project costs (including cost share) under any resulting award. The project may incur only those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

DOE Financial Assistance Rules 2 CFR Part 200 as amended by 2 CFR Part 910

As stated above, the rules associated with what is allowable cost share are generally the same for all types of organizations. Following are the rules found to be common, but again, the specifics are contained in the regulations and cost principles specific to the type of entity:

(A) Acceptable contributions. All contributions, including cash contributions and third-party in-kind contributions, must be accepted as part of the prime recipient's cost sharing if such contributions meet all of the following criteria:

- (1)** They are verifiable from the recipient's records.
- (2)** They are not included as contributions for any other federally-assisted project or program.
- (3)** They are necessary and reasonable for the proper and efficient accomplishment of project or program objectives.
- (4)** They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:
 - a.** For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A-122 is determined in accordance with the for-profit cost principles in 48 CFR Part 31 in the FAR, except that patent prosecution costs are not allowable unless specifically authorized in the award document. (v) Commercial Organizations. FAR Subpart 31.2—Contracts with Commercial Organizations; and
 - b.** Other types of organizations. For all other non-federal entities, allowability of costs is determined in accordance with 2 CFR Part 200 Subpart E.
- (5)** They are not paid by the federal government under another award unless authorized by federal statute to be used for cost sharing or matching.
- (6)** They are provided for in the approved budget.

(B) Valuing and documenting contributions

- (1)** Valuing recipient's property or services of recipient's employees. Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize depreciation or use charges. The full value of the item may be applied when the item will be consumed in the performance of the award or fully depreciated by the end of

the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

- a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or
 - b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.
- (2)** Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.
- (3)** Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.
- (4)** Valuing property donated by third parties.
 - a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.
 - b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:
 - i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of

comparable space and facilities in a privately-owned building in the same locality.

- ii. The value of loaned equipment must not exceed its fair rental value.

(5) Documentation. The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:

- a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.
- b. The basis for determining the valuation for personal services and property must be documented.

APPENDIX B – SAMPLE COST SHARE CALCULATION FOR BLENDED COST SHARE PERCENTAGE

The following example shows the math for calculating required cost share for a project with \$2 million in federal funds, with four tasks requiring different non-federal cost share percentages:

Task	Proposed Federal Share	Federal Share %	Recipient Share %
Task 1 (R&D)	\$1,000,000	80%	20%
Task 2 (R&D)	\$500,000	80%	20%
Task 3 (Demonstration)	\$500,000	50%	50%

Federal share (\$) divided by federal share (%) = Task Cost

Each task must be calculated individually as follows:

Task 1

\$1,000,000 divided by 80% = \$1,250,000 (Task 1 Cost)
 [Task 1 Cost] minus [federal share] = non-federal share
 \$1,250,000 - \$1,000,000 = \$250,000 (non-federal share)

Task 2

\$500,000 divided 80% = \$625,000 (Task 2 Cost)
 [Task 2 Cost] minus [federal share] = non-federal share
 \$625,000 - \$500,000 = \$125,000 (non-federal share)

Task 3

\$500,000 / 50% = \$1,000,000 (Task 3 Cost)
 [Task 3 Cost] minus [federal share] = non-federal share
 \$1,000,000 - \$500,000 = \$500,000 (non-federal share)

The calculation may then be completed as follows:

Tasks	\$ Federal Share	% Federal Share	\$ Non-Federal Share	% Non-Federal Share	Total Project Cost
Task 1	\$1,000,000	80%	\$250,000	20%	\$1,250,000
Task 2	\$500,000	80%	\$125,000	20%	\$625,000
Task 3	\$500,000	50%	\$500,000	50%	\$1,000,000
Totals	\$2,000,000		\$875,000		\$2,875,000

Blended Cost Share %

Non-federal share (\$875,000) divided by Total Project Cost (\$2,875,000) = 30.4% (non-federal)
 Federal share (\$2,000,000) divided by Total Project Cost (\$2,875,000) = 69.6% (federal)

APPENDIX C – WAIVER REQUESTS FOR: 1. FOREIGN ENTITY PARTICIPATION; AND 2. FOREIGN WORK

1. Waiver for Foreign Entity Participation

Many of the technology areas DOE funds fall in the category of critical and emerging technologies (CETs). CETs are a subset of advanced technologies that are potentially significant to United States national and economic security.⁷⁷ For projects selected under this FOA, all recipients and subrecipients must be organized, chartered or incorporated (or otherwise formed) under the laws of a state or territory of the United States; have majority domestic ownership and control; and have a physical location for business operations in the United States. To request a waiver of this requirement, an applicant must submit an explicit waiver request in the Full Application.

Waiver Criteria

Foreign entities seeking to participate in a project funded under this FOA must demonstrate to the satisfaction of DOE that:

- a. Its participation is in the best interest of the United States industry and United States economic development;
- b. The project team has appropriate measures in place to control sensitive information and protect against unauthorized transfer of scientific and technical information;
- c. Adequate protocols exist between the United States subsidiary and its foreign parent organization to comply with export control laws and any obligations to protect proprietary information from the foreign parent organization;
- d. The work is conducted within the United States and the entity acknowledges and demonstrates that it has the intent and ability to comply with the United States Competitiveness Provision (see [Section VI.B.xxii.](#)); and
- e. The foreign entity will satisfy other conditions that may be deemed necessary by DOE to protect United States government interests.

Content for Waiver Request

A Foreign Entity waiver request must include the following:

- a. Information about the entity: name, point of contact, and proposed type of involvement in the project;
- b. Country of incorporation, the extent of the ownership/level control by foreign entities, whether the entity is state owned or controlled, a summary of the ownership breakdown of the foreign entity, and the percentage of

⁷⁷ See [Critical and Emerging Technologies List Update \(whitehouse.gov\)](#).

- ownership/control by foreign entities, foreign shareholders, foreign state or foreign individuals;
- c. The rationale for proposing a foreign entity participate (must address criteria above);
 - d. A description of the project's anticipated contributions to the United States economy;
 - How the project will benefit the United States, including manufacturing, contributions to employment in the United States and growth in new markets and jobs in the United States;
 - How the project will promote manufacturing of products and/or services in the United States;
 - e. A description of how the foreign entity's participation is essential to the project;
 - f. A description of the likelihood of Intellectual Property (IP) being created from the work and the treatment of any such IP; and
 - g. Countries where the work will be performed (Note: if any work is proposed to be conducted outside the United States, the applicant must also complete a separate request foreign work waiver.)

DOE may also require:

- A risk assessment with respect to IP and data protection protocols that includes the export control risk based on the data protection protocols, the technology being developed, and the foreign entity and country. These submissions could be prepared by the project lead (if not the prime recipient), but the prime recipient must make a representation to DOE as to whether it believes the data protection protocols are adequate and make a representation of the risk assessment – high, medium, or low risk of data leakage to a foreign entity.
- Additional language be added to any agreement or subagreement to protect IP, mitigate risk, or other related purposes.

DOE may require additional information before considering the waiver request.

DOE's decision concerning a waiver request is not appealable.

APPENDIX D – REQUIRED USE OF AMERICAN IRON, STEEL, MANUFACTURED PRODUCTS, AND CONSTRUCTION MATERIALS BUY AMERICA REQUIREMENTS FOR INFRASTRUCTURE PROJECTS

A. Definitions

For purposes of the Buy America requirements, based both on the statute and OMB Guidance Document dated April 18, 2022, the following definitions apply:

Construction materials includes an article, material, or supply—other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives⁷⁸—that is or consists primarily of:

- Non-ferrous metals;
- Plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables);
- Glass (including optic glass);
- Lumber; or
- Drywall.

Infrastructure includes, at a minimum, the structures, facilities, and equipment for, in the United States, roads, highways, and bridges; public transportation; dams, ports, harbors, and other maritime facilities; intercity passenger and freight railroads; freight and intermodal facilities; airports; water systems, including drinking water and wastewater systems; electrical transmission facilities and systems; utilities; broadband infrastructure; and buildings and real property. Infrastructure includes facilities that generate, transport, and distribute energy.

Moreover, according to the OMB guidance document:

When determining if a program has infrastructure expenditures, Federal agencies should interpret the term “infrastructure” broadly and consider the definition provided above as illustrative and not exhaustive. When determining if a particular construction project of a type not listed in the definition above constitutes “infrastructure,” agencies should consider whether the project will serve a public function, including whether the project is publicly owned and operated, privately operated on behalf of the public, or is a place of public accommodation, as opposed to a project that is privately owned and not open to the public. Projects with the former qualities have greater indicia of infrastructure, while projects with the latter quality have fewer. Projects consisting solely of the

⁷⁸ BIL, § 70917(c)(1).

purchase, construction, or improvement of a private home for personal use, for example, would not constitute an infrastructure project.

The Agency, not the applicant, will have the final say as to whether a given project includes infrastructure, as defined herein. Accordingly, in cases where the “public” nature of the infrastructure is unclear but the other relevant criteria are met, DOE strongly recommends that applicants complete their full application with the assumption that Buy America requirements will apply to the proposed project.

Project means the construction, alteration, maintenance, or repair of infrastructure in the United States.

B. Buy America Requirements for Infrastructure Projects (“Buy America” requirements)

In accordance with Section 70914 of the BIL, none of the project funds (includes federal share and recipient cost share) may be used for a project for infrastructure unless:

- (1) all iron and steel used in the project are produced in the United States--this means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States;
- (2) all manufactured products used in the project are produced in the United States—this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation; and
- (3) all construction materials⁷⁹ are produced in the United States—this means that all manufacturing processes for the construction material occurred in the United States.

The Buy America requirements only apply to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does the Buy America requirements apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project, but are not an integral part of the structure or permanently affixed to the infrastructure project.

These requirements must flow down to all sub-awards, all contracts, subcontracts and purchase orders for work performed under the proposed project, except where the prime recipient is a

⁷⁹ Excludes cement and cementitious materials, aggregates such as stone, sand, or gravel, or aggregate binding agents or additives.

for-profit entity. Based on guidance from the Office of Management and Budget (OMB), the Buy America requirements of the BIL do not apply to DOE projects in which the prime recipient is a for-profit entity; the requirements only apply to projects whose prime recipient is a State, local government, Indian tribe, Institution of Higher Education, or non-profit organization.

For additional information related to the application and implementation of these Buy America requirements, please see OMB Memorandum M-22-11, issued April 18, 2022:

<https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-11.pdf>

Note that for all applicants—both non-Federal entities and for-profit entities—DOE is including a Program Policy Factor that the Selection Official may consider in determining which Full Applications to select for award negotiations that considers whether the applicant has made a commitment to procure U.S. iron, steel, manufactured products, and construction materials in its project.

C. Waivers

The DOE financial assistance agreement will require each recipient: (1) to fulfill the commitments made in its application regarding the procurement of U.S.-produced products and (2) to fulfill the commitments made in its application regarding the procurement of other key component metals and domestically manufactured products that are deemed available in sufficient and reasonably available quantities or of a satisfactory quality at the time of award negotiation.

In limited circumstances, DOE may waive the application of the Buy America requirements where DOE determines that:

- (1) Applying the Buy America requirements would be inconsistent with the public interest;
- (2) The types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality; or
- (3) The inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25%.

If an applicant or recipient is seeking a waiver of the Buy America requirements, it may submit a waiver request after it has been notified of its selection for award negotiations. A waiver request must include:

- A detailed justification for the use of “non-domestic” iron, steel, manufactured products, or construction materials to include an explanation as to how the non-domestic item(s) is essential to the project;

-
- A certification that the applicant or recipient made a good faith effort to solicit bids for domestic products supported by terms included in requests for proposals, contracts, and nonproprietary communications with potential suppliers;
 - Applicant/Recipient name and Unique Entity Identifier (UEI)
 - Total estimated project cost, DOE and cost-share amounts;
 - Project description and location (to the extent known);
 - List and description of iron or steel item(s), manufactured goods, and construction material(s) the applicant or recipient seeks to waive from Domestic Content Procurement Preference requirement, including name, cost, country(ies) of origin (if known), and relevant PSC and NAICS code for each;
 - Waiver justification including due diligence performed (e.g., market research, industry outreach) by the applicant or recipient; and
 - Anticipated impact if no waiver is issued

DOE may require additional information before considering the waiver request.

Waiver requests are subject to public comment periods of no less than 15 days and must be reviewed by the Made in America Office. There may be instances where an award qualifies, in whole or in part, for an existing waiver described at [DOE Buy America Requirement Waiver Requests](#).

DOE's decision concerning a waiver request is not appealable.

APPENDIX E – LIST OF ACRONYMS

c-Si	Crystalline Silicon
CBP	Community Benefits Plan
CdTe	Cadmium Telluride
CETs	Critical and Emerging Technologies
CIGS	Copper Indium Gallium Diselenide
COI	Conflict of Interest
CRADA	Cooperative Research and Development Agreement
CTL	Certified Test Laboratory
DEC	Determination of Exceptional Circumstances
DEIA	Diversity, Equity, Inclusion, and Accessibility
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier
DOL	Department of Labor
EERE	Energy Efficiency and Renewable Energy
FAR	Federal Acquisition Regulation
FCOI	Financial Conflicts of Interest
FFATA	Federal Funding and Transparency Act of 2006
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FFRDC	Federally Funded Research and Development Center
GAAP	Generally Accepted Accounting Principles
GW _{ac}	Gigawatts (Alternating Current)
GW _{dc}	Gigawatts (Direct Current)
HBCUs	Historically Black Colleges and Universities
IEC	International Electrotechnical Commission
IPMP	Intellectual Property Management Plan
IRB	Institutional Review Board
ISOS	International Summit on Organic Photovoltaic Stability
kWh	Kilowatt-hours
LCOE	Levelized Cost of Energy
M&O	Management and Operating
MFA	Multi-Factor Authentication
MPIN	Marketing Partner ID Number
MQT	Module Quality Test
MSI	Minority-Serving Institution
MYPP	Multi-Year Program Plan
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NREL	National Renewable Energy Laboratory
NNSA	National Nuclear Security Agency
NSF	National Science Foundation

OFCCP	Office of Federal Contractor Compliance Programs
OIG	Office of Inspector General
OMB	Office of Management and Budget
OSS	Open-Source Software
OSTI	Office of Scientific and Technical Information
OTA	Other Transactions Authority
PACT	Perovskite PV Accelerator for Commercializing Technologies
PCE	Power Conversion Efficiency
PII	Personal Identifiable Information
PV	Photovoltaics
QA/QC	Quality Assurance/Quality Control
R&D	Research and Development
RD&D	Research, Development, and Demonstration
RFI	Request for Information
RFP	Request for Proposal
SAM	System for Award Management
SciENCv	Science Experts Network Curriculum Vita
SETO	Solar Energy Technologies Office
SMART	Specific, Measurable, Attainable, Realistic, and Timely
SOPO	Statement of Project Objectives
SPOC	Single Point of Contact
STEM	Science, Technology, Engineering, and Mathematics
TAA	Technical Assistance Agreement
Te	Tellurium
TIA	Technology Investment Agreement
UCC	Uniform Commercial Code
UEI	Unique Entity Identifier
WBS	Work Breakdown Structure
WP	Work Proposal

APPENDIX F – COMMUNITY BENEFITS PLAN GUIDANCE

DOE is committed to pushing the frontiers of science and engineering; catalyzing high- quality domestic clean energy jobs through research, development, demonstration, and deployment; and ensuring energy equity and energy justice⁸⁰ for disadvantaged communities. Therefore, and in accordance with the Administration’s priority to empower workers and harness opportunities to create good union jobs as stated in EO 14008 (Executive Order on Tackling the Climate Crisis at Home and Abroad),⁸¹ it is important to consider the impacts of the successful commercial deployment of any innovations resulting from this FOA on the current and future workforce.

The goal of the Community Benefits Plan is to allow the application to illustrate engagement in critical thought about implications of how the proposed work will benefit the American people and lead to broadly shared prosperity, including for workers and disadvantaged communities.⁸² The three sections of the Community Benefits Plans are considered together because there may be significant overlap among audiences considered in workforce and disadvantaged communities.

Example DEIA, Energy Equity, and Workforce Plan Elements

Outlined below are examples of activities that applicants might consider when developing their Community Benefits Plan. Applicants are not required to implement any of these specific examples and should propose activities that best fit their research goals, institutional environment, team composition, and other factors. Creativity is encouraged.

DEIA

DOE strongly encourages applicants to involve individuals and entities from disadvantaged communities. Tapping all the available talent requires intentional approaches and yields broad benefits.

Equity extends beyond diversity to equitable treatment. Equitable access to opportunity for members of the project team is paramount. This includes ensuring all members of the team, including students, are paid a living wage,

⁸⁰ DOE defines energy justice as “the goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those disproportionately harmed by the energy system” (Initiative for Energy Justice, 2019). Aligned with that definition, the remainder of this document refers to “energy equity” to encompass energy justice and DOE’s efforts related to Justice40. <https://www.energy.gov/diversity/articles/how-energy-justice-presidential-initiatives-and-executive-orders-shape-equity>

⁸¹ <https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad>

⁸² See footnote 2 for guidance on the definition and tools to locate and identify disadvantaged communities.

provided appropriate working conditions, and provided appropriate benefits. In the execution of their project plan, applicants are asked to describe efforts in diversity, equity, inclusion, and accessibility. In this context, efforts toward DEIA are defined as:⁸³

- 1) The practice of including the many communities, identities, races, ethnicities, backgrounds, abilities, cultures, and beliefs of the American people;
- 2) The consistent and systematic fair, just, and impartial treatment of all individuals, including protecting workers rights and adhering to Equal Employment Opportunity laws;
- 3) The recognition, appreciation, and use of the talents and skills of employees of all backgrounds; and
- 4) The provision of accommodations so that all people, including people with disabilities, can fully and independently access facilities, information and communication technology, programs, and services.

Successful plans will not only describe how the project team seeks to increase DEIA but also will describe the overall approaches to retention, engagement, professional development, and career advancement. Specifically, they will demonstrate clear approaches to ensure all team members' strengths are meaningfully leveraged, and all members are provided opportunities and paths for career development, especially including paths for interns and trainees to secure permanent positions. Diversity should be considered at all levels of the project team, not just leveraging early career individuals to meet diversity goals.

DOE strongly encourages applicants to consider partnerships to promote DEIA, justice, and workforce participation. Minority Serving Institutions, Minority Business Enterprises, minority-owned businesses, disability-owned businesses, women-owned businesses, Native American-owned businesses, veteran-owned businesses, or entities located in an underserved community that meet the eligibility requirements are encouraged to lead these partnerships as the prime applicant or participate on an application as a proposed partner to the prime applicant.

When crafting the DEIA section of the Plan, applicants should describe how they will act to promote each of the four DEIA efforts above into their investigation. It is important to note that diversity, equity, inclusion, and accessibility are four different but related concepts that should not be conflated. For instance, you can achieve diversity without equity; all four must

⁸³ <https://www.whitehouse.gov/wp-content/uploads/2021/11/Strategic-Plan-to-Advance-Diversity-Equity-Inclusion-and-Accessibility-in-the-Federal-Workforce-11.23.21.pdf>

be addressed. Applicants could discuss how the proposed investigation could contribute to training and developing a diverse scientific workforce. Applicants could describe the efforts they plan to take, or will continue to take, to create an inclusive workplace, free from retaliation, harassment, and discrimination. Applicants could outline any barriers to creating an equitable and inclusive workplace and address the ways in which the team will work to overcome these barriers within the bounds of the specific research project. The plan could detail specific efforts to inform project team members in any capacity of their labor rights and rights under Equal Employment Opportunity laws and their free and fair chance to join a union. Note that this inclusion of informing project team members is also incorporated into awards through the National Policy Assurances.

Equal treatment of workers, including students, is necessary but overcoming institutional bias requires intentionally reducing sometimes hidden barriers to equal opportunity. Applicants could consider measures like childcare, flexible schedules, paid parental leave, pay transparency, and other supports to ensure that societal barriers do not hinder realization of DEIA intentions. Some of these considerations may result in common approaches in different sections of the plan, and that is acceptable as long as the submission is not a singular approach to all sections.

EERE especially encourages applicants to form partnerships with diverse and often underrepresented institutions, such as MSIs, labor unions, and community colleges that otherwise meet the eligibility requirements. Underrepresented institutions that meet the eligibility requirements are encouraged to lead these partnerships as the prime applicant. The DEIA section of the Plan could include engagement with underrepresented institutions to broaden the participation of disadvantaged communities and/or with local stakeholders, such as residents and businesses, entities that carry out workforce development programs, labor unions, local government, and community-based organizations that represent, support, or work with disadvantaged communities. Applicants should ensure there is transparency, accountability, and follow-through when engaging with community members and stakeholders.

Specific examples include:

- Building collaborations and partnerships with researchers and staff at MSIs;
- Addressing barriers identified in climate surveys to remove inequities;
- Providing anti-bias training and education in the project design and implementation teams;
- Offering training, mentorship, education, and other support to

students and early/mid-career professionals from disadvantaged communities;

- Providing efforts toward improving a workplace culture of inclusion;
- Developing technology and technology integration innovations to meet the needs of disadvantaged communities;
- Creating partnerships with local communities, especially under-resourced and disadvantaged communities;
- Voluntary recognition of a union and informing employees of their rights, regardless of their classification;
- Making research products and engagement materials accessible in a greater variety of formats to increase accessibility of research outputs;
- Implementing training or distributing materials to reduce stigma towards individuals with disabilities;
- Designing technologies that strategically fit within the existing workforce for installation and maintenance of the potential innovation.

Energy Equity

The Energy Equity section should articulate how project proposals will drive equitable access to, participation in, and distribution of the benefits produced from successful technology innovations to disadvantaged communities and groups. Intentional inclusion of energy equity requires evaluating the anticipated long-term costs and benefits that will accrue to disadvantaged groups as a result of the project, and how research questions and project plans are designed for and support historically disadvantaged communities' engagement in clean energy decisions. Similar to potential cost reductions or groundbreaking research findings resulting from the research, energy equity and justice benefits may be uncertain, occur over a long period of time, and have many factors within and outside the specific proposed research influencing them.

Applicants should describe the influencing factors and the most likely energy equity implications of the proposed research. Applicants should describe any long-term constraints the proposed technology may pose to communities' access to natural resources and Tribal cultural resources. There may be existing equity research available to use and cite in this description, or the applicant could describe milestone-based efforts toward developing that understanding through this innovation. These near- and long-term outcomes may include but are not limited to: a decrease in the percent of income a

household spends on energy costs (energy burden);⁸⁴ an increase in access to low-cost capital; a decrease in environmental exposure and burdens; increases in clean energy enterprise creation and contracting (e.g., women or minority-owned business enterprises); increased parity in clean energy technology access and adoption; increases in energy democracy, including community ownership; and an increase in energy resilience.

Specific examples include:

- Describing how a successful innovation will support economic development in diverse geographic or demographic communities;
- Creating a plan to engage equity and justice stakeholders in evaluating the broader impacts of the innovation or in the development of the research methodology;
- Describing how the proposed research strategy and methodology was informed by input from a wide variety of stakeholders;
- Creating a literature review of the equity and justice implications of the outcomes of the specific research if the innovation is successful or a plan with dedicated budget and expertise (staffing or subawardee) to evaluate the potential equity implications of successful innovation outcomes.

Workforce

The Workforce section of the Community Benefits Plan should articulate the future workforce implications of the innovation or a milestone-driven plan for understanding those implications. This includes documenting the skills, knowledge, and abilities that would be required of workers installing, maintaining, and operating the technology that may be derivative of the applicant's research, as well as the training pathways and its accessibility for workers to acquire the necessary skills. There may be field-specific or relevant existing research that could be cited in this section. In addition, applicants could detail the process they will use to evaluate long-term impacts on jobs, including job growth or job loss, a change in job quality, disruptions to existing industry and resulting changes to relationships between employers and employees and improvements or reductions in the ability of workers to organize for collective representation, and anything else that could result in changes to regional or national labor markets.

For additional support with developing the Workforce section of a Community Benefits Plan, please refer to the DOE's Community Benefits Plan Frequently Asked Questions (FAQs) webpage

⁸⁴ Energy burden is defined as the percentage of gross household income spent on energy costs:
<https://www.energy.gov/eere/slsc/low-income-community-energy-solutions>

(<https://www.energy.gov/bil/community-benefits-plan-frequently-asked-questions-faqs>). This new resource, though created primarily for BIL-funded demonstration and deployment projects, may be useful for R&D projects.

Applicants will find section 2 of the FAQ (“Investing in America’s Workforce”) particularly helpful for understanding key federal policies, terms and concepts, as well as workforce development strategies relevant to examination of the workforce implications of applicants’ proposed research.

Specific examples include:

- Outlining the challenges and opportunities for commercializing the technology in the United States;
- Creating a literature review of the workforce implications of the outcomes of the specific research if the innovation is successful, or a plan with dedicated budget and expertise (staffing or subawardee) to evaluate the potential equity implications of successful innovation outcomes;
- Creating a plan and milestones for assessing how a successful innovation will have implications for job savings or loss, either at the macroeconomic level or within specific industries;
- Describing how the project will support workforce training to address needs for successful innovation;
- Voluntary recognition of a union and informing employees of their rights, regardless of its classification;
- Creating a plan to evaluate how a successful innovation will result in potential workforce shifts between industries or geographies.

Inclusion of SMART milestones

EERE requires that the applicant’s Community Benefits Plan include one Specific, Measurable, Attainable, Realistic and Timely (SMART) milestone for each budget period. An exemplary SMART milestone clearly answers the following questions:

- What needs to be accomplished?
- What measures and deliverables will be used to track progress toward accomplishment?
- What evidence suggests that the accomplishment is achievable?
- Why choose this milestone?
- When will the milestone be reached?

APPENDIX G – TOPIC 1 COMPETITIVE BASELINE PROJECT GUIDELINES AT DIFFERENT FUNDING LEVELS TABLE FORMAT

	\$5 million Federal Award	\$10 million Federal Award	\$20 million Federal Award
Performer	The Team as a Whole	For-Profit Lead Applicant	For-Profit Lead Applicant
Team	No formal guideline beyond the basic applicant eligibility requirements.	Project team has established and documented: <ul style="list-style-type: none"> • Experience in industrial R&D and manufacturing (preferably in the PV sector); • Clearly defined roles, responsibilities and decision making processes; • Business systems for supplier selection for capital equipment and critical raw materials; • Experience in statistical experimental design and statistical procedures for qualifying processes and tools; 	In addition to \$10 million requirements, project team has established and documented: <ul style="list-style-type: none"> IV. Management team and senior leadership with significant experience bringing products from R&D to production in a manufacturing environment (preferably in the PV sector); V. Modern project and program management practices informed through Theory of Constraints; VI. Full traceability from incoming materials to outgoing products; VII. Quality systems including statistical process control, statistical design of experiments, statistically informed raw and intermediate materials specifications.
Single Junction Cell Performance	Demonstrated small area cells (~0.1 cm ² aperture area ⁸⁵) with PCE ≥18% on devices with ≥1.5 eV band gap	ISO 17025 Certified Test Laboratory (CTL) verified performance of cells ≥ 1 cm ² aperture area ⁸² with PCE ≥18% on devices with ≥1.5 eV band gap	No formal guideline
	OR	OR	
Tandem Cell Performance	Demonstrated small area cells (~0.1 cm ² aperture area ⁸²) with PCE ≥23%	ISO 17025 CTL verified performance of cells ≥ 1 cm ² aperture area ⁸² with PCE ≥24%	
Notes:	Data must be provided to show that this performance can be readily reproduced with a mean PCE for ≥20 cells across ≥4 substrates produced across ≥2 days		
Single Junction Minimodule Performance	No formal guideline	ISO 17025 CTL verified performance of minimodules ≥25 cm ² aperture area ⁸² with PCE ≥15%	No formal guideline
		OR	
Tandem Minimodule Performance		ISO 17025 CTL verified performance of minimodules ≥25 cm ² aperture area ⁸² with PCE >20%	ISO 17025 CTL verified PCE of ≥27%, consistent with the Performance Target Matrix for minimodules ≥25 cm ² aperture area ⁸²

⁸⁵ In order to be defined as “aperture area” an opaque mask must be used to define the optically active area.

Notes:		Data must be provided to show that this performance can be readily reproduced with a mean PCE across a minimum of 10 separate devices produced across ≥ 2 days.	Data must be provided to show that this performance can be readily reproduced with a mean PCE across a minimum of 10 separate devices produced across ≥ 2 days.
Durability Testing - Lab	Demonstrated combined heat and light stress testing: <ul style="list-style-type: none"> ≥ 5 cells held at Maximum Power Point or higher voltage and subjected to ≥ 60 °C for ≥ 1000 hours at ~ 1 sun illumination. The drop in efficiency must be $\leq 20\%$ relative at 1000 hours. 	Demonstrated combined heat- and light-stress testing on encapsulated minimodules: <ul style="list-style-type: none"> ≥ 5 devices held at Maximum Power Point or higher voltage and subjected to ≥ 60°C for ≥ 1000 hours at ~ 1 sun illumination. The drop in efficiency must be $\leq 10\%$ relative at 1000 hours. 	Passed at least 4 of the 5 accelerated stress tests specified in the Performance Target Matrix (i.e., MQT 10, MQT 11, MQT 13, MQT 21, ISOS-L-2).
Durability Testing - Outdoor	No formal guideline	Devices on-sun at outdoor testing facilities (preferably with samples at PACT ⁸⁶)	Demonstrated ≥ 3 months of outdoor field testing with $< 3\%$ relative degradation (with minimodules on test at PACT ⁸³ for ≥ 10 weeks) with ≥ 10 W of samples (≥ 20 minimodules).
Notes:	<ul style="list-style-type: none"> Cell starting performance and size for degradation testing must be greater than or equal to cell performance requirement. Cells should be appropriately preconditioned using heat/light stabilization or dark soaking. ≥ 10 cells should be from a single batch of production. Cells may be encapsulated or unencapsulated in controlled environment. 	<ul style="list-style-type: none"> Minimodule starting performance and size for degradation testing must be greater than or equal to minimodule performance requirement. Devices should be appropriately preconditioned using heat/light stabilization or dark soaking. ≥ 10 minimodules should be from a single batch of production 	<ul style="list-style-type: none"> Minimodule starting performance and size for degradation testing must be greater than or equal to minimodule performance requirement.
Fabrication Capability - Current	≥ 100 devices/week	≥ 100 minimodules/week (which should be from ≥ 25 substrates of ≥ 100 cm ² area each)	≥ 500 minimodules/week (which should be from ≥ 100 substrates of ≥ 100 cm ² area each)
Fabrication Capability - Future Plan	≥ 100 devices per week at ≥ 100 cm ² aperture area	≥ 100 devices per week at ≥ 500 cm ² aperture area	scale to 1-shift operation capable of producing ≥ 2000 devices per week at ≥ 500 cm ² aperture area
Notes	The production capability listed is considered the peak capability and it is understood that teams will not typically operate at this level for multiple weeks.		

This is the end of the Funding Opportunity Announcement. Thank you for reading.

⁸⁶ See <https://pv pact.sandia.gov/> for details on PACT facilities