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

Concentrating Solar Flux to Heat and Power

Funding Opportunity Announcement (FOA) Number: DE-FOA-0003269
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FOA Issue Date:	4/4/24
Submission Deadline for Concept Papers:	5/16/24, 5 p.m. ET
Submission Deadline for Full Applications:	8/8/24, 5 p.m. ET
Expected Submission Deadline for Replies to Reviewer Comments:	9/20/24, 5 p.m. ET
Expected Timeframe for EERE Selection Notifications:	December 2024
Expected Timeframe for Award Negotiations:	December 2024 – March 2025

- Applicants must submit a Concept Paper by 5 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 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 **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	5/29/2024	Applicant Education Services
0002	6/25/2024	Clarification of SOPO page limit to 10 pages, on page 57

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I. Funding Opportunity Description

A. Background and Context

i. Background and Purpose

Building a clean and equitable energy economy and addressing the climate crisis is a top priority of the Biden Administration. This FOA will advance the Biden Administration's goals to achieve carbon pollution-free electricity by 2035 and to "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"[1] to the benefit of all Americans. The U.S. Department of Energy (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.

This FOA is being issued by the DOE Office of Energy Efficiency and Renewable Energy (EERE) Solar Energy Technologies Office (SETO). SETO supports solar energy research, development, demonstration, and technical assistance in seven areas—photovoltaics (PV), concentrating solar-thermal power (CSP), systems integration, manufacturing and competitiveness, strategic analysis and institutional support, solar workforce development, and equitable access to solar energy—to improve the affordability, reliability, and domestic benefit of solar technologies on the electrical grid.

In May 2021, SETO released its *Multi-Year Program Plan*,[2] which describes activities and specific goals through 2025. In September 2021, DOE released the *Solar Futures Study*,[3] which examines solar energy's role in achieving the decarbonization of the grid. Both documents guide SETO's strategic efforts.

According to the *Solar Futures Study*, solar capacity will need to grow from 5% of the U.S. electricity supply in 2022 to 40% by 2035 and 45% by 2050. This will require the United States to install 30 gigawatts alternating current (GW_{ac}) of solar power by 2025 and ramp up to 60 GW_{ac} per year from 2025 to 2030. With supportive policies, electrification, and aggressive cost reductions, solar energy could provide 1 terawatt (TW) of solar electricity capacity to the grid by 2035 and 1.6 TW of capacity by 2050. Preliminary modeling shows that decarbonizing the

[1] Executive Order 14008. January 27, 2021. "Tackling the Climate Crisis at Home and Abroad."
[2] Silverman, T. J., and H. Huang. May 2021. *Solar Energy Technologies Office Multi-Year Program Plan*. SETO. www.energy.gov/sites/default/files/2021-05/Solar Energy Technologies Office 2021 Multi-Year Program Plan_1.pdf.
[3] SETO. September 2021. *Solar Futures Study*. www.energy.gov/eere/solar/solar-futures-study.

entire energy economy could result in as much as 3 TW of solar capacity due to increased electrification.[4]

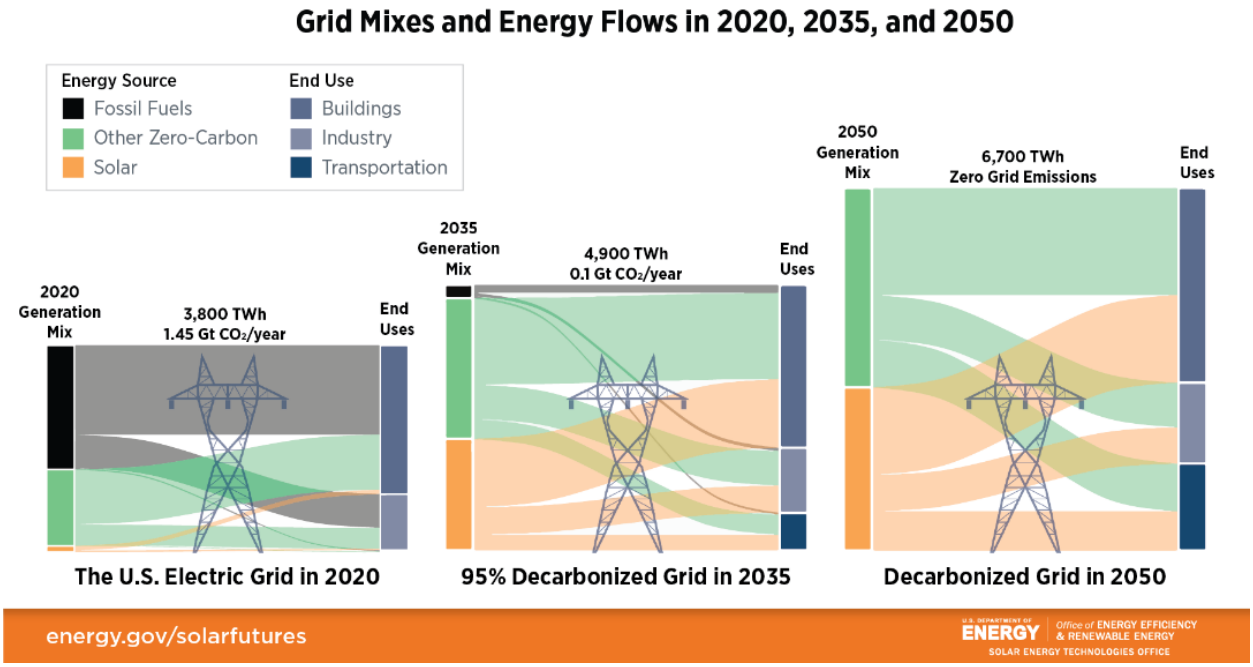


Figure 1: *Solar capacity grows from 5% of the electricity mix today to 45% in 2050, serving more building, industry, and transportation end uses. SOURCE: National Renewable Energy Laboratory (NREL)/DOE Solar Futures Study.*

Attaining these solar capacity targets will require the deployment of flexible and dispatchable energy generation and energy storage technologies, such as CSP with thermal energy storage (TES), to ensure reliability of the grid. Beyond the grid, renewable fuels and thermal technologies can address applications that are difficult to decarbonize through electrification.

Reducing the cost of solar energy is essential to accelerating solar deployment and affordably decarbonizing the grid. SETO is committed to reaching cost targets that support greater energy affordability by cutting the cost of solar electricity by 50% between 2020 and 2030.[5] SETO's 2030 CSP targets, shown in **Figure 2**, will enable the technology to compete with other power generation sources.

[4] Ibid.

[5] SETO. Goals of the Solar Energy Technologies Office. www.energy.gov/eere/solar/goals-solar-energy-technologies-office.

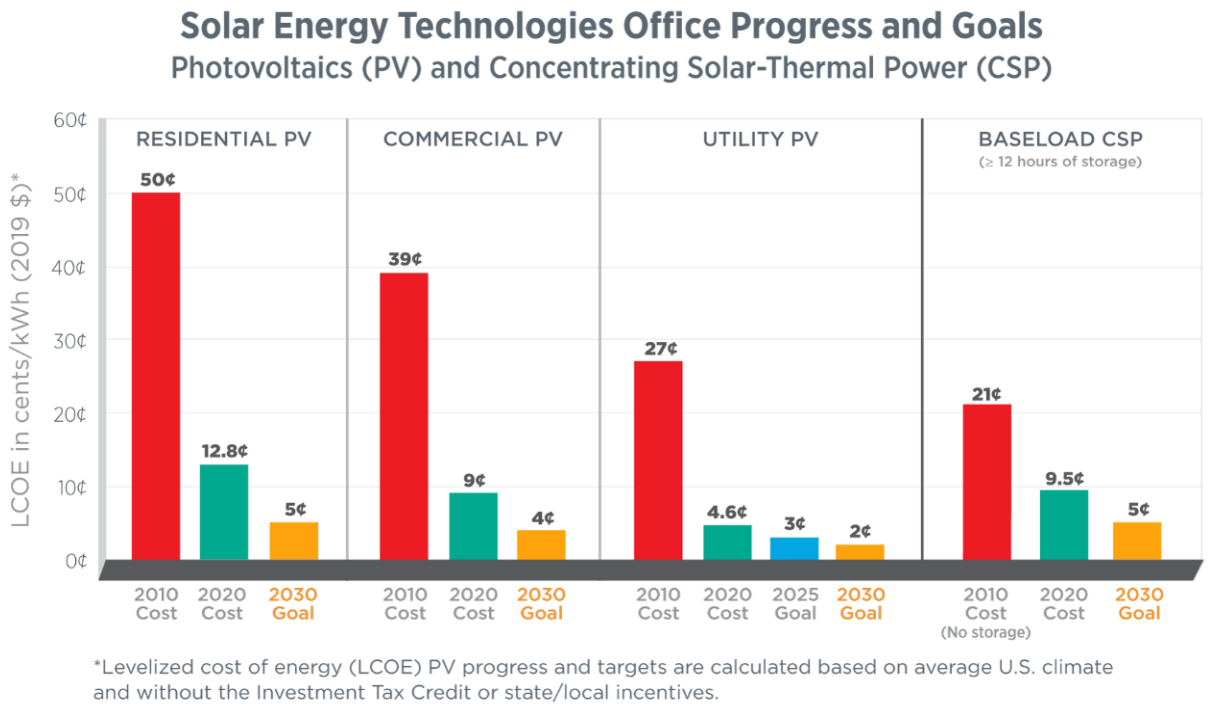


Figure 2: *Levelized cost of energy (LCOE) benchmarks and goals for PV and CSP technologies*

The research, development, and demonstration (RD&D) activities to be funded under this FOA will support the government-wide approach to the climate crisis by driving innovation that can lead to the deployment of clean energy technologies, which are critical for climate protection. Specifically, this FOA will help decarbonize the energy system and high-temperature industrial processes in the United States through innovation and advancement in CSP technologies, including solar collectors, supercritical carbon dioxide (sCO_2) power cycles, and high-temperature solar receivers and reactors. By achieving desired performance and technoeconomic metrics, these technologies can help enable broad deployment of concentrating solar-thermal (CST) systems in the United States.

In addition to technical challenges, this FOA addresses diversity, equity, and inclusion (DEI) challenges surrounding increased solar deployment. The solar industry and research communities do not mirror the demographics of the United States.[6] Women and minorities are underrepresented in the solar industry and in science, technology, engineering, and math (STEM) fields. STEM fields also lack diversity in geographical origin, with U.S. rural areas underrepresented relative to large population centers. Since STEM students and graduates support RD&D activities in universities, national laboratories, and private industry, the lack of diversity in that pipeline adversely affects the opportunities and potential scientific and economic outcomes. This FOA calls for

[6] Solar Energy Industries Association. *U.S. Solar Industry Diversity Study 2019*. www.seia.org/sites/default/files/2019-05/Solar-Industry-Diversity-Study-2019.pdf.

creative solutions to DEI challenges where achievement of DEI goals is fully integrated with that of technical goals.

ii. Technology Space and Strategic Goals

A CST system uses mirrors (known as "collectors") to concentrate sunlight onto a receiver, heating up a material in the receiver to convert this light energy (solar flux) into thermal energy. The thermal energy generated by a CST system can be used in a variety of ways. CST systems can be connected to TES to provide energy on demand. In a CSP plant, this thermal energy is generally used to spin a turbine and generate electricity. Solar industrial process heat (SIPH) involves a CST system delivering heat to an industrial use, often by providing steam to the application. CST systems can also incorporate a solar-thermal reactor, which uses thermal energy to drive a chemical reaction to generate a desired chemical, fuel, or other product. This solar-thermal reactor can be used either in place of the traditional receiver or at a later point in the integrated system.

While PV has dominated the U.S. solar electricity market, CSP technologies offer unique value as a renewable energy resource that can readily deliver high-temperature heat and incorporate energy storage for on-demand solar power. There are nearly 100 CSP plants in commercial operation worldwide, representing almost 7 GW_{ac} of electricity-generating capacity. These plants serve as real-world laboratories for developing best practices and identifying priority areas for further technology development. Continued optimization of these practices will improve the performance, reliability, and cost of future CSP plants, which have the potential to provide between 25 and 160 GW of U.S. capacity by 2050.[7]

Achieving a net-zero carbon energy supply by 2050 will require the adoption of clean energy technologies in sectors beyond electricity generation. Even with more renewable electricity available, many industrial processes will be difficult to electrify because they require extremely high temperatures or other unique chemical process characteristics. CST technology can address this need. This FOA solicits applications to address concerns with CST cost, performance, reliability, and scalability, while moving toward commercialization. In addition, this FOA seeks to advance new CST systems optimized for specific applications.

American innovation and technology development have played a key role in advancing CSP technologies, from the first commercial parabolic trough plants—the Solar Energy Generating Systems plants[8] built in the 1980s and 1990s—to

[7] Murphy, C., et al. *The Potential Role of Concentrating Solar Power within the Context of DOE's 2030 Solar Cost Targets*. NREL. www.osti.gov/biblio/1491726.
[8] Informally referred to as "Generation 1 CSP."

the Solar One and Two demonstration plants. Solar Two,[9] directly supported by DOE, became the basis for Generation 2 CSP, the currently deployed state-of-the-art technology for CSP and TES that uses a molten-nitrate-salt-based CSP tower architecture. SETO estimates that a new Generation 2 CSP plant built in the Southwest region of the United States would have an LCOE of $0.095 per kilowatt-hour (kWh).

For next-generation CSP plants (Generation 3 CSP or Gen3 CSP), SETO has set a target to lower the cost of electricity from baseload plants with greater than 12 hours of storage to $0.05/kWh by 2030. This represents a 50% reduction of existing costs. Although this target is aggressive, there are multiple pathways to achieve it.[10] All pathways require significant improvements across the CSP system, but greater progress in one area can allow for more moderate change in others. These interdependencies and trade-offs between cost and performance improvement factors create many opportunities for technology development. **Figure 3**[11] describes one potential pathway to $0.05/kWh by 2030.

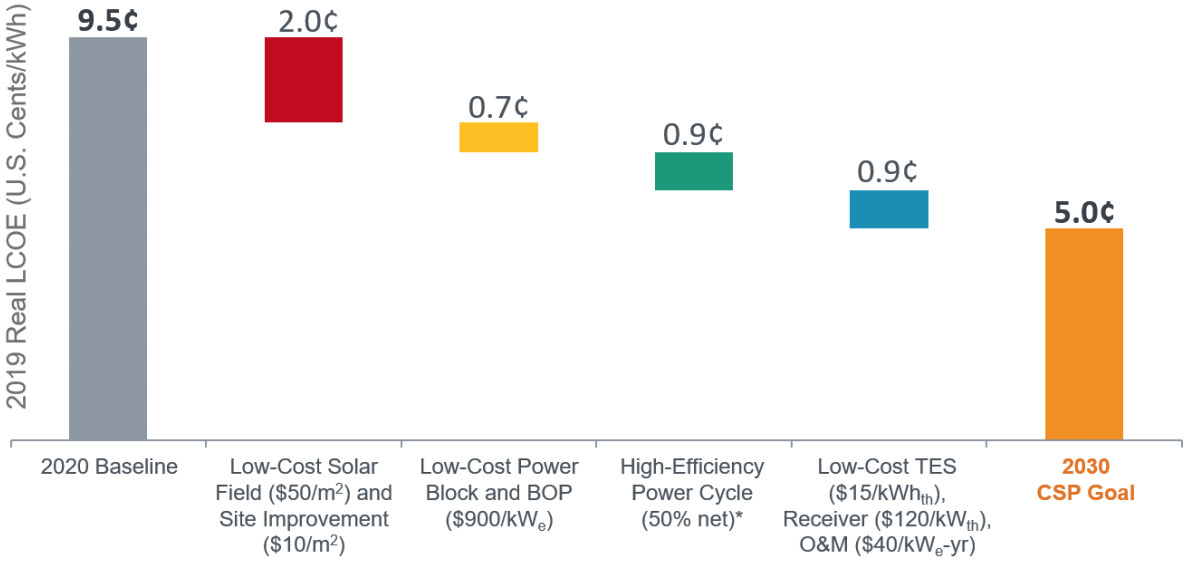


Figure 3. *One scenario for reaching the $0.05/kWh LCOE goal from the 2020 benchmark*

SETO's primary technical strategy to achieve this LCOE goal is to raise the temperature of the heat that next-generation CSP plants deliver to the power cycle, thereby increasing power cycle efficiency. The Generation 3 Concentrating

[9] Bradshaw, R. W., et al. *Final Test and Evaluation Results from the Solar Two Project*. DOE. www.osti.gov/biblio/793226.
[10] SETO. 2030 Solar Cost Targets. www.energy.gov/eere/solar/articles/2030-solar-cost-targets.
[11] SETO. 2020 SETO Peer Review Presentations. www.energy.gov/eere/solar/downloads/2020-seto-peer-review-presentations.

Solar Power Systems funding program,[12] launched in 2018, provided $85 million for research to advance high-temperature components and develop integrated assembly designs with TES that can reach operating temperatures greater than 700°C (1,290°F). In March of 2021, SETO announced a $25 million award led by Sandia National Laboratories (SNL) to build a megawatt-scale integrated test facility to validate the performance of a particle CSP system providing thermal energy to sCO_2.[13] The facility makes use of an open-aperture free-falling particle receiver that has been developed by SNL since 1985. This receiver allows the heat transfer media to be directly illuminated by the sun without the use of high-temperature piping. SNL broke ground on the Generation 3 Particle Pilot Plant (G3P3) facility in February of 2023. Construction is expected to be completed in 2024, with field testing commencing in early 2025. In addition, an sCO_2 turbine has recently been planned for inclusion in the facility.[14] The G3P3 facility will aim to prove the viability of a particle-based thermal transport system integrated with a highly efficient sCO_2-based power cycle.

To enable plant integration and demonstration of the sCO_2 power block with TES, SETO developed the Integrated Thermal Energy Storage and Brayton Cycle Equipment Demonstration (Integrated TESTBED) program.[15] This program aims to develop, build, and operate a recompression, closed Brayton sCO_2 power cycle (RCBC) integrated with TES, where concentrated solar-thermal energy is supplied by a newly built heliostat collector field. Operating at a turbine inlet temperature of 600°C, this plant can employ conventional stainless-steel alloys that are widely available today. The sCO_2 RCBC is unique for its ability to operate more efficiently than traditional steam Rankine cycles, scale down to sizes of approximately 5 MW_e, and leverage dry cooling. The TESTBED facility makes use of a particle-based TES system. Construction is expected to be complete in 2025, with testing beginning in the first half of 2026.

Beyond CSP for electricity, SETO works to make SIPH a cost-effective alternative to conventional carbon fuel approaches. SETO pursues cost reductions and process integration improvements for a range of temperatures and industrial applications. Developing scalable, low-cost solutions is a key challenge. SIPH could power both low-temperature processes, such as enhanced oil recovery, food processing, and water desalination, and high-temperature processes, such

[12] SETO. Generation 3 Concentrating Solar Power Systems. www.energy.gov/eere/solar/generation-3-concentrating-solar-power-systems-gen3-csp.
[13] Ibid.; EERE. February 2023. "DOE Breaks Ground on Concentrating Solar Power Pilot Culminating $100 Million Research Effort." www.energy.gov/eere/articles/doe-breaks-ground-concentrating-solar-power-pilot-culminating-100-million-research.
[14] Office of Clean Energy Demonstrations. Long-Duration Energy Storage Demonstrations Selections for Lab Call. www.energy.gov/oced/long-duration-energy-storage-demonstrations-selections-lab-call.
[15] SETO. SETO 2020 – Integrated TESTBED – Heliogen, Inc. www.energy.gov/eere/solar/seto-2020-integrated-testbed-heliogen-inc.

as calcination to produce cement, thermochemical water splitting for producing solar fuels, and ammonia synthesis for producing fertilizer.

Across a range of SIPH concepts, SETO targets a levelized cost of heat (LCOH) of $0.02 per kilowatt-hour thermal (kWh_{th}) to be directly competitive with natural gas heating. This LCOH includes cost for the collector system, receiver and thermal transport system, and TES.

SETO's efforts are part of a multiyear, multiprong strategy that is guided by the Industrial Heat Shot,[16] a DOE-wide initiative to develop cost-competitive industrial heat decarbonization technologies with at least 85% lower greenhouse gas (GHG) emissions compared to 2020 emissions by 2035. DOE has identified three key methods to decarbonize industrial heat and achieve the target emission reductions: electrification of heating technologies, integration of low-emission heat sources such as CST, and development of innovative low-temperature process technologies. SETO funded opportunities[17, 18] that focused on the integration of CST as a low-emission heat source for several industrial processes, including ammonia, cement, propylene, ethylene, and solar fuel production.

The results outlined in the DOE *Industrial Decarbonization Roadmap*[19] indicate that a significant portion of industrial heat applications require temperatures less than 300°C. This range can be readily supplied by a variety of commercial solar collectors, including modular solar collector systems. However, these technologies must be cost competitive with process steam, generated by natural gas, to be commercialized. Thus, research into low-temperature industrial process heat might focus primarily on capital costs and LCOH reduction. The collector system is often the largest cost sensitivity for these systems (Topic Area 1). Novel CST systems are needed to couple with high-temperature applications, particularly those > 550°C. In many cases, a solar receiver or reactor is the enabling technology that needs to be developed to begin designing an appropriate system (Topic Area 2).

[16] DOE. September 2022. "Energy Earthshots – U.S. Department of Energy Industrial Heat Shot." www.energy.gov/sites/default/files/2022-09/earth-shot-industrial-heat-fact-sheet.pdf.
[17] EERE. February 2022. "Concentrating Solar-Thermal Power Fiscal Year 2022 Research, Development, and Demonstration Program." FOA no.: DE-FOA-0002630. eere-exchange.energy.gov/FileContent.aspx?FileID=53c577e4-2983-454d-b406-885912a2c3fa.
[18] EERE. September 2023. "Solar-Thermal Fuels and Thermal Energy Storage via Concentrated Solar-thermal Energy." FOA no.: DE-FOA-0003080. eere-exchange.energy.gov/FileContent.aspx?FileID=1dadba90-64eb-486f-af9a-6cee79504b62.
[19] DOE. September 2022. *Industrial Decarbonization Roadmap*. www.energy.gov/sites/default/files/2022-09/Industrial%20Decarbonization%20Roadmap.pdf.

SETO funds CSP research and development (R&D) through other programs, including the Heliostat Prize,[20] the Heliostat Consortium for Concentrating Solar-Thermal Power,[21] the Small Business Innovation Research (SBIR) program,[22] the Energy Program for Innovation Clusters,[23] Small Innovative Projects in Solar (SIPS),[24] and the Solar-Thermal Fuels and Thermal Energy Storage via Concentrated Solar-Thermal Energy FOA.[25]

This FOA solicits proposals for RD&D in three topic areas. Technologies in each area may support a variety of CST forms, including CSP, SIPH, and high-temperature solar-thermal reactors. Each topic area focuses on scaling and maturing impactful technologies for specified CST subsystems.

- **Topic Area 1: Scalable Concentrating Solar Collectors** requests advanced collector concepts that can enable a low-cost and reliable integrated collector field.
- **Topic Area 2: Scalable Supercritical Carbon Dioxide (sCO_2) Turbomachinery** requests proposals to advance viable turbine and compressor technology for a specified power cycle.
- **Topic Area 3: Scalable Concentrating Solar-Thermal Receivers and Reactors** requests innovative receiver or reactor concepts that could enable new CST systems, as well as the development of receivers to improve existing CSP systems.

In all cases, innovations to support aggressive technoeconomic targets as well as maturation of existing technology to enable near-term CST deployment are appropriate. Each topic area requires the development of plans to enable commercialization on aggressive timelines. This includes appropriate planning for follow-on technology development and incorporation of project partners who can support the technology advancement.

[20] SETO. American-Made Heliostat Prize. www.energy.gov/eere/solar/american-made-heliostat-prize.
[21] SETO. HelioCon. www.energy.gov/eere/solar/heliocon.
[22] SETO. "Funding Opportunity Announcement: SBIR/STTR FY 2024 Phase I Release 2." www.energy.gov/eere/solar/funding-opportunity-announcement-sbirsttr-fy-2024-phase-i-release-2.
[23] Office of Technology Transitions. Energy Program for Innovation Clusters. www.energy.gov/technologytransitions/energy-program-innovation-clusters.
[24] SETO. April 2023. "Funding Notice: Small Innovative Projects in Solar (SIPS): Concentrating Solar-Thermal Power and Photovoltaics." www.energy.gov/eere/solar/articles/funding-notice-small-innovative-projects-solar-sips-concentrating-solar-thermal.
[25] SETO. September 2023. "Funding Notice: Solar-thermal Fuels and Thermal Energy Storage via Concentrated Solar-thermal Energy." www.energy.gov/eere/solar/articles/funding-notice-solar-thermal-fuels-and-thermal-energy-storage-concentrated.

iii. Teaming Partner List (Optional)

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 will be 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 Area, 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 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. Topic Areas

i. Scalable Outputs for Leveraging Advanced Research (SOLAR) Tiers Methodology

The SOLAR Tiers methodology for translating lab-scale R&D projects to large-scale pilot demonstrations is used in all topic areas in this FOA. The methodology emphasizes thoughtfully traversing the technology readiness level (TRL) scale, defined in Appendix E, focused on the end goal of a commercial system.

New CST technology development is challenging due to nonlinear correlations between size and performance. Performance is difficult to validate with lab-scale prototypes because large commercial-scale systems generally have fundamental attributes not well represented in smaller-scale devices. For example, commercial CSP power plants use thermal components at the 100–500 megawatts thermal (MW_{th}) scale, can store more than 1,000 MWh_{th} of heat, and

operate under daily temperature cycles from ambient to over 700°C for Gen3 systems. In contrast, bench-scale prototypes are typically between 0.001 and 0.1 MW_{th}. The impacts of thermal expansion, thermal ratcheting, creep-fatigue cycling, and other attributes often do not manifest in a similar manner at such extremely different scales.

Additionally, the absence of critical project partners and stakeholders may hinder the progression of R&D projects to demonstration scale. Bench-scale experiments often use processes, parts, or designs that may be unsuitable for commercial systems. Early involvement of partners with appropriate industrial knowledge and a line of sight to demonstration can accelerate technology development by addressing these design considerations at smaller scales. Since large-scale thermal system projects require significant capital investment where a trial-and-error testing approach is not possible, iteration of small-scale systems that can be scaled up is critical.

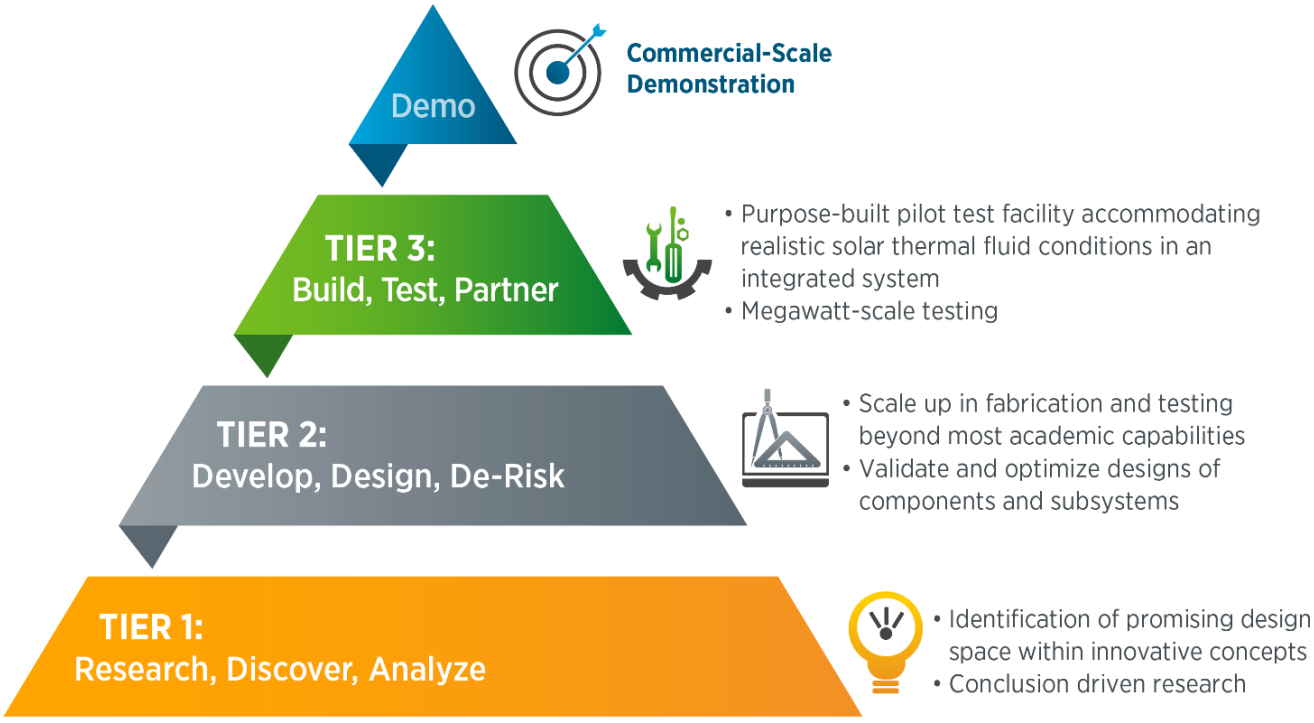


Figure 4: *SOLAR Tiers methodology structure*

In all three topic areas, applicants must explicitly indicate which of the three SOLAR Tiers their project addresses. In most cases, projects should explicitly align with one tier and should clearly articulate a vision for progressing a technology through the remaining tiers, ultimately building toward a commercial-scale demonstration. Projects must generate appropriate foundational knowledge for their technical maturity, demonstrate risk reduction, and anticipate the practical challenges for development and scale-up. The

maximum allowed federal funding for a project will depend on the tier identified in the application. At DOE's discretion, applications may be reassigned from one tier to another based on DOE's assessment of technology maturity described in the application.

- Tier 1: Research, Discover, and Analyze (up to $3 million federal funds)
- Tier 2: Develop, Design, and De-Risk (up to $5 million federal funds)
- Tier 3: Build, Test, and Partner (up to $10 million federal funds)

Tiers and Stage Gates

Tier 1: Research, Discover, and Analyze (RD&A)
Tier 1 projects should focus on broadly understanding a specific innovative technology at TRLs 2 through 4. Design and risk assessment development should iteratively influence Tier 1 activities. This may include exploring appropriate materials, parameter space, or design choices to identify leading candidates for each critical aspect. Successful Tier 1 projects may also include disproving a concept or clarifying and quantifying the key technology barriers, as these discoveries often allow for effort to be redirected to more impactful topics.

Overall, Tier 1 applicants should seek to prove or disprove that an innovation has adequate merit and value to advance to efforts in Tier 2. Relevant prototypes should be fabricated and studied in moderate-fidelity testing environments at appropriate temperatures.

Tier 2: Develop, Design, and De-Risk (DD&D)
Submissions to Tier 2 should build a case that the novel proposed concept is adequately understood to have a reasonable chance of commercial adoption with further development, testing, and demonstration. Prototypes of high-risk components should be designed and tested at scales significantly greater than lab-scale prototypes (TRL 4–6). Components should be shown to operate in tandem with other CSP system components (e.g., a new design for a specified pump driving a heat transfer fluid through a relevant heat exchanger and into a storage vessel). Component integration risks should be addressed. A sophisticated system and total plant cost analysis is required. Plant design and analyses should inform a path into Tier 3 for a large-scale integrated test facility. Material properties should be tested in conditions that closely resemble the operating environment. Where appropriate, a pathway to industry acceptance of new system components and materials should be integrated into the project. The uncertainty on each component's efficiency over each operating mode (e.g., design point, transient events, system start-up and shutdown) should be substantially reduced. The challenges of scaling up each component should be investigated.

Tier 2 projects should be designed to justify the significant financial investment required for a Tier 3-sized system. Furthermore, significant engagement with a candidate Tier 3 test facility should occur during the project to ensure feasibility of successful testing of a > 1 MW pilot. Engineering drawings of integration at a specific facility and a plan to manufacture MW-scale components should be in place.

Tier 3: Build, Test, and Partner (BT&P)

Tier 3 projects will encompass procurement, construction or installation, commissioning, and testing at an identified test facility for a pilot-scale system (TRL 6–7). These pilot-scale tests should take place in a relevant environment, validate modeled performance under all potential operational modes, and minimize risk in transitioning this idea to a commercial demonstration plant. Tier 3 projects should be designed to enable further investment and development by the private sector. Appropriate commercialization partners or other stakeholders should be involved in the project. Justification of Tier 3 efforts must include a developed business plan and proof of specific commercial off-takers.

Tier 3 projects are generally expected to be tested at a scale of at least 1 MW for at least 100 to 250 hours, although other metrics of scale may be appropriate depending on the specific technology. The sophistication of a Tier 3 project will be judged, in part, by testing the operability of relevant components working in tandem rather than in isolation.

Progressing between Tiers

If successful, applicants to Tiers 1 or 2 should explicitly plan to graduate their project to Tier 2 and/or Tier 3 in future SETO or DOE solicitations or through other funding sources. Pending appropriations and budget availability, SETO may run future solicitations to allow project teams to apply for funding to work on progressing through subsequent tiers.

Table 1 below shows one example of a technology's logical progression through tiers while broadly de-risking all critical aspects of the technology. The table is not intended to be exhaustive and will vary significantly based on the technology being developed.

Table 1. Example SOLAR Tier Progression through the Stage Gates

Attribute	RD&A (Tier 1)	DD&D (Tier 2)	BT&P (Tier 3)
Component Integration	All components of the system are conceptually understood. Highest-risk components and system-level integration are the primary focus.	Design accounts for nuances and operational limitations of all components. Innovations are tested coupled to neighboring components or boundary conditions.	The entire subsystem optimized and tested together at a commercially relevant scale.

Solar-Thermal Plant System Integration	Full power plant concept developed and justified. Requirements imposed on innovation identified.	Address stakeholder concerns with respect to integrating the technology system into the larger CST system.	Appropriate boundary conditions used for a range of commercially relevant operational modes in capstone-testing campaign.
Scalability	Moderate-fidelity design of 1 MW system (10 MWh) and low-fidelity design of commercial concept; screening of manufacturing processes; understanding of system interfaces.	Complete MW-scale design; moderate-fidelity commercial system design; specific manufacturing processes planned.	Complete cost estimate of commercial system based on learnings from testing; commercial-scale manufacturing proven.
Thermal Efficiency	Measure isolated thermal, hydraulic, reaction properties; determine properties to stated confidence interval; model integrated component; measure component performance.	Measure coupled component performance; develop and validate modeling of system transients; impact of varying operational modes and hold times characterized.	Prove modeling in advance TRL scenario; minimize performance uncertainty through repeated testing; fully impose boundaries required by each component.
Mechanical Survivability	Measure new and rapidly aged properties of critical subcomponents and interconnects; incorporate lifetime understanding into design decisions; sophisticated extrapolation of measured properties to commercial-size components.	Develop pathway to code case-quality data; predict lifetime to high fidelity; long-term, redundant subcomponent testing; integrated prototype testing.	Finalize pathway to commercially relevant code case; do post-testing analysis of MW-scale prototype; support data from multiple tests, proving component- or system-level performance.
Chemical Survivability	Screening and initial lifetime testing; theoretical interactions developed and tested.	Long-term compatibility tests and flow compatibility testing; robustness of chemical control determined.	Post-testing analysis of chemical impact; further supporting of flow testing data.
Operability	Develop principal concept of control objectives and control system; perform a failure modes and effects analysis; analyze dynamic properties such as flux profile, wind, and weather.	Develop integrated control strategy; use prototypes to validate impact of control strategy.	Sufficiently exercise capstone prototype to prove operating regimes' performance and impact for the commercial scale.
Cost	Identify formal cost modeling or methodology; create full list of parameters to include in cost model; identify those parameters to be defined by work in the project and those defined externally; define initial ranges for parameters.	Multiple quotes for most components; substantial reduction in possible ranges for most parameters based upon experimentation; verification and validation of the conclusions by an independent third party.	Validate component costs via purchase orders; team and vendor create roadmap(s) to further component cost reductions, via either volume purchases or possible design revisions.

Teaming	Initial conversations with engineering, procurement, and construction companies (EPCs) and commercial industry to learn of challenges and risks; convening of relevant stakeholders.	Initial partnership with EPCs and/or commercial industry on design and cost analysis; quotes on construction.	Partnership with EPCs and/or commercial industry.
DEI	DEI plan focused on **how** the R&D is executed as well as assessments of potential broader impacts of the system.	Create a plan with dedicated budget and expertise (staffing or sub-awardee) to evaluate the potential equity implications of successful innovation outcomes. Identify unique methods to address DEI, energy equity, and workforce initiatives such as Justice40.	Project implementation of Justice40[26] with community impact. Collect data, conduct reoccurring reviews, and implement improvements regarding the effect of plant operation on local communities.

ii. Topic Area 1: Scalable Concentrating Solar Collectors

This topic area solicits innovations to decrease the installed costs of solar collectors to $50/m^2 with high reliability and efficiency over a 30-year lifetime. Heliostat systems, line-focusing collectors, and other novel collector forms are of interest.

Introduction

Solar collectors are the mirrors that track the sun and concentrate solar radiation to a solar-thermal receiver. In most cases, solar collectors are the most expensive subsystem in a CST plant. Reductions in the collector system's cost significantly impact the overall CST system's cost and can help achieve SETO's LCOE and LCOH targets. The collector system reliability and performance are also key factors in the overall plant LCOE and LCOH, as described in Figure 5. The collector system can dictate both the size and the maximum achievable temperature of the CST plant, ultimately driving the application space a CST system can support. Mature parabolic trough collectors may offer the lowest-risk pathway to support low-temperature SIPH applications. Linear Fresnel collectors or other unique line-focusing collectors may also be useful for particular SIPH applications. Heliostat systems can enable high-temperature CST systems including CSP, solar-thermal reactors, and high-temperature SIPH. In all cases, demonstrating system reliability is a key challenge to commercial acceptance.

[26] The White House. Justice40. www.whitehouse.gov/environmentaljustice/justice40/.

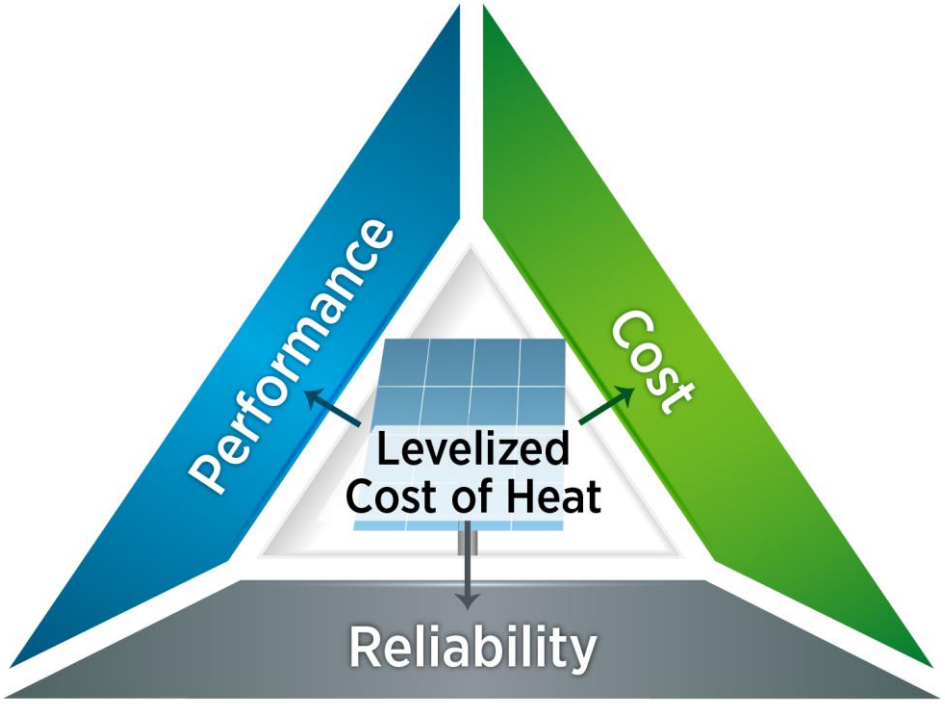


Figure 5. *Collector cost, performance, and reliability, over a lifetime of use, are major contributors to a plant's LCOH.*

Line-Focusing Collectors

Parabolic trough technology is the most broadly deployed form of solar collectors, with an installed cost of about $120/m^2 to $152/m^2.[27] Parabolic troughs are highly modular and can be arranged in solar fields of various sizes and architecture to support SIPH applications.[28] However, it will take aggressive cost reductions and reliability improvements to support SETO's LCOH goal of $0.02/kWh$_{th}$. In addition, significant technical challenges arise when attempting to support SIPH at temperatures over 390°C with line-focusing collectors due to both limitations of the heat transfer fluids and the thermal efficiency of the receiver at relatively modest concentration ratios. Novel or emerging SIPH markets may be best supported by parabolic trough, linear Fresnel collector, or other unique collector forms.

Heliostat Collectors

Heliostats, ranging in cost from about $96/m^2 to $127/m^2,[29] make up over one-third of the capital cost for a solar power tower project. Power tower systems

[27] Kurup, P., et al. 2020. "Manufacturing Cost Analysis of Advanced Parabolic Trough Collector: Preprint." The 26th SolarPACES Conference. NREL. www.nrel.gov/docs/fy21osti/77829.pdf.

[28] DOE. *Industrial Decarbonization Roadmap*. www.energy.gov/industrial-technologies/doe-industrial-decarbonization-roadmap.

[29] Kurup, P., et al. *Cost Update: Commercial and Advanced Heliostat Collectors*. NREL. www.nrel.gov/docs/fy22osti/80482.pdf.

can enable large-scale, high-temperature SIPH systems as well as high-temperature and high-efficiency electricity systems (generally 550°C, or even greater than 700°C for Gen3 CSP). The central receiver and associated heliostat field of power tower designs can enable small- and large-scale systems by changing the number of heliostats and varying the tower height. This approach puts increased operational and controls challenges on the heliostat system, but it can enable many desirable use cases.

To advance heliostat technology development, SETO has established a national laboratory-led consortium, HelioCon.[30] Applicants to this topic area seeking to advance novel heliostats should leverage knowledge, innovations, and capabilities developed by HelioCon.

In September 2022, HelioCon released a detailed roadmap[31] describing key technical gaps and promising strategies to achieve low-cost, high-performance heliostat systems. HelioCon's detailed gap analysis was carried out under six technical topics:

(1) Metrology and standards
(2) Components and controls
(3) Advanced manufacturing
(4) Resources, training, and education
(5) Field deployment
(6) Technoeconomic analysis.

SETO strives to reduce the cost of heliostats while increasing efficiency and proving system reliability. All efforts in this topic should address cost reductions, system performance, and reliability as core objectives.

Table 2 provides performance metrics for a reliable heliostat field.

Table 2. Current General Heliostat State-of-the-Art Performance Parameters

Metric	Performance Target
Service Life	≥ 30 years
Azimuth/Elevation Tracking Error, No Wind	≤ 0.5 mrad rms each axis
Tracking Error with 27 mph wind	≤ 1.25 mrad rms each axis
Beam Quality (0–27 mph wind)	≤ 1.25 mrad rms in each axis as nominal case

[30] HelioCon. heliocon.org/.
[31] Zhu, G., et al. September 2022. *Roadmap to Advance Heliostat Technologies for Concentrating Solar-Thermal* Power. NREL. heliocon.org/roadmap_report_release.html.

Metric	Performance Target
	≤ 1.5 mrad rms in each axis as worst case
Mirror Reflectivity	≥ 95%
Expected Mirror Reflectivity after 30 years of Operation	≥ 90%
Azimuth Position Range	- 359°, + 359°
Elevation Position Range	- 10°, + 90°
Combined Range of Motion	359° rotation at 60° elevation
Move to Stow (ability to move to the stow position with the given wind speed)	≤ 50 mph
Nonoperational Survivability, Wind Speed	≤ 90 mph
Operational Air Temperature Range	0° to 136°F
Hail Survival	≥ 1 in., 75 ft/sec, 20°F
Humidity	0% to 100% relative

Other Novel Collector Concepts
Also sought are other novel solar collector systems that integrate with a specified CST system and application and may significantly impact DOE's decarbonization mission due to the size of the target market.

Funding through this FOA is intended to significantly advance the commercial maturity of a concept. Applications should focus on a selected SOLAR Tier based on the technology maturity.

Areas of Interest
Areas of interest include, but are not limited to:

- Advanced manufacturing
- Automated robotic installation
- Communication and control systems
- Structures and facets
- Solar field analysis tools and standards
- Anti-soiling and cleaning technologies
- Wind and weather impact.

SOLAR Tiers for Collector RD&D
Across each tier and as described in detail in Section I.B.i above, applications should describe the TRL-appropriate RD&D to address metrics for installed cost ($/m^2), annualized efficiency, concept-specific reliability, and lifetime of the technology. The applicants stated Tier level should be based on technology maturity, and operations and maintenance costs. In addition, build quality, based

on proposed manufacturing, assembly, and installation methods should be addressed. Installed cost must account for manufacture, assemble, installation, and initial calibration.

SOLAR Tier 1

Tier 1 concepts may focus on high-impact innovations that, if fully developed, could support achieving SETO's major targets of a $\$50/m^2$ collector field or an integrated SIPH system with an LCOH of $\$0.02/kWh_{th}$. Generally, one or more major subcomponents should be the target of research to support a new integrated collector design. Appropriate activities can include advancing the foundational understanding of the innovation, testing the innovation in a manner to prove its robustness for the application, developing collaboration with collector designers, and overcoming key risks that would inhibit the innovation from being proven in an integrated collector test. Robust models, tools, and other outputs should be developed to enable the handoff of the new concept to appropriate stakeholders.

SOLAR Tier 2

In most cases, Tier 2 concepts are required to build an integrated collector prototype and test the integrated operation of its design. Alternatively, the impact of the innovation must be tested on a fully assembled collector. One or more new technologies should be integrated in the design to support improvements compared to existing technology and prove the use of the collector for the identified application. Clear component- and system-level performance metrics should be described that would ultimately enable market adoption. In parallel, accelerated testing campaigns of high-risk subcomponents should occur. Simulated controls strategies should be developed and validated to the extent possible. Collector assembly, shipping, and deployment concepts should be developed. Initial partnership with EPC companies and/or commercial industry should be formed.

SOLAR Tier 3

This tier is reserved for adequately mature concepts able to be deployed and operated in a pilot system or a demonstration facility. Applications should focus on proving confidence in performance, cost, reliability, and quality to support reliable operation for the product's 30-year lifetime, providing a sound business case for future deployments. Research teams are expected to execute a testing campaign with a minimum threshold of collectors adequate to deliver approximately 1 MW or more of thermal energy to a receiver, operating in tandem, and showing integrated optical/mechanical performance and control systems. The research team's test campaign is required to fully exercise the system in relevant environments, validate modeled performance under all potential operational modes, and ultimately minimize risks in transitioning this idea to a commercial demonstration plant. The end goal of these projects should

be to enable further investment and development by the private sector. Appropriate commercialization partners or other stakeholders should be involved in the project. Justification of Tier 3 efforts must include a developed business plan and proof of specific commercial off-takers. Applicants should review cost share requirements outlined in Section III.B.iii below.

iii. Topic Area 2: Scalable Supercritical Carbon Dioxide (sCO_2) Turbomachinery

SETO solicits proposals for RD&D to enable the deployment of sCO_2 turbomachinery for advanced CSP systems. Multiple heat engine and heat pump cycles are of interest to enable cost-effective CST plants coupled with TES.

Introduction

CST is unique as a renewable-energy technology that can directly deliver thermal energy at temperatures above 750°C. The efficiency of sCO_2-based heat engine cycles increases as the temperature of the working fluid increases within the Carnot limit ($\eta \leq 1 - T_{cold}/T_{hot}$). The RCBC can surpass an efficiency of 50% at temperatures above 720°C. Furthermore, sCO_2 cycles are unique in their ability to maintain high efficiency even at small scales (below 10 MW_e), making them well suited for combined heat and power applications as well as stand-alone power applications of varying sizes. The working fluid is uniquely compatible with dry cooling integration,[32] relieving the use of water at the plant. sCO_2-based technologies can be utilized in dispatchable power generation and electric thermal energy storage (ETES).[33] This topic area solicits proposals to further mature and de-risk sCO_2 turbomachinery technology and its integration with the broader cycle to ultimately enable cost-competitive CSP deployment.

[32] Katcher, K. M., et al. 2023. "Defining a Compact Dry Cooler Design to Reduce LCOE Contribution in a CSP Facility." *AIP Conference Proceedings*, Vol. 2815, No. 1.

[33] Here, "ETES" refers to using electricity from the grid to charge TES reservoirs. Many scenarios exist where using combined inputs of solar-thermal and electrically charged TES can be thermodynamically and/or economically synergistic.

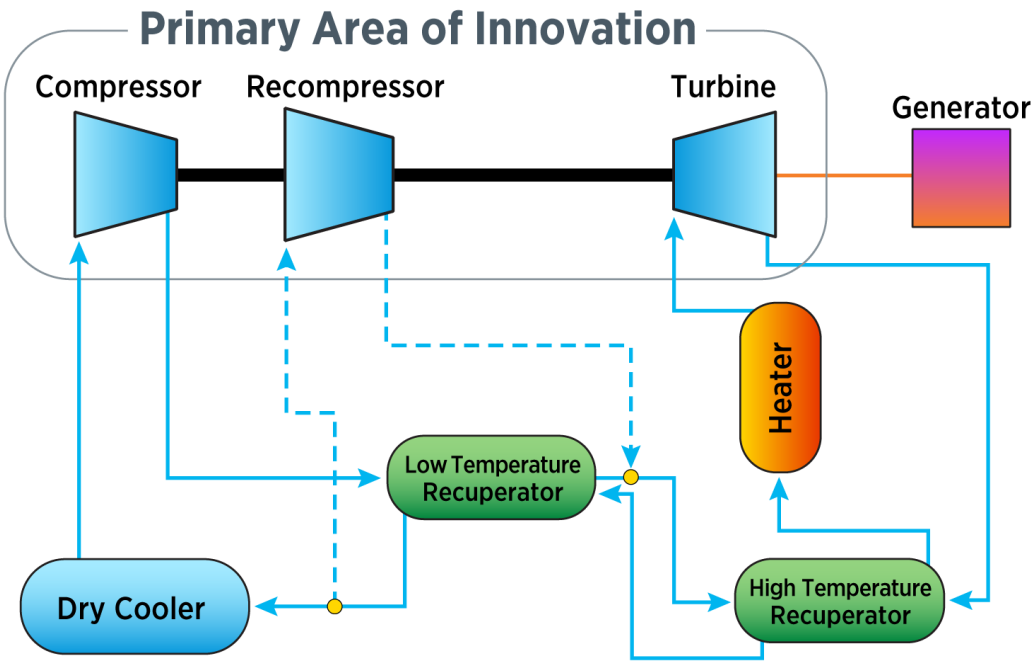


Figure 6. *Recompression, closed Brayton sCO_2 power cycle of interest*

sCO_2 Power Cycles and Heat Pumps

R&D over the past decade has advanced an array of components and the system understanding of several advanced sCO_2 cycles. This includes development of compressors,[34] turbines,[35] and integrated compressor-expanders[36] with further work on bearings,[37] seals,[38] and materials[39] for high-temperature sCO_2 applications.

Technical risks and operational experience barriers that inhibit commercial adoption remain. To significantly increase the deployment of CSP technology coupled with sCO_2-based technologies, further maturation and industry experience are required. sCO_2 turbomachinery needs to be cheaper, more

[34] Cich, S. D., et al. 2021. "Mechanical Design and Testing of a 2.5 MW sCO_2 Compressor Loop." ASME Turbo Expo 2021: Turbomachinery Technical Conference and Exposition. Paper no: GT2021-04155, V010T30A004. doi.org/10.1115/GT2021-04155.

[35] Wilkes, J., et al. 2022. "Design and Testing of a 275 Bar 700 Degree Celsius Expander for an Integrally Geared Supercritical CO_2 Compander." ASME Turbo Expo 2022: Turbomachinery Technical Conference and Exposition. Paper No: GT2022-83284, V009T28A025. doi.org/10.1115/GT2022-83284.

[36] Moore, J. 2017. *Development of a High Efficiency Hot Gas Turbo-expander and Low Cost Heat Exchangers for Optimized CSP Supercritical CO_2 Operation*. Southwest Research Institute. www.osti.gov/biblio/1373211.

[37] Ertas, B., et al. 2020. "Additively Manufactured Compliant Hybrid Gas Thrust Bearing for sCO_2 Turbomachinery: Experimental Evaluation and Fluid-Structure Model Predictions." ASME Turbo Expo 2020: Turbomachinery Technical Conference and Exposition. Paper No: GT2020-14964, V10AT25A018. doi.org/10.1115/GT2020-14964.

[38] Nielson, J., et al. 2022. "Component Testing of a High Temperature Dry Gas Seal." The 7th International Supercritical CO_2 Power Cycles Symposium. Paper no. 190. sco2symposium.com/proceedings2022/190-paper.pdf.

[39] Pint, B., and R. R. Pillai. 2019. *Lifetime Model Development for Supercritical CO_2 CSP Systems*. doi.org/10.2172/1515655.

reliable, and more efficient to compete with mature steam-based turbomachinery.

Drastically increased domestic CSP deployment will likely require that the industry achieve SETO's LCOE goals for power generation. One path to achieving this goal may be developing and deploying the RCBC cycle at a cost below $900/kW_e and cycle efficiency > 50% for Gen3 CSP systems. The $900/kW_e metric includes costs for turbomachinery, recuperators, and air coolers. The 50% power cycle efficiency is derived from 70% gross efficiency goal and nearly 20% consumption by the compressors; both of these efficiencies are impacted by turbine inlet temperature. This cycle efficiency target (50%) can be achieved with peak cycle temperatures above 720°C.

Consistent with these goals, this topic area solicits proposals to develop innovations leading to integrated sCO_2 RCBC turbomachinery with a total installed capital of less than $300/kW_e (including turbine(s) and compressor(s)) and a gross expander efficiency of > 70%. This metric is consistent with an optimal recuperated Brayton cycle with compressor and recompressor efficiency of > 82%, expander efficiency > 89%, and an assumed turbine inlet temperature of 720°C.[40] Under these assumptions, for a 100 MW_{th} input, 70 MW_e shaft power is output by the expander, and 20 MW_e is used by the two compressors, resulting in a 70% gross efficiency and 50% net efficiency.

Table 3. Select Research Areas and Target Metrics for a 720°C RCBC Cycle (The table is not exhaustive.)

Research Area	Description	Metric
Broad-range compressor efficiency near sCO_2 critical point	Impeller design, inlet guide vanes, and interactions with two-phase sCO_2	85% compressor efficiency over a broad range of flow at 33°C (near CO_2's critical point)
Lube oil system elimination	Process gas-cooled bearing system	Elimination of lube oil system capital and operating cost; vendor has gas bearings that meet operational and cost needs to eliminate lube oil
Dry gas seal (DGS) for ≥ 700°C	DGS operation closer to turbine inlet	Leakage rate target at ≥ 700°C; increased expander efficiency
Hermetic seal casing	Elimination of DGS using bearings and couplings	Reduced capital cost
Elimination of gearbox for high-speed applications	Power electronics for direct coupling at 11,000–27,000 revolutions per minute	Reduced gearbox losses
Expander efficiency and reduced capital cost	Improved manufacturing methods and materials	90% expander efficiency target at ≤ $150/kW_e

[40] Brun, K., et al., eds. 2017. *Fundamentals and Applications of Supercritical Carbon Dioxide (sCO_2) Based Power Cycles*. Woodhead Publishing.

Elimination of turbine stop/control valves	Optimization of high-speed and low-speed turbomachinery to minimize cost and complexity as well as consider rotor dynamics	≤ $100/kW$_e$
Operations and maintenance (O&M)	Maintenance and control hardware and strategy to enable near-autonomous operation	Operational cost of $10/kW$_e$-year + $2/MW$_e$
Overall cost and efficiency of the power block	Turbomachinery development impact on power block cost and efficiency	≤ $900/kW$_e$ ≥ 50% efficiency Lifetime of 30 years

This specific cycle and performance goal have been the focus of much synergistic research.[41, 42, 43, 44] However, other cycle variations and drastically different concepts may have a strong impact on CSP deployment and are of interest. For example, partial cooling variations may expand the accessible change in temperature (ΔT) of the TES system, improving the technoeconomics of the entire power plant.[45] sCO_2 cycles may complement CSP and SIPH systems by serving as a heat pump for charging ETES applications. SETO has funded analysis[46, 47] and component development of turbomachinery and heat exchangers for conceptual heat pump systems. Proposals describing work on sCO_2 turbomachinery outside of the Gen3 CSP paradigm must describe the integrated CST system concept and justify the broad commercial applicability of the proposed cycle. A quantitative explanation of the system technoeconomics and target market size is required. Applications must describe turbomachinery performance and cost metrics for the target application.

SOLAR Tiers for sCO_2 Turbomachinery RD&D

Across each tier and as described in detail in Section I.B.i above, applications should describe the TRL-appropriate RD&D to address metrics for cost ($/kW$_e$), component and cycle efficiency, reliability, and lifetime of the technology. Based

[41] SETO. U.S. Department of Energy sCO_2 Workshop 2019. www.energy.gov/eere/solar/articles/us-department-energy-sco2-workshop-2019.

[42] Southwest Research Institute. January 2024. "Step Demo Pilot Plant Makes New Breakthrough for SCO_2 Power Generation." www.swri.org/press-release/step-demo-pilot-plant-makes-new-breakthrough-sco2-power-generation.

[43] SETO. SETO 2020 – Integrated TESTBED – Heliogen, Inc. www.energy.gov/eere/solar/seto-2020-integrated-testbed-heliogen-inc.

[44] Neises, T. December 2020. "Steady-State Off-Design Modeling of the Supercritical Carbon Dioxide Recompression Cycle for Concentrating Solar Power Applications with Two-Tank Sensible-Heat Storage." *Solar Energy* 212: 19–33.

[45] Augustine, C., et al. 2023. *FY19-FY21 Concentrating Solar Power Systems Analysis Final Report*. NREL. www.osti.gov/biblio/1923360.

[46] McTigue, J. D., et al. 2022. *Integrated Heat Pump Thermal Storage and Power Cycle for CSP (Final Technical Report)*. NREL. www.osti.gov/biblio/1855976.

[47] McTigue, Joshua D., et al. "Supercritical CO_2 Heat Pumps and Power Cycles for Concentrating Solar Power." *AIP Conference Proceedings* 2445, no. 1. doi.org/10.1063/5.0090002.

on technology maturity, O&M costs and build quality based on proposed manufacturing, assembly, and installation methods should be addressed. Installed cost must account for manufacture, assemble, installation, and initial calibration.

SOLAR Tier 1

Tier 1 concepts may prioritize the development of subcomponents necessary to support sCO_2 turbomachinery, including, but not limited to:

- Dry gas seals and bearings
- Magnetic couplings and bearings
- Alternative materials
- Alternative manufacturing methods
- Other novel innovations that increase the reliability or efficiency of, or decrease the cost of, sCO_2 turbomachinery

The applicant should demonstrate how the subcomponent advancements help achieve the < \$300/kW_e cost target (which includes compressor, stop/control valve, and expander) and a gross turbine efficiency of > 70%. Research and component design work should justify building a component for a > 5 MW_e system using the proposed innovation(s). Subcomponents must be fully exercised at relevant operational conditions sufficient to prove reliability and performance models. Outputs must include models, tools, manufacturing plan, and an integrated component design.

SOLAR Tier 2

Tier 2 proposals should prioritize the integration and testing of novel turbomachinery components theoretically consistent with cost and performance metrics when manufactured at scale. Innovations should mature sufficiently to build and test optimized turbomachinery under both design and off-design conditions. Projects must mature concept understanding adequate for designing a 5–100 MW_e cycle and components. The technoeconomics of the targeted use case should be fully understood (e.g., Gen3 CSP, Gen2 CSP, ETES, SIPH system). In parallel, accelerated testing campaigns of high-risk subcomponents should occur. Simulated controls strategies should be developed and validated to the extent possible. Manufacturing strategies should be analyzed and understood with manufacturing partners. Initial partnership with EPCs and/or commercial industry should be formed.

SOLAR Tier 3

Tier 3 concepts must propose adequately mature sCO_2 turbomachinery utilized in a scaled pilot or full-scale cycle demonstration. Applications should focus on proving confidence in performance, cost, reliability, and quality. Applications should include (at a minimum) specific metrics for:

- Reliability
- Cost and confidence factors
- Operational modes
- Maintenance
- Deployment time
- Quality and repeatability.

Research teams are expected to execute a testing campaign that fully exercises the system in a relevant environment, validates modeled performance under all potential operational modes, and ultimately minimizes risk in transitioning this idea to a commercial demonstration plant. The end goal of these projects should be to enable further investment and development by the private sector. Appropriate commercialization partners or other stakeholders should be involved in the project. Justification of Tier 3 efforts must include a developed business plan and proof of specific commercial off-takers. Applicants should review cost share requirements outlined in Section III.B.iii below.

iv. Topic Area 3: Scalable Concentrating Solar-Thermal Receivers and Reactors

This topic solicits proposals for novel solar receivers, solar reactors, and improvements to existing solar receiver concepts. Successful receiver or reactor technologies will support the deployment of CST systems that can impact the U.S. market. Targeted outcomes include:

- Development of a complete receiver subsystem with ≥ 10 MW_{th} capacity and ≥ 750°C outlet temperature that can be integrated and tested with a ≥ 10 MW_e sCO_2 power cycle.
- Development of a ≥ 1 MW_{th} reactor archetype that integrates solar thermal energy with industrial production of chemicals, cement, or minerals.
- Testing and integration of solar steam or heat with the product of industrial products for scaled-up reactor use.
- Enabling near-term cost, reliability, and performance improvements of commercial CST receivers.
- De-risking receiver or reactor concepts to enable novel CST systems that can achieve broad commercial deployment.

Introduction

Research into high-temperature, high-efficiency solar receivers will enable new cost-effective systems and new applications for CST. A known example is higher-temperature power towers for high-efficiency power cycles. A new application example is the development of solar and TES-fueled reactors to replace fossil energy for thermochemical production of fuels, cement, chemicals, and metals

such as steel and aluminum. This topic leverages the SOLAR Tiers methodology, described in detail in Section I.B.i above, to focus risk retirement objectives to effectively transition novel concepts to a ≥ 1 MW_{th}-scale capstone-testing campaign, with sufficient supporting information to enable commercial adoption and operation. While discussion is focused on scaling power tower systems due to their ability to scale to large industrial size and their compatibility with very high temperature requirements, applicants may also apply with receivers and reactors for other collector systems. A specific example may be moderate-temperature industrial process heat use for parabolic trough collectors.

The solar receiver or receiver/reactor system is defined as all components supporting the heat transfer medium (HTM). Components include the panel or heat exchange area where concentrated sunlight increases the HTM temperature, pumps, pipes, and similar equipment to enable the movement of the HTM, and the heat exchange system, which enables the HTM to charge TES or a chemical reactor. Applicants to this topic may consider direct solar reactors, where concentrated sunlight drives a chemical reaction without an intervening HTM, or they may propose indirect systems, where the solar energy is delivered to power a reactor somewhere other than at the receiver via a viable, CSP-relevant HTM. **Figure 7** below details the factors that make innovation in receivers challenging.

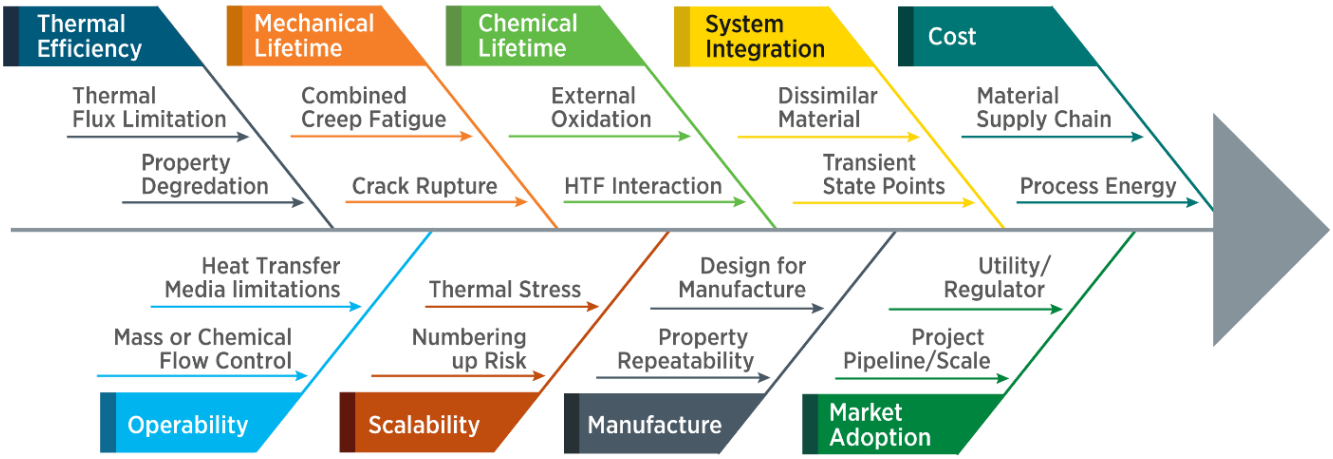


Figure 7. *Barriers to innovations in receiver technology*

Commercial and Novel Solar Receiver Systems

The state of the art in commercial CSP for electricity generation can be subdivided into two regimes: below 390°C, using parabolic trough technology, and up to 560°C power towers, generally using molten-salt HTM. Other forms exist, but these two approaches have achieved the most commercial success. Research is ongoing using DOE funding on Gen3 CSP technology with specific targets enabling a power cycle temperature at ≥ 720°C. In the years leading up to

the development of SETO's Gen3 CSP program, several promising novel receiver concepts were developed and tested at various scales. The CSP Gen3 roadmap[48] identified CSP receiver technology by HTM. The results are summarized below in **Table 4**.

Table 4. Novel Receiver/HTM Considered for Gen3 CSP

Type of Heat Transfer Media	Advantages	Disadvantages	Reference
Liquid (salt, chloride, and carbonate)	1. High heat transfer coefficient 2. HTM can be used as TES	1. Corrosion 2. High cost of system 3. Thermal conductivity not efficient 4. High cost of heat trace to maintain heat	49
Liquid metal (sodium, lead-bismuth)	1. High thermal conductivity 2. High heat transfer coefficient	1. Very corrosive 2. Risk of explosion (contact with water); risk of fire (contact with air) 3. High cost	50
Gas (pressurized CO2/H2O, low-pressure air)	1. Wide commercial supply 2. Environmentally friendly	1. Low heat transfer coefficient 2. Need indirect TES 3. Requires high pumping power	51
Particle (silica sand, ceramics)	1. Wide commercial supply 2. Environmentally friendly 3. Direct TES	1. Low effective thermal conductivity 2. Low heat transfer coefficient for indirectly irradiated receivers 3. Direct receivers require high-absorptivity particles 4. Particles face abrasion and attrition issues	52

Based on the results of the Gen3 CSP program, DOE has selected particles as the most viable near-term route to enable the temperature, efficiency, and LCOE targets of SETO's CSP program. Liquid salt receivers and high-temperature gas receivers were identified by the Gen3 program to be limited by corrosion, lifetime, and capital cost concerns. Even so, work on liquid sodium receivers at moderate temperatures (≤ 570°C) remains in development.

[48] Mehos, M., et al. January 2017. *Concentrating Solar Power Gen3 Demonstration Roadmap*. NREL. www.nrel.gov/docs/fy17osti/67464.pdf.
[49] Turchi, C., et al. July 2021. *CSP Gen3: Liquid-Phase Pathway to SunShot*. NREL. www.nrel.gov/docs/fy21osti/79323.pdf.
[50] Hosemann, P., et al. March 2020. *High Operating Temperature Heat Transfer Fluids for Solar Thermal Power Generation. Final Report.* SETO. www.osti.gov/biblio/1670850.
[51] Brayton Energy. "Gen3 Gas Phase System Development and Demonstration." www.energy.gov/sites/default/files/2021-08/Executive%20Summary%20-%20Gen3%20Gas%20Phase%20System%20Development%20and%20Demonstration%20-%20Brayton%20Energy.pdf.
[52] Ho, C. K., et al. November 2021. *Gen 3 Particle Pilot Plant (G3P3) -- High-Temperature Particle System for Concentrating Solar Power (Phases 1 and 2)*. SNL. www.osti.gov/servlets/purl/1832285.

The use of solid particles as the heat transfer media has the following advantages:

1. Solid particles function as both HTM and TES.
2. The cost of solid particles is low, especially if silica sand is used.
3. Particles are highly stable under high temperatures, well beyond the current Gen3 temperature requirements. They may ultimately be an enabling technology for high-temperature, non-electricity CST applications.

Gaseous receivers were evaluated by the Gen3 CSP program, but high-pressure gaseous receivers fail to achieve lifetime targets in enclosed nickel alloy tubes at 750°C applications.[53] In addition, high pumping cost due to receiver elevation and the need for an intermediate TES material different from the gas-heat transfer media are challenges for such systems. However, there is opportunity at lower temperatures to use indirect storage or novel concepts at higher temperatures. Pressurized gaseous receivers may be particularly suitable for high-temperature CST applications with novel receiver designs or materials.

A consortium of researchers led by NREL published the *Concentrating Solar Power Best Practices Study*.[54] A variety of receiver performance shortcomings were identified in existing commercial CSP plants. While it is unlikely that current-generation CSP concepts achieve DOE's $0.05/kWh LCOE target, concepts that have a near-term impact on the cost, reliability, and performance of commercial systems may apply. Proposals improving commercial receiver concepts should focus on a short-term pathway to commercial impact.

Beyond power applications, the use of concentrated solar heat for low- and high-temperature SIPH applications is another area of interest. DOE's *Industrial Decarbonization Roadmap*[55] subdivides industrial heat requirements into several temperature regimes: 80, 150, 300, 550, and 1,100°C. The roadmap suggests that low- and-medium-temperature process steam and heating applications below 300°C represent more than 50% of industrial energy use and CO_2 emissions. The quantity of lower-temperature (< 300°C) process heat in chemicals, food, and refining suggests there could be early opportunities for low- or no-carbon technologies that can supply heat in this range. Current state-of-the-art solar heating technologies such as parabolic trough, dish concentrators, and linear Fresnel collectors are well developed and can be used for ≤ 300°C

[53] Messner, M. C., et al. June 2022. *srlife: A Fast Tool for High Temperature Receiver Design and Analysis*. Argonne National Lab. www.osti.gov/biblio/1871331.
[54] Mehos, M., et al. June 2020. *Concentrating Solar Power Best Practices Study*. NREL. www.nrel.gov/docs/fy20osti/75763.pdf.
[55] DOE. *Industrial Decarbonization Roadmap*. www.energy.gov/industrial-technologies/doe-industrial-decarbonization-roadmap.

process heat for industry. Unique innovations to the receiver in such systems are of interest in this topic area. Concepts innovating on the integrated receiver and collector in a line-focusing or other distributed system should apply to Topic Area 1.

Potential SIPH uses at temperatures ≥ 300°C include steel, cement, chemical, and refining industries as outlined in the *Industrial Decarbonization Roadmap*. Current commercial technologies, such as molten-salt towers and troughs, can supply heat to process industries below 550°C. Research in Gen3 CSP technologies using particles has shown that these media are capable of supplying heat up to 800°C. Gen3 CSP technology has not been demonstrated beyond this temperature limit. While Gen2 and Gen3 CSP technologies can provide heat in the range of 300–800°C, no mature receiver is available to meet the needs beyond 800°C. Innovations are needed to enable new CST systems for very high-temperature applications. Other innovative HTM/receiver combinations may be best suited for targeted applications.

Solar Receiver Technical Requirements

At the most basic level, three metrics determine the impact of a solar receiver on the levelized cost of heat: cost ($/kW$_{th}$), efficiency, and lifetime. The receiver system is composed of three subsystems, including the receiver component,[56] HTM transport, control valves and emission control systems, and structural support (e.g., tower). While a broad solution space for achieving system technoeconomic goals exists between these metrics and other variables of the system, these targets will help focus applications. Applicants may apply with targets outside those described if the proposal provides a pathway to achieving critical technoeconomic targets, such as baseload power generation at $0.05/kWh$_{e}$ LCOE or $0.02/kWh$_{th}$ LCOH targets.

Cost

The current molten-salt-nitrate power tower receiver panel cost has been estimated[57] at $68/kW$_{th}$ ($46.88 million for a 695 MW$_{th}$ receiver) and $142/kW$_{th}$ for the receiver system. The cost for a falling particle receiver has been estimated at around $143/kW$_{th}$.[58] These receiver system costs include the receiver component, tower, piping (riser, downcomer), interconnects, cold pump (or equivalent), and auxiliary components (valves, sensors, etc.). SETO targets a cost < $120/kW$_{th}$ for the receiver system.

[56] The receiver component is the hardware that accepts incident light and exchanges energy to the HTM. The broader "receiver system" definition includes this component.
[57] Tilley, D., et al. December 2014. *Baseload Nitrate Salt Central Receiver Power Plant Design (Final Report)*. Abengoa Solar. www.osti.gov/servlets/purl/1165353.
[58] Ho, C. K., et al. *Gen 3 Particle Pilot Plant (G3P3)*. www.osti.gov/servlets/purl/1832285.

Efficiency

SETO targets a receiver optical-to-thermal efficiency of 90% for Gen3 CSP. This metric is inherently impacted by the target temperature of the system and the assumed illumination intensity on the receiver. This efficiency must account for all thermal energy on the receiver target area compared to the amount of thermal energy that can be delivered to TES. Optical properties of the receiver material impacting radiation losses must be accounted for, along with convection (including realistic wind speeds) and conduction losses as well as heat, which cannot be recuperated (or how to recuperate lost heat). The current state of the art for falling particle heating is approximately 800°C HTM outlet temperature with an efficiency of 50–80%,[58] and centrifugal receiver testing has exceeded 800°C with a comparable efficiency of 50–80% at varying mass flow rates and concentration ratios.[59]

Theoretically, blackbody receiver efficiency decreases with increasing concentration and receiver temperature. SETO targets an efficiency of 90% for a concentration ratio (CR) up to 1,000 suns and 800°C outlet temperature as well as a target efficiency of 85% for a cavity receiver of 1,000°C and CR of 1,400 suns. Analyses of combined receiver efficiency and solar field efficiency of CST for various concentration ratios, receiver power, and cavity temperature have been published.[60] Open-aperture particle receivers can suffer from excessive convective losses based on wind velocity. Annualized efficiency in such systems must account for expected wind conditions. Thermal loss analyses developed for molten salt panel receivers are not directly applicable. Table 5 describes receiver optical efficiency targets for various temperatures.

Pumping Losses

The pumping loss depends on the heat transfer media. For molten-salt power tower systems, M. Lubkoll, et al. describe a system with less than 10% pumping energy loss.[61] For particles, due to higher density, A. Zolan et al. describe a pumping energy loss between 2 and 5% depending on the size of the receiver.[62] For gas receivers, due to the low density and high temperatures, energy losses due to pumping or circulation are significantly higher.

[59] Lubkoll, M., et al. 2022. "Development Progress of the CentRec® Particle Receiver Technology." *AIP Conference Proceedings* 2445, 110005. doi-org.proxy.scejournals.org/10.1063/5.0086510.
[60] Zolan, A., et al. 2023. "Impact of Temperature and Optical Error on the Combined Optical and Thermal Efficiency of Solar Tower Systems for Industrial Process Heat." SolarPACES 2023.
[61] Lubkoll, M., et al. "Development Progress of the CentRec® Particle Receiver Technology." doi-org.proxy.scejournals.org/10.1063/5.0086510.
[62] Zolan, A., et al. "Impact of Temperature and Optical Error on the Combined Optical and Thermal Efficiency of Solar Tower Systems for Industrial Process Heat."

Lifetime

The lifetime is 30 years. This is the plant lifetime typically considered in the financial models that inform SETO's cost and performance targets. As in all thermal plants, replacement of parts can be a viable O&M strategy. If equipment replacement is invoked by applicants, the increased operational cost should be offset by reduced capital cost, efficiency improvements, or other attributes of the integrated system.

Table 5. Suggested Targets for Annual Receiver Efficiency (Averaged) for Varying Concentration Ratios and Cavity Temperatures

Concentration Ratio	HTM Outlet Temperature	Design Point Efficiency	Annualized Efficiency
600–1,000	565°C	94%	90%
700–1,400	1,000°C	90%	85%
800–2,000	1,200°C[63]	80%	70%

Solar Reactor Technical Requirements

Direct and indirect receiver-reactors are necessarily more complex than traditional solar receivers. While success metrics similar to that of traditional receivers should be considered for thermochemical systems, it is recognized that there may be substantial uncertainty in achieving these. Chemical gradients, reaction rates, separation, and thermal recuperation must be accounted for in technoeconomic objectives. Only then can system efficiency, reliability, and trade-off analysis be relevant. Targets set by the FOA are:

- Cost of receiver system ≤ $120/kW$_{th}$
- Cost of integrated reactor system ≤ $300/kW$_{th}$ or that necessary to attain a LCOH of $0.02/kWh$_{th}$[64]
- $15/kWh$_{th}$ for any integrated TES subsystem
- Receiver efficiency as listed in Table 5
- Lifetime of 30 years
- GHG emission reduction ≥ 70% over the life of the system.

SOLAR Tiers for Receivers and Reactors

Across each tier and as described in detail in Section I.B.i above, applications should describe the TRL-appropriate RD&D to address metrics for cost ($/kW$_{th}$), component and system efficiency, reliability, and lifetime of the technology. Based on technology maturity, O&M costs and build quality based on proposed manufacturing, assembly, and installation methods should be addressed.

[63] Novel systems targeting temperatures above 1,000°C are not well defined. Other performance and cost targets may be appropriate for very high-temperature use cases based on the requirements of the use case.

[64] Both small-scale systems and unique high-temperature systems may justify a $0.03/kWh LCOH based on the market requirements. Market analyses will be required to set LCOH for both small- and large-scale systems.

Installed cost must account for manufacture, assembly, installation, and initial calibration.

SOLAR Tier 1
Solar Tier 1 receiver and reactor projects should target proving the technology in a prototype test at a scale no less than 10 kW_{th}. Materials and manufacturing methods should be de-risked in relevant environments. Accelerated lifetime tests of high-risk failures should be accomplished. Thermophysical models should be developed and validated to an adequate extent to enable optimized component design. System-level technoeconomic analysis and commercialization plans accounting for the receiver or reactor innovations should be developed.

SOLAR Tier 2
Solar Tier 2 receiver and reactor projects must target a prototype test in an on-sun or similarly relevant environment at a scale no less than 100 kW_{th}. All risks of the components should be addressed through separate effects testing. Lifetime models of the component should be developed. Collaborations should be initiated to enable a future > 1 MW_{th} build and test of the conceptual receiver or reactor system. Clear component- and system-level performance metrics should be described that would ultimately enable market adoption. Simulated controls strategies should be developed and validated to the extent possible.

SOLAR Tier 3
This tier is reserved for adequately mature concepts able to be deployed and operated in a pilot system or a demonstration facility at a scale of at least 1 MW_{th}. Capstone tests should use the designed HTM and demonstrate all optical, thermal, and chemical interactions in a high-fidelity integrated system. The research team's test campaign is required to fully exercise the system in relevant environments, validate modeled performance under all potential operational modes, and ultimately minimize risk in transitioning this idea to a commercial demonstration plant. Justification of Tier 3 efforts must include a developed business plan and proof of specific commercial off-takers. Applicants should review cost share requirements outlined in Section III.B.iii below.

C. Applications Specifically Not of Interest

The following types of applications will be deemed nonresponsive and will not be reviewed or considered (See Section III.D. of the FOA):

- Applications that fall outside the technical parameters specified in Sections I.A. and I.B. of the FOA.

- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics).
- Systems that employ extremely hazardous materials.
- Systems to be operated in outer space.

D. Diversity, Equity, and Inclusion

It is the policy of the Biden Administration that:

[T]he Federal Government should pursue a comprehensive approach to advancing equity[65] for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality. Affirmatively advancing equity, civil rights, racial justice, and equal opportunity is the responsibility of the whole of our government. Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments, and agencies (agencies) must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity.

By advancing equity across the Federal Government, we can create opportunities for the improvement of communities that have been historically underserved, which benefits everyone.[66]

As part of this whole of government approach, this FOA seeks to encourage the participation of underserved communities[67] and underrepresented groups. Applicants are highly encouraged to include individuals from groups historically

[65] The term "equity" means the consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality.

[66] Executive Order 13985, "Advancing Racial Equity and Support for Underserved Communities Through the Federal Government" (Jan. 20, 2021).

[67] The term "underserved communities" refers to populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life, as exemplified by the list of in the definition of "equity." E.O. 13985. For purposes of this FOA, as applicable to geographic communities, applicants can refer to economically distressed communities identified by the Internal Revenue Service as Qualified Opportunity Zones; communities identified as disadvantaged or underserved communities by their respective States; communities identified on the Index of Deep Disadvantage referenced at https://news.umich.edu/new-index-ranks-americas-100-most-disadvantaged-communities/, and communities that otherwise meet the definition of "underserved communities" stated above.

underrepresented[68,69] in STEM on their project teams. Further, Minority Serving Institutions[70], Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or entities located in an underserved community that meet the eligibility requirements (See Section III.) are encouraged to apply as the prime applicant or participate on an application as a proposed partner to the prime applicant. The Selection Official may consider the inclusion of these types of entities as part of the selection decision (See Section V.C.).

As part of the application, applicants are required to describe how diversity, equity, and inclusion objectives will be incorporated in the project. Specifically, applicants are required to submit a Diversity, Equity, and Inclusion Plan that describes the actions the applicant will take to support people from underrepresented groups in STEM, advance equity, encourage the inclusion of individuals from underrepresented groups in the project, and foster a welcoming and inclusive environment. The extent the project activities will be located in, or benefit underserved communities should also be addressed (See Section IV.D.). The plan should include at least one SMART (Specific, Measurable, Attainable, Realistic, and Timely) milestone per budget period supported by metrics to measure the success of the proposed actions. This plan will be evaluated as part of the technical review process and incorporated into the award if selected.

[68] According to the National Science Foundation's 2019 report titled, "Women, Minorities and Persons with Disabilities in Science and Engineering", women, persons with disabilities, and underrepresented minority groups—blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives—are vastly underrepresented in the STEM (science, technology, engineering, and math) fields that drive the energy sector. That is, their representation in STEM education and STEM employment is smaller than their representation in the U.S. population. https://ncses.nsf.gov/pubs/nsf19304/digest/about-this-report For example, in the U.S., Hispanics, African Americans and American Indians or Alaska Natives make up 24 percent of the overall workforce, yet only account for 9 percent of the country's science and engineering workforce. DOE seeks to inspire underrepresented Americans to pursue careers in energy and support their advancement into leadership positions. https://www.energy.gov/articles/introducing-minorities-energy-initiative

[69] See also. Note that Congress recognized in section 305 of the American Innovation and Competitiveness Act of 2017, Public Law 114-329:

> (1) [I]t is critical to our Nation's economic leadership and global competitiveness that the United States educate, train, and retain more scientists, engineers, and computer scientists; (2) there is currently a disconnect between the availability of and growing demand for STEM-skilled workers; (3) historically, underrepresented populations are the largest untapped STEM talent pools in the United States; and (4) given the shifting demographic landscape, the United States should encourage full participation of individuals from underrepresented populations in STEM fields.

[70] Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities/Other Minority Institutions as educational entities recognized by the Office of Civil Rights (OCR), U.S. Department of Education, and 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.

E. Authorizing Statutes

The programmatic authorizing statute is Energy Act of 2020 Division Z Sec. 3004(b)(2)(B).

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 a total of approximately $30,000,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 8-16 awards under this FOA. EERE may issue one, multiple, or no awards. Individual awards may vary between $750,000 and $10,000,000.

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

Topic Area Number	Topic Area 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	Scalable Concentrating Solar Collectors	8-16	$750,000	Solar Tier 1: $3,000,000 Solar Tier 2: $5,000,000 Solar Tier 3: $10,000,000	$30,000,000	12-36 months
2	Scalable Supercritical Carbon Dioxide (sCO_2) Turbomachinery					
3	Scalable Concentrating Solar-thermal Receivers and Reactors					

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 1 year up to 3 years, 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, see Section VI.B.xiv.

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)[71]

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.

[71] 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/.

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.

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 and subrecipient(s) must be domestic entities. The following types of domestic entities are eligible to participate as a prime recipient or subrecipient of this FOA:

1. Institutions of higher education;
2. For-profit entities;
3. Nonprofit entities; and
4. State and local governmental entities and federally recognized Indian Tribes (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/National Nuclear Security Agency (NNSA) FFRDCs are eligible to apply for funding as a prime recipient or subrecipient.

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, DOE 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 DOE'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.

Cost Share 20% and 50%

The cost share must be at least 20% of the total project costs[72] for research and development projects and 50% of the total project costs for demonstration and commercial application (Tier 3) projects.[73] The cost share must come from non-federal sources unless otherwise allowed by law.

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 entire project, 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.

[72] Total project costs are the sum of the government share, including FFRDC costs if applicable, and the recipient share of project costs.

[73] 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.

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.K.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 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 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); or
- 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. 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; and
- 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, Full Applications, and Replies to Reviewer Comments 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, Full Application, or Reply to Reviewer Comments. Once the Concept Paper, Full Application, or Reply to Reviewer Comments 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, Full Application, or Reply to Reviewer Comments 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. Responsiveness Criteria

All "Applications Specifically Not of Interest," as described in Section I.C. of the FOA, are deemed nonresponsive and are not reviewed or considered.

E. Other Eligibility Requirements

i. Requirements for DOE/NNSA FFRDCs Listed as the Applicant

A DOE/NNSA FFRDC is eligible to apply for funding under this FOA if its cognizant Contracting Officer provides written authorization and this authorization is submitted with the application.

The following wording is acceptable for the 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.

If a DOE/NNSA FFRDC is selected for award negotiation, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory's Management and Operating (M&O) contract.

ii. 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. 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.

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

An entity may submit more than one Concept Paper and Full Application to this FOA, provided that each application describes a unique, scientifically distinct project and an eligible Concept Paper was submitted for each Full Application.

G. Questions Regarding Eligibility

EERE will not make eligibility determinations for potential applicants prior to the date on which 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 includes multiple submission 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; and
- 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. Applicant Education Services

The Department of Energy and the National Renewable Energy Laboratory developed a program under the American-Made Network to provide Applicant Education Services. The program is designed to increase the accessibility to this FOA by providing educational services to applicants for developing (1) diversity, equity, and inclusion strategy and (2) technology-to-market strategy. The services are free of charge. Applicants can reach out to and engage with the following points of contact:

- Diversity, equity, and inclusion strategy: University of Arizona Center for Innovation (Amanda Buchanan, amanda.buchanan635@gmail.com; Casey Carrillo, cCarrillo@uaci.com)
- Technology-to-market strategy: ADL Ventures (Frank Yang, frank@adlventures.com; Nicole Jacobsen, nicole@adlventures.com)

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

DOE 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	The cover page should include the project title, the specific announcement Topic Area being addressed, both the technical and business points of contact, names of all team member organizations, names of project managers senior/key personnel and their organizations, the project location(s), SOLAR Tier level, the approximate total budget of the project, and any statements regarding confidentiality.
Technology Description	4 pages maximum	Applicants are required to succinctly describe: • 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 in the relevant field and application, including key shortcomings, limitations, and challenges; • How the proposed technology will overcome the shortcomings, limitations, and challenges in the relevant field and application; • The potential impact that the proposed project would have on the relevant field and application; • 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; and • The impact that EERE funding would have on the proposed project.
Diversity, Equity, and Inclusion Plan	1 page maximum	Applicants are required to succinctly describe their approach to incorporating diversity, equity, and inclusion objectives into their project, addressing the following:

		• Innovative DEI tasks and objectives including specific and measurable accomplishments; • The impact of the activity if successful; • Explanation of how the activity is interconnected with the entire project.
Addendum	1 page maximum	Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed project team, including: • Whether the Principal Investigator (PI) and project team have the skill and expertise needed to successfully execute the project plan; • Whether the applicant has prior experience which demonstrates an ability to perform tasks of similar risk and complexity; • Whether the applicant has adequate access to equipment and facilities necessary to accomplish the effort and/or clearly explain how it intends to obtain access to the necessary equipment and facilities; and • Applicants may provide graphs, charts, or other data to supplement their Technology Description.

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.

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
SF-424: Application for Federal Assistance	PDF	n/a	ControlNumber_LeadOrganization_App424
Technical Volume	PDF	20	ControlNumber_LeadOrganization_TechnicalVolume
Resumes	PDF	3 pages each	ControlNumber_LeadOrganization_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_SOPO
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_DEIP
Budget Justification Workbook	MS Excel	n/a	ControlNumber_LeadOrganization_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide	MS PowerPoint	1	ControlNumber_LeadOrganization_Slide
Subrecipient Budget Justification	MS Excel	n/a	ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, (see DOE O 412.1A, Attachment 2)	PDF	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	n/a	ControlNumber_LeadOrganization_SF-LLL
Foreign Entity Waiver Requests and Foreign Work Waiver Requests	PDF	n/a	ControlNumber_LeadOrganization_Waiver
Current and Pending Support	PDF	n/a	ControlNumber_LeadOrganization_CPS
Location(s) of Work	Excel	n/a	ControlNumber_LeadOrganization_LOW
Transparency of Foreign Connections	PDF	n/a	ControlNumber_LeadOrganization_TFC
Potentially Duplicative Funding Notice	PDF	n/a	ControlNumber_LeadOrganization_PDFN

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. SF-424: Application for Federal Assistance

Applicants must complete the SF-424 Application for Federal Assistance, which is available on EERE Funding Application and Management Forms.

Effective January 1, 2020, the System for Award Management (SAM) is the central repository for common government-wide certifications and representations required of Federal grants recipients. As registration in SAM is required for eligibility for a federal award and registration must be updated annually, Federal agencies use SAM information to comply with award requirements and avoid increased burden and costs of separate requests for such information, unless the recipient fails to meet a federal award requirement, or there is a need to make updates to their SAM registration for other purposes.

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

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

iii. 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 20 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must 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. The Technical Volume should clearly describe and expand upon information provided in the Concept Paper.

Technical Volume Content Requirements	
SECTION/PAGE LIMIT	**DESCRIPTION**
Cover Page	The cover page should include the project title, the specific FOA Topic Area being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, names of the PI, Senior/Key Personnel and their organizations, the project location(s), and any statements regarding confidentiality.
Project Overview (Approximately 10% of the Technical Volume)	The Project Overview should contain the following information: • 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: The applicant should explicitly identify the targeted improvements to the baseline technology and the critical success factors in achieving that goal. • 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.
Technical Description, Innovation, and Impact (Approximately 30% of the Technical Volume)	The Technical Description should contain the following information: • Relevance and Outcomes: The applicant should provide a detailed description of the technology, 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. • Innovation and Impacts: The applicant should describe the current state-of-the-art in the applicable field, the specific innovation of the proposed technology, 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.
Workplan and Market Transformation Plan	The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go

(Approximately 40% of the Technical Volume)	decision points, and Project Schedule. A detailed SOPO is separately requested. The Workplan should contain the following information: • Project Objectives: The applicant should provide a clear and concise (high-level) statement of the goals and objectives of the project as well as the expected outcomes. • Technical Scope Summary: The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period. • WBS and Task Description Summary: The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the final project goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a standard WBS for any project. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. 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 to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA. The summary provided should be consistent with the SOPO. The SOPO will contain a more detailed description of the WBS and tasks. • Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a Specific, Measurable, Attainable, Realistic, and Timely (SMART) technical milestone. SMART milestones should be Specific, Measurable, Achievable, Relevant, and Timely, and must demonstrate a technical achievement rather than simply completing a task. Unless otherwise specified in the FOA, the minimum requirement is that each project must have at least one milestone per quarter for the duration of the project with at least one SMART technical milestone per year (depending on the project, more milestones may be necessary to comprehensively demonstrate progress). The applicant should also provide the means by which the milestone will be verified. The summary provided should be consistent with the Milestone Summary Table in the SOPO. • Go/No-Go Decision Points (See Section VI.B.xiv. for more information on the Go/No-Go Review): The applicant should provide a summary of project-wide 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 to 18-month period) of the project. The applicant should also provide the specific technical and DEI criteria to be used to evaluate the project at the Go/No-Go decision point. The summary provided should be consistent with the SOPO. Go/No-Go decision points are considered "SMART" and can fulfill the requirement for an annual SMART milestone. • End of Project Goal: 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. The summary provided should be consistent with the SOPO. • Project Schedule (Gantt Chart or similar): The applicant should provide a schedule for the entire project, including task and subtask durations, milestones, and Go/No-Go decision points. • Buy America Requirements for Infrastructure Projects: Within the first two pages of the Workplan, include a short statement on whether the project will involve the construction, alteration, and/or repair of infrastructure in the United States. See Appendix D for applicable definitions and other information to inform this statement. • Project Management: The applicant should discuss the team's proposed management plan, including the following: o The overall approach to and organization for managing the work; o The roles of each project team member; o Any critical handoffs/interdependencies among project team members; o The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices; o The approach to project risk management; o A description of how project changes will be handled; o If applicable, the approach to Quality Assurance/Control; o How communications will be maintained among project team members. • Market Transformation Plan: The applicant should provide a market transformation plan, including the following: o Identification of target market, 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, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, and product distribution.
Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	The Technical Qualifications and Resources should contain the following information: • A description of the project team's 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; • Relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives; • The time commitment of the key team members to support the project; • A description of the technical services to be provided by DOE/NNSA FFRDCs, if applicable; • The skills, certifications, or other credentials of the construction and ongoing operations workforce; • For multi-organizational projects, describe succinctly: ○ 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; and ○ Communication plans

iv. Resumes

A resume provides information reviewers can use to evaluate an individual's skills, experience, and potential for leadership within the scientific community. Applicants must submit a resume (limited to three pages) for each Principal Investigator and Senior/Key Personnel that includes the following:

1. Contact information;
2. Education and training: Provide name of institution, major/area, degree, and year for undergraduate, graduate, and postdoctoral training;

3. Research and professional experience: Beginning with the current position, list professional/academic positions in chronological order with a brief description. 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;
4. Awards and honors;
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. Synergistic activities: List up to five professional and scholarly activities related to the proposed effort; and
7. There should be no lapses in time over the past 10 years or since age 18, whichever period is shorter.

As an alternative to a resume, it is acceptable to use the biographical sketch format approved by the National Science Foundation (NSF). The biographical sketch format 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/researchprotection/commonform_biographicalsketch.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.

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

v. 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.

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

Letters of support or endorsement for the project from entities that do not have a substantive role in the project will not be accepted.

vi. Statement of Project Objectives (SOPO)

Applicants must complete a SOPO. A SOPO template is available on EERE Funding Application and Management Forms and on EERE eXCHANGE at https://eere-eXCHANGE.energy.gov/. The SOPO, including the Milestone Table, must not exceed 10 pages when printed using standard 8.5" x 11" paper with 1" margins (top, bottom, left, and right) with font not smaller than 12-point (except in figures or tables, which may be 10-point font).

Save the SOPO in a single Microsoft Word file using the following convention for the title "ControlNumber_LeadOrganization_SOPO".

vii. Diversity, Equity, and Inclusion Plan

As part of the application, applicants are required to describe how diversity, equity, and inclusion objectives will be incorporated in the project. Specifically, applicants are required to submit a Diversity, Equity, and Inclusion Plan that describes the actions the applicant will take to foster a welcoming and inclusive environment, support people from groups underrepresented in STEM, advance equity, and encourage the inclusion of individuals from these groups in the project; and the extent the project activities will be located in, or benefit underserved communities (also see Section I.A.iii.). The plan should be specific to the proposed project and not a restatement of an organization's policies. The plan should include at least one SMART milestone per Budget Period supported by metrics to measure the success of the proposed actions and will be incorporated into the award if selected. The Diversity, Equity, and Inclusion Plan should contain information pertaining to the following project aspects and activities:

- Equity Impacts: the impacts of the proposed project on underserved communities, including social and environmental impacts.
- Benefits: The overall benefits of the proposed project, if funded, to underserved communities; and
- How diversity, equity, and inclusion objectives will be incorporated in the project.
- That status quo of major objectives in the absence of a funding selection
- An explanation of how the DEIP is interconnected with the technical objectives of the project.

The following is a non-exhaustive list of actions that can serve as examples of ways the proposed project could incorporate diversity, equity, and inclusion elements. These examples should not be considered either comprehensive or prescriptive. Applicants may include appropriate actions not covered by these examples.

a. Include persons from groups underrepresented in STEM as PI, co-PI, and/or other senior personnel;
b. Include persons from groups underrepresented in STEM as student researchers or post-doctoral researchers;
c. Include faculty or students from Minority Serving Institutions as PI/co-PI, senior personnel, and/or student researchers, as applicable;
d. Enhance or collaborate with existing diversity programs at your home organization and/or nearby organizations;
e. Collaborate with students, researchers, and staff in Minority Serving Institutions;
f. Disseminate results of research and development in Minority Serving Institutions or other appropriate institutions serving underserved communities;
g. Implement evidence-based, diversity-focused education programs (such as implicit bias training for staff) in your organization;
h. Identify Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses and Veteran Owned Businesses to solicit as vendors and sub-contractors for bids on supplies, services, and equipment.

The Diversity, Equity, and Inclusion Plan must not exceed 5 pages. Save the Diversity, Equity and Inclusion Plan in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_DEIP".

viii. Budget Justification Workbook

Applicants must complete the Budget Justification Workbook, which is available on EERE Funding Application and Management Forms and on EERE eXCHANGE at https://eere-eXCHANGE.energy.gov/. 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.

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

ix. 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 project director/principal investigator(s), the project title, 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), and major participants (for collaborative projects). 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.

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

x. Summary Slide

Applicants must provide a single slide summarizing the proposed project. 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 technical goals;
- Proposed DEI goals
- Any key graphics (illustrations, charts and/or tables);
- The project's key idea/takeaway;
- Project title, prime recipient, PI, and Senior/Key Personnel information; and
- 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".

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.

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

xii. Budget for DOE/NNSA 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.

Prime 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.

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

xv. 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.A. 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 waiver request.

Performance of Work in the United States (Foreign Work Waiver Request)
As set forth in Section IV.K.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".

xvi. 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 or lead project manager 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 approved common disclosure format available at Common Form for Current and Pending (Other) Support (nsf.gov).

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.[74]

xvii. Locations of Work

The applicant must provide a list of locations where project work will be performed by the prime recipient or subrecipient(s) including the following information for each location:

- Location Type
- Location Type Category
- Is this a Principal Place of Performance?
- Prime or Subrecipient Location?
- If Subrecipient, Subrecipient/Community Name
- Facility Name (if applicable)
- Is location in a foreign country?
- Street Address, City, State, 5-Digit Zip Code - +4
- Briefly describe the primary activity at this location or with this population. For example, management headquarters; construction, operations, production; raw materials extraction, etc.
- Latitude/Longitude
- Does the location or community qualify as a disadvantaged community (DAC) according to the Climate and Economic Justice Screening Tool (CEJST)?
- If DAC, add the census tract number or describe the distributed disadvantaged community served (e.g., migrant workers)
- % of work performed at this location

For your convenience, a Locations of Work template is available on EERE eXCHANGE at https://eere-eXCHANGE.energy.gov/. Applicants are strongly encouraged to use the template. If the template is not used, the submission must include all of the elements described above, and as outlined in the template.

Applicants must provide the Locations of Work Documentation as a Microsoft Excel file using the following convention for the title: "Control Number_LeadOrganization_LOW."

xviii. Transparency of Foreign Connections

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

[74] Typically, these individuals have doctoral or other professional degrees, although individuals at the master's 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.

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 physical 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 percent;
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."

xix. Potentially Duplicative Funding Notice

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."

E. Content and Form of Replies to Reviewer Comments (Optional)

EERE will provide applicants with reviewer comments following the evaluation of all eligible Full Applications. Applicants will have a brief opportunity to prepare a short Reply to Reviewer Comments (Reply). The Reply must not exceed three pages. If a Reply is more than three pages in length, EERE will review only the first three pages and disregard additional pages. Applicants may use the Reply to respond to one or more comments or to supplement their Full Application. The Reply may include text, graphs, charts, or data.

EERE will post the reviewer comments in EERE eXCHANGE. The expected submission deadline is on the cover page of the FOA; however, it is the applicant's responsibility

to monitor EERE eXCHANGE if the expected date changes. The deadline will not be extended for applicants who are unable to timely submit their Reply due to failure to check EERE eXCHANGE or relying on the expected date alone. Applicants should anticipate having approximately three (3) business days to submit a Reply.

Applicants are not required to submit a Reply to Reviewer Comments. EERE will review and consider each eligible Full Application, even if no Reply is submitted or if the Reply is found to be ineligible.

F. 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.xix. Participants and Collaborating Organizations);
- Current and Pending Support (See Sections IV.E.xvi. and VI.B.xx. Current and Pending Support);
- An Intellectual Property Management Plan (if applicable) 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;
- A Data Management Plan 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.xxiii.;
- 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.

G. 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 at all times during which it 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. 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.

H. 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.

I. Intergovernmental Review

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

J. 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 (selectees) 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 their 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 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, DOE 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 DOE. 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 DOE'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 USC 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

To the greatest extent practicable, all equipment and products purchased with funds made available under this FOA should be American made. This requirement does not apply to used or leased equipment.

vii. Build America Buy America Requirements for Infrastructure Projects

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. As part of the research, technology, and economic security risk review, DOE may contact the applicant and/or proposed project team members for additional information to inform the review.

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 Guide[75] 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, organizations, and governments. The recipient will be required to provide DOE with advanced written notification of any potential collaboration with foreign entities, organizations, or governments in connection 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, organizations, or government regarding the potential collaboration or negotiating the terms of any potential agreement.

b. Existing collaborations with foreign entities, organizations, and governments. The recipient will be required to provide DOE with a written list of all existing

[75] 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

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 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 technology is unique and innovative, and how the technology will advance the current state of the art;
- The applicant has identified risks and challenges of the technology, regulatory and financial aspects of the proposal including possible mitigation strategies, and has shown the impact that EERE funding and the proposed project would have on the relevant field and application;
- The applicant has the qualifications, experience, capabilities, and other resources necessary to complete the proposed project; and
- The proposed work, if successfully accomplished, would clearly meet the objectives as stated in the FOA.

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 (50%)
This criterion involves consideration of the following factors:

Technical Merit and Innovation

- Extent to which the proposed technology, process, or project is innovative or replicable;
- Degree to which the current state of the technology and the proposed advancement are clearly described;
- Extent to which the application specifically and convincingly demonstrates how the applicant will move the state of the art to the proposed advancement;
- Sufficiency of technical detail in the application to assess whether the proposed work is scientifically meritorious and revolutionary, including relevant data, calculations, and discussion of prior work, with analyses that support the viability of the proposed work;
- Extent to which project has buy-in from needed stakeholders to ensure success;
- Degree to which key manufacturing and supply chain challenges are considered, as applicable, for viable scale-up in this and future demonstrations;
- Degree to which siting and environmental constraints are considered for deployment;
- Extent to which project has the potential to reduce emissions and provide clean energy acceleration benefits for a community or region; and
- Sufficiency of existing infrastructure to support addition of proposed demonstration.

Impact of Technology Advancement

- Ability of the project to advance 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 demonstration/deployment is replicable and may lead to future demonstrations; and
- Extent to which the project facilitates stakeholder relationships across new or existing stakeholders to gain technical buy-in and increase potential for future deployments.

Project Management

- Adequacy of proposed project management systems including the ability to track scope, cost, and schedule progress and changes;
- Reasonableness of budget and spend plan as detailed in the budget justification workbook for proposed project and objectives;
- Adequacy of contingency funding 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;
- Adequacy, reasonableness, and soundness of the project schedule, as well as annual Go/No-Go decisions prior to a budget period continuation application, interim milestones, and metrics to track process;
- Adequacy of the identification of risks, including labor and community opposition or disputes, and "timely" and appropriate strategies for mitigation and resolution; and
- Soundness of a plan to expeditiously address environmental, siting, and other regulatory requirements for the project, including evaluation of resilience to climate change.

Criterion 2: Project Research and Market Transformation Plan (25%)
This criterion involves consideration of the following factors:

Research Approach, Workplan, and SOPO

- Degree to which the approach and critical path have been clearly described and thoughtfully considered; and
- Degree to which the task descriptions are clear, detailed, timely, and reasonable, resulting in a high likelihood that the proposed Workplan and SOPO will succeed in meeting the project goals.

Identification of Technical Risks

- Discussion and demonstrated understanding of the key technical risk areas involved in the proposed work and the quality of the mitigation strategies to address them. At a minimum, discuss:
    - Technical risks,
    - Cost and Schedule risks,
        - Including potential supply chain challenges

Baseline, Metrics, and Deliverables

- Level of clarity in the definition of the baseline, metrics, and milestones; and
- Relative to a clearly defined project baseline, the strength of the quantifiable metrics, milestones, and mid-point deliverables defined in the application, such that meaningful interim progress will be made.

Market Transformation Plan

- Identification of target market, competitors, 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 3: Team and Resources (15%)
This criterion involves consideration of the following factors:

- Capability of the Principal Investigator(s) and the proposed team to address all aspects of the proposed work with a high probability of success. The qualifications, relevant expertise, and time commitment of the individuals on the team;
- Diversity of expertise and perspectives of the team and the inclusion of industry partners that will amplify impact;
- Sufficiency of the facilities to support the work;
- Degree to which the proposed consortia/team demonstrates the ability to facilitate and expedite further demonstration, development, and commercial deployment of the proposed technologies;
- Level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the Workplan; and
- Reasonableness of the budget and spend plan for the proposed project and objectives.

Criterion 4: Diversity, Equity, and Inclusion (10%)
This criterion involves consideration of the following factors:

- Clear articulation of the project's goals related to diversity, equity, and inclusion;
- Quality and impact of the project's DEI 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 DEI goals;
- Extent of engagement of organizations that represent disadvantaged communities, including Minority Serving Institutions (MSIs), Minority

Business Entities, and nonprofit or community-based organizations; and

- The extent to which DEI objectives are interconnected with the technical scope of the project.
- 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.
- Likelihood that the plan will result in improved understanding of distributional public benefits and costs related to the innovation if successful.
- 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.

iii. Criteria for Replies to Reviewer Comments

EERE has not established separate criteria to evaluate Replies to Reviewer Comments. Instead, Replies to Reviewer Comments are attached to the original applications and evaluated as an extension of the Full Application.

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. 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:

- The degree to which the proposed project exhibits technological diversity when compared to the existing DOE project portfolio and other projects selected from the subject FOA;

- The degree to which the proposed project, including proposed cost share, optimizes the use of available EERE funding to achieve programmatic objectives;
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers;
- The 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;
- The degree to which the proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications);
- The 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)); and partnerships with Minority Business Enterprises, minority-owned businesses, woman-owned businesses, veteran-owned businesses, or Indian Tribes;
- The degree to which the proposed project will employ procurement of U.S. iron, steel, manufactured products, and construction materials.
- The degree to which the proposed project avoids duplication/overlap with other publicly or privately funded work.
- The degree to which the proposed project supports complementary efforts or projects, which, when taken together, will best achieve the research goals and objectives.
- The degree to which the proposed project enables new and expanding market segments.

D. 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, and risk reviews, 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.D.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.

EERE may obtain additional information through pre-selection interviews that will be used to make a final selection determination. EERE may select applications for funding and make awards without pre-selection interviews.

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

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 response 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 (see 41 U.S.C. 2313).

The applicant, at its option, may review information in the entity information domain in 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.

DOE will consider any written comments by the applicant, in addition to the other information in the entity information domain in 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, risk reviews, and the amount of funds available in arriving at selections for this FOA.

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.

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.

A notification encouraging the submission of a Full Application does not authorize the applicant to commence performance of the project.

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 will take 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.K.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. As an alternate, 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 one-time actions applicants must take before applying to this FOA. Some of these 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 that are currently 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 should 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 with the SAM at 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 at 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 Concept Papers, and Full Applications will not be accepted through Grants.gov.

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.net, 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.

National Historic Preservation Act (NHPA)

All recipients selected for an award must comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA) prior to using Federal funds. Section 106 applies to historic properties that are listed in or eligible for listing in the National Register of Historic Places. DOE and recipients

selected for an award must consider the effects of project activities on historic properties, pursuant to Section 106 of the NHPA. DOE will perform a NHPA review under the umbrella of its NEPA review.

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 contactors 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:

(1) *''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.''*

(2) 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.

(3) 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 United States government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

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. Subject Invention Utilization Reporting

To ensure that prime recipients, subrecipients, and contractors holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, EERE may require that each prime recipient holding title to a subject

invention submit annual reports for ten (10) years from the date the subject invention was disclosed to EERE on the utilization of the subject invention and efforts made by prime recipient or their licensees or assignees 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, and such other data and information as EERE may specify.

xii. 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.

xiii. Reporting

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

xiv. 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, EERE will evaluate project performance, project schedule adherence, meeting milestone objectives, 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) EERE's Go/No-Go decision; (7) the recipient's submission of a continuation application;[76] and (8) written approval of the continuation application by the Contracting Officer.

[76] 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.

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, EERE may take appropriate action, including but not limited to, redirecting, suspending, or terminating the award.

xv. 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 United States 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 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.

xvi. 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

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.

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.

xvii. 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.

xviii. 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.

xix. 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 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.

xx. 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.E.xvii.

xxi. 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 any subrecipient and contractor 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 the recipient can show 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 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.

xxii. Interim Conflict of Interest Policy for Financial Assistance

The DOE interim Conflict of Interest Policy for Financial Assistance (COI Policy)[77] 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

[77] 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.

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.

xxiii. 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.

xxiv. 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 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.

xxv. 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 SETO.FOA.CSP@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 which 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 termination of award negotiations;
- The modification, suspension, and/or termination of a funding agreement;
- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

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 terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- DEC: On June 07, 2021, DOE approved a Determination of Exceptional Circumstances (DEC) under the Bayh-Dole Act to further promote domestic manufacture of DOE science and energy technologies. In accordance with this DEC, all awards, including sub-awards, under this FOA shall include the U.S. Competitiveness Provision in accordance with Section VI.B.xxi. U.S. Manufacturing Commitments 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 DECs 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.

i. 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 government contractors.

ii. 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, 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 under this FOA 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.

M. Copyright

The prime recipient and subrecipients 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. The term "PII" refers to information which can be used to distinguish or trace an individual's identity, such as their name, social security number, biometric records, alone, or when combined with other personal or identifying information which is linked or linkable to a specific individual, such as date and place of birth, 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, non-profit 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.

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 $1,000,000 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 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 also 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, equipment for their own 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 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 only incur 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)	$400,000	50%	50%
Task 4 (Outreach)	$100,000	100%	0%

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
$400,000 / 50% = $800,000 (Task 3 Cost)
Task 3 Cost minus federal share = non-federal share
$800,000 - $400,000 = $400,000 (non-federal share)

Task 4
Federal share = $100,000
Non-federal cost share is not mandated for outreach = $0 (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	$400,000	50%	$400,000	50%	$800,000
Task 4	$100,000	100%	$0	0%	$100,000
Totals	$2,000,000		$775,000		$2,775,000

Blended Cost Share %
Non-federal share ($775,000) divided by Total Project Cost ($2,775,000) = 27.9% (non-federal)
Federal share ($2,000,000) divided by Total Project Cost ($2,775,000) = 72.1% (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.[78] 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.xxi.); 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

[78] 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.

2. Performance of Work in the United States (Foreign Work Waiver Request)

As set forth in Section IV.K.iii., all work funded under this FOA must be performed in the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit an explicit waiver request in the Full Application. A separate waiver request must be submitted for each entity proposing performance of work outside of the United States.

Overall, a waiver request must demonstrate to the satisfaction of DOE that it would further the purposes of this FOA and is otherwise in the economic interests of the

United States to perform work outside of the United States. A request for a foreign work waiver must include the following:

1. The rationale for performing the work outside the United States ("foreign work");
2. A description of the work proposed to be performed outside the United States;
3. An explanation as to how the foreign work is essential to the project;
4. A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the U.S. economy;
5. The associated benefits to be realized and the contribution to the project from the foreign work;
6. How the foreign work 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;
7. How the foreign work will promote manufacturing of products and/or services in the United States;
8. A description of the likelihood of IP being created from the foreign work and the treatment of any such IP;
9. The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
10. The countries in which the foreign work is proposed to be performed; and
11. The name of the entity that would perform the foreign work.

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 additives[79] —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

[79] 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 materials[80] 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.

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

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 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:

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 – DEFINITION OF TECHNOLOGY READINESS LEVELS

TRL 1:	Basic principles observed and reported
TRL 2:	Technology concept and/or application formulated
TRL 3:	Analytical and experimental critical function and/or characteristic proof of concept
TRL 4:	Component and/or breadboard validation in a laboratory environment
TRL 5:	Component and/or breadboard validation in a relevant environment
TRL 6:	System/subsystem model or prototype demonstration in a relevant environment
TRL 7:	System prototype demonstration in an operational environment
TRL 8:	Actual system completed and qualified through test and demonstrated
TRL 9:	Actual system proven through successful mission operations

APPENDIX F – LIST OF ACRONYMS

COI	Conflict of Interest
CR	Concentration Ratio
CRADA	Cooperative Research and Development Agreement
CSP	Concentrating Solar-Thermal Power
CST	Concentrating Solar-Thermal
DEC	Determination of Exceptional Circumstances
DEI	Diversity, Equity, and Inclusion
DGS	Dry Gas Seal
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier
EERE	Energy Efficiency and Renewable Energy
EPC	Engineering, Procurement, and Construction
FAR	Federal Acquisition Regulation
FCOI	Financial Conflicts of Interest
FFATA	Federal Funding and Transparency Act of 2006
FFRDC	Federally Funded Research and Development Center
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
G3P3	Generation 3 Particle Pilot Plant
GAAP	Generally Accepted Accounting Principles
GW	Gigawatt
HTM	Heat Transfer Medium
IPMP	Intellectual Property Management Plan
IRB	Institutional Review Board
LCOE	Levelized Cost of Electricity
LCOH	Levelized Cost of Heat
M&O	Management and Operation
MFA	Multi-Factor Authentication
MPIN	Marketing Partner ID Number
MSI	Minority-Serving institution
MYPP	Multi-Year Program Plan
MW	Megawatt
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Agency
NSF	National Science Foundation
OIG	Office of Inspector General
OMB	Office of Management and Budget
OSTI	Office of Scientific and Technical Information
OTA	Other Transactions Authority
PII	Personal Identifiable Information

PV	Photovoltaics
R&D	Research and Development
RD&D	Research, Development, and Demonstration
RFI	Request for Information
RFP	Request for Proposal
SAM	System for Award Management
SBIR	Small Business Innovation Research
SciENcv	Science Experts Network Curriculum Vita
sCO_2	Supercritical Carbon Dioxide
SEGS	Solar Energy Generating Systems
SIPH	Solar Industrial Process Heat
SIPS	Small Innovative Projects in Solar
SMART	Specific, Measurable, Attainable, Realistic, and Timely
SNL	Sandia National Laboratories
SETO	Solar Energy Technologies Office
SOPO	Statement of Project Objectives
SPOC	Single Point of Contact
STEM	Science, Technology, Engineering, and Mathematics
TAA	Technical Assistance Agreement
TES	Thermal Energy Storage
TIA	Technology Investment Agreement
TRL	Technology Readiness Level
TW	Terawatt
UCC	Uniform Commercial Code
UEI	Unique Entity Identifier
WBS	Work Breakdown Structure
WP	Work Proposal