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

Solar-thermal Fuels and Thermal Energy Storage via Concentrated Solar-thermal Energy

Funding Opportunity Announcement (FOA) Number: DE-FOA-0003080
FOA Type: Initial
Assistance Listing Number: 81.087

FOA Issue Date:	09/21/2023
Informational Webinar:	10/16/2023 1:00 p.m. ET
Submission Deadline for Concept Papers:	11/03/2023 5:00 p.m. ET
Submission Deadline for Full Applications:	01/12/2024 5:00 p.m. ET
Expected Submission Deadline for Replies to Reviewer Comments:	02/28/2024 5:00 p.m. ET
Expected Date for EERE Selection Notifications:	04/2024
Expected Timeframe for Award Negotiations:	Summer 2024

- Applicants must submit a Concept Paper by 5:00 p.m. ET on the due date listed above to be eligible to submit a Full Application.

- To apply to this FOA, applicants must register with and submit application materials through EERE eXCHANGE at https://eere-eXCHANGE.energy.gov, EERE's online application portal.

- Applicants must designate primary and backup points-of-contact in EERE eXCHANGE with whom EERE will communicate to conduct award negotiations. If an application is selected for award negotiations, it is not a commitment to issue an award. It is imperative that the applicant/selectee be responsive during award negotiations and meet negotiation deadlines. Failure to do so may result in cancelation of further award negotiations and rescission of the selection.

- **Unique Entity Identifier (UEI) and System for Award Management (SAM)** - Each applicant (unless the applicant is excepted from those requirements under 2 CFR 25.110) is required to: (1) register in the SAM at https://www.sam.gov before

submitting an application; (2) provide a valid UEI number in the application; and (3) maintain an active SAM registration with current information when the applicant has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable UEI and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, DOE will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

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

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I. Funding Opportunity Description

A. Background and Context

i. Program Purpose

This funding opportunity announcement (FOA) is being issued by the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) Solar Energy Technologies Office (SETO). 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" to the benefit of all Americans. 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 innovations that can lead to the largescale deployment of clean energy technologies.

Specifically, this FOA will implement two approaches to energy storage in concentrated solar-thermal (CST) systems: thermochemical storage via solar fuel production and local thermal energy storage (TES) for dispatchable energy. The two technologies will support the government-wide approach to the climate crisis by driving the innovation that can lead to the deployment of clean energy technologies, which are critical for climate protection.

SETO supports solar energy RD&D, as well as technical assistance, in five areas—photovoltaics (PV), concentrating solar-thermal power (CSP),[1] systems integration, manufacturing and competitiveness, and soft costs—to improve the affordability, reliability, and domestic benefit of solar technologies on the electric grid. In May 2021, SETO released its Multi-Year Program Plan[2] which describes the activities and specific goals for 2025. In September 2021, DOE released the Solar Futures Study,[3] which examined solar power's role in achieving the decarbonization of the electricity grid and the industrial sector by 2035 and 2050. Both documents guide SETO's strategic efforts.

Solar energy technologies are essential to achieving a 100% clean electricity system by 2035 and a net-zero energy system by 2050. According to the Solar Futures Study, solar capacity will need to grow from 3% of the U.S. electricity supply today to 40% by 2035 and 45% by 2050. This will require the U.S. to install 30 gigawatts (GW_{ac}) of solar power each year between now and 2025 and ramp

[1] CSP specifically refers to electricity producing systems while CST systems produce heat for any application.
[2] https://www.energy.gov/sites/default/files/2021-06/Solar%20Energy%20Technologies%20Office%202021%20Multi-Year%20Program%20Plan%2006-21.pdf
[3] https://www.energy.gov/eere/solar/solar-futures-study

up to 60 GW_{ac} per year from 2025-2030. With supportive policies, electrification, and aggressive cost reductions, solar energy could provide 1 terawatt (TW_{ac}) of solar electricity to the grid by 2035 and 1.6 TW_{ac} of electricity by 2050. Preliminary modeling shows that decarbonizing the entire energy system could result in as much as 3 TW_{ac} of solar capacity due to increased electrification across the energy system.

This increased deployment of solar technology for electricity generation will require the development and deployment of flexible and dispatchable electricity and energy storage technologies. In 2021, DOE launched the Long Duration Storage Energy EarthShot[4] to accelerate the development of energy storage technologies that store and deliver 10 or more hours of energy (10 kilowatt hours [electrical] [kWh_e] of storage per kilowatt [electrical] of power rating). The initiative aims to reduce the cost of these technologies by 90%, to a levelized cost of storage (LCOS) of \$0.05/kWh_e by the end of this decade. Additionally, achieving a net-zero carbon energy supply by 2050 will require the adoption of clean energy technologies in sectors that are difficult to decarbonize through electrification. There are multiple pathways to achieve these goals, but all require sustained innovation across solar energy technologies.

The solar industry, which includes associated research communities, does not match the diversity of the United States' demographics. Women and minorities are underrepresented in the solar industry and in the 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.

[4] https://www.energy.gov/eere/long-duration-storage-shot

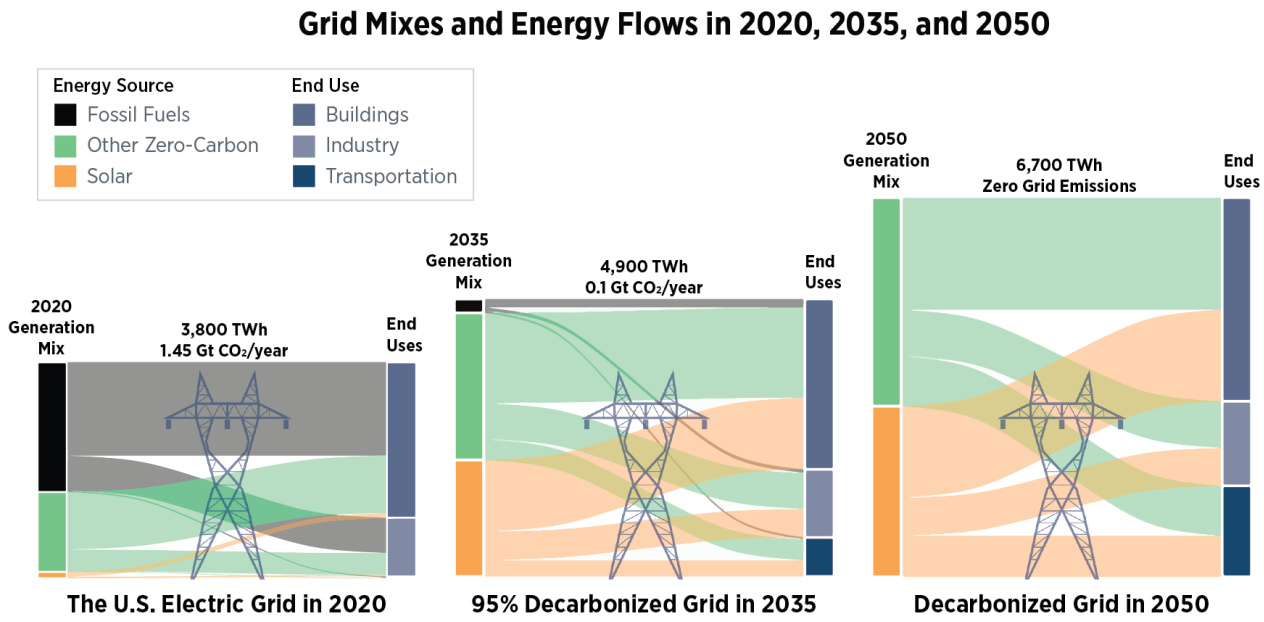

Figure 1. *Solar capacity grows from 4% of the electricity mix today to 45% in 2050, serving more building, industry, and transportation end uses. Source: National Renewable Energy Laboratory (NREL)/DOE Solar Futures Study*

To achieve the administration's energy justice goals, SETO is working to ensure that the research it funds will support more equitable participation in the solar energy research community. To this end, SETO, recognizing the inherent advantages of diverse teams, requires applicants to this FOA to include a diversity, equity, inclusion, and accessibility (DEIA) plan that describes proposed activities applicants will engage in to broaden participation from members of groups and institutions that are historically underrepresented in solar energy research.

ii. Technology Space and Strategic Goals

This FOA seeks applications to address two unique areas of interest in concentrated solar-energy: solar-thermal fuel production and solar-thermal energy storage (TES). Detailed technical descriptions of the specific Topic Areas are provided in the sections that follow.

CST technologies use the sun as a source of emission-free, high-temperature heat. CST uses fields of mirrors that track the sun and focus its rays onto a receiver. Within the receiver, that sunlight raises a heat-transfer medium to a high temperature, which can then be used to generate electricity or supply heat to a selected application. American innovation and technology development played a key role in the development of CSP technologies. The first commercial parabolic trough CSP plants—Solar Energy Generating Systems—were built in the 1980s and 1990s. The technology advanced to demonstration plants Solar

One and the SETO-supported Solar Two.[5] These plants using molten nitrate salts,have become the basis for today's CSP tower architecture.

DOE's SETO office improved integrated assembly designs with thermal energy storage that can reach operating temperatures greater than 700° Celsius (1,290° Fahrenheit). 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[6] and to build a pathway based on solid particle heat transfer media. SNL broke ground on the Generation 3 Particle Pilot Plant facility in February of 2023. Today, there are nearly 100 CSP plants producing electricity in commercial operation worldwide, representing almost 7 GW of capacity. Looking forward, SETO has set a target to lower the cost of electricity to $0.05/kWh by 2030 from baseload plants with greater than 12 hours of storage for the next generation of CSP plants.[7] All pathways require significant improvements across SETO's research areas, but greater progress in one area can allow for more moderate change in others. These interdependencies and trade-offs among cost- and performance-improvement factors create many opportunities for technology development. Figure 2 describes one potential pathway to $0.05/kWh by 2030.

[5] Pacheco, et al. Final Test and Evaluation Results from the Solar Two Project. SAND2002-0120. https://www.osti.gov/biblio/793226

[6] https://www.energy.gov/eere/articles/doe-breaks-ground-concentrating-solar-power-pilot-culminating-100-million-research, https://www.energy.gov/eere/solar/generation-3-concentrating-solar-power-systems-gen3-csp

[7] SETO. 2030 Solar Cost Targets. https://www.energy.gov/eere/solar/articles/2030-solar-cost-targets

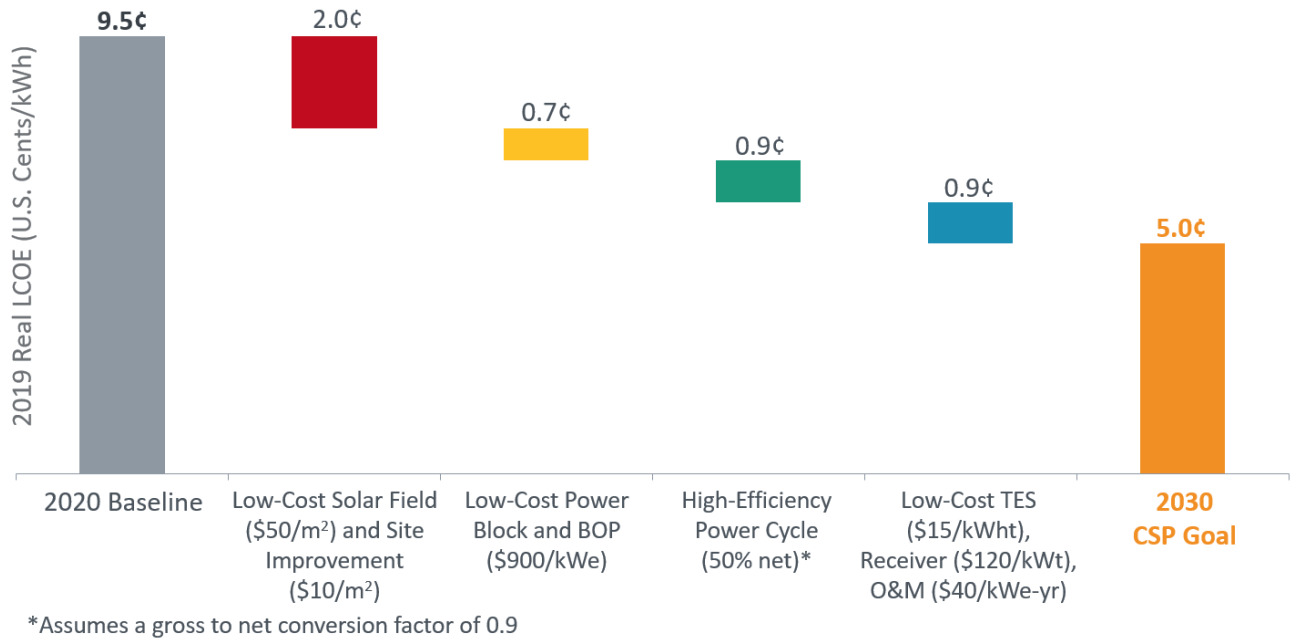

Figure 2. *One scenario for reaching the $0.05/kwh levelized cost of electricity goal from the 2018 benchmark*[8]

This FOA extends beyond using CSP solely for electricity. It targets the development solar-thermal energy storage for fuel production, other industrial applications, and power production. An impactful application of CST is using renewable solar heat to produce energy-dense liquid or solid fuels without fossil fuel precursors (Topic Area 1). A fuel can be defined as any substance that during combustion gives off a large amount of industrial and/or otherwise useful heat. A CST system can produce fuel in Direct Normal Irradiance-rich regions for transport and use in any location.

A plethora of existing thermochemical and electrochemical transformations display promise for the cost-efficient transformation of renewable heat, electricity, and energy-poor chemicals into valuable chemical fuels. Thermal energy generated by CST technologies may combine with renewable electricity to convert energy-poor exhaust gases into energy-rich fuels. Some examples may include using heat and electricity to transform steam, nitrogen, or carbon dioxide into energy-dense fuels such as hydrogen (H_2), ammonia, hydrocarbons, or synthetic fuels. The high energy density of fuels leads to very low transportation costs.

[8] SETO. "2020 SETO Peer Review Presentations." https://www.energy.gov/eere/solar/downloads/2020-seto-peer-review-presentations

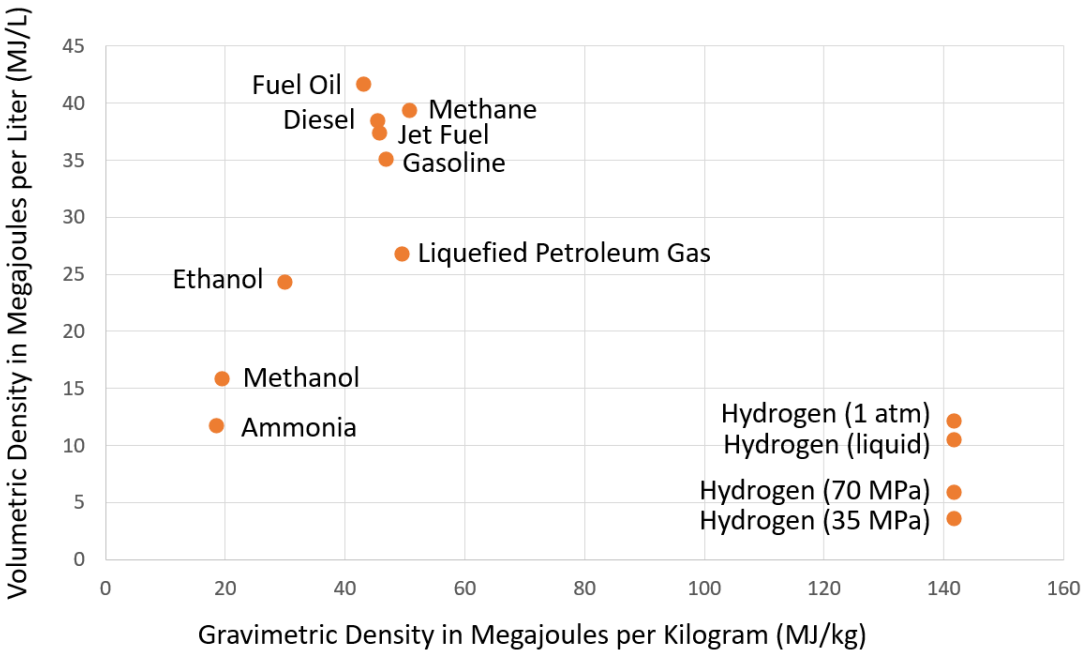

Figure 3. *This chart shows the fuel densities for well-known fuels that are representative of the fuels of interest in this FOA*[9]*.*

The direct conversion of sustainable energy sources into chemical fuels presents a potential solution to energy storage and decarbonization challenges. To significantly reduce the negative impacts of greenhouse gas (GHG) emissions from carbon-based fuels and products critical to our way of life, DOE launched the Clean Fuels & Products Shot™. The seventh initiative associated with DOE's Energy Earthshots™, this Shot focuses on decarbonizing the fuel and chemical industry through alternative sources of carbon to advance cost-effective technologies with a minimum of 85% lower GHG emissions by 2035.[10] These fuels can be transported to regions without access to decarbonized energy sources, stockpiled for extremely long-term energy storage, and may even be able to address seasonal variations of solar energy production. Additionally, solar fuels may be used to synthesize valuable chemical reagents, burned to provide high-temperature industrial process heat, or combusted to power conventional turbines or engines. In this manner, the carbon dependency of numerous difficult-to-abate sectors might be substantially reduced, all while maintaining backwards compatibility with legacy energy, industrial, and transportation infrastructure. These efforts are intended to support the Administration roadmap for "100% carbon pollution-free electricity by 2035 and net-zero GHG emissions by 2050," for which DOE has released the industrial decarbonization roadmap document in 2022.[11]

[9] https://www.eia.gov/todayinenergy/detail.php?id=14451
[10] https://www.energy.gov/eere/clean-fuels-products-shottm-alternative-sources-carbon-based-products
[11] https://www.energy.gov/sites/default/files/2022-09/Industrial%20Decarbonization%20Roadmap.pdf

CST coupled with TES is a particularly promising approach to long duration energy storage (Topic Area 2). Integration with TES systems is a principal advantage of CSP, as it enables reliable power generation that compares favorably with intermittent renewables like solar PV and wind coupled with battery storage. CSP-TES systems can achieve high-capacity factors using molten salts, rock bed, or heated particles for thermal storage, and these systems can scale storage duration independently of the power block. CST-TES integration systems may also enable 24/7 operation needed for an industrial process plant to justify its capital expenditure costs. This FOA topic is intended to be applicable to power, industrial process heat, and renewable solar fuel production.

Significant scientific and technoeconomic challenges must be overcome before CST-integrated routes to solar fuels reach commercial maturity. These range from advancements in catalyst activity and lifetime to successful integration and on-sun demonstration. For solar fuel production, most of these areas for improvement are highly specific to the fuel being produced and its route to synthesis. However, there is a need for substantial reductions in operating temperature for the chemical transformations for CSP-TES integration. Although on-sun temperatures on the order of 900°C are achievable with incumbent tower-based CSP receivers, the temperature of the thermal reservoir used for TES functionally sets the maximum deliverable temperature during off-sun operation. While TES for power applications allow the use of renewable energy around the clock and TES for industrial process heat allow industrial plants to operate nearly 24/7, renewable thermal fuels allow long distance transport and long duration supply of energy to all sectors. Thus, TES for power, industrial process heat, and renewable fuels represent a critical step towards 100% decarbonization.

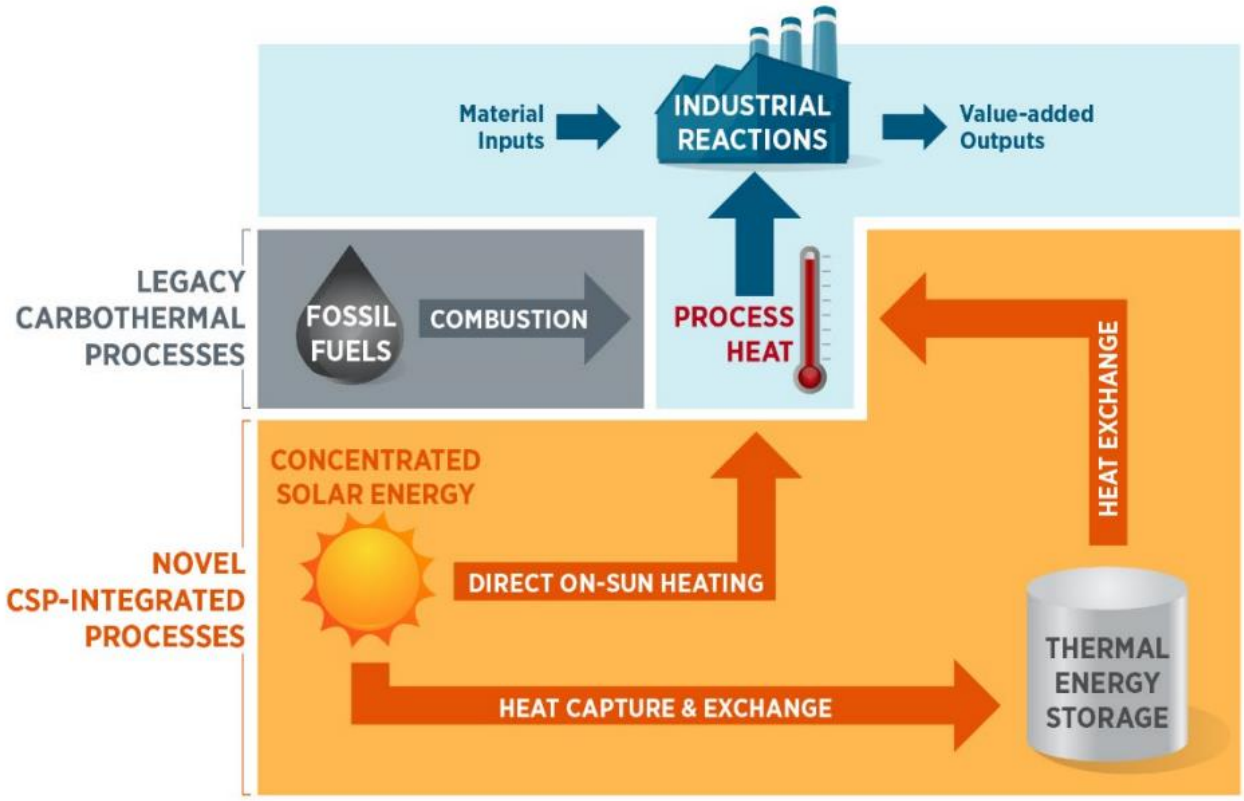

Figure 4. *Conceptualized replacement of fossil energy using concentrated solar thermal*

Gen3 CSP powerplants are envisaged to operate at temperatures exceeding 700°C, along with 12 or more hours of thermal energy storage, to achieve the cost target of $0.05/kWh and enable potential deployment between 25 and 150 GW of U.S. capacity by 2050.[12] Beyond electricity generation, CSP technology can also be used in thermally driven industrial processes to help meet the industrial decarbonization goals.[13] Several industrial processes, including calcination for cement production, steel production, ammonia production, and solar fuels, require temperatures in excess of 1000°C. Operation in high-temperature, harsh environments presents new material challenges. This requires materials with high yield strengths, high creep/fatigue resistance, improved resistance to environmental conditions such as oxidation, corrosion, etc., resistance to time-dependent crack growth, phase stability, and improved thermal shock and ductility.

Researchers, plant designers, and end users have primarily focused on nickel-based superalloys for high-temperature applications in power and aviation industries. The advanced-ultra supercritical (A-USC) steam boiler and turbine

[12] C. Murphy, Y. Sun, W. Cole, G. Maclaurin, C. Turchi, and M. Mehos. "The Potential Role of Concentrating Solar Power within the Context of DOE's 2030 Solar Cost Targets." 2019.

[13] SETO Fiscal Year 2022 Concentrating Solar-Thermal Power Research, Development, and Demonstration Funding Program | Department of Energy

consortia has supported development of materials for operations up to temperatures of 760°C.[14,15] These A-USC materials are mainly nickel-based superalloys and a few ferritic and austenitic steels. The temperature requirements for Gen3 CSP are similar to the A-USC, hence, several of the A-USC materials can be used for the fabrication of relevant components, such as heat exchangers, receivers, pipes, tubes, and valves. The DOE CSP program has continuously funded nickel alloy research for Gen3 CSP since 2012. Research so far suggests that 740H and H282 are the most promising for several of the harshest CSP applications.[16] 740H and H282 are still in their early stages of adoption in industries with a limited number of suppliers, which makes their choice cost prohibitive. Inconel 617 and 625 and Haynes 230 have also seen considerable interest and research. Along with nickel alloys, A-USC research also extends to martensitic 9-12% Cr steels for applications around 650°C. However, these alloys are yet to be proven for long term reliable operations for applications in CSP.

The motivation to pursue higher temperature applications will necessitate both maturation of A-USC materials and the development of novel materials that can operate between 760°C and 1400°C. Innovations in material and manufacturing must be strongly tied to a specific component research for CST or Gen3 CSP systems. Material research for high-temperature components that operate beyond 760°C including receivers; receiver-reactors; primary heat exchangers; energy storage materials; containment materials for storage, coating, and window materials; and ancillary components, such as piping, tubing, valves, and turbine materials. The material classes that are of interest for further research and development include but are not limited to: oxide and non-oxide ceramics, ceramic matrix composites, ultra-high temperature ceramics (borides, carbides of transition metals) and their composites, MAX phase materials, functionally graded materials, coatings, oxide dispersion-strengthened nickel alloys, and high entropy alloys. Figure 5 shows material development needs overlayed on a typical technology readiness level (TRL) maturation paradigm.

[14] D.L. Klarstrom and L.M. Pike and V.R.Ishwar, "Nickel-Base Alloy Solutions for Ultrasupercritical Steam Power Plants." Procedia Eng., 55 (2013), 221-225

[15] J. Shingledecker, R. Purgert and P. Rawls, "Current Status of the U.S. DOE/OCDO A-USC Materials Technology Research and Development Program." Advances in Materials Technology for Fossil Power Plants Proceedings from the Seventh International Conference October 22–25, (2013).

[16] Shingledecker, Siefert: DOI: https://link.springer.com/chapter/10.1007%2F978-3-319-89480-5_1

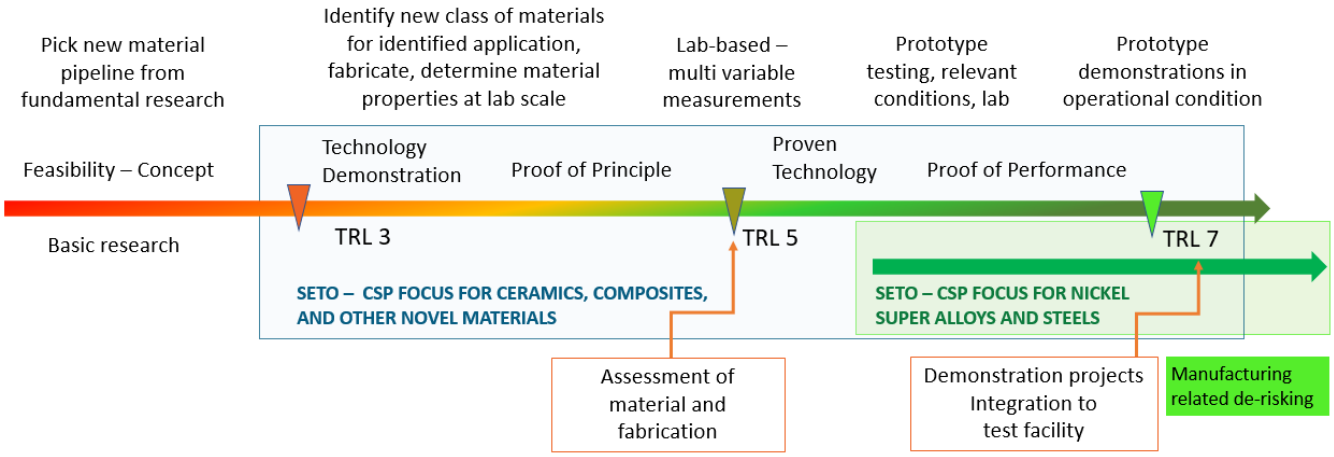

Figure 5. *Material research priority for high-temperature CSP components.*

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

The SOLAR Tiers methodology is common to both topic areas in this FOA. A methodology of translating lab-scale research and development (R&D) projects to large-scale pilot demonstrations is outlined. New industrial-use thermal technology development is inherently challenging due to non-linear size and performance correlations. 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 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 0.001-0.1 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 adoption of developing projects. Bench-scale experiments often use processes, parts, or designs that may be unsuitable for commercial systems. While these designs may minimize variables outside the specific research project scope, their findings may not translate for scaled-up systems. Early involvement of partners with appropriate industrial knowledge and a line of sight to demonstration efforts can accelerate technology development by addressing these designs at smaller scales while significant iteration is still feasible. Large-scale thermal system projects require significant capital investment where a trial-and-error testing approach is not tenable.

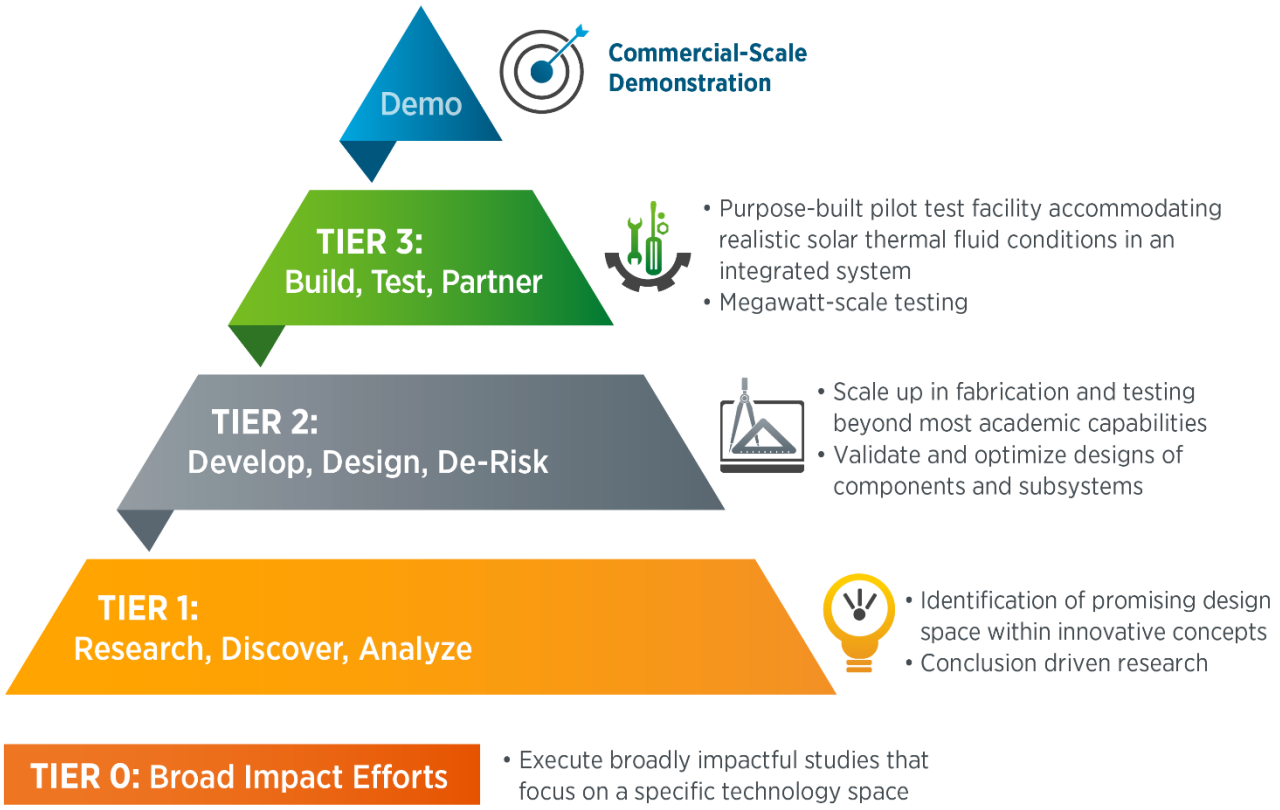

Figure 6. *SOLAR Tier Structure*

In both topic areas, applicants must explicitly indicate which of three SOLAR Tiers their project addresses.[17] 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.

- Tier 1: Research, Discover, Analyze; up to $3M federal funds
- Tier 2: Develop, Design, De-Risk; up to $5M federal funds
- Tier 3: Build, Test, Partner; up to $10M federal funds
- Tier 0: Synergistic Technology Advancement; up to $2M federal funds

Tiers and Stage-Gates

[17] In limited cases, teams may propose efforts that are broadly beneficial to a well-understood technology space and not focus on scaling a specific technology. These are called "Tier 0." Such proposals will be judged on the extent to which results can be communicated and used in an impactful manner.

Tier 1. Research, Discover, Analyze

Most Tier 1 projects should focus on broadly understanding a specific innovative technology. Design and risk assessment development should iteratively influence Tier 1 activities. This may include exploring an appropriate discovery space to give confidence that leading candidates for critical aspects of the systems have been identified or that they do not exist. Meritorious outcomes may also include convincingly 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, typically at the 1-100 kilowatt scale, should be fabricated and studied in low-fidelity testing environments at appropriate temperatures. Research activities may include, but are not limited to: material characterization, durability and accelerated lifetime testing of materials, integrated system design and techno-economic analyses, heat transfer characterization of novel heat transfer or thermal storage media, evaluation of test plans, performance validation or analysis of resulting data, analytical methodologies or computational tools to assess a broad range of existing and new technologies, development of novel materials systems along with joining strategies and methods, and multiphysics model validation.

Tier 2. Develop, Design, De-Risk

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 the 0.1-1.0 MW scale (or 1-10 MWh). Components should be shown to operate in tandem (such as 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. Design and costing work should inform a path into Tier 3 for a large-scale integrated test facility. Material property lifetime testing campaigns should closely resemble the operating environment. Where appropriate, a pathway to industry acceptance of new materials should be integrated into the project. The uncertainty on each component's efficiency over each operating mode 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 into a Tier 3-sized system. Furthermore, significant engagement with a candidate Tier 3 test facility should begin 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, Partner

Tier 3 projects will encompass procurement, construction or installation, commissioning, and testing at an identified test facility for a pilot-scale system. Research teams are expected to execute a testing campaign that fully exercises a component or 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. 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_{th} 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 isolation.

Progressing between Tiers

If successful, applicants to Tier 1 or 2 should explicitly plan to graduate their project to Tier 2 and/or Tier 3 in future, analogous solicitations. Pending appropriations and budget availability, SETO may run future solicitations to allow successful project teams to apply for funding to subsequent tiers. Successful Tier 1 or 2 projects will need to apply to future solicitations to advance work to Tier 2 and/or 3. At DOE's discretion, applications may be reassigned from one tier to another based on reviewers' assessment of technology maturity described in the application.

***Table 1**. SOLAR Tier Maturation Attributes*

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 component boundaries are primary focus.	Design accounts for nuances and operational limitations of all components. Innovations are tested coupled to neighboring components or boundary conditions.	The entire sub-system is optimized and tested together.
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 boundaries conditions used for a range of 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; 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 relevant code case; do post-testing analysis of MW-scale prototype; supporting measurements
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 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, either via volume purchases or possible design revisions; validate performance functions at scale

Tier 0: Broad Impact Efforts

For both topic areas, proposals which respond to broad challenges of a known technology are sought. Unlike Tier 1, 2, and 3 responsive proposals, Tier 0 efforts do not seek to advance a novel technology design to commercialization. Instead, Tier 0 proposals should respond to synergistic challenges limiting the broader technology space's commercial adoption. These efforts may focus on research, analysis, stakeholder engagement, engineering studies, tool development, *etc*.

B. Topic Areas

The section is divided into two areas:

1. Topic Area 1: Solar-Thermal Fuel Production
2. Topic Area 2: Solar-Thermal Energy Storage

i. Topic Area 1: Solar-Thermal Fuel Production

Topic Area 1 solicits RD&D applications to produce fuels synthesized using CST-generated heat potentially supported by renewable electricity. Six areas of interest are described. Applications should be responsive to the SOLAR Tier methodology (described above) seeking to advance technologies to commercial adoption (Tier 1-3). Research proposals on specific topics with broad value to stakeholders are also appropriate (Tier 0).

CST provides a unique opportunity to generate renewable, high quality thermal energy for fuel production. Table 2 lists five specific and one general area of interest for CST integration into specific fuel production processes. This Topic Area solicits concepts where CST is an enabling energy source that results in targeted GHG emission reductions. In many cases, combined thermo-electro approaches are appropriate. The benefits of a thermo-electro approach may be conceptualized using the water splitting reaction as an example. Water splitting exists on a continuum, with pure thermolysis at 2500°C to electrolysis at room temperature. In effect, all systems between these extremes are thermoelectrochemical in nature, as applied potentials may reduce the temperature needed to turn over a thermochemical water-splitting redox couple and elevated temperatures may reduce the necessary overpotential for water electrolysis.

Although purely electrochemical routes to fuels using green electricity are a critical component of a zero-carbon economy, this FOA focuses on direct heat integration with electrochemical processes to produce renewable fuels. As such, proposals that use electricity only or seek to develop low-temperature electrolysis (<100 °C) systems are not of interest. Additionally, proposals that evaluate the use of bio-based material precursors and bio-based routes are not of interest.

Table 2 summarizes select solar-to-fuel conversions and processes that have been identified as high-interest for this Topic, either due to their technical maturity or the perceived impact of successful integration with CST-TES systems. These areas of interest are discussed in further detail below. Additionally, applicants may submit proposals for other solar-to-fuels strategies (Interest 1.6). For all topics, concepts must reduce GHG emissions by at least 70% without negating a competitive technoeconomic case for the fuel. The applicant must determine baseline emissions from existing refining and petrochemical processes. Note, Interest Areas 1.1 and 1.4 focus on near-term technologies, and SETO is open to Tier 3 projects that are demonstration-ready if they create significant on-ramp for future CST deployment and broad learnings about the system. Solar Tier 1 proposals will be deemed nonresponsive in these areas. However, for all interest areas, Tier 0 proposals that respond to synergistic

challenges limiting the broader technology space's commercial adoption will be accepted. The funding request should correspond to the SOLAR tier corresponding to the proposal.

Table 2. *Topic Area 1 Interest Areas*

Interest Area	Topic Title	Applicable	SOLAR Tier
1.1	Thermoelectrochemical Water and CO_2 Splitting	YES	0/2/3
1.2	Thermochemical Water and CO_2 Splitting	YES	0/1/2/3
1.3	Syngas Production	YES	0/1/2/3
1.4	Liquid Fuels Production	YES	0/2/3
1.5	Ammonia Production	YES	0/1/2/3
1.6	Additional Solar-Thermal-to-Fuel Strategies	YES	0/1/2/3
-	Hydrogen using Low Temperature Electrolysis	NO	-
-	Hydrogen and syngas production using photocatalysis and Bio based materials	NO	-

1.1 Thermoelectrochemical Water and CO_2 Splitting

Currently, the primary methods for hydrogen production rely on carbon-based fuels which generate carbon emissions. CST presents an alternative approach to enable hydrogen production using novel water-splitting catalysis or carbon monoxide (CO) production using carbon dioxide (CO_2). These approaches may enable efficiencies and selectivities far in excess of those even theoretically achievable by incumbent low-temperature electrolysis (LTE) systems. Beyond CO production, electrolysis of CO_2 to ethanol, ethylene, formic acid, methane, and methanol have been reported in the literature.[18]

High-temperature solid-oxide electrolysis (HTSE) is one approach to high-efficiency hydrogen generation using a water source. Industrial interest in HTSE is focused on solid-oxide electrolysis cells (SOECs), which typically operate at temperatures above 800°C. These temperatures provide an additional thermal driving force for the water splitting reaction, reducing the equilibrium potential of the electrochemical reaction by around half a volt compared to LTE systems. Typical estimates for thermal energy are small, 6 kWh_{th}/kg, for heat at thermo-neutral temperatures of 800°C and 35-40 kWh_e/kg of hydrogen for electrical energy. The energy input and temperatures required from CST are rather nominal, as most of the heat used to bring the input steam and air to 800°C can be obtained via recuperation.

[18] Bobadilla, L.F.; Azancot, L.; Luque-Álvarez, L.A.; Torres-Sempere, G.; González-Castaño, M.; Pastor-Pérez, L.; Yu, J.; Ramírez-Reina, T.; Ivanova, S.; Centeno, M.A.; et al. Development of Power-to-X Catalytic Processes for CO2 valorisation: From the Molecular Level to the Reactor Architecture. Chemistry 2022, 4, 1250–1280. https://doi.org/10.3390/chemistry4040083

The Hydrogen and Fuel Cell Technologies Office (HFTO) is responsible for[19] HTSE material research and research for long-term operation, which is not part of this FOA. This FOA seeks the integration of HTSE with CST-TES and the generation of hydrogen for further use in syngas and other fuel production. Conversion of CO_2 to fuels and chemicals using concentrated solar thermal energy is also encouraged in the current FOA. Specific metrics are provided in Table 3, which lists H_2 targets only; CO_2 splitting targets are not available and defined by the final product made.

***Table 3**. Topic Area 1.1 Thermoelectrochemical Water Splitting Targets and Metrics (focused on H_2; CO_2 applicants are encouraged to identify equivalent metrics)*

Objective/ Goal [1, 2]	**Metric**	**Nominal**	**Stretch Target**	**Baseline Performance**
Reduce H_2 Cost	Cost, $/kg H_2	<2	1	>4
System Electricity Consumption	kWh/kg H_2 (efficiency)	<36 (≥93%)	<35 (≥95%)	<38 (≥88%)
Thermal energy[3] Consumption	kWh-th/kg H_2	<8	<7	<9
Total Energy Efficiency[4]		≥76%	≥79%	≥71%
GHG Reduction	Percentage	≥70%	≥85%	Applicant Defined
Uninstalled System Capital Cost[5]	$/kW	≤500	≤200	≤2,500
Lifetime[6]	Hours	≥40,000	≥80,000	≥20,000

1 Derived from Table "Technical Targets for High Temperature Electrolyzer Stacks and Systems," HFTO site, https://www.energy.gov/eere/fuelcells/technical-targets-high-temperature-electrolysis
2 All performance, durability, and capital cost targets must be met simultaneously on the same stack or system for achieving the hydrogen cost targets.
3 The difference between "Electrical Efficiency" and "Total Energy Efficiency" values can be used to better estimate the thermal energy consumption.
4 Includes both electrical and thermal energy inputs.
5 An "Electrolysis System" that includes the stack and balance of plant with various heat exchangers and an interface with CST must be defined and cost estimated.
6 Use the definitions from https://www.energy.gov/eere/fuelcells/technical-targets-high-temperature-electrolysis for definition of uninstalled cost and lifetime

1.2 Thermochemical Water and CO_2 Splitting

[19] David Peterson, Ned Stetson, Dimitrios Papageorgopoulos, William T Gibbons and Katie Randolph, U.S. DOE EERE Activities in High Temperature Electrolysis and Reversible Fuel Cells, 2021 Meet. Abstr. MA2021-03 2 DOI 10.1149/MA2021-0312mtgabs

Thermochemical water splitting (TCWS) and CO_2 splitting are areas of interest. Commercial interest in such systems primarily centers around two-step thermochemical cycles. In these systems, a metal oxide catalyst is initially partially reduced using high-temperature heat. Subsequently, the reduced catalyst can exothermically react with water to produce hydrogen or with CO_2 to produce CO. CST systems with the high-temperature step occurring in the receiver or coupled with TES can enable high-temperature splitting. Applications focused on thermochemical water and CO_2 splitting should go beyond fundamental materials-level catalyst development, which is supported by HFTO. Proposals should address innovative and integrated system concepts with CST and TES for commercial relevance. Applications at all SOLAR tiers are sought that focus on improved redox materials with high product evolution rates, low temperature difference between reduction and oxidation cycles, high-capacity receiver/reactor, high cycle capability of material, heat recovery in solid and gas phase. The key technological risks particular to this application and targets are discussed in Table 4.

Table 4. *Topic Area 1.2 Thermochemical Water and CO2 Splitting Targets and Metrics*

Objective/Goal	Target	Stretch Value	Baseline
Solar Reactor Production	Up to 400 kW_{th}	1-2 MWth	Applicant Defined
Maximum Reactor Temperature*	1,200°C	1,000°C	>1,500°C
Solar-Gas Efficiency	10%	20%	Applicant Defined
Active Material productivity	250 moles/kg	375 moles/kg	Applicant Defined
Catalyst Stability	10,000 cycles	100,000 cycles	Applicant Defined
GHG Reduction	70%	85%	Applicant Defined
Hydrogen Production Cost	$2.5/kg	$1/kg	Applicant Defined

*Maximum reactor temperature set to reduce cost and to avoid ultra-high temperature materials for construction

1.3 Syngas Production from Water and CO_2

Syngas (Synthesis Gas) is a widely used, versatile gas mixture that can be upgraded to make various chemicals and fuels. It is a mixed gas composition that primarily consists of H_2 and CO, where the ratios of each component depend on synthetic processes to make the gases and the desired downstream products. Currently, the two main approaches used to produce syngas rely on fossil fuels like coal and natural gas as a feedstock.

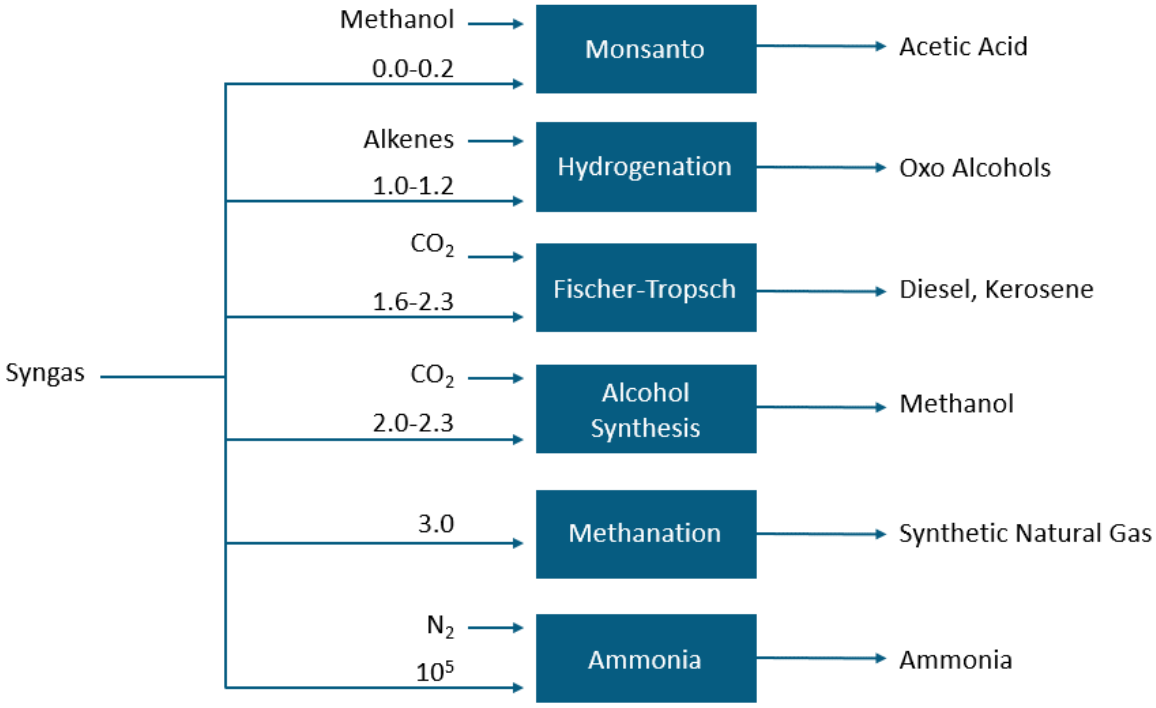

Figure 7. *Spectrum of Syngas Composition for Various Downstream Products*

At least two methods have been identified for producing syngas using water or CO_2 as feedstock with high-temperature CST; however, proposals that extend beyond these examples are acceptable:

1. Solar Thermochemical Water and/or CO_2 Splitting
2. Reverse Water Gas Synthesis (RWGS) to produce CO, using H_2 from electrolysis or otherwise

Interest area 1.2 focused on the thermochemical splitting of water *or* CO_2, while this section considers simultaneous thermochemical splitting to offer a thermodynamically favorable pathway to syngas production. With co-thermochemical splitting, the quality of the syngas may be controlled *in situ*, potentially tailoring a mixture of hydrogen and CO that may be suitable for Fischer-Tropsch (FT) synthesis of hydrocarbons (Interest 1.4). A practical study of Syngas[20] synthesis using a tower receiver established the feasibility of producing 2:1 H_2/CO_2 using thermochemical splitting with an efficiency of solar-to-syngas of 4.1%. This direct approach eliminates the energy penalty associated with additional steps for adjusting the syngas mixture, but there is room for improvement.

[20] Schäppi, R., Rutz, D., Dähler, F., Muroyama, A., Haueter, P., Lilliestam, J., Patt, A., Furler, P., Steinfeld, A. (2022): Drop-in fuels from sunlight and air, Nature 601, pp. 63-68. https://doi.org/10.1038/s41586-021-04174-y.

The reverse water gas shift reaction is another promising reaction for CST integration. In the RWGS, a catalyst can be used to help convert CO_2 and hydrogen into CO and water. The RWGS may be paired with another method to generate the reactant hydrogen using solar-thermal or renewable-generated electricity. At low reaction temperatures, the mildly endothermic RWGS reaction competes with methanation, which is thermodynamically favored. However, at the high temperatures of CSP (~700 °C), the catalytic RWGS reaction is favored.

Since the H_2:CO content of syngas for various products depend on the product slate, specific metrics for this topic are hard to generate. Applicants should compare with a generic natural gas-based process and identify appropriate benchmarks for conversion efficiency, GHG reduction, and cost based on current state of the art.

1.4 Liquid Fuels Upgradation

This interest area focuses on producing various chemical fuels or other chemical precursor materials using syngas as a reactant. FT synthesis is a mature process used commercially to convert syngas to methanol and long-chain hydrocarbons. This reaction can be generalized as shown in Eq 1, where hydrogen and CO are reacted to produce liquid fuels ($C_nH_{(2n+2)}$) (where n is typically > 10) and water is generated as a byproduct.[21] FT reactors typically operate at 230-240 °C and 25-40 bar.

$$(2n+1)H_2 + n\,CO \rightarrow C_nH_{(2n+2)} + n\,H_2O\;\Delta H = -152\;kJ/mole$$

As discussed in interest 1.3, the RWGS may be used to produce syngas using solar thermal energy from on-sun receiver reactors or from thermal energy storage. RWGS may integrate with FT processes to produce liquid fuels in a streamlined fashion. Table 5 provides the targets for scaleup and integration, including GHG reduction. Pre-pilot and Pilot scale projects correspond to Tier 2 and Tier 3 SOLAR tiers.

Table 5. *Topic Area 1.5 Liquid fuels production Targets and Metrics*

	Pre-pilot (SOLAR Tier 2)	**Pilot (SOLAR Tier 3)**	**Demonstration**
Allowable Primary Products	Sustainable aviation fuel, renewable diesel, sustainable marine fuels	Sustainable aviation fuel, renewable diesel, sustainable marine fuels	Sustainable aviation fuel, renewable diesel, sustainable marine fuels

[21] Vincent Dieterich, Alexander Buttler, Andreas Hanel, Hartmut Spliethoff and Sebastian Fendt, "Power-to-liquid via synthesis of methanol, DME or Fischer–Tropsch-fuels: a review," Energy Environ. Sci., 2020, 13, 3207-3252.

Minimum Throughput	8 million British Thermal Units (MMBTU)/day of gas equivalent; or 35 gallons per day of final fuel equivalent for processes that utilize CO2 as a feed (12,500 gallons per annum)	16 MMBTU/day of gas equivalent; 25,000 gallons of per annum; or 70 gallons per day	1,000,000 gallons of fuel per year; 800 MMBTU/day of biogas equivalent
Full Integration	No	Yes	Yes
Minimum GHG Reduction	70%	70%	70%
Fuel Selling Price	$2.75/GGE	$2.75/GGE	$2.75/GGE
Cumulative Time on Stream	500 hours	1,000 hours	1,000 hours
Continuous Time on Stream	100 hours	200 hours	500 hours
Phased Project	No	Yes	Yes

GGE = Gasoline gallon equivalent
GHG = Greenhouse gases
Full integration refers to integration with precursor generation and integration with solar and TES in addition to heat integration between the liquid processes and previous steps.

1.5 Ammonia Production

Ammonia production is industrially performed in a two-stage process. In the first step, hydrogen is produced, typically using primary and secondary steam methane reforming (SMR) reactors. This is followed by the Haber–Bosch reaction where ammonia is synthesized with a multistep process using hydrogen, nitrogen, and CO as reactants.

Proposals are welcome for innovative technologies, particularly at Tier 1 or 2 levels, for CST integration with ammonia production pathway. Hydrogen production is discussed earlier in Topic Area 1, however other innovative concepts for CST-integration with ammonia synthesis and the Haber-Bosch process are of interest. Applicants may use the current Haber-Bosch process as a baseline for their proposed scope of work.

1.6 Additional Solar-Thermal-to Fuels Strategies

Additional strategies to generate fuels and chemical feedstocks using concentrated solar-thermal are welcomed. Proposals should establish the

current state-of-the-art in these areas and should demonstrate incorporation with CST systems. Such proposals should justify their technology based on the value of the generated chemical product or the perceived market opportunity for energy storage or transport. Applicants are encouraged to develop metrics that are applicable to their research that follow or are similar to those in Tables 3, 4 and 5.

ii. Topic Area 2: Concentrating Solar Thermal Energy Storage

This topic solicits technology development proposals for thermal energy storage systems which can be driven by concentrated solar thermal energy input. The use case may be specifically for electricity production (CSP) or other specified CST applications, such as industrial process heat, chemical production, or fuel production. Proposals may fall into one of two categories: SOLAR Tier 1-3 responsive concepts that seek to de-risk specific technology concepts and advance to commercial testing, or Solar Tier 0 proposals that seek to overcome isolated challenges applicable to a broad range of TES technologies for commercial CST applications, including CSP.

The increased drive to decarbonize the U.S. electricity grid and industrial heat sector has led to several initiatives in DOE that impact TES research. In November 2022, the DOE Office of Clean Energy Demonstrations (OCED) opened applications for nearly $350 million in funding to develop Long-Duration Energy Storage solutions to support a low-cost, reliable, carbon-free electric grid.[22] This was followed by OCED offering $30 million for LDES demonstration projects at the national labs. In parallel, DOE provided $385 million in 2022 to develop cost-competitive industrial heat decarbonization technologies with at least 85% lower greenhouse gas emissions by 2035.[23]

SETO has supported R&D efforts to improve the reliability, lower the costs, and develop new CST+TES technologies for a variety of system applications. Previous initiatives included open solicitations, such as the SunShot and APOLLO FOAs, as well as programs focused specifically on advancing TES technologies, including the ELEMENTS FOA, the FIRM TES Topic within the SETO FY2019 FOA, and the Pumped Thermal Energy Storage Topic in the SETO FY2021 FOA.[24] Additionally, SETO has funded system-level integration efforts that incorporate TES, including the 2017 Gen3 CSP Systems FOA and the Integrated TESTBED topic within the

[22] https://www.energy.gov/articles/biden-harris-administration-announces-nearly-350-million-long-duration-energy-storage
[23] https://www.energy.gov/sites/default/files/2022-09/earth-shot-industrial-heat-fact-sheet.pdf
[24] Concentrating Solar Power Competitive Awards | Department of Energy

SETO FY2020 FOA. Other DOE offices are also supporting TES R&D, including the DAYS program from ARPA-E,[25] and the Office of Fossil Energy.[26]

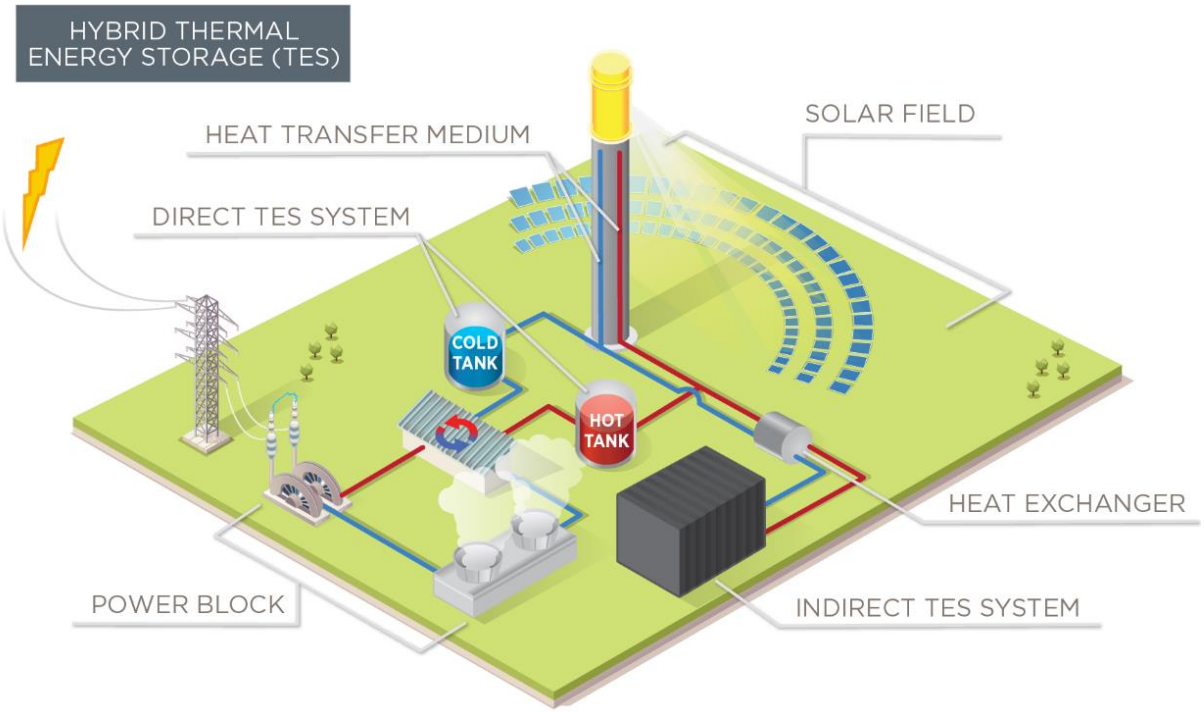

Figure 8. *CSP plant with hybrid TES: Two different TES systems may be used because each has a unique value and cost. In one possible embodiment, shown here, the direct TES system provides a more efficient and timely response, while the indirect TES system can store substantially more energy at a cheaper cost per kWh.*

Unlike most previous SETO FOA topics on thermal energy storage, this topic solicits proposals focused on industrial sector applications and electricity production use cases. Applicants to this FOA must describe concepts that are synergistic and thermodynamically workable with solar thermal energy as an input. Concepts must target, at a minimum, 10 hours of thermal storage (kWh_{th} per kW_{th} of power capacity). Broadly, systems of interest can be divided by 1) the use case and 2) the temperature regime. For the purposes of this topic, low-temperature systems require energy below 350°C, moderate-temperature systems operate between 350°C and 550°C (competing with Solar Salt), and high-temperature systems operate above 550°C.

Direct/Indirect/Hybrid: Existing commercial power tower CST+TES systems, such as the two-tank nitrate salt design, are examples of a **direct** configuration where the heat-transfer medium (HTM) cycling through the solar receiver also serves as

[25] https://arpa-e.energy.gov/technologies/programs/days
[26] https://netl.doe.gov/energy-asset-transformation

the TES medium.[27] Alternatively, the TES system can be **indirect**, in which the medium storing energy requires a thermal exchange with the HTM.[28]

Additionally, **hybrid** system concepts could exist that use a combination of direct and indirect storage and multiple TES media (See Figure 7). Such a system may be appropriate to allow the system to satisfy multiple levels of storage requirement (i.e., daily storage and seasonal storage). TES in CSP plants can take a variety of forms including systems that use the **sensible** heat stored by changing the temperature of a medium, the **latent** energy stored and released during the phase change of a material, or the **thermochemical** energy stored in a cycled endothermic/exothermic chemical reaction.[29] Thermochemical energy storage designs tend to have significantly higher volumetric energy density than sensible or latent system, which tends to make them more amenable to addressing very long duration storage applications, due to the lowered costs of storing large volumes of storage material.

TES System Components: A complete TES system concept must account for:

- The TES medium
- The TES containment vessels
- Any relevant heat exchangers, including heat exchange into the power cycle or process heat application working fluid
- Any associated chemical reactor or reactant storage for thermochemical energy storage
- Transport of the TES medium (e.g., salt pumps, particle conveyance systems)
- Piping, component interface, and auxiliary hardware
- Physical and operational integration with the full CSP plant

Applicants should describe the expected cost of their proposed TES system in dollars per kilowatt-hour thermal ($/kWh$_{th}$) and describe the expected cost sensitivity as a function of storage duration. Each of the above TES system components should be accounted for in a conceptual commercial system technoeconomic analysis. Some of these costs scale with the thermal throughput rate ($/kW$_{th}$), while others scale with the amount of thermal energy stored ($/kWh$_{th}$). Applicants are encouraged to describe these scaling relationships for their specific TES system. Note that depending on the expected operational concept, the charge rate (kW$_{th}$) may be very different from the discharge rate

[27] example: https://www.energy.gov/eere/success-stories/articles/eere-success-story-mirage-reality-energy-department-investment-brings

[28] example: https://www.energy.gov/lpo/solana

[29] Stekli, Joseph, Levi Irwin, and Ranga Pitchumani. "Technical challenges and opportunities for concentrating solar power with thermal energy storage." Journal of Thermal Science and Engineering Applications 5.2 (2013).

(kW_{th}). Applications should explicitly describe assumptions and methodologies used in any technoeconomic analyses.

Applicants should also provide a quantified energy and mass balance to demonstrate a full accounting of energy efficiency and expected operational modes of the system. A well-designed solar thermal energy storage system has high energetic efficiency and high exergetic efficiency after accounting for charge, hold, and discharge of the TES subsystem.

To provide a complete accounting of system cost and performance, the following must be described:

1. Capital costs of the TES system components
2. Operational costs
3. Designed component and system lifetime, which may dictate maintenance expectations and operational costs
4. Energetic and exergetic system efficiency. Low exergetic efficiency ultimately places a cost on the receiver and solar field.
5. The requirements/limits imposed on the total solar thermal facility by the TES concept. This may include specific operational modes, specific input/output temperature limitations, or scaling limitations.

Examples of recent research in TES areas:

1) Commercial Molten Nitrate Salt (Solar Salt)
Most commercial CSP plants use a 60%/40% mixture of sodium and potassium nitrate nicknamed Solar Salt, and the cost of a nitrate salt TES system is reasonably well known to be in the range 25-50 $/kWh$_{th}$-hr.[30] Solar Salt tank design has been highlighted as a primary concern in the CSP Best Practices Study.[31]

2) Other Molten Salt Systems

[30]Technical Report NREL/TP-5500-57625, Molten Salt Power Tower Cost Model for the System Advisor Model (SAM) Craig S. Turchi and Garvin A. Heath National Renewable Energy Laboratory (2013).
[31] Technical Report NREL/TP-5500-57625, Molten Salt Power Tower Cost Model for the System Advisor Model (SAM) Craig S. Turchi and Garvin A. Heath National Renewable Energy Laboratory (2013).

Beyond Solar Salt, other salt mixtures such as Carbonate,[32] and $MgCl_2$-NaCl-KCl mixtures have been studied.[33,34,35]

3) Flowing Particle Systems

DOE's Gen3 CSP initiative has advanced the use of flowing hot particles as a thermal storage media and a replacement for the heat transfer fluid.[36,37,38,39,40] Particles are unique for their broad range of temperature applicability, lack of corrosion risk, opportunities to handle with less need of expensive containment materials and piping, and the opportunity to use very cheap materials, such as sand.

4) Rock Bed TES

The other means of solid TES utilizes large-diameter rock beds through which air (or another fluid) is moved, transferring heat from solar receiver; and extracting heat via air (or other fluid) to the application. Notwithstanding the poor heat transport properties of air, rock bed TES is one of the lowest cost TES systems available.

5) Solid-Liquid Phase Change TES

Latent TES systems have been commercially applied in building energy technologies at very low temperatures. For CST and CSP, systems harvesting the enthalpy of fusion have been studied for higher-temperature applications. The system is charged by melting the TES media with energy supplied by the heat-transfer fluid (HTF). A cooler HTF is later used to extract the energy causing the TES media to freeze.

6) Thermochemical Energy Storage (TCES)

Thermochemical energy storage offers significant upside, as well as technical challenges. Storing energy in molecular bonds can be over an order of magnitude more energy dense than sensible or latent energy storage. Additionally, the

[32] Turchi, Craig S., Judith Vidal, and Matthew Bauer. "Molten salt power towers operating at 600–650 C: Salt selection and cost benefits." Solar Energy 164 (2018): 38-46.

[33] Zhao, Youyang and Klammer, Noah and Vidal, Judith, ""Purification strategy and effect of impurities on corrosivity of dehydrated carnallite for thermal solar applications", RSC Advances, 2019,9, 41664-41671

[34] B. A. Pint, J. W. McMurray, A. W. Willoughby, J. M. Kurley, S. R. Pearson, M. J. Lance, D. N. Leonard, H. M. Meyer, J. Jun, S. S. Raiman and R. T. Mayes, (2019) "Reestablishing the paradigm for evaluating halide salt compatibility to study commercial chloride salts at 600°-800°C," Materials and Corrosion, 70 (2019) 1439-1449.

[35] Klammer, N.; Engtrakul, C.; Zhao, Y.; Wu, Y.; Vidal, J., Method To Determine MgO and MgOHCl in Chloride Molten Salts. Analytical Chemistry 2020, 92 (5), 3598-3604.

[36] Chung, Ka Man, et al. "Measurement and analysis of thermal conductivity of ceramic particle beds for solar thermal energy storage." Solar Energy Materials and Solar Cells 230 (2021): 111271.

[37] Mills, Brantley, et al. Technoeconomics of Particle-based CSP Featuring Falling Particle Receivers with and without Active Heliostat Control. No. SAND2022-13437. Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2022.

[38] Albrecht, Kevin, et al. Performance Evaluation of a Prototype Moving Packed-Bed Particle/sCO_2 Heat Exchanger. No. SAND2022-12615. Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2022.

[39] Buck, Reiner, and Jeremy Sment. "Techno-economic analysis of multi-tower solar particle power plants." Solar Energy 254 (2023): 112-122.

[40] Sment, Jeremy, et al. "Design considerations for a high-temperature particle storage bin." AIP Conference Proceedings. Vol. 2303. No. 1. AIP Publishing LLC, 2020.

quality of energy can have negligible decay with time, making TCES ideal for very long-duration seasonal storage.

High-temperature thermal energy storage requires analysis of the thermo-mechanical stresses placed upon the storage system upon temperature cycling. These stresses may be exacerbated by the dissolution, corrosion, or general degradation that may occur on the inside and the outside of the storage vessel. The TES material itself must be of high thermal stability for extended lifetimes (30 years). In addition, the following equations for metrics are used for TES energetic efficiency (η) and exergetic efficiency (ζ):

$$\eta = \frac{Q_{out}}{Q_{in}} \quad (1)$$

$$\zeta = \frac{Q_{out}}{Q_{in}}\frac{W_{out}}{W_{in}} = \frac{Q_{out}}{Q_{in}}\frac{\left(1-\frac{T_\infty}{T_{PB}}\right)}{\left(1-\frac{T_\infty}{T_{RO}}\right)} \quad (2)$$

where Q_{in} is the total energy transferred from the HTF to the storage system during charging, Q_{out} is the total energy transferred from the storage system to the HTF during discharging, T_{PB} is the temperature of the working fluid at the inlet of the turbine in Kelvin, T_{RO} is the temperature of the HTF at the outlet of the receiver in Kelvin, and T_∞ is the ambient temperature, nominally taken to be 293K.

Specific to thermocline TES, additional equations for the quality of temperature during charge and discharge cycles are considered. One example of thermocline impact on temperature degradation is an increase of the heat-transfer fluid outflow temperature during charging, relative to the inflow temperature during discharging, and a decrease of the HTF outflow temperature during discharging, relative to the inflow temperature during charging. The maximum changes are expressed as:

$$\Delta T_{c,out,max} = \frac{T_{c,out,max} - T_{d,in}}{T_{c,in} - T_{d,in}} \quad (3)$$

$$\Delta T_{d,out,max} = \frac{T_{c,in} - T_{d,out,min}}{T_{c,in} - T_{d,in}} \quad (4)$$

where max and min, refer to maximum and minimum temperatures in thermocline; in and out refer to fluid inlet and outlet temperatures in the thermocline; and c and d refer to charging and discharging cycles.

Thermocline TES utilization factor (ε) refers to the energy utilization from the stored energy.

$$\varepsilon = \frac{E_{util}}{E_{stor}} \quad (5)$$

Equations (3)-(5) pertain only to thermocline TES.

Table 6 provides select targets for Topic area 2; however, the targets are defined by application, either utility power or Industrial Process Heat (IPH); and for IPH, based on the application. The targets have been provided for a utility power 700°C application. However, the applicant is encouraged to redefine the objective targets for each defined application, namely, exergetic and energetic efficiencies and TES costs/LCOH. For each application, the targets have to be redefined based on the industry need.

Table 6. *Topic Area 2 TES Targets and Metrics for differing TES applications*

Definition	**Target**	**Comments**
Application	IPH Utility Power	Select application area to focus on temperature
Temperature for Focus Area	<350°C 350-550°C >550°C	Temperature of TES is determined by application and heat required for reaction/power
Temporal Requirements	Charge Time	Select based on application requirements
	Hold Time (user-defined)	
	Discharge Time (>10 hours)	
Objective/Goal	**Target**	**Comments**
Energetic Efficiency	Utility electricity 99% IPH user defined	Applicant needs to justify energetic- and exergetic-efficiency targets based on the application and scale
Exergetic Efficiency	Utility electricity 95% IPH user defined	
TES Capital Cost	15 $/kWh	
LCOH Requirement	$20/MW$_{th}$	LCOH cost definition includes collector field, receiver, and TES system
Temperature Stability: Equations (3), (4) $\Delta T_{(c,out,max)}$,$\Delta T_{(d,out,max)}$	10%	Modify if applications allow broader temperature
Thermocline Utilization Factor, ε, Equation (5)	70%	Only if thermocline used for TES

Solar Tier 0 TES Proposals

Proposed research, analysis, information dissemination and other TES development efforts may not be compatible with the described SOLAR Tiers methodology. Such proposals should explicitly state why and how their unique approach will be broadly impactful to the commercialization of CST systems.

All work for projects selected under this FOA must be performed in the United States. See Section IV.K.iii. and Appendix C.

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).
- Solar fuels produced using bio-based precursors and bio-based technologies are not eligible for funding.
- Low-temperature TES (< 150 °C) for use in building and low temperature technologies are not eligible.
- Low-temperature electrolysis.
- TES and solar fuel systems that cannot be coupled to CSP.

D. Community Benefits Plan

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

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

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 8-15 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	Solar-Thermal Fuel Production	4-8	$750,000	$10,000,000	$15,000,000	12-36 months
2	Concentrating Solar Thermal Energy Storage	4-8	$750,000	$10,000,000	$15,000,000	12-36 months

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

ii. Period of Performance

EERE anticipates making awards that will run from 12 months up to 36 months in length, comprised of one or more budget periods. Project continuation will be contingent upon several elements, including satisfactory performance and

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

iii. New Applications Only

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

B. EERE Funding Agreements

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

i. Cooperative Agreements

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

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

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

ii. Funding Agreements with Federally Funded Research and Development Center (FFRDCs)[41]

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

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.

[41].

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 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[42] for R&D projects, and 50% of the total project costs for demonstration and commercial application projects.[43] The cost share must come from non-federal sources unless otherwise allowed by law.

Examples of activities that would be considered demonstrations under Topics 1 and 2 include all Tier 3 activities where no research and development is planned. Examples include testing an existing or GEN II CSP plant with a purchased SOEC, testing a purchased TES system with an existing CSP System, or integrating a modular gas-to-liquid plant with a prototype CO and H_2 production electrolyzers.

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

i. Legal Responsibility

Although the cost share requirement applies to the project as a whole, including work performed by members of the project team other than the prime recipient, the prime recipient is legally responsible for paying the entire cost share. If the funding agreement is terminated prior to the end of the project period, the prime recipient is required to contribute at least the cost share percentage of total expenditures incurred through the date of termination.

The prime recipient is solely responsible for managing cost share contributions by the project team and enforcing cost share obligation assumed by project team members in subawards or related agreements.

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

[43] 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.

a. 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 any of the following sources to meet its cost share obligations:

- Revenues or royalties from the prospective operation of an activity beyond the project period;
- Proceeds from the prospective sale of an asset of an activity;

- Federal funding or property (e.g., federal grants, equipment owned by the federal government); 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.

iii. 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.

iv. 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.

v. 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 and Non-DOE/NNSA FFRDCs Included as a Subrecipient

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

a. Authorization for non-DOE/NNSA FFRDCs
The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with its authority under its award.

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

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

c. Funding, Cost Share, and Subaward with FFRDCs

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

Unless instructed otherwise by the DOE Contracting Officer for the DOE award, all FFRDCs are required to enter into a Cooperative Research and Development Agreement[44] (CRADA) or, if the role of the DOE/NNSA FFRDC is limited to technical assistance and intellectual property (IP) is not anticipated to be generated from the DOE/NNSA FFRDC's work, a Technical Assistance Agreement (TAA), with at least the prime recipient before any project work begins. Any questions regarding the use of a CRADA or TAA should be directed to the cognizant DOE field IP counsel.

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

d. Responsibility
The prime recipient will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues including, but not limited to disputes and claims arising out of any agreement between the prime recipient and the FFRDC.

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

DOE 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.

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

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).

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

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

C. Content and Form of the Concept Paper

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

Section	Page Limit	Description
Cover Page	1 page maximum	The cover page should include the project title, the specific announcement Topic Area being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, the project location(s), and any statements regarding confidentiality.
Technology Description	4 pages maximum	Applicants are required to describe succinctly: • 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.
Community Benefits Plan	1 pages maximum	Applicants are required to succinctly describe their approach to the Community Benefits Plan, addressing the three core elements: • Advance diversity, equity, inclusion, and accessibility; • Contribute to energy equity; and • Invest in America's workforce.
Addendum	1 pages maximum	Applicants are required to succinctly describe 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 worked together with its teaming partners on prior projects or programs; • 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
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
SF-424: Application for Federal Assistance	PDF	n/a	ControlNumber_LeadOrganization_App424
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, if applicable (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
Community Benefits Plan	PDF	5	ControlNumber_LeadOrganization_CBP
Current and Pending Support	PDF	n/a	ControlNumber_LeadOrganization_CPS
Transparency of Foreign Connections	PDF	n/a	ControlNumber_LeadOrganization_TFP
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. 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 or focus area, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project. • Feasibility: The applicant should demonstrate the technical feasibility of the proposed technology and capability of achieving the anticipated performance targets, including a description of previous work done and prior results. This section should also address the project's access to necessary infrastructure (e.g., transportation, water, electricity transmission), including any use of existing infrastructure, as well as to a skilled workforce. • Innovation and Impacts: The applicant should describe the current state-of-the-art in the applicable field, the specific innovation of the proposed technology or focus area, the advantages of proposed technology over current and emerging technologies, and the overall impact on advancing the state-of-the-art/technical baseline if the project is successful.

Workplan (Approximately 40% of the Technical Volume)	The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go 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, including milestones in the Community Benefits Plan. • 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.xv. 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. See Section VI.B.xiv. The applicant should also provide the specific technical and community benefits plan 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:
	  ○ The overall approach to and organization for managing the work;
	  ○ The roles of each project team member;
	  ○ Any critical handoffs/interdependencies among project team members;
	  ○ The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices;
	  ○ The approach to project risk management, including a plan for securing a qualified workforce and mitigating risks to project performance including but not limited to community or labor disputes;
	  ○ A description of how project changes will be handled;
	  ○ If applicable, the approach to Quality Assurance/Control; and

	○ How communications will be maintained among project team members. • Market Transformation Plan: The applicant should provide a market transformation plan, including the following: ○ 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 formal cost modeling or methodology; identification of substantial reduction in possible ranges for most parameters based upon experimentation; verification and validation of the conclusions by an independent third party; validation of component costs via purchase orders; team and vendor roadmap(s) to further component cost reductions, either via volume purchases or possible design revisions; validation of performance functions at scale. ○ 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

iii. 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://nsf.gov/bfa/dias/policy/nsfapprovedformats/biosketch.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".

iv. 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".

v. Statement of Project Objectives (SOPO)

Applicants must complete a SOPO. A SOPO template is available at: EERE Funding Application and Management Forms. 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".

vi. SF-424: Application for Federal Assistance

Applicants must complete the SF-424 Application for Federal Assistance, which is available at: EERE Funding Application and Management Forms. The list of certifications and assurances in Field 21 can be found at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms, under Certifications and Assurances. Note: The dates and dollar amounts on the SF-424 are for the complete project period and not just the first project year, first phase or other subset of the project period.

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

vii. Budget Justification Workbook

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

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

viii. Summary for Public Release

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

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

ix. 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 goals;
- Any key graphics (illustrations, charts and/or tables);
- The project's key idea/takeaway;
- Topline community benefits;
- Project title, prime recipient, PI, and Senior/Key Personnel information; 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".

x. 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".

xi. 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 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".

xii. 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".

xiii. SF-LLL: Disclosure of Lobbying Activities (required)

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.

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

xiv. Waiver Requests (if applicable)

Foreign Entity Participation
For projects selected under this FOA, all recipients and subrecipients must qualify as domestic entities. See Section III. To request a waiver of this requirement, the applicant must submit an explicit waiver request in the Full Application. Appendix C lists the information that must be included in a waiver request.

Foreign Work Waiver Request
As set forth in Section IV.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.

xv. Community Benefits Plan

The Community Benefits Plan must set forth the applicant's approach to ensuring the Federal investments advance the following three objectives: (1) DEIA; (2) energy equity; and (3) investing in America's workforce. The below sections set

forth the content requirements for the Community Benefits Plan, which addresses each of these objectives. Applicants must address all three sections.

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

The plan should be specific to the proposed project and not a restatement of an organization's policies. Applicants should describe the future implications or a milestone-based plan for identifying future implications of their research on energy equity, including, but not limited to, benefits for the U.S. workforce. These impacts may be uncertain, occur over a long period of time, and/or have many factors within and outside the specific proposed research. Applicants are encouraged to describe the influencing factors and the most likely workforce and energy equity implications of the proposed research if the research is successful. While some guidance and example activities are provided in Appendix I, applicants are encouraged to leverage promising practices and develop a plan tailored to their project.

The Community Benefits Plan must not exceed [five] pages. It must be submitted in PDF format using the following convention name for the title "ControlNumber_LeadOrganization_CBP." This Plan must address the technical review criterion titled, "Community Benefits Plan." See Section V. of the FOA.

The Community Benefits Plan must address the following three sections:

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

2) **Energy Equity:**

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

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

See Appendix I for more guidance.

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

For every activity, list the following items:

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

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

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

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

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

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

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

Definitions:

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

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

Senior/key personnel – An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research,

development and demonstration (RD&D) project proposed to be carried out with a DOE award.[45]

xvii. Locations of Work

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

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

1. Entity name, website address and mailing address;
2. The identity of all owners, principal investigators, project managers, and senior/key personnel who are a party to any *Foreign Government-Sponsored Talent Recruitment Program* of a foreign country of risk (i.e., China, Iran, North Korea, and Russia);
3. The existence of any joint venture or subsidiary that is based in, funded by, or has a foreign affiliation with any foreign country of risk;
4. Any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity;
5. Percentage, if any, that the proposed recipient or subrecipient has foreign ownership or control;
6. Percentage, if any, that the proposed recipient or subrecipient is wholly or partially owned by an entity in a foreign country of risk;
7. Percentage, if any, of venture capital or institutional investment by an entity that has a general partner or individual holding a leadership role in such entity who has a foreign affiliation with any foreign country of risk;

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

8. Any technology licensing or intellectual property sales to a foreign country of risk, during the 5-year period preceding submission of the proposal;
9. Any foreign business entity, offshore entity, or entity outside the United States related to the proposed recipient or subrecipient;
10. Complete list of all directors (and board observers), including their full name, citizenship and shareholder affiliation, date of appointment, duration of term, as well as a description of observer rights as applicable;
11. Complete capitalization table for your entity, including all equity interests (including LLC and partnership interests, as well as derivative securities). Include both the number of shares issued to each equity holder, as well as the percentage of that series and all equity on a fully diluted basis. Identify the principal place of incorporation (or organization) for each equity holder. If the equity holder is a natural person, identify the citizenship(s). If the recipient or subrecipient is a publicly traded company, provide the above information for shareholders with an interest greater than 5%;
12. A summary table identifying all rounds of financing, the purchase dates, the investors for each round, and all the associated governance and information rights obtained by investors during each round of financing; and
13. An organization chart to illustrate the relationship between your entity and the immediate parent, ultimate parent, and any intermediate parent, as well as any subsidiary or affiliates. Identify where each entity is incorporated.

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

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

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 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.xviii. Participants and Collaborating Organizations);
- Current and Pending Support (See Sections IV.E.xvii. and VI.B.xix. Current and Pending Support);
- 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 when the applicant has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable UEI and SAM requirements. If an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, DOE will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

NOTE: Due to the high demand of UEI requests and SAM registrations, entity legal business name and address validations are taking longer than expected to process. Entities should start the UEI and SAM registration process as soon as possible. If entities have technical difficulties with the UEI validation or SAM registration process they should use the HELP feature on SAM.gov. 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 (selectee) must request prior written approval to charge pre-award costs. Pre-award costs are those incurred prior to the effective date of the federal award directly pursuant to the negotiation and in anticipation of the federal award where such costs are necessary for efficient and timely performance of the scope of work. Such costs are allowable only to the extent that they would have been allowable if incurred after the date of the federal award and **only** with the written approval of the federal awarding agency, through the Contracting Officer.

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

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

1. **National Environmental Policy Act (NEPA) Requirements Related to Pre-Award Costs**
   EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA. Applicants should carefully consider and should seek legal counsel or other expert advice before taking any action related to the proposed project that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to EERE completing the NEPA review process.

   EERE does not guarantee or assume any obligation to reimburse pre-award costs incurred prior to receiving written authorization from the Contracting

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

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

1. Requirement

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

2. Failure to Comply

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

3. Waiver

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

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

iv. Construction

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

v. Foreign Travel

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

vi. Equipment and Supplies

Property disposition may be required at the end of a project if the current fair market value of property exceeds $5,000. For-profit entity disposition requirements are set forth at 2 CFR 910.360. Property disposition requirements for other non-federal entities are set forth in 2 CFR 200.310 – 200.316.

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.

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[46] to gain an understanding of the requirements and possible actions the recipients, subrecipients, contractors, and subcontractors must take. Additional guidance may also be found in the National Policy Assurances, produced by DOE.

xiii. Foreign Collaboration Considerations

a. Consideration of new collaborations with foreign entities and governments. The recipient will be required to provide DOE with advanced written notification of any potential collaboration with foreign entities or governments in connection with its DOE-funded award scope. The recipient will then be required to await further guidance from DOE prior to contacting the proposed foreign entity or government regarding the potential collaboration or negotiating the terms of any potential agreement.

b. Existing collaborations with foreign entities and governments. The recipient will be required to provide DOE with a written list of all existing foreign collaborations in which has entered in connection with its DOE-funded award scope.

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

[46] 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

VI. 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.

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 (10%)
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: Community Benefits Plan (15%)
This criterion involves consideration of the following factors:

Diversity, Equity, Inclusion and Accessibility

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

Energy Equity

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

Workforce Implications

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

iii. Criteria for Replies to Reviewer Comments

DOE 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 demonstration and commercialization and overcome key market barriers;

- The degree to which the proposed project is likely to lead to increased high-quality employment and manufacturing in the United States;
- 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, when compared to the existing DOE project portfolio and other projects to be selected from the subject FOA, contributes to the total portfolio meeting the goals reflected in the Community Benefits Plan criteria; and
- The degree to which the proposed project will employ procurement of U.S. iron, steel, manufactured products, and construction materials.

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, 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.

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 responses to EERE's written clarification questions or video or conference calls with EERE representatives.

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

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

iv. Recipient Responsibility and Qualifications

DOE, prior to making a federal award with a total amount of federal share greater than the simplified acquisition threshold, is required to review and consider any responsibility and qualification information about the applicant that is in the entity information domain in SAM.gov (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, 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.

VII. 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.

iii. Full Application Notifications

EERE will notify applicants of its determination via a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE eXCHANGE. The notification letter will inform the applicant whether or not its Full Application was selected for award negotiations. Alternatively, EERE may notify one or more applicants that a final selection determination on particular Full Applications will be made at a later date, subject to the availability of funds or other factors.

iv. Applicants Selected for Award Negotiations

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

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

Please refer to Section IV.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, which means EERE may consider the Full Application for federal funding in the future. A notification letter stating the Full Application is

designated as an alternate does not authorize the applicant to commence performance of the project. EERE may ultimately determine to select or not select the Full Application for award negotiations.

vi. Unsuccessful Applicants

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

B. Administrative and National Policy Requirements

i. Registration Requirements

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

1. **EERE Funding Opportunity Exchange (eXCHANGE)**
   Register and create an account on EERE eXCHANGE at https://eere-eXCHANGE.energy.gov. This account will allow the user to apply to any open EERE FOAs in EERE eXCHANGE.

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

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

2. **System for Award Management**
   Register in SAM (https://www.sam.gov). Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called a

Marketing Partner ID Number (MPIN) are important steps in SAM registration. Please update your SAM registration annually.

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

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

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

ii. Award Administrative Requirements

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

iii. Foreign National Participation

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

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

iv. Subaward and Executive Reporting

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

v. National Policy Requirements

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

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

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

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

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.

Awardees in States or Territories with a DOE-executed Programmatic Agreement (PA) must adhere to all the Stipulations outlined in the PA, including reporting

requirements. Executed PAs are available on this website: https://www.energy.gov/eere/wipo/historic-preservation-executed-programmatic-agreements. So long as the proposed project/undertaking is within a State or Territory that has executed a Programmatic Agreement, the terms of the Programmatic Agreement will apply to all DOE Recipients and subrecipients within the applicable state, and their activities. Applicants that do NOT have a PA which includes Guam and tribal governments, must follow the added restrictions in a NEPA determination to ensure Section 106 compliance.

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:

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

(1) The limitation above shall not contravene requirements applicable to Standard Form 312 Classified Information Nondisclosure Agreement (https://fas.org/sgp/othergov/sf312.pdf), Form 4414 Sensitive Compartmented Information Disclosure Agreement (https://fas.org/sgp/othergov/intel/sf4414.pdf),

or any other form issued by a federal department or agency governing the nondisclosure of classified information.

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

ix. Statement of Federal Stewardship

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

x. Statement of Substantial Involvement

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

1. EERE shares responsibility with the recipient for the management, control, direction, and performance of the project.

2. EERE may intervene in the conduct or performance of work under this award for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities.

3. EERE may redirect or discontinue funding the project based on the outcome of EERE's evaluation of the project at the Go/No-Go decision point(s).

4. EERE participates in major project decision-making processes.

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

application;[47] and (8) written approval of the continuation application by the Contracting Officer.

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

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

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 U.S. government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the U.S. government would otherwise 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

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

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

the federal share of the financial assistance agreement is more than $1 million, the recipient or subrecipient must:

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

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 proposed collaborating organizations prior to award. Recipients will have an ongoing responsibility to notify DOE of changes to the personnel and collaborating organizations, and submit updated information during the life of the award.

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's team must agree to a U.S. Competitiveness provision requiring that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States unless it can be showed 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, contractors and projects, are available at: https://www.energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards.

Please note that a subject invention is any invention conceived or first actually reduced to practice in performance of work under an award. An invention is any invention or discovery which is or may be patentable. The recipient includes the prime recipient and any subrecipients and contractors.

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)[48] is applicable to all non-Federal entities applying for, or that receive, DOE funding

[48] 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.

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

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

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. 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).

VIII. 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.

IX. Other Information

A. FOA Modifications

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

B. Government Right to Reject or Negotiate

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

C. Commitment of Public Funds

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

D. Treatment of Application Information

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

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

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

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

> **Notice of Restriction on Disclosure and Use of Data:**
> Pages [list applicable pages] of this document may contain trade secrets or business-sensitive, proprietary, or otherwise confidential information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance agreement between the submitter and the government. The government may use or disclose any information that is not appropriately

marked or otherwise restricted, regardless of source. [End of Notice]

In addition, (1) the header and footer of every page that contains trade secrets or business-sensitive, proprietary, or otherwise confidential information must be marked as follows: "Contains Trade Secrets or Business-Sensitive, Proprietary, or Otherwise Confidential Information Exempt from Public Disclosure," and (2) every line or paragraph containing such information must be clearly marked with double brackets or highlighting. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

E. Evaluation and Administration by Non-Federal Personnel

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

F. Notice Regarding Eligible/Ineligible Activities

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

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

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

H. Requirement for Full and Complete Disclosure

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

- The cancellation of award negotiations;
- The modification, suspension, and/or cancellation of a funding agreement;

- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

I. Retention of Submissions

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

J. Title to Subject Inventions

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

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions;
- All other parties: The Federal Non-Nuclear Energy Act of 1974, 42. U.S.C. § 5908, provides that the government obtains title to new inventions unless a waiver is granted (see below);
- Class Patent Waiver: DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. To avail itself of the class waiver, a domestic large business must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States.
- Advance and Identified Waivers: For an applicant not covered by a Class Patent Waiver or the Bayh-Dole Act, the applicant may request a patent waiver that will cover subject inventions that may be invented under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to EERE within the timeframes set forth in the award's intellectual property data terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- DEC: On June 07, 2021, DOE approved a DETERMINATION OF EXCEPTIONAL CIRCUMSTANCES (DEC) UNDER THE BAYH-DOLE ACT TO FURTHER PROMOTE DOMESTIC MANUFACTURE OF DOE SCIENCE AND ENERGY TECHNOLOGIES. In

accordance with this DEC, all awards, including sub-awards, under this FOA shall include the U.S. Competitiveness Provision in accordance with the U.S. Manufacturing Commitments section of this FOA. A copy of the DEC can be found at https://www.energy.gov/gc/determination-exceptionalcircumstances-decs. Pursuant to 37 CFR 401.4, any non-profit 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.

Government Use License

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

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

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

Q. Annual Independent Audits

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

If an educational institution, noprofit organization, or state/local government is a prime recipient or subrecipient and has expended $750,000 or more of federal awards during the non-federal entity's fiscal year, a Single or Program-Specific Audit is required. For additional information, please refer to 2 CFR 200.501 and Subpart F.

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

R. Informational Webinar

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

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

APPENDIX A – COST SHARE INFORMATION

Cost Sharing or Cost Matching

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

How Cost Sharing Is Calculated

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

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

- Formula: Total Project Cost ($) minus federal share ($) = Non-federal share ($)
  Example: $1,250,000 minus $1,000,000 = $250,000

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

What Qualifies for Cost Sharing

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

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

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

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

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

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

General Cost Sharing Rules on a DOE Award

1. **Cash Cost Share** encompasses all contributions to the project made by the recipient or subrecipient(s) for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, or equipment for their company with organizational resources. If the cost of the item or service is reimbursed, it is cash cost share. All cost share items must be necessary to the performance of the project.

2. **In-Kind Cost Share** encompasses all contributions to the project made by the recipient or subrecipient(s) that do not involve a payment or reimbursement and represent donated items or services. In-Kind cost share items include volunteer personnel hours, donated existing equipment, and donated existing supplies. The cash value and calculations thereof for all In-Kind cost share items must be justified and explained in the Cost Share section of the project Budget Justification. All cost share items must be necessary to the performance of the project. Consult your DOE contact if you have questions before filling out the In-Kind cost share section of the Budget Justification.

3. **Funds from other federal sources** may **not** be counted as cost share. This prohibition includes FFRDC subrecipients. Non-federal sources include any source not originally derived from federal funds. Cost sharing commitment letters from subrecipients must be provided with the original application.

4. **Fee or profit**, including foregone fee or profit, are not allowable as project costs (including cost share) under any resulting award. The project may incur only those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

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

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

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

(1) They are verifiable from the recipient's records.

(2) They are not included as contributions for any other federally-assisted project or program.

(3) They are necessary and reasonable for the proper and efficient accomplishment of project or program objectives.

(4) They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:

a. For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A–122 is determined in accordance with the for-profit cost principles in 48 CFR Part 31 in the FAR, except that patent prosecution costs are not allowable unless specifically authorized in the award document. (v) Commercial Organizations. FAR Subpart 31.2—Contracts with Commercial Organizations; and

b. Other types of organizations. For all other non-federal entities, allowability of costs is determined in accordance with 2 CFR Part 200 Subpart E.

(5) They are not paid by the federal government under another award unless authorized by federal statute to be used for cost sharing or matching.

(6) They are provided for in the approved budget.

(B) Valuing and documenting contributions

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

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

a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or

b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.

(2) Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.

(3) Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.

(4) Valuing property donated by third parties.

a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.

b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:

i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of

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

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

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

a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.

b. The basis for determining the valuation for personal services and property must be documented.

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

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

Task	Proposed Federal Share	Federal Share %	Recipient Share %
Task 1 (R&D)	$1,000,000	80%	20%
Task 2 (R&D)	$500,000	80%	20%
Task 3 (Demonstration)	$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.[49] 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

[49] 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. Waiver for Performance of Work in the United States (Foreign Work Waiver)

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[50] —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

[50] 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[51] are produced in the United States—this means that all manufacturing processes for the construction material occurred in the United States.

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

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

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

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

For additional information related to the application and implementation of these Buy America requirements, please see OMB Memorandum M-22-11, issued April 18, 2022: https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-11.pdf

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

C. Waivers

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

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

(1) Applying the Buy America requirements would be inconsistent with the public interest;

(2) The types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality; or

(3) The inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25%.

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

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

DOE may require additional information before considering the waiver request.

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

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

APPENDIX E – 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 – ENVIRONMENTAL CONSIDERATIONS SUMMARY

While not all information may be available at the proposal stage, please provide as much detail and information as is available. Consultation with experts or advisors in your organization to assist with your responses is highly recommended. If there is documentation to support responses to any of the items below, please attach it to your application in Exchange. Your responses will assist DOE in determining the appropriate level of NEPA review if your proposal is selected, and in preparing an environmental assessment (EA) or environmental impact statement (EIS), if necessary.

1. Please provide a general description of the proposed project area(s) and facilities. Please describe whether the project would leverage existing facilities/infrastructure and/or would new facilities/infrastructure be constructed. More specifically, please describe new facilities to be constructed, any modifications of existing facilities, and any new infrastructure or facilities necessary for the construction or operation of the proposed project (e.g., access roads, laydown areas, off-site parking areas, railroad links, docks, water outfalls and intakes, pipelines, electrical transmission, waste treatment facilities, etc.).
2. Please provide a map showing proposed project locations including the geographic coordinates of the location(s) and a site layout map showing project facilities and associated infrastructure.
3. Please provide as brief description of the proposed project location(s) existing environmental burdens, relying on available tools, such as DOE's Energy Justice Dashboard (beta)[52] or the U.S. Environmental Protection Agency's EJScreen[53].
4. Please describe:
    i. any coordination or discussions that have been initiated or the plan to coordinate with state and/or federal agencies (e.g., State Historic Preservation Office, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Nuclear Regulatory Commission, etc.),
    ii. any coordination or discussions that have been initiated with any Tribal governments,
    iii. any studies, reviews, and/or plans that have been completed for the proposed project area (e.g., cultural resource surveys, identification of prime or unique farmland in the proposed project area, wildlife surveys, etc.),
    iv. any environmental considerations and/or mitigation strategies that have been incorporated into the proposed project (e.g., measures to protect or reduce impacts to cultural resources, historic properties, state or

[52] https://www.energy.gov/diversity/energy-justice-dashboard-beta
[53] https://www.epa.gov/ejscreen

federally protected species, wetlands, floodplains, and/or minimize traffic, and noise, etc.).

v. whether the proposed project location(s) is within a floodplain, how the floodplain was defined, and how future flooding will factor into the project's design.

APPENDIX G – LIST OF ACRONYMS

AC	Alternating Current
A-USC	Advanced-Ultra Supercritical
CBP	Community Benefits Plan
CETs	Critical and Emerging Technologies
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COI	Conflict of Interest
CRADA	Cooperative Research and Development Agreement
CSP	Concentrating Solar-Thermal Power
CST	Concentrated Solar-Thermal
DEC	Determination of Exceptional Circumstances
DEIA	Diversity, Equity, Inclusion, and Accessibility
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier
DOL	Department of Labor
EERE	Energy Efficiency and Renewable Energy
FAR	Federal Acquisition Regulation
FCOI	Financial Conflicts of Interest
FFATA	Federal Funding and Transparency Act of 2006
FFRDC	Federally Funded Research and Development Center
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FT	Fischer-Tropsch
GAAP	Generally Accepted Accounting Principles
GGE	Gasoline Gallon Equivalent
GHG	Greenhouse Gases
GW	Gigawatt
GWh	Gigawatt Hour
H_2	Hydrogen
HBCUs	Historically Black Colleges and Universities
HFTO	Hydrogen and Fuel Cell Technologies Office
HTF	Heat-Transfer Fluid
HTM	Heat-Transfer Medium
HTSE	High-Temperature Solid-Oxide Electrolysis
IP	Intellectual Property
IPH	Industrial Process Heat
IPMP	Intellectual Property Management Plan
IRB	Institutional Review Board
kWh	Kilowatt Hour
kWh_e	Killowatt Hour (electrical)
kWh_{th}	Kilowatt Hour (thermal)

LTE	Low-Temperature Electrolysis
M&O	Management and Operating
MFA	Multi-Factor Authentication
MMBTU	Million British Thermal Units
MPIN	Marketing Partner ID Number
MSI	Minority-Serving institution
MW	Megawatt
MWh	Megawatt Hour
MW_{th}	Megawatt (thermal)
MYPP	Multi-Year Program Plan
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Agency
NREL	National Renewable Energy Laboratory
NSF	National Science Foundation
OCED	Office of Clean Energy Demonstrations
OFCCP	Office of Federal Contractor Compliance Programs
OIG	Office of Inspector General
OMB	Office of Management and Budget
OSS	Open-Source Software
OSTI	Office of Scientific and Technical Information
OTA	Other Transactions Authority
PII	Personal Identifiable Information
PV	Photovoltaic
R&D	Research and Development
RD&D	Research, Development, and Demonstration
RFI	Request for Information
RFP	Request for Proposal
RWGS	Reverse Water Gas Synthesis
SAM	System for Award Management
SciENcv	Science Experts Network Curriculum Vita
SETO	Solar Energy Technologies Office
SMART	Specific, Measurable, Attainable, Realistic, and Timely
SMR	Steam Methane Reforming
SNL	Sandia National Laboratories
SOEC	Solid-Oxide Electrolysis Cell
SOPO	Statement of Project Objectives
SPOC	Single Point of Contact
STEM	Science, Technology, Engineering, and Mathematics
TAA	Technical Assistance Agreement
TCES	Thermochemical Energy Storage
TCWS	Thermochemical Water Splitting
TES	Thermal Energy Storage
TIA	Technology Investment Agreement
TRL	Technology Readiness Level

TW	Terrawatt
TW_{ac}	Terrawatt (alternating current)
UCC	Uniform Commercial Code
UEI	Unique Entity Identifier
WBS	Work Breakdown Structure
WP	Work Proposal

APPENDIX H – COMMUNITY BENEFITS PLAN GUIDANCE

DOE is committed to pushing the frontiers of science and engineering; catalyzing high- quality domestic clean energy jobs through research, development, demonstration, and deployment; and ensuring energy equity and energy justice[54] for disadvantaged communities. Therefore, and in accordance with the Administration's priority to empower workers and harness opportunities to create good union jobs as stated in EO 14008 (Executive Order on Tackling the Climate Crisis at Home and Abroad),[55] it is important to consider the impacts of the successful commercial deployment of any innovations resulting from this FOA on the current and future workforce.

The goal of the Community Benefits Plan is to allow the application to illustrate engagement in critical thought about implications of how the proposed work will benefit the American people and lead to broadly shared prosperity, including for workers and disadvantaged communities.[56] The three sections of the Community Benefits Plans are considered together because there may be significant overlap among audiences considered in workforce and disadvantaged communities.

Example DEIA, Energy Equity, and Workforce Plan Elements

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

DEIA

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

Equity extends beyond diversity to equitable treatment. Equitable access to

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

[55] https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and- abroad

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

opportunity for members of the project team is paramount. This includes ensuring all members of the team, including students, are paid a living wage, provided appropriate working conditions, and provided appropriate benefits. In the execution of their project plan, applicants are asked to describe efforts in diversity, equity, inclusion, and accessibility. In this context, efforts toward DEIA are defined as:[57]

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

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

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

When crafting the DEIA section of the Plan, applicants should describe how they will act to promote each of the four DEIA efforts above into their

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

investigation. It is important to note that diversity, equity, inclusion, and accessibility are four different but related concepts that should not be conflated. For instance, you can achieve diversity without equity; all four must be addressed. Applicants could discuss how the proposed investigation could contribute to training and developing a diverse scientific workforce. Applicants could describe the efforts they plan to take, or will continue to take, to create an inclusive workplace, free from retaliation, harassment, and discrimination. Applicants could outline any barriers to creating an equitable and inclusive workplace and address the ways in which the team will work to overcome these barriers within the bounds of the specific research project. The plan could detail specific efforts to inform project team members in any capacity of their labor rights and rights under Equal Employment Opportunity laws and their free and fair chance to join a union. Note that this inclusion of informing project team members is also incorporated into awards through the National Policy Assurances.

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

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

Specific examples include:

- Building collaborations and partnerships with researchers and staff at MSIs;
- Addressing barriers identified in climate surveys to remove

inequities;
- Providing anti-bias training and education in the project design and implementation teams;
- Offering training, mentorship, education, and other support to students and early/mid-career professionals from disadvantaged communities;
- Providing efforts toward improving a workplace culture of inclusion;
- Developing technology and technology integration innovations to meet the needs of disadvantaged communities;
- Creating partnerships with local communities, especially under-resourced and disadvantaged communities;
- Voluntary recognition of a union and informing employees of their rights, regardless of their classification;
- Making research products and engagement materials accessible in a greater variety of formats to increase accessibility of research outputs;
- Implementing training or distributing materials to reduce stigma towards individuals with disabilities;
- Designing technologies that strategically fit within the existing workforce for installation and maintenance of the potential innovation.

Energy Equity

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

Applicants should describe the influencing factors and the most likely energy equity implications of the proposed research. Applicants should describe any long-term constraints the proposed technology may pose to communities' access to natural resources and Tribal cultural resources. There may be existing equity research available to use and cite in this description, or the

applicant could describe milestone-based efforts toward developing that understanding through this innovation. These near- and long-term outcomes may include, but are not limited to: a decrease in the percent of income a household spends on energy costs (energy burden);[58] an increase in access to low-cost capital; a decrease in environmental exposure and burdens; increases in clean energy enterprise creation and contracting (e.g., women or minority-owned business enterprises); increased parity in clean energy technology access and adoption; increases in energy democracy, including community ownership; and an increase in energy resilience.

Specific examples include:

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

Workforce

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

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

For additional support with developing the Workforce section of a Community Benefits Plan, please refer to the DOE's Community Benefits Plan Frequently Asked Questions (FAQs) webpage (https://www.energy.gov/bil/community-benefits-plan-frequently-asked-questions-faqs). This new resource, though created primarily for BIL-funded demonstration and deployment projects, may be useful for R&D projects.

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

Specific examples include:

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

Inclusion of SMART milestones

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

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