Department of Energy (DOE)
Office of Energy Efficiency and Renewable Energy (EERE)

Funding Opportunity in Support of the Hydrogen Shot and a University Research Consortium on Grid Resilience

Funding Opportunity Announcement (FOA) Number: DE-FOA-0002792
FOA Type: Mod 0001
Assistance Listing Number: 81.087

FOA Issue Date:	08/23/2022
Submission Deadline for Concept Papers:	09/23/2022 5:00pm ET
Submission Deadline for Full Applications:	12/01/2022 5:00pm ET
Expected Submission Deadline for Replies to Reviewer Comments:	02/10/2023 5:00pm ET
Expected Date for EERE Selection Notifications:	April 2023
Expected Timeframe for Award Negotiations:	April – August 2023

- Applicants must submit a Concept Paper by 5:00pm 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.

Modifications

All modifications to the FOA are [HIGHLIGHTED] in the body of the FOA.

Mod. No.	Date	Description of Modification
1	9/8/2022	Edited the FFRDC eligibility (Section III.A.ii and footnote 59) to indicate that for Topic 4 only core members of the M2FCT consortium are ineligible to apply as subrecipients. Core national laboratories in M2FCT include Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Argonne National Laboratory, National Renewable Energy Laboratory, and Oak Ridge National Laboratory.

Table of Contents

I. Funding Opportunity Description

A. Background and Context

The Office of Energy Efficiency and Renewable Energy (EERE) is issuing Funding Opportunity Announcement (FOA) DE-FOA-0002792 that will address two unique areas of interest: one with topics focused on supporting the DOE Hydrogen Shot on behalf of the Hydrogen and Fuel Cell Technologies Office (HFTO) and a second EERE-wide topic area focused on grid resilience through a university research consortium.

i. Background and Purpose

Building a clean and equitable energy economy and addressing the climate crisis is a top priority of the Biden Administration. This FOA will advance the Biden Administration's goals to achieve carbon pollution-free electricity by 2035 and to "deliver an equitable, clean energy future, and put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050"[1] to the benefit of all Americans. The Department of Energy is committed to pushing the frontiers of science and engineering, catalyzing clean energy jobs through research, development, demonstration, and deployment (RDD&D), and ensuring environmental justice and inclusion of underserved communities.

The research, development, and demonstration (RD&D) activities to be funded under this FOA will support the government-wide approach to the climate crisis by driving innovation that can lead to the development and deployment of clean energy technologies, which are critical for climate protection. Specifically, this FOA will support the goals of DOE's Hydrogen Shot,[2] which targets affordable clean hydrogen production at $1/kg within the decade, and the H2@Scale Initiative,[3] which aims to advance affordable hydrogen production, transport, storage, and utilization to enable decarbonization and revenue opportunities across multiple sectors. The FOA will also target electricity grid resilience, a crosscutting DOE priority in which hydrogen and other renewable and energy efficiency technologies will play a key role. Modernizing and expanding the electricity grid will make the nation's energy sector more resilient, while enabling the buildout of affordable, reliable, clean energy to support President Biden's goal of 100% clean power by 2035.

As part of the whole-of-government approach to advance equity across the Federal Government, it is the policy of the Biden Administration that the Federal Government should pursue a comprehensive approach to advancing equity for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by

[1] Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021.
[2] Hydrogen Shot | Department of Energy, https://www.energy.gov/eere/fuelcells/hydrogen-shot
[3] H2@Scale | Department of Energy, https://www.energy.gov/eere/fuelcells/h2scale

persistent poverty and inequality. As part of this approach, this FOA will encourage the participation of underserved communities and underrepresented groups.

ii. Technology Space and Strategic Goals

This FOA targets two areas of interest critical to building energy resilience and achieving net-zero GHG emissions by 2050, including:

- Area of Interest 1: Hydrogen and Fuel Cell Technologies in Support of Hydrogen Shot
- Area of Interest 2: Improving Electricity Grid Resilience.

Area of Interest 1: Hydrogen and Fuel Cell Technologies in Support of Hydrogen Shot

Hydrogen and fuel cell technologies are part of a comprehensive portfolio of solutions to address the climate crisis and position America as a global leader in clean energy technology and clean energy jobs. Hydrogen is a unique and flexible energy carrier due to diverse domestic options for hydrogen production as well as the broad spectrum of end uses, as shown in the H2@Scale vision illustrated in Figure 1. The versatility of hydrogen offers opportunities to address priorities in the Administration's clean energy plan through affordable clean hydrogen in strategic, high-impact applications across sectors. For hydrogen to achieve its potential as an energy carrier, key challenges around affordability, durability, and reliability must still be addressed. Innovations to produce, store, transport, and utilize hydrogen across multiple sectors are key to enabling these cost reductions and performance improvements.

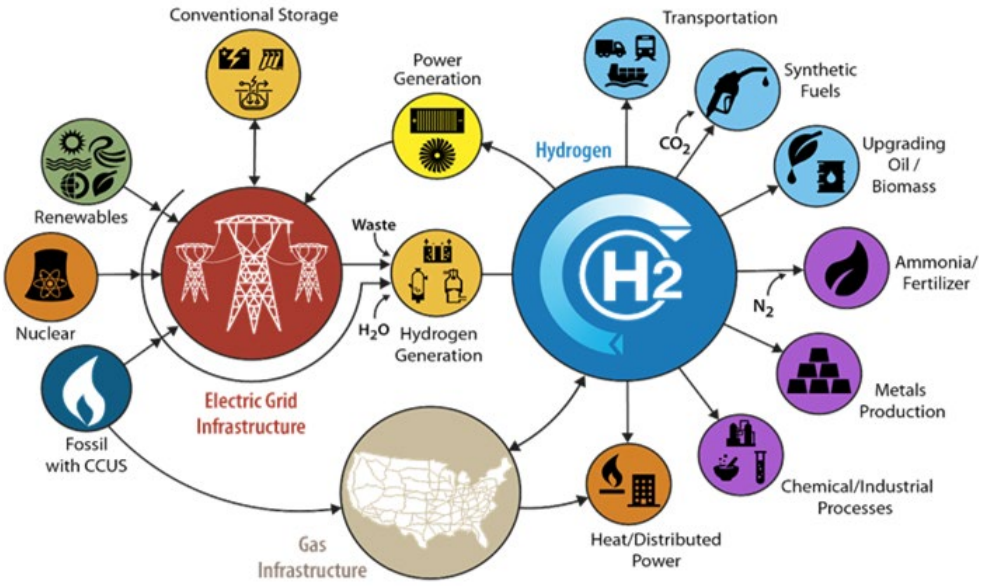

Figure 1. The H2@Scale vision.

The Hydrogen Shot, announced June 7, 2021, by Energy Secretary Granholm as DOE's first *Energy Earthshot Initiative*, sets an ambitious goal for hydrogen cost reduction. Currently, hydrogen production from renewable energy and electrolysis costs about $5 per kilogram. Achieving the Hydrogen Shot's goal to reduce the cost of clean hydrogen by 80% to $1 per 1

kilogram in 1 decade ("1 1 1") can unlock new markets for hydrogen, including steel manufacturing, clean ammonia, energy storage, and heavy-duty trucks. This would create more clean energy jobs, reduce greenhouse gas and criteria pollutant emissions, increase energy security and resiliency, and position America to compete in the clean energy market on a global scale.

HFTO conducts comprehensive efforts to tackle the technological, economic, and institutional challenges to the development of hydrogen and fuel cells. HFTO supports a broad RD&D portfolio addressing materials-, component- and systems-level RD&D on clean hydrogen and fuel cell technologies (e.g., hydrogen production from renewable fuels, fuel cells for medium and heavy-duty transportation applications, and hydrogen delivery and fueling infrastructure, among others). Technology acceleration efforts are also conducted to address first-of-a-kind demonstrations of integrated energy systems, as well as manufacturing innovations and safety codes and standards. HFTO RD&D relies heavily on collaborations among various industry and university stakeholders and the national laboratories, including through HFTO-managed consortia.

Additional supporting activities include efforts to reduce vulnerabilities and build supply chain resilience, strengthen and diversify the STEM workforce in the hydrogen and fuel cell communities, and support partnerships and activities that ensure the economic and environmental benefits of HFTO investments are available to disadvantaged communities (underserved or overburdened communities).

The specific topics to be funded in this interest area are summarized below. Detailed topic descriptions are provided in Section I.B.

Topic 1: HydroGEN: Solar Fuels from Photoelectrochemical and Solar Thermochemical Water Splitting

Aligned with the nation's clean energy and climate goals, there is growing interest in developing advanced technologies that enable efficient harvesting of sunlight to produce energy-rich fuels from abundant feedstocks such as water or air, also known as *solar fuels*. As an example, hydrogen can be produced using solar energy to split water. DOE's advanced water splitting (AWS) materials consortium, HydroGEN, has made significant progress in the areas of photoelectrochemical (PEC) and solar thermochemical (STCH) hydrogen production pathways through materials discovery and development. However, there is still significant ground to be covered in the AWS research and development (R&D) materials space to enable low cost and large-scale hydrogen production from these advanced pathways. This topic will solicit applications for collaborative R&D projects that leverage HydroGEN's world-class capabilities and expertise to advance a PEC or STCH pathway with potential to achieve an interim target of \$2/kg H_2 and an ultimate target of \$1/kg H_2. The utilization of abundant, low-cost perovskite materials as photo-absorbers, catalysts, catalyst supports, and/or redox materials in a promising PEC or STCH solar hydrogen process is of particular interest.

Topic 2: Development and Validation of Sensor Technology for Monitoring and Measuring of Hydrogen Losses

In this topic, DOE aims to address potential issues associated with hydrogen emissions which can contribute to overall greenhouse gas (GHG) emissions, particularly as a result of hydrogen leakage or losses across the value chain from production through end use. DOE seeks applications that plan to develop commercially viable hydrogen sensor technologies capable of environmental monitoring, with a specific interest in high-resolution sensing and quantification of hydrogen losses in outdoor applications where hydrogen levels need to be monitored on-site at very low concentrations. Properties of interest include parts-per-billion level sensitivity, quantification capability, rapid response and recovery time, resistance to weather elements, and selectivity to hydrogen in ambient air. Such technologies are needed to inform environmental impact analyses of large-scale hydrogen deployments in production, transport, or end-use applications, and will complement current commercially available hydrogen safety sensors that are designed to detect leaks at the parts-per-million level.

Topic 3: Materials-based Hydrogen Storage Demonstrations

Achieving national clean-hydrogen goals will require significant advancements in the practical storage of low-cost hydrogen. The development, demonstration, and deployment of higher density, lower pressure, and safe hydrogen storage technologies at relevant scale is a critical research component of the H2@Scale initiative. This topic area seeks applications for demonstration projects that establish and validate the potential for materials-based hydrogen transport and storage technologies that could provide benefits over traditional compressed or liquid transport and storage systems in a specified non-onboard-vehicle application. All classes of hydrogen carriers and storage materials relevant to transport and stationary storage are of interest, including adsorbents, all types of metal hydrides, and hydrogen-rich liquids. Use cases may include any high-impact applications identified in the H2@Scale initiative, including the energy, industrial and chemical, and transportation sectors. This topic strongly encourages approaches other than ammonia production, which is covered elsewhere within the DOE portfolio.

Topic 4: M2FCT: High Performing, Durable, and Low-PGM Catalysts/Membrane Electrode Assemblies (MEAs) for Medium- and Heavy-duty Applications

Fuel cells are an attractive technology to power medium- and heavy-duty vehicles (e.g., trucks, buses, marine vessels, and rail locomotives). They offer several advantages over incumbent technologies such as diesel engines, including higher efficiency, higher torque, reduced local air pollutants and GHG emissions, and no noise pollution. Additionally, fuel cell vehicles offer fast fueling and long driving range. Such vehicles require very high system durability at costs that are competitive with incumbent powertrains. This topic area will solicit applications that, in coordination with the Million Mile Fuel Cell Truck (M2FCT) consortium, will develop innovative catalysts integrated into MEAs that will reduce the cost and enhance the durability and performance of

proton exchange membrane fuel cell stacks for medium- and heavy-duty transportation applications, in line with DOE targets.

Area of Interest 2: Improving Electricity Grid Resilience

This area of interest is funded by multiple EERE offices and will target electricity grid resilience, a DOE priority in which hydrogen and other renewable energy technologies will play a key role. Modernizing and expanding the electricity grid will make the nation's energy sector more resilient, while enabling the buildout of affordable, reliable, clean energy to support President Biden's goal of 100% clean power by 2035. Through the Infrastructure Investment and Jobs Act[4] of 2021, DOE is providing more than $14 billion in financial assistance to states, Indian tribes, utilities, and other entities that provide products and services for enhancing the reliability, resilience, and efficiency of the electric grid.

Topic 5: University Research Consortium on Grid Resilience (URCGR)

Topic 5 of this FOA will provide up to $20 million to establish a regionally diverse university research consortium to support states and tribes, both individually and regionally, in developing the tools, data, analysis, plans, criteria, and methods needed to implement successful grid resilience programs and prioritize infrastructure investments needed to achieve energy resilience and decarbonization goals.[5, 6] The University Research Consortium on Grid Resilience (URCGR) will have established agreements with universities in Canada and Mexico to conduct research on a broad array of energy sources and topics and foster information sharing on best practices and cross-border dependencies, and will work collaboratively with tribes, states, regions, industry, utilities, and other stakeholders to support energy resilience planning and pilot projects that may serve as a model for other states, tribes, and regions.

iii. Diversity, Equity, and Inclusion

It is the policy of the Biden Administration that:

> [T]he Federal Government should pursue a comprehensive approach to advancing equity[7] for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent

[4] U.S. Department of Energy. November 2021. "DOE Fact Sheet: The Bipartisan Infrastructure Deal Will Deliver For American Workers, Families and Usher in the Clean Energy Future." https://www.energy.gov/articles/doe-fact-sheet-bipartisan-infrastructure-deal-will-deliver-american-workers-families-and-0

[5] 2022 Federal Appropriations Explanatory Statement, Division D https://docs.house.gov/billsthisweek/20220307/BILLS-117RCP35-JES-DIVISION-D.pdf

[6] 2021 Federal Appropriations Explanatory Statement, Energy and Water Development https://www.appropriations.senate.gov/imo/media/doc/EWRept.pdf

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

> poverty and inequality. Affirmatively advancing equity, civil rights, racial justice, and equal opportunity is the responsibility of the whole of our Government. Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments and agencies (agencies) must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity.
>
> By advancing equity across the Federal Government, we can create opportunities for the improvement of communities that have been historically underserved, which benefits everyone.[8]

As part of this whole of government approach, this FOA seeks to encourage the participation of underserved communities[9] and underrepresented groups. Applicants are highly encouraged to include individuals or student organizations from groups historically underrepresented[10] in STEM (Science, Technology, Engineering and Mathematics) on their project teams.

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

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

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

[10] According to the National Science Foundation's 2019 report titled, "Women, Minorities and Persons with Disabilities in Science and Engineering", women, persons with disabilities, and underrepresented minority groups—blacks or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives—are vastly underrepresented in the STEM (science, technology, engineering and math) fields that drive the energy sector. That is, their representation in STEM education and STEM employment is smaller than their representation in the U.S. population. https://ncses.nsf.gov/pubs/nsf19304/digest/about-this-report

Further, Minority Serving Institutions (MSIs)[11], Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or entities located in an underserved community that meet the eligibility requirements (See Section III) are encouraged to apply as the prime applicant or participate on an application as a proposed partner to the prime applicant. The Selection Official may consider the inclusion of these types of entities as part of the selection decision (See Section V.C.).

iv. Teaming Partner List

EERE is compiling a Teaming Partner List to facilitate the widest possible national participation in the formation of applicant teams for this topic. The list allows organizations who may wish to participate in an application to express their interest to potential applicants and to explore potential partners.

The Teaming Partner List will be available on EERE Exchange at https://eere-Exchange.energy.gov under FOA DE-FOA-0002792 during the time of its release through its closing. The Teaming Partner List will be updated at least weekly until the close of the Full Application period, to reflect new Teaming Partners who have provided their information. Any organization that would like to be included on this list should submit the following information to HFTOFOA@ee.doe.gov, with the subject line "Teaming Partner Information FOA-0002792": Topic Area(s) of Interest, Organization Name, Contact Name, Contact Address, Contact Email, Contact Phone, Organization Type (including MSI designation or disadvantaged community status, if relevant), Area of Technical Expertise, and Brief Description of Capabilities.

By submitting a request to be included on the Teaming Partner List, the requesting organization consents to the publication of the above-referenced information. By facilitating this Teaming Partner List, EERE does not endorse or otherwise evaluate the qualifications of the entities that self-identify themselves for placement on the Teaming Partner List. EERE will not pay for the provision of any information, nor will it compensate any applicants or requesting organizations for the development of such information.

In addition to the Teaming Partner List, applicants may also access H2 Matchmaker,[12] an online information resource to assist hydrogen suppliers and users in identifying opportunities to expand development of regional hydrogen hubs. H2Matchmaker includes an interactive map containing self-reported clean hydrogen producers, hydrogen consumers, infrastructure provider/operators, and other key stakeholders (e.g., Government, Tribal, Labor, Workforce Development, Safety Codes and Standards, Financier/Investor, Environmental Justice

[11] Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities (HBCUs)/Other Minority Institutions (OMIs) as educational entities recognized by the Office of Civil Rights (OCR), U.S. Department of Education, and identified on the OCR's Department of Education U.S. accredited postsecondary minorities' institution list. See https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

[12] https://www.energy.gov/eere/fuelcells/h2-matchmaker

Organizations), including whether the organization may be relevant to the Justice40 Initiative.[13] Any organization that would like to be included in H2 Matchmaker can do so by filling out the H2 Matchmaker form available at https://www.energy.gov/eere/fuelcells/h2-matchmaker. Teams are encouraged to use this resource to identify hydrogen providers, off-takers, and end-users of the system.

Teams that include representation from diverse entities such as, but not limited to, Minority Serving Institutions (MSIs), including HBCUs/OMIs, or through linkages with Opportunity Zones,[14] are encouraged. Applicants are highly encouraged to include individuals or student organizations from groups historically underrepresented in STEM on their project teams.

B. Topic Areas

i. Area of Interest 1: Hydrogen and Fuel Cell Technologies in Support of Hydrogen Shot

a. Topic 1: HydroGEN: Solar Fuels from Photoelectrochemical and Solar Thermochemical Water Splitting

Topic 1 Introduction and Background

Aligned with the nation's clean energy and climate goals, there is growing interest in developing advanced technologies that enable efficient harvesting of sunlight to produce energy-rich fuels from abundant feedstocks such as water or air, also known as *solar fuels*.[15] As an example, hydrogen can be produced using solar energy to split water and used as an energy carrier or fuel, or as a feedstock in synthesizing liquid chemical fuels such as hydrocarbons or ammonia.[16] DOE has supported several collaborative efforts focused on solar fuels, for example, through the *Fuels from Sunlight Innovative Hubs.*[17] These include the prior *Joint Center for Artificial Photosynthesis* (JCAP), as well as the current *Liquid Sunlight Alliance* (LiSA) and the Center for

[13] The Justice40 initiative, created by Executive Order 14008, establishes a goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities. https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf.

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

[15] A Congressional Committee has specifically identified the importance of research and development of entirely solar driven processes for hydrogen production.
https://docs.house.gov/meetings/AP/AP00/20210716/113895/HRPT-117-13.pdf

[16] See for example: https://science.osti.gov/-/media/bes/pdf/reports/2020/Solar_Fuels_Brochure.pdf

[17] BES DOE Energy Innovation Hubs | U.S. DOE Office of Science(SC) (osti.gov), https://science.osti.gov/bes/Research/DOE-Energy-Innovation-Hubs

Hybrid Approaches in Solar Energy to Liquid Fuels (CHASE). In addition, HFTO's HydroGEN[18] consortium on AWS materials, part of the DOE's Energy Materials Network (EMN), includes a focus on multiple renewable hydrogen production pathways, including several relevant to solar hydrogen production.

Since the consortium's establishment in 2016, HydroGEN researchers have made significant progress in the areas of low and high temperature electrolysis, as well as the PEC and STCH hydrogen production pathways. This progress has successfully leveraged world-class national laboratory capabilities in the discovery and development of innovative materials and materials systems. HydroGEN has supported over 30 competitively selected R&D projects with industry and academic partners by providing streamlined access to national lab resources and expertise. The consortium is also credited with contributing over 100 publications,[19] fostering cross-cutting activities to advance material performance and durability through community engagement and protocol development,[20] and initiating critical laboratory-led efforts to address specific R&D gaps in the AWS portfolio. Despite the progress, there is still significant ground to be covered in the AWS materials R&D space to enable low-cost and large-scale hydrogen production, especially in the direct solar hydrogen production pathways of PEC and STCH.

The focus of this topic is on direct solar water-splitting pathways based on PEC or STCH approaches. Specifically, collaborative R&D projects are sought that leverage HydroGEN's world-class capabilities and expertise in tightly coupled theory, synthesis, and characterization to advance a PEC or STCH pathway with potential to achieve an interim goal of \$2/kg H_2 and an ultimate goal of \$1/kg H_2. While solar hydrogen could also be generated using electricity from photovoltaics or concentrated solar power (CSP) coupled with low- or high-temperature electrolyzers, these pathways are not included in this topic.

Given the recent emergence of the perovskite materials class in diverse clean-energy applications based on their abundance, low-cost, and tunability,[21] there is specific interest

[18] The HFTO HydroGEN EMN consortium (https://www.h2awsm.org/) currently comprises five core national laboratories: the NREL (lead lab), SNL, LBNL, INL, LLNL.

[19] HydroGEN Overview: A Consortium on Advanced Water Splitting Materials (energy.gov), https://www.hydrogen.energy.gov/pdfs/review22/p148_dinh_2022_o.pdf

[20] Advanced Water Splitting Technologies Development: Best Practices and Protocols | Frontiers Research Topic (frontiersin.org), https://www.frontiersin.org/research-topics/16823/advanced-water-splitting-technologies-development-best-practices-and-protocols#articles

[21] Zelenay, P., *et. al.* Carbon-Free Perovskite Oxide Oxygen Evolution Reaction Catalysts for AEM Electrolyzer - IOPscience

under this topic to explore the use of perovskites as photo-absorbers, catalysts, catalyst supports or redox materials in PEC or STCH applications.[22, 23]

Topic 1 Anticipated Funding and Award Details

DOE's anticipated funding levels, including the federal funding per award are given below:

Topic Area	Total Funding Level ($000)	Anticipated Number of Awards	Federal Funding per Award ($000)	Max. Project Duration (years)	Min Required Non-Federal Cost Share %
Topic 1: HydroGEN: Solar Fuels from Photoelectrochemical and Solar Thermochemical Water Splitting	**$12,500[24]**	**7 to 9**	**$750 - $1,000**	**3**	**20%**

Topic 1 Description and Objectives

EERE is soliciting applications that will leverage and support HydroGEN's mission in accelerated R&D of advanced water-splitting materials, with a specific interest in demonstrating advancements in a PEC or STCH process with potential to meet the DOE target of $2/kg H_2 by 2026[25] and/or the Hydrogen Shot goal of $1/kg H_2 by 2031. Previous analysis has indicated that solar-to-hydrogen (STH) efficiencies as high as 25% may be needed in durable PEC or STCH systems to achieve these aggressive cost targets,[26] though lower efficiencies could be sufficient with tradeoffs in system lifetime and capital cost. Applications are encouraged that build on prior advances in efficiency and durability through HydroGEN and the DOE Innovation Hubs and leverage abundant and low-cost materials and components to enable meeting the interim and ultimate H_2 production cost goals. The utilization of abundant, low-cost perovskite materials as photo-absorbers, catalysts, catalyst supports, and/or redox materials in a promising PEC or STCH solar hydrogen process is of particular interest.[27]

[22] Mohite, A. *et.al.* Highly efficient solar water-splitting using 3D/2D hydrophobic perovskites with corrosion resistant barriers. https://www.hydrogen.energy.gov/pdfs/review21/p193_mohite_2021_o.pdf

[23] Haeussler, Anita, Anne Julbe, and Stéphane Abanades. "Investigation of reactive perovskite materials for solar fuel production via two-step redox cycles: thermochemical activity, thermodynamic properties and reduction kinetics." Materials Chemistry and Physics 276 (2022): 125358.

[24] Includes federal funding that will be provided for core national laboratories within HydroGEN to support the selected FOA projects after the selection of awards.

[25] The $2/kg H_2 target was set by the Bipartisan Infrastructure Law to be met in 2026 for electrolysis. Though PEC and STCH are considered longer term, any approaches that can meet this interim target will also be considered, in addition to those that could potentially meet the Hydrogen Shot goal of $1/kg H_2 by 2031.

[26] http://energy.gov/sites/prod/files/2015/06/f23/fcto_myrdd_production.pdf

[27] A Congressional Committee has specifically recognized the potential for perovskites as catalysts and catalyst supports for hydrogen extraction from hydrogen rich feedstocks and carriers. https://docs.house.gov/meetings/AP/AP00/20210716/113895/HRPT-117-13.pdf

Topic 1 General Requirements

Applicants must clearly describe the PEC or STCH solar hydrogen process being advanced through materials R&D and how they will engage with HFTO's HydroGEN consortium, specifically including which national labs and capabilities could be leveraged for the project. The full list of capabilities can be found on the HydroGEN website: https://h2awsm.org/.

In their proposals, applicants must:

- Present a plausible technoeconomic argument[28] for how the project's advances in materials efficiency, durability, and cost could enable meeting the interim hydrogen production cost target of $2/kg with a future pathway to $1/kg
- Identify the critical materials challenge or challenges currently limiting efficiency and/or durability with specific impact on cost
- Propose an R&D plan that addresses the challenges through materials innovations that clearly identifies expected impacts in terms of well-articulated and quantitative technology-specific metrics
- Include a demonstration of solar hydrogen production conducted under practical operating conditions representative of the PEC or STCH process, using sunlight or simulated sunlight (as appropriate[29]). STCH systems must demonstrate hydrogen production at a rate of 1 g/h and PEC systems must demonstrate hydrogen production at a rate of 0.1 g/h for diurnal operation over two weeks.
- Describe specific HydroGEN resources the applicant proposes to utilize to avoid duplication and to best leverage existing capabilities and expertise

Further descriptions of the topic's areas of interest in the PEC and STCH pathways are outlined below, along with examples of pathway-relevant materials metrics and targets. Specific additional details of the application requirements are also described for each.

Photoelectrochemical (PEC) Water Splitting

Specific areas of interest for research projects focused on the development of materials or material systems for efficient and durable PEC water-splitting include but are not limited to (1) innovations in bandgap and bandgap alignment, (2) functional interfaces, and (3) stable surface catalysis and protective coatings. Different process implementations leveraging PEC are possible, but all proposed PEC projects must advance the state-of-the-art (SOA) and target efficiency and durability requirements needed to meet hydrogen production cost targets.[30] DOE has defined four standard types of PEC systems,[31] with Types 2, 3, and 4 under current investigation. A successful Type 3 or Type 4 PEC photoelectrode project would need to achieve

[28] For example, using the H2A tool: https://www.hydrogen.energy.gov/h2a_production.html

[29] In some cases, the hydrogen production step would not require sunlight

[30] Example targets for different PEC systems can be found in the HFTO Multi-Year Research, Development, and Demonstration (MYRDD&D) Plan: http://energy.gov/sites/prod/files/2015/06/f23/fcto_myrdd_production.pdf

[31] Descriptions of PEC reactor Types 2, 3 and 4 can be found in Technoeconomic Analysis of Photoelectrochemical (PEC) Hydrogen Production (energy.gov) https://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/pec_technoeconomic_analysis.pdf

15% STH efficiency for the entirety of operation exceeding 1,000 hours, with proposed pathways for achieving efficiencies up to 25% and durability up to 10,000 hours.

Type 2 PEC particle systems have inherently lower capital costs, which relaxes requirements on efficiency and durability. A successful Type 2 PEC particle project would need to achieve a 5% STH efficiency for the entirety of operation exceeding 1,000 hours, with proposed pathways for achieving up to 10% STH with durability up to 5,000 hours for achieving hydrogen cost targets. All proposed PEC systems must provide sufficient information on the efficiency, durability, and capital costs needed to enable the interim and ultimate hydrogen cost targets, assuming process optimizations and achieving economies of scale.

In support of meeting the general requirements, applications for a PEC project must specifically:

- Include a process flow diagram of the PEC system, and system analysis that clearly identifies the key materials challenges being addressed
- Define SMART (Specific, Measurable, Achievable, Relevant, Time-bound) materials metrics and targets (e.g., in corrosion resistance and durability, absorber quantum efficiency, catalyst activity, etc.) for meeting the interim hydrogen cost target of $2/kg with extrapolation to additional requirements for meeting $1/kg
- Describe the SOA methodologies to be used in integrated theory, synthesis, and characterization of PEC materials proposed in meeting targets (including but not limited to methods in multi-scale computation, combinatorial synthesis and characterization, machine learning and artificial intelligence)
- Describe the proposed experimental procedures for the collection, quantification, and analysis of PEC-hydrogen generated under outdoor or simulated sunlight

Projects utilizing abundant, low-cost perovskite materials in the PEC device or system are encouraged.

Solar Thermochemical Hydrogen (STCH) Production

Several STCH process implementations may have the potential to meet the DOE hydrogen production targets and are of interest for this solicitation. For all processes, proposed STCH projects must advance the SOA, and target efficiency, durability, and process integration requirements needed to meet hydrogen production cost targets.[32] Leveraging developments in CSP technologies through the EERE Solar Energy Technologies Office (SETO[33]) is strongly encouraged.

Innovative multi-step and hybrid STCH processes able to operate at temperatures below 550°C (compatible with SETO's Generation 2 CSP systems) or at temperatures up to 800°C (compatible

[32] Example targets for STCH systems can be found in the HFTO MYRD&D Plan: http://energy.gov/sites/prod/files/2015/06/f23/fcto_myrdd_production.pdf

[33] Concentrating Solar-Thermal Power Systems | Department of Energy, https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-systems

with SETO's Generation 3 CSP systems[34]) are of interest; but these systems can be challenged by complexity and cost associated with the integration of multiple process steps, and often require the assistance of solar-produced electricity.[35] One example of a multi-step/hybrid STCH process in this category is the four-step copper chloride cycle (with the high-temperature step at < 500°C) and the two-step hybrid copper chloride cycle (including an electrochemical step to produce hydrogen, and with a high-temperature step < 600°C).[36] This is just one example and other concepts are also of interest. Proposals must identify and address materials challenges for all the thermochemical and electrochemical steps included in such processes. In addition, cost projections for a multi-step/hybrid system must include costs for solar collection and concentration (aligned with SETO tower systems or with commercial dish or trough concentrators, as appropriate) and must take into account the cost of any additional electricity requirements.[37]

A number of theoretically less complex two-step metal oxide redox STCH cycles have been investigated in recent years,[38] but these typically operate at extremely high reduction temperatures (as high as 2,000°C) with high associated operating costs, requiring technology beyond the SETO Generation 3 CSP systems. One example is the two-step metal oxide STCH process using the perovskite material $BaCe_{0.25}Mn_{0.75}O_3$ as a redox material, which has demonstrated operations at reduction temperatures of 1,350°C. [39] This process has potential for high conversion efficiencies when incorporated in a feasible reactor design, but with limited cycling durability. Accelerated discovery, development, and demonstration of alternative redox materials for a two-step STCH process is of interest, but projected costs and materials challenges associated with the required operating temperatures must be addressed.

In support of meeting the general requirements, applications for a STCH project must specifically:

- Include a process flow diagram of the multi-step/hybrid STCH process with a conceptual design of a practical reactor implementation, and system analysis that clearly identifies the key materials challenges being addressed
- Define SMART materials metrics and targets (e.g., related to thermodynamic, kinetic, and phase-stability parameters) for meeting the interim hydrogen

[34] Generation 3 Concentrating Solar Power Systems (Gen3 CSP) Phase 3 Project Selection, https://www.energy.gov/eere/solar/generation-3-concentrating-solar-power-systems-gen3-csp-phase-3-project-selection

[35] Bauer, M. *et. al.;* De-Risking Solar Receivers to Achieve SunShot Targets. *Energies* **2022**, *15* (7), 2508. https://doi.org/10.3390/en15072508

[36] Lewis, M., *et. al.;* Nuclear Production of Hydrogen: Fourth Information Exchange Meeting, *OECD Publishing* **2010**, https://doi.org/10.1787/9789264087156-28-en

[37] Murphy, S. *et. al.*; The Potential Role of Concentrating Solar Power within the Context of DOE's 2030 Solar Cost Targets. **2019,** https://www.nrel.gov/docs/fy19osti/71912.pdf

[38] Abanades, S. Metal Oxides Applied to Thermochemical Water-Splitting for Hydrogen Production Using Concentrated Solar Energy. *ChemEngineering* **2019**, *3* (3), 63. https://doi.org/10.3390/chemengineering3030063.

[39] Barcellos, Debora R., et al. "BaCe 0.25 Mn 0.75 O 3− δ—a promising perovskite-type oxide for solar thermochemical hydrogen production." Energy & Environmental Science 11.11 (2018): 3256-3265.

production cost target of \$2/kg H_2 taking into account costs of appropriate solar concentration technologies (aligned with SETO targets and projections) and the cost of any electricity requirements; and describe a plausible pathway for meeting the \$1/kg H_2 goal.
- Describe the SOA methodologies to be used in integrated theory, synthesis, and characterization of STCH materials proposed in meeting targets (including but not limited to methods in multi-scale computation, combinatorial synthesis and characterization, machine learning and artificial intelligence)
- Describe the proposed experimental procedures for the collection, quantification, and analysis of hydrogen produced from the hydrogen-generation step of the STCH process; performed under practical operating conditions of temperature, pressure, steam/H_2 ratios (if applicable) associated with that step, and with active cycled materials subjected to conditions simulating exposure to concentrated solar power

Projects utilizing abundant, low-cost perovskite materials in the STCH cycle or integrated system are encouraged.

Topic 1 Project Structure

Applicants should propose projects up to 3 years in length for a maximum total DOE funding of \$1,000,000 per project. The funding request should be commensurate with the level of work proposed. Applicants should plan projects as two or three multi-phase efforts with a quantitative Go/No-Go decision point separating each phase (budget period). Phase 1 should be planned for a maximum of \$300,000 federal funding and a 12-18 month duration to demonstrate the feasibility of the proposed material concept.

Projects must satisfy the agreed upon quantitative performance criteria for the phase 1 Go/No-Go decision before DOE will commit support for additional phases. DOE anticipates that all of the selected projects will not achieve their phase 1 Go/No-Go criteria. A No-Go decision will result in a discontinuation of support beyond phase 1.

All projects will be expected to work with the HydroGEN consortium to leverage existing resources and expertise and to avoid duplication.

Topic 1 Teaming Arrangements

EERE encourages applicants to visit the HydroGEN website[40] to identify consortium nodes that would benefit the project. Successful applicants will work closely with the HydroGEN consortium to leverage the unique node capabilities identified in their applications to facilitate the development of their water splitting materials and systems. Teams that include a university with demonstrated expertise with perovskite materials are highly encouraged.

[40] https://h2awsm.org/

While applications should clearly identify the specific HydroGEN capabilities they would like to utilize, applicants should ***not include*** the cost of using HydroGEN nodes in their proposed budget. EERE will provide access to nodes in HydroGEN at no cost to the selected projects based on award negotiations. EERE encourages applicants to list by priority the HydroGEN nodes they would like to leverage with the understanding that the applicant is to perform the majority of the research effort. Depending on EERE resources and the level of availability of each consortium node, EERE may de-scope or negotiate this list during award negotiation.

Each project selected for award must execute the HydroGEN standard non-disclosure agreement (NDA).[41] Consistent with EMN guiding principles, non-proprietary results and data resulting from awards under this topic will be included in a HydroGEN data portal. Additional collaborative activities with HydroGEN will include providing relevant feedback to the consortium's development of best practices and protocols.

Teaming arrangements that include multiple stakeholders across academia, industry, national laboratories as appropriate, and across technical disciplines are strongly encouraged. For example, teams that include multiple partners are preferred over applications that only include a single organization. Please see Section I.A.iv for more information on teaming.

Topic 1 Applications Specifically Not of Interest

Under this topic EERE is not interested in applications focused primarily on the following:

- Applications for materials for electrolysis technologies, including liquid alkaline, proton exchange membrane, alkaline exchange membrane, and solid oxide electrolysis cells
- Applications that produce CO_2 and/or process biomass, municipal waste streams or fossil fuels.

b. Topic 2: Development and Validation of Sensor Technology for Monitoring and Measuring Hydrogen Losses

Topic 2 Introduction and Background

The United States currently produces over 10 million metric tonnes (MMT) of hydrogen per year, which is delivered to end users primarily through gaseous pipelines, tube trailers, and liquid tankers. While most hydrogen is currently produced through reforming of natural gas, the U.S. is projecting significant growth in the supply of clean hydrogen, to 50 MMT/year by 2050, targeting up to a 10% reduction in national greenhouse gas emissions relative to 2005 levels.[42] Given this anticipated ramp-up in hydrogen demand, stakeholders within the environmental and atmospheric modeling community have recently raised concerns that indirect impacts of hydrogen on global warming can reduce the projected decarbonization benefits of hydrogen. Although the percentage of H_2 in the atmosphere is currently extremely

[41] https://www.h2awsm.org/sites/default/files/hydrogen-nda-template-example_0_0.pdf

[42] Fuel Cell and Hydrogen Energy Association, "Road Map to a US Hydrogen Economy," https://www.fchea.org/us-hydrogen-study.

low (less than 600 ppb),[43] DOE is aware that this atmospheric hydrogen can indirectly generate a warming effect by reacting with other elements in a manner that produces greenhouse gases or extends their life. This could be exacerbated from hydrogen loss[44] during industrial production, storage, or transport, such as through leaks from pipelines or boil-off of liquid hydrogen.

When hydrogen loss is taken into account, the total life cycle impact on global warming is believed to be relatively small compared to the overall benefits of hydrogen, but further investigation is warranted. In late March 2022, HFTO co-led a virtual workshop with the European Commission (EC) on the current status of knowledge and key R&D gaps. HFTO and the EC invited approximately 150 global experts and included representatives from multiple DOE offices as well as national labs and other stakeholders within the environmental and atmospheric modeling community. A major technical gap identified in the workshop is the need to measure and quantify hydrogen loss from existing infrastructure to inform climate modeling and analysis efforts.

Since the percentage of atmospheric hydrogen is so low, evaluation of the global warming impacts of hydrogen technologies will require measurements of hydrogen in outdoor environments at the parts per billion (ppb) level, which is not feasible with current commercially available hydrogen sensor systems. Current sensors, intended for use in mitigation of safety risks, have been designed to detect hydrogen leaks at a parts per million (ppm) level and are not capable of detection and quantification at the levels required for this new application.

Topic 2 Anticipated Funding and Award Details

DOE's anticipated funding levels, including the range of federal funding per award are given below:

[43] Patterson, J. D., Aydin, M., Crotwell, A. M., Pétron, G., Severinghaus, J. P., Krummel, P. B., Langenfelds, R. L., Saltzman, E. S. (2021). H_2 in Antarctic firn air: Atmospheric reconstructions and implications for anthropogenic emissions. Proceedings of the National Academy of Sciences, 118(36). https://doi.org/10.1073/pnas.2103335118

[44] For the purposes of this FOA and consistent with international definitions, hydrogen "loss" refers to any H_2 addition to the atmosphere from anthropogenic activities, including releases and leaks. "Release" refers to any planned, foreseen, and/or necessary H_2 addition to the atmosphere from anthropogenic activities (e.g., for safety reasons, depressurization events). "Leak" refers to any unexpected, accidental, and/or unintended H_2 addition to the atmosphere from anthropogenic activities.

Topic Area	Total Funding Level ($000)	Anticipated Number of Awards	Federal Funding per Award ($000)	Max. Project Duration (years)	Min Required Non-Federal Cost Share %
Topic 2: Development and Validation of Sensor Technology for Monitoring and Measuring Hydrogen Losses	**$8,000**	**6 to 8**	**$1,000 – 1,500**	**3**	**20%**

Topic 2 Description and Objectives

In this topic, DOE aims to address potential issues associated with hydrogen emissions which can contribute to overall greenhouse gas (GHG) emissions, particularly as a result of hydrogen leakage or losses across the value chain from production through end use. DOE seeks applications that plan to develop commercially viable hydrogen sensor technologies with environmental monitoring capabilities, with a specific interest in high-resolution sensing and quantification of hydrogen losses in outdoor applications where hydrogen levels need to be monitored on-site at very low concentrations. Properties of interest are shown below in Table 1, and include 10 ± 0.5 ppb sensitivity detection, quantification capability, response time of less than 30 seconds and recovery time of less than 60 seconds (consistent with ISO 26142), resistance to weather elements, and selectivity to hydrogen in ambient air.

Table 1. Topic 2 Properties of Interest.

	Properties of Interest
Measurement Range	10 ± 0.5 ppb sensitivity detection, with quantification capability
Operating Temperature	At least -30 to 80°C
Response Time	Less than 30 seconds
Recovery Time	Less than 60 seconds
Gas Environment	Ambient air, 10% - 98% relative humidity range
Lifetime	At least 10 years
Interference Resistant	At minimum, resistant with respect to hydrocarbons
Other	Resistance to weather elements; selectivity to hydrogen in ambient air

Topic 2 General Requirements

Applications should include a detailed description of the proposed technology's end-of-project capabilities and targeted metrics for hydrogen detection and quantification for environmental monitoring. If the proposed system does not meet all properties of interest, applicants should describe the future development path to meet the properties of interest. Applicants should define their expected quantification capabilities, including a time scale (e.g., response time and recovery time) for measurements. While this topic is not intended to develop technologies for mitigating safety risk, applicants should address whether the proposed technology is capable of mitigating safety risk: specifically, whether the detection and measurement range meet the

requirements of relevant industry safety standards and the DOE targets for Hydrogen Safety Sensors[45] and whether the technology can be integrated into a notification system for emergency response.

System designs must be capable of on-site high-resolution detection and quantification of hydrogen in an outdoor environment, and may include multiple technologies such as, but not limited to, electrochemical sensors, fiber optic sensors, Raman scattering and LiDAR, or ultrasonic/acoustic sensors. Proposals may include single units or networked devices, such as an array of point sensors, for large-scale deployments. The systems should be deployable, robust, and serviceable at a range of sites or facilities where hydrogen leakage may occur such as bulk storage sites, pipelines, compressor stations, refueling locations, liquefaction equipment, or transfer stations. Applications should include a detailed description of plans for performance validation; and, where possible, include field testing in real-world hydrogen production, transportation, or end-use scenarios to prove commercial readiness.

As part of their proposals, applicants must:

- Identify the challenges currently limiting current sensor technology for use in environmental monitoring, and the innovative approach of the proposed system to address these challenges
- Propose an R&D plan for design and development
- Describe the proposed system's end-of-project capabilities and as applicable, future development path to meet the properties of interest for environmental monitoring
- Describe how the proposed system will be tested, including a description of data that will be collected during testing to validate performance for commercial viability
- Compare performance metrics and estimated cost with current state-of-the-art safety sensors
- As applicable, address cybersecurity challenges and vulnerabilities

Required project deliverables include data from lab-scale and field validation of the sensor(s) developed, including calibration results against ppb level reference samples. Deliverables also include analysis of the coverage area, type of use scenario, potential/ideal deployment locations in reference to hydrogen equipment, total number of sensors required, power consumption needs, ability to withstand environmental conditions, identification of potential interference compounds in the use scenario, cost analysis, and performance validation results of the sensor technology. While not required, portability is also of interest for scenarios where appropriate.

Topic 2 Project Structure

Applicants should propose 2-3 year projects for total DOE funding amounts between $1,000,000 and $1,500,000. The funding request should be commensurate with the level of

[45] DOE Targets for Hydrogen Safety Sensors (Table 3.7.6). Multi-Year Research, Development, and Demonstration Plan (Revised 2015). https://www.energy.gov/sites/prod/files/2015/06/f23/fcto_myrdd_safety_codes.pdf

work proposed. Projects should be planned with two or three phases (depending on the duration of the project) with a Go/No-Go decision point separating each phase (budget period). Applicants should provide project work plans with strong quantitative Go/No-Go decision points, including clear metrics that demonstrate capability of the technology for high resolution measurement of hydrogen releases, targeting the metrics given in the previous section as applicable. Projects must include at least 20% cost share consistent with R&D activities.

Topic 2 Teaming Arrangements

Teaming arrangements that include multiple stakeholders across academia, industry, national laboratories as appropriate, and across technical disciplines are strongly encouraged. For example, teams that include multiple partners are preferred over applications that only include a single organization. Teaming arrangements which leverage existing sensor facilities (e.g., at national laboratories, including but not limited to the NREL Sensor Laboratory) and which maximize field demonstration opportunities are strongly encouraged. Please see Section I.A.iv for more information on teaming.

Topic 2 Applications Specifically Not of Interest

Applications for mitigation of hydrogen losses, such as boil-off mitigation, hydrogen storage materials, etc., are not of interest for this topic area, as these are covered elsewhere in the portfolio and the focus of this Topic is on sensors. Applications that address the detection but not quantification of hydrogen will be considered unresponsive.

c. Topic 3: Materials-based H2 Storage Demonstrations

Topic 3 Introduction and Background

Achieving the aim of the Hydrogen Shot production cost target must be coupled with significant advancements in the practical transport and storage of low-cost hydrogen to enable its availability not only at the production site but also at the point of use. The development, demonstration, and deployment of higher density, lower pressure, and safe hydrogen transport and storage technologies at relevant scale is a critical research component of the DOE's clean hydrogen program,[46] and supports both the Hydrogen Shot and H2@Scale initiatives.[47]

Current stationary applications typically require the use and long-term, on-site, storage of large-scale, bulk quantities of hydrogen. This limits the practicality of certain bulk transport and storage methods. Hydrogen is typically transported and stored as either a compressed gas or as a cryogenic liquid:

- *Gaseous hydrogen storage* of bulk quantities requires very large vessels, and high operating and capital costs due to the need for energy-intensive compression and safe storage

[46] U.S. Department of Energy, *Department of Energy Hydrogen Program Plan,* https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf

[47] U.S. Department of Energy, *H2@Scale*, https://www.energy.gov/eere/fuelcells/h2scale

vessels. The large footprint of gaseous bulk storage is further exacerbated by inclusion of setback distances due to safety concerns with storage of large quantities of high-pressure hydrogen. As an alternative to storage vessels, geologic storage in salt formations has been used to store large quantities of gaseous hydrogen for use primarily by the oil and chemical industries. However, the geographic limitation of viable salt formation sites for geologic storage prevents its widespread use for stationary applications.

- *Cryogenic liquid hydrogen storage* offers higher density and smaller footprints, but its use is complicated due to the high cost, energy demands of liquefaction, storage difficulties associated with multi-layer vacuum insulation, thermal inefficiencies, and hydrogen boil-off. Furthermore, the total liquid hydrogen production capacity is currently limited within the U.S. and the cost to build new liquefaction plants is a barrier to market entry.

While DOE is actively investigating solutions to many of the above barriers, it is unlikely that traditional compressed or liquid hydrogen storage options will be sufficient for all transport and stationary storage applications, and alternative methods need to be developed.

Materials-based options can provide certain benefits over compressed or liquid storage, as they have the potential to operate at lower pressure and ambient temperature, and therefore may bring large cost and energy savings. Hydrogen carriers are hydrogen-rich liquid or solid phase materials from which hydrogen can be liberated on-demand. Hydrogen carriers include conventional H_2 storage materials such as intermetallic hydrides, complex hydrides and sorbents; as well as compounds such as organic hydrocarbon liquids. These materials could be used for transport and stationary storage applications.

Prior DOE research has primarily been focused on improving hydrogen storage materials to enable their use onboard vehicles. To date, state-of-the-art materials have not been able to surpass the performance of high-pressure compressed hydrogen for this application. However, the performance requirements for transport and stationary applications are significantly different than for onboard vehicle applications; for example, weight and volume constraints required for onboard storage may be significantly relaxed for other use cases. The advantage of hydrogen carriers in such applications arises from their facile and stable storage in large quantities for long periods of time, as well as their ability to be transported and transferred more easily. For example, certain types of metal hydrides, which are considered too heavy for onboard applications, possess high volumetric capacities, good thermodynamics, rapid kinetics, and stable reversibility suitable for use in other applications. Importantly, many classes of these metal hydrides are composed of readily available metals, making them attractive for low-cost, large-scale storage. This is just one example of a class of materials which was discounted in the past for onboard vehicular applications but may be ideal for certain transport or stationary applications.

Topic 3 Anticipated Funding and Award Details

DOE's anticipated funding levels, including the range of federal funding per award are given below:

Topic Area	Total Funding Level ($000)	Anticipated Number of Awards	Federal Funding per Award ($000)	Max. Project Duration (years)	Min Required Non-Federal Cost Share %
Topic 3: Materials-based H_2 Storage Demonstrations	**$10,000**	**2 to 5**	**$2,000 – 5,000**	**4**	**50%**

Topic 3 Description and Objectives

EERE seeks applications for demonstration projects that establish and validate the potential for materials-based hydrogen transport and storage technologies to provide benefits over traditional compressed or liquid transport and storage systems in a specified non-onboard-vehicle application. All classes of hydrogen carriers and storage materials relevant to transport and stationary storage are of interest, including adsorbents, all types of metal hydrides, and hydrogen-rich liquids. This topic strongly encourages approaches other than ammonia production, which is covered elsewhere within the DOE portfolio such as through the ARPA-E REFUEL program. Unlike many transportation applications, where EERE has developed detailed technical target tables for onboard storage systems, the large range of scales and duty cycles for diverse non-onboard vehicle applications has necessitated the ongoing development of different storage targets for each specific end-use. Therefore, proposed projects must include a detailed analysis of the required system needs for a specific selected use case, and to what extent the proposed materials-based solution provides benefits over traditional compressed or liquid hydrogen methods.

Use cases may include any high-impact application identified in the H2@Scale initiative, including the energy, industrial and chemical, and transportation (excluding onboard fuel storage) sectors. Energy sector applications could include either primary or backup power cases, such as for data or telecommunications centers, building applications (including fuel cell power), public services, or energy storage (including for mitigating curtailment of renewable energy generation). Examples of industrial and chemical sector applications include iron reduction and synthetic fuels production, among others. In the transportation sector, materials-based carriers for hydrogen delivery pathways that traditionally use compressed or liquid hydrogen are also of interest.

Topic 3 General Requirements

Proposals should include a discussion of the hydrogen-rich material(s) to be used in the selected end use, with data showing its hydrogen capacity, hydrogen uptake and release behavior, stability, cost, and any other relevant information regarding its operation, including engineering, environmental, and safety concerns. Applicants should address the entire life cycle

of the carrier material, including synthesis/production, hydrogenation, dehydrogenation, hydrogen purification, transport, potential side products/end of life issues, and toxicity, as applicable. EERE is not interested in applications for this topic which focus primarily on new materials discovery or development, therefore, the selected material should not require a significant amount of research to improve its performance and to be demonstrated.

Applicants should also address all aspects of the proposed system utilizing the selected material, including details on the system, tank or vessel design, hydrogen delivery, infrastructure, hydrogenation/dehydrogenation reactor design, dispensing requirements, safety, codes, standards, and siting and regulatory concerns.

Proposed work should include the design and fabrication of a functional system which may be prototype, pilot, or full-scale with demonstration of the application in a practical scenario. Applicants are encouraged to demonstrate hydrogen storage capacities greater than those already demonstrated for current state-of-the-art for the proposed material/system. The project scale should be based on the relevance to the specific use case and to the current state of the technology. The demonstration should elucidate the key research and development needs and priorities required to advance the proposed approach for full scale commercial viability.

As part of their proposals, applicants must:

- Describe the current status of the technology, including any limitations of commercially available components
- Compare the proposed concept's cost and performance capabilities (e.g., storage capacity, pressure, flow rate, temperature) with current state-of-the-art
- Detail the design, development, and demonstration effort
- Specify the hydrogen storage material or materials being considered
- Include a detailed estimate of the cost of the proposed technology, including capital cost at the component and system level, operating costs (including energy consumption and maintenance), and potential installation costs (for the specific application)
- Describe how the proposed system will be tested, including a description of data that will be collected during testing to validate system performance for commercial viability
- As applicable, address cybersecurity challenges and vulnerabilities
- To ensure market relevance, EERE encourages applicants to include letters of support from industry stakeholders (e.g., for end use application such as data center developers/operators, power system manufacturers, public service operators, local jurisdictions)

Topic 3 Project Structure

Applicants should propose 3-4 year projects for a total DOE funding amount of $2,000,000 to $5,000,000. The funding request should be commensurate with the level of work proposed. Projects should be planned as 3-4 multi-phase efforts (depending on the duration of the project) with a Go/No-Go decision point separating each phase (budget period). Each phase

(budget period) should be planned for approximately 12 to 18 months. Applicants should provide project work plans with strong quantitative Go/No-Go decision points including clear metrics that demonstrate progress in meeting the project's schedule, performance objectives and overall goals. Project teams are required to provide **50% cost share,** consistent with demonstration activities.

During the first budget period, projects should include a detailed analysis to confirm that the proposed storage method provides benefits over traditional compressed or liquid storage systems for the selected application. By the end of the first budget period, projects will be expected to deliver data projecting the cost and operation details of the storage system and its performance for the application. Subsequent budget periods should focus on fabrication of the prototype, pilot, or full-scale system.

Topic 3 Teaming Arrangements

Industry-led efforts are highly encouraged. Project teams should include other relevant stakeholders as appropriate, such as hydrogen providers, off-takers, and end-users of the system. Proposals should detail the proposed engagement and expected work of the stakeholders. Applicants are encouraged to consider leveraging the world-class capabilities of the DOE's national laboratories if applicable and, if used, detail how national laboratory capabilities will be effectively leveraged.[48] Please see Section I.A.iv for more information on teaming.

Topic 3 Applications Specifically Not of Interest

Under this topic EERE is not interested in applications focused primarily on the following:

- Analysis only activities
- Novel material development or discovery
- Onboard vehicle or man-portable power application demonstrations
- Demonstrations of strictly compressed, cryo-compressed, or liquid hydrogen systems

d. Topic 4: M2FCT: High Performing, Durable, Low-PGM Catalysts and Membrane Electrode Assemblies for Medium- and Heavy-Duty Applications

Topic 4 Introduction and Background

Hydrogen-fueled proton-exchange membrane fuel cells (PEMFCs) are an attractive technology to power multiple applications, particularly zero-emission medium- and heavy-duty vehicles for on road (trucks and buses), as well as marine, rail, and off-road (e.g., mining and construction) applications. They offer several advantages over incumbent technologies such as diesel engines, including higher efficiency, reduced emissions, higher torque, and no noise pollution.

[48] https://www.energy.gov/national-laboratories

Additionally, fuel cell vehicles offer fast fueling and adequate fuel storage for applications demanding long range.

Medium- and heavy-duty truck applications demand a lifetime of up to one million miles, and therefore require fuel cells with highly durable components including membranes, catalysts, and electrode structures. For PEMFCs, and membrane electrode assemblies (MEAs) in particular, cost is driven by platinum group metal (PGM) catalyst content, and durability decreases with decreasing PGM loading. This makes it difficult to concurrently meet durability and cost targets for medium- and heavy-duty transportation applications. In the most demanding applications, additional challenges include operation in the presence of fuel and air impurities, starting and stopping, freezing and thawing, and humidity and load cycling that result in mechanical and chemical stresses on fuel cell materials, components, and interfaces.

Regardless of application, it is critical to provide a total cost of ownership that is competitive with incumbent and advanced alternative powertrains, considering capital, fuel costs, and lifetime. High fuel cell system durability is essential to amortize capital costs over a longer lifetime. For example, long haul trucks require a lifetime of over one million miles, which is roughly equivalent to 25,000 operating hours. Significantly longer vehicle lifetimes and range requirements also mean that hydrogen fuel costs comprise a greater proportion of vehicle lifecycle cost. As such, increased fuel cell efficiency is a key parameter for economic viability. Cost-competitiveness with incumbent and advanced alternative powertrains requires continued R&D to simultaneously reduce capital costs of fuel cell components and systems while maintaining high efficiency and durability.

The DOE has set targets for long-haul class 8 fuel cell trucks at 25,000 hour lifetime, 68% peak efficiency, and $80/kWnet fuel cell system cost by 2030.[49] To meet these targets, advances are required for fuel cell stack and balance-of-plant components and their associated manufacturing technologies and processes.

To expedite fuel cell competitiveness for heavy-duty applications, the DOE launched the Million Mile Fuel Cell Truck consortium (M2FCT), which includes multiple national laboratories with demonstrated leadership in the topic area in partnership with universities and industry to accelerate R&D to enable meeting a fuel cell durability of a million miles and other relevant targets.[50] The M2FCT cross-disciplinary national laboratory core team serves as a resource for industry and the research community. Applications selected in this Topic are expected to partner with M2FCT to leverage capabilities and expertise in areas such as testing and utilizing appropriate accelerated stress tests (ASTs).

[49] U.S. Department of Energy "Hydrogen Class 8 Long Haul Truck Targets" Program Record, December 12, 2019: https://www.hydrogen.energy.gov/pdfs/19006_hydrogen_class8_long_haul_truck_targets.pdf

[50] Million Mile Fuel Cell Truck (M2FCT) consortium announcement, October 8, 2020: https://www.energy.gov/eere/articles/doe-launches-two-consortia-advance-fuel-cell-truck-and-electrolyzer-rd

Topic 4 Anticipated Funding and Award Details

DOE's anticipated funding levels, including the range of federal funding per award are given below. The funding requested should be commensurate with the level of work proposed.

Topic Area	Total Funding Level ($000)	Anticipated Number of Awards	Federal Funding per Award ($000)	Max. Project Duration (years)	Min Required Non-Federal Cost Share %
Topic 4: M2FCT: High Performing, Durable, Low-PGM Catalysts and MEAs for Medium- and Heavy-Duty Applications	**$10,000**	**3 to 4**	**Up to $3,000**	**3**	**20%**

Topic 4 Description and Objectives

This topic seeks applications that, in coordination with the M2FCT consortium, will develop novel and innovative catalysts *integrated into MEAs* that will reduce the cost and enhance the durability and performance of PEM fuel cell stacks for heavy-duty applications, in line with DOE targets. Specifically, proposed catalyst designs submitted in response to this topic should meet, when integrated in an MEA, the following M2FCT 2025 ***end-of-life*** MEA target:

- *Demonstration of 2.5 kW/g_{PGM} power output (1.07 A/cm^2 current density at 0.7 V; 750 mW/cm^2 at 0.7 V) after running a heavy-duty AST equivalent to 25,000 hours*

The target is for MEA-level performance with total PGM loading constrained to 0.3 mg/cm^2.[51] DOE seeks proposals for commercially viable approaches that can be manufactured at high volumes with minimal environmental/toxicity issues, emissions, and energy footprint. Approaches that allow for ease of end-of-life disassembly and recovery of PGM/other components are encouraged. In addition, commercially viable concepts that can eliminate other subsystem components (e.g., humidifier) and reduce parasitic losses, are encouraged.

The topic focuses on developing advanced low-PGM cathode catalysts for the oxygen reduction reaction and integrating these into high-performing electrodes that meet heavy-duty application performance and durability requirements. Hence, low-PGM cathode catalyst development should be the primary focus of the proposed projects. Applicants in this topic should clearly articulate their path for meeting the M2FCT 2025 MEA target by the end of the project. Monometallic Pt catalysts have shown relatively good stability, but lack the activity needed to meet targeted fuel cell performance and cost targets as higher loadings are required. Platinum-based catalysts with transition metals in alloyed, dealloyed, and intermetallic structures (e.g., PtCo) have demonstrated higher activity but lower durability compared to monometallic Pt catalysts, particularly for heavy-duty applications. Additional innovation is

[51] MEA test conditions: 88°C, 2.5 atm, SR: 1.5 cathode/2 anode, 40% relative humidity, integral cell conditions.

necessary, including novel synthesis routes and structures to meet the topic's end of life performance targets.

Project proposals should emphasize innovative catalyst development approaches and designs that when integrated into MEAs address both performance and durability challenges, as well as enable fuel cell cost reduction. MEA integration activities (e.g., support, ionomer optimization, and electrode engineering) complementary to the catalyst development activities should also be included as part of the project plan. Concepts that duplicate current activities within M2FCT or the DOE portfolio are not solicited.

Topic 4 General Requirements

Applicants are required to describe how they will engage with DOE's M2FCT core lab consortium team, specifically including which national labs and capabilities are necessary for the project. The full list of capabilities can be found on the M2FCT website: https://millionmilefuelcelltruck.org.

Applications must additionally include the following:

- Details of novel low-PGM cathode oxygen reduction catalyst synthesis and electrode layer design (≤0.25 mg_{PGM}/cm^2 cathode loading and ≤0.30 mg_{PGM}/cm^2 total loading).
- Details of how the approach improves durability of lower-cost fuel cells under realistic conditions.
- Details of how the approach will meet the M2FCT 2025 MEA target.
- The approach for catalyst and MEA manufacturing, including feasibility for high volumes and estimate of maximum throughput (e.g., meters per minute for roll-to-roll processes).
- The approach for MEA integration and testing.
- Proposed accelerated stress testing based on the MEA test protocols from M2FCT.
- Plans to deliver a set of MEAs (6 or more, each with active area ≥ 50 cm^2) for independent testing and evaluation by the M2FCT core lab consortium.

Topic 4 Project Structure

The maximum DOE funding for this topic is $10,000,000. Applicants should propose projects up to 3 years in length for a total DOE funding of up to $3,000,000 for each project, and the funding requested should be commensurate with the level of work proposed. EERE intends to select 3 to 4 projects based on available funds and proposed scope. Projects should be planned as two or three multi-phase efforts (depending on the duration of the project) with a Go/No-Go decision point separating each phase (budget period). Each phase (budget period) should be planned for approximately 12 to 18 months. Applicants should provide project work plans with strong quantitative Go/No-Go decision points including clear metrics that demonstrate progress in meeting the project's schedule, performance objectives and overall goals. Projects must include at least 20% cost share, consistent with R&D activities.

Topic 4 Teaming Arrangements

Applicants are required to work with DOE's M2FCT consortium, which leverages national laboratory resources to develop a better mechanistic understanding of fuel cell components enabling improvements (https://millionmilefuelcelltruck.org). EERE encourages applicants to visit the M2FCT website to identify expertise, capabilities, or facilities that would benefit the project. While applications should clearly identify the specific M2FCT capabilities they would like to utilize, applicants should not include the cost of using M2FCT capabilities in their proposed budget. EERE will provide access to M2FCT capabilities at no cost to the selected projects based on award negotiations. EERE encourages applicants to list by priority the capabilities they would like to leverage with the understanding that the applicant is to perform the majority of the research effort. Depending on EERE resources and the level of availability, EERE may de-scope or negotiate this list during award negotiation.

Teaming arrangements that include multiple stakeholders across academia, industry, national laboratories as appropriate, and across technical disciplines are strongly encouraged and preferred. Please see Section I.A.iv for more information on teaming.

Topic 4 Applications Specifically Not of Interest

Under this Topic, applications focused on the following are not of interest:

- Anion-exchange fuel cell technologies
- PGM-free catalysts and electrodes
- Phosphoric acid-based fuel cell technologies
- Solid oxide fuel cells

ii. Area of Interest 2: Improving Electricity Grid Resilience

a. Topic 5: The University Research Consortium for Grid Resilience (URCGR)

Topic 5 Introduction and Background

Our extensive, reliable electric power grid has fueled the Nation's growth since the early 1900s. As the engine of our industrial and economic growth, the electricity grid has grown and evolved over the past century with emphasis on providing reliable power at all times. The grid has become a critical element of our national security and defense infrastructure. Access to electricity is such a fundamental enabler for the economy that the National Academy of Engineering named "electrification" the greatest engineering achievement of the 20th century.[52] However, the nation's power grid must be more resilient to an evolving spectrum of threats and hazards and must be ready to support an increasing amount of variable renewable power generation to meet President Biden's goal of 100% clean power by 2035 and net-zero emissions by 2050. Developing a clean, resilient grid also requires understanding the cross-border

[52] Wulf, William A. "Great achievements and grand challenges." The Bridge 30.3 (2000): 4.

dependencies with Canada and Mexico as both Canada and Mexico have electrical interconnections and other dependencies with the United States.

The grid faces ever-increasing and complex threats, including intensifying cyber and physical attacks, severe weather, wildfires, and fuel delivery failures. Combined with factors such as managing legacy infrastructure while increasing reliance on digital and communications technologies, these threats can cause devastating large-area, long-duration outages. The technological transformation of the grid, including renewables, distributed energy resources (DERs), and smart grid, presents opportunities for grid resilience and decarbonization, but with new vulnerabilities as well. Today's standard grid reliability metrics (and associated data, analytics, and modeling tools), accepted planning and operational practices, workforce development, and investment priorities do not sufficiently address these threats.

The President's National Infrastructure Advisory Council defines resilience as the ability to prepare for and adapt to changing conditions and reduce disruptive events' magnitude and duration. Additionally, the North American Electric Reliability Corporation defines reliability by strictly avoiding instability, uncontrolled separation, or cascading failures of the bulk power grid.[53] DOE is leading the transition to a resilient power system that minimizes the impacts of such events and affects. Specific challenges to be addressed concerning grid resilience and decarbonization include:

1. Ensuring secure energy supply chains and delivery systems.
2. Mitigating vulnerabilities associated with interdependencies between the electric grid and other infrastructures.
3. Achieving sustained system availability with current technologies, architectures, and computing tools while the grid continues to evolve with the addition of new technologies.
4. Understanding human-machine interfaces and effects of human behavior, including societal, physical, and economic impacts.
5. Developing new analytical methods that provide readily usable decision and visualization tools for disaster mitigation and recovery.

Extreme weather events like the Dixie Wildfire, Hurricane Ida, and the 2021 Texas Freeze have made it clear that existing energy infrastructure cannot endure the impacts of climate change. Modernizing and expanding the electricity grid will make the nation's energy sector more resilient, while enabling the buildout of affordable, reliable, clean energy. Grid resilience is a key feature of the Infrastructure Investment and Jobs Act.

The Infrastructure Investment and Jobs Act is a United States federal statute enacted by the 117th United States Congress and signed into law by President Joe Biden on November 15, 2021. The Act provides approximately $1.1 trillion of key investments needed to improve and

[53] https://www.nerc.com/pa/Stand/Pages/ResultsBasedStandards.aspx

rebuild the Nation's infrastructure. DOE's portion of the funding includes more than $62 billion for investments in energy infrastructure that can support a pathway to a clean, resilient, and equitable energy future. The funding includes $14 billion in financial assistance to States, Indian Tribes, utilities, and other entities that provide products and services for enhancing the reliability, resilience, and efficiency of the electric grid.

To support states, tribes, and regions in the planning and deployment of this massive investment, DOE is looking to build a regionally diverse university research consortium focused on developing a decarbonized and more resilient power system domestically and in coordination with counterpart universities in Mexico and Canada.[54, 55]

Topic 5 Anticipated Funding and Award Details

DOE's anticipated funding levels, including the range of federal funding per award are below:

Topic Area	Total Funding Level ($000)	Anticipated Number of Awards	Federal Funding per Award ($000)	Max. Project Duration (years)	Min Required Non-Federal Cost Share %
University Research Consortium on Grid Resilience	$20,000	1	$20,000	3	0 - 20%[56]

Topic 5 Description and Objectives

This topic intends to create a University Research Consortium on Grid Resilience (URCGR) that will support states and tribes, both individually and regionally, in developing the modeling tools, baseline information, data, analysis, plans, metrics, analytics, workforce, and methods needed to develop and implement successful grid resilience programs, establish decarbonization and emission reduction goals, and prioritize infrastructure investments aimed at achieving these goals. In support of this objective, the URCGR should work with tribes, states, regions, utilities, and other stakeholders on the following activities.

[54] As directed through the 2022 Federal Appropriations Explanatory Statement, Division D https://docs.house.gov/billsthisweek/20220307/BILLS-117RCP35-JES-DIVISION-D.pdf

[55] As directed through the 2021 Federal Appropriations Explanatory Statement, Energy and Water Development https://www.appropriations.senate.gov/imo/media/doc/EWRept.pdf

[56] Tasks that are focused on analysis, outreach, education, or workforce development do not require non-Federal cost share. Tasks that involve research and development (i.e., partnering with states, tribes, or regions to develop and implement pilot grid resilience projects) will require a minimum 20% non-Federal cost share.

Analysis, Outreach, Education and Workforce Development Activities
(Non-federal Cost Share: 0%)

- **Baseline Data:** URCGR should develop tools to support tribes, states, disadvantaged communities, and regions in developing a baseline of their current level of grid resilience and energy-related emissions, including greenhouse gases (GHGs) and criteria pollutants.
- **Metrics and Analysis:** Based on the latest guidance on energy resilience, the URCGR should work with states, tribes, and regions to develop and use a standard set of grid resilience metrics to track progress and measure success, including methods to measure impacts on disadvantaged communities.
- **Best Practices:** The URCGR should collect, organize, and share the best-practice examples of grid resilience plans and implementation with tribes, states, disadvantaged communities, and regions. Additionally, the URCGR should evaluate and report on cross border options to increase grid resilience, as well as opportunities to enable the development and harmonization of codes and standards, and address common challenges such as safety, siting, and permitting.
- **Modeling Tools:** The URCGR should develop tools to help states, tribes, and regions best understand where their current and future grid resilience challenges lie and how best to address them.
- **Plans:** Using the baseline, metrics, and modeling tools developed above, the URCGR should work with states, tribes, and regions to develop grid resilience plans that best reflect the regional nature of grid resilience (e.g., droughts and wildfires in the West, hurricanes in the Southeast), including methods to mitigate negative impacts on and deliver positive benefits to disadvantaged communities as defined through the Justice40 Initiative.[57]
- **Workforce Development:** Regionally relevant grid resilience solutions will require a skilled workforce to deliver these results. The URCGR should work with states, tribes, and regions to identify workforce needs and required skills and capabilities to implement the specific outcomes identified. The URCGR should regularly engage and gather feedback from affected and disadvantaged communities as defined through the Justice40 Initiative.
- **Infrastructure Investment Priorities:** The URCGR should work with states, tribes, and regions to identify what infrastructure investments would best support those grid resilience plans considering local and regional approaches.
- **Decarbonization Goals:** The URCGR should work with states, tribes, and regions to develop specific decarbonization goals that support their grid resilience plans and the nation's broader decarbonization efforts.

[57] The Justice40 initiative, created by Executive Order 14008, establishes a goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities. https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf.

Grid Resiliency Pilot Projects
(Non-federal cost share: 20%)

The URCGR is also encouraged to work with states, tribes, and regions to design or develop regional grid resilience pilot research and development projects to serve as models for how investments in infrastructure can serve their needs. These projects should include an industry or utility partner and will require a minimum 20% cost share. Examples of pilot projects to support grid resilience priorities in specific states, tribes, or regions may include (but are not limited to):

- Testing energy storage systems that use renewable energy such as solar or wind power to generate hydrogen and store it safely and cost effectively, such as in abandoned oil/gas wells/other appropriate bulk storage approaches.
- Integrating and demonstrating stationary fuel cells for resiliency or innovative concepts such as tri-generation which can use various fuels or sewage waste, and co-produce power, heat, and hydrogen as needed.
- Integrating hydrogen production from electrolysis with co-production of value-added commodities such as ammonia or methanol.
- Leveraging methane normally flared for local electricity use.
- Installing grid-interconnected solar PV that supports large-scale EV charging with utility system peak controls.
- Designing and demonstrating controls strategies that optimize end use loads, feeders, substations, and other line capacity.

Over the course of the award, the URCGR must organize two national meetings, inviting and engaging with team partners or collaborators from Canada and Mexico. The participants should share outcomes from their work, including approaches to and cross-border options for grid resilience and decarbonization, and develop a peer-to-peer learning environment that extends throughout the full period of the award.

Topic 5 Project Structure

The maximum DOE funding for this topic is $20,000,000. DOE intends to select one consortium to be funded for up to 3 years. Applicants should propose work in three phases (budget periods) with a Go/No-Go decision point separating each phase. The award will be made over three years with yearly evaluations based on go-no-go criteria. The member universities will be expected to work directly with states, tribes, utilities, and industry to help states and tribes develop plans (both individually and regionally) that address grid resilience challenges across state and tribal boundaries. The Consortium and/or its member universities should also have agreements in place with universities in Canada and Mexico to allow for information exchange on cross-border dependencies and grid resilience. Applicants should include a minimum 20% cost share for grid resilience pilot projects that are included as part of the project. See Appendices A and B for a description of what qualifies as cost share and how to calculate cost share.

Topic 5 Teaming Arrangements

EERE expects the URCGR to include multiple universities from different states, with enough regional diversity to represent all key regions of the U.S. electric grid, and with broad expertise in the electric power system. The proposed team should designate one university as the prime recipient to lead and coordinate the effort, provide guidance to other universities in the URCGR, and develop a cohesive and integrated approach for consortia efforts. The lead university should have the demonstrated ability to coordinate the team of universities and other partners across multiple regions. U.S. universities are the only entities eligible to apply as prime recipients.

The URCGR members must have demonstrated expertise in grid resilience and decarbonization (or related technologies). At least one of the principal member universities (the prime or a key partner) must have formal relationships with universities in Canada and Mexico. Universities or other organizations from Canada and Mexico can be included on the team as subrecipients for a nominal level of funding or as cost sharing partners. As set forth in Section IV.J.iii., any work to be performed *outside* of the United States must be approved through the DOE foreign work waiver process (see Section IV.D.xv. and Appendix C for the format and necessary information to be included in the Foreign Work Waiver request, which must be submitted with the FOA application, if applicable). DOE encourages additional cost share that may be provided for the non-U.S. partners associated with the selected project (such as through Canadian or Mexican government funding to complement DOE funding). The Consortium needs to be large enough to represent the different regions of the country. Partnerships with utilities, industry, and non-governmental organizations are encouraged. Please see Section I.A.iv for more information on teaming.

Topic 5 Applications Specifically Not of Interest

Under this Topic, applications focused on the following are not of interest:

- Applications that are not led by U.S. universities
- Applications that are just focused on one region of the U.S.
- Applicants that do not have expertise in the electric power system

All work under EERE funding agreements must be performed in the United States. See Section IV.J.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 for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics).
- Applications that fall outside the technical parameters specified in Section I.A and I.B of the FOA, including:

- Topic 1
  - Applications for materials for electrolysis technologies, including liquid alkaline, proton exchange membrane, alkaline exchange membrane, and solid oxide electrolysis cells
  - Applications that produce CO_2 and/or process biomass, municipal waste streams or fossil fuels
- Topic 2
  - Applications for mitigation of hydrogen losses, such as boil-off mitigation, hydrogen storage materials, etc., are not of interest for this topic area
  - Applications that address the detection but not quantification of hydrogen
- Topic 3
  - Analysis only activities
  - Novel material development or discovery
  - Onboard vehicle or man-portable power application demonstrations
  - Demonstrations of strictly compressed, cryo-compressed, or liquid hydrogen systems
- Topic 4
  - Anion-exchange fuel cell technologies
  - PGM-free catalysts and electrodes
  - Phosphoric acid-based fuel cell technologies
  - Solid oxide fuel cells
- Topic 5
  - Applications that are not led by U.S. universities.
  - Applications that are just focused on one region of the country.
  - Applicants that do not have expertise in the electric power system.

D. Authorizing Statutes

The programmatic authorizing statutes are (1) Energy Policy Act of 2005 (EPAct 2005) Public Law 109-58 (Aug. 8 2005), Title VIII, Sections 801 to 816; 42 U.S.C. Sections 16151 to 16165 and (2) Consolidated Appropriations Act, 2021, Public Law 116-260 (Dec 27, 2020), Division Z--Energy Act of 2020, Section 9009.

Awards made under this announcement will fall under the purview of 2 Code of Federal Regulation (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 $60.5M of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 19-27 awards under this FOA. 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	HydroGEN: Solar Fuels + Perovskites: Photoelectrochemical & Solar Thermochemical	7-9	$750,000	$1,000,000	$12,500,000*	36
2	Development and Validation of Sensor Technology for Monitoring and Measuring hydrogen Losses	6-8	$1,000,000	$1,500,000	$8,000,000	24-36
3	Materials-based H_2 Storage Demonstrations	2-5	$2,000,000	$5,000,000	$10,000,000	36-48
4	M2FCT: High Performing, Durable, and Low-PGM Catalysts/MEAs for Medium- and Heavy-duty Applications	3-4	$2,000,000	$3,000,000	$10,000,000	36
5	University Research Consortium on Grid Resilience	1	$20,000,000	$20,000,000	$20,000,000	36

Includes federal funding that will be provided for core national laboratories within HydroGEN to support the selected FOA projects after the selection of awards.

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. Before the expiration of the initial budget period(s), EERE may perform a down-select among different recipients and provide additional funding only to a subset of recipients.

ii. Period of Performance

EERE anticipates making awards that will run from 24 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 review. For a complete list, see Section VI.B.xiv. At the Go/No-Go decision points, EERE 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. As a result of this evaluation, EERE 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.

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 United States 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)

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.

III. Eligibility Information

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

A. Eligible Applicants

i. Individuals

U.S. citizens and lawful permanent residents are eligible to apply for funding as a prime recipient or subrecipient.

ii. Domestic Entities

For-profit entities, educational institutions, and nonprofits that are incorporated (or otherwise formed) under the laws of a particular state or territory of the United States and have a physical location for business operations in the United States are eligible to apply for funding as a prime recipient or subrecipient. 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.

State, local, and tribal government entities are eligible to apply for funding as a prime recipient or subrecipient.

DOE/NNSA FFRDCs are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient. Exceptions to this are:

- FFRDC members of the HydroGEN consortium[58] are not eligible to apply as either a prime recipient or subrecipient under Topic 1. FFRDC members of the HydroGEN consortium are eligible to apply as a subrecipient under Topics 2, 3, 4, and 5.

[58] National Renewable Energy Laboratory, Sandia National Laboratories, Lawrence Berkeley National Laboratory, Idaho National Laboratory, Lawrence Livermore National Laboratory

- FFRDCs that are core members of the M2FCT consortium[59] are not eligible to apply as either a prime recipient or subrecipient under Topic 4. All FFRDC members of the M2FCT consortium are eligible to apply as a subrecipient under Topics 1, 2, 3, and 5.

For Topic 5 of this FOA, United States universities are the only entities eligible to apply as prime recipients; however, all entities are eligible to apply as subrecipients.

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

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

iii. Foreign Entities

Foreign entities, whether for-profit or otherwise, are eligible to apply for funding under this FOA. Other than as provided in the "Individuals" or "Domestic Entities" sections above, all prime recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a state or territory of the United States and have a physical location for business operations in the United States. If a foreign entity applies for funding as a prime recipient, it must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed) under the laws of a state or territory of the United States to be the prime recipient. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate.

Foreign entities may request a waiver of the requirement to designate a subsidiary in the United States as the prime recipient in the Full Application (i.e., a foreign entity may request that it remains the prime recipient on an award). To do so, the applicant must submit an explicit written waiver request in the Full Application. Appendix C lists the necessary information that must be included in a request to waive this requirement. The applicant does not have the right to appeal EERE's decision concerning a waiver request.

In the waiver request, the applicant must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to have a foreign entity serve as the prime recipient. EERE may require additional information before considering the waiver request.

A foreign entity may receive funding as a subrecipient.

[59] Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Argonne National Laboratory, National Renewable Energy Laboratory, and Oak Ridge National Laboratory. ~~, Brookhaven National Laboratory, Pacific Northwest National Laboratory~~

iv. Incorporated Consortia

Incorporated consortia, which may include domestic and/or foreign entities, are eligible to apply for funding as a prime recipient or subrecipient. For consortia incorporated (or otherwise formed) under the laws of a state or territory of the United States, please refer to "Domestic Entities" above. For consortia incorporated in foreign countries, please refer to the requirements in "Foreign Entities" above.

Each incorporated consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium must provide a written description of its internal governance structure and its internal rules to the EERE Contracting Officer.

v. Unincorporated Consortia

Unincorporated Consortia, which may include domestic and foreign entities, must designate one member of the consortium to serve as the prime recipient/consortium representative. The prime recipient/consortium representative must be incorporated (or otherwise formed) under the laws of a state or territory of the United States. The eligibility of the consortium will be determined by the eligibility of the prime recipient/consortium representative under Section III.A of the FOA.

Upon request, unincorporated consortia must provide the EERE Contracting Officer with a collaboration agreement, commonly referred to as the articles of collaboration, which sets out the rights and responsibilities of each consortium member. This agreement binds the individual consortium members together and should discuss, among other things, the consortium's:

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

B. Cost Sharing

Topic Areas 1, 2, and 4: The cost share must be at least 20% of the total allowable costs for research and development projects (i.e., the sum of the government share, including FFRDC costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project).
Topic Area 3: The cost share must be at least 50% of the total allowable costs for demonstration and commercial application projects and must come from non-federal sources unless otherwise allowed by law.
Topic Area 5: For activities that are classified as Education/Outreach/Analysis/

Workforce Development activities performed under Topic 5, no cost share is required. For activities that are classified as research and development, the cost share must be at least 20% of the total allowable costs (i.e., the sum of the government share, including FFRDC costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project).

All cost share must come from non-federal sources unless otherwise allowed by law. (See 2 CFR 200.306 and 2 CFR 910.130 for the applicable cost sharing requirements.) To assist applicants in calculating proper cost share amounts, EERE has included a cost share information sheet and sample cost share calculation in Appendices A and B (for blended cost share) of this FOA.

Topic Area Number	Topic Area Title	Recipient Cost Share (%)
Topic 1	HydroGEN: Solar Fuels from Photoelectrochemical and Solar Thermochemical Water Splitting	20%
Topic 2	Development and Validation of Sensor Technology for Monitoring and Measuring Hydrogen Losses	20%
Topic 3	Materials-based H_2 Storage Demonstrations	50%
Topic 4	M2FCT: High Performing, Durable, Low-PGM Catalysts and Membrane Electrode Assemblies for Medium- and Heavy-Duty Applications	20%
Topic 5	University Research Consortium on Grid Resilience	0%, 20%

i. Legal Responsibility

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

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

ii. Cost Share Allocation

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

iii. Cost Share Types and Allowability

Every cost share contribution must be allowable under the applicable federal cost principles, as described in Section IV.J.i. of the FOA. In addition, cost share must be verifiable upon submission of the Full Application.

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

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

In-kind contributions are those where a value of the contribution can be readily determined, verified and justified but where no actual cash is transacted in securing the good or service comprising the contribution. Allowable in-kind contributions include, but are not limited to: the donation of volunteer time or the donation of space or use of equipment.

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

The prime recipient may not use the following sources to meet its cost share obligations including, but not limited to:

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

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

Cost share contributions must be specified in the project budget, verifiable from the prime recipient's records, and necessary and reasonable for proper and efficient accomplishment of the project. As all sources of cost share are considered part of total project cost, the cost share dollars will be scrutinized under the same federal regulations as federal dollars to the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

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

iv. Cost Share Contributions by FFRDCs

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

v. Cost Share Verification

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

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

vi. Cost Share Payment

EERE 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 EERE 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

Concept Papers, Full Applications, and Replies to Reviewer Comments must meet all compliance criteria listed below or they will be considered noncompliant. EERE will not review or consider noncompliant submissions, including Concept Papers, Full Applications, and Replies to Reviewer Comments that were: submitted through means other than EERE

eXCHANGE; submitted after the applicable deadline; and/or submitted incomplete. EERE will not extend the submission deadline for applicants that fail to submit required information by the applicable deadline due to server/connection congestion.

i. Compliance Criteria

a. Concept Papers

Concept Papers are deemed compliant if:

- The Concept Paper complies with the content and form requirements in Section IV.C. of the FOA; and
- The applicant successfully uploaded all required documents and clicked the "Submit" button in EERE eXCHANGE by the deadline stated in this FOA.

b. Full Applications

Full Applications are deemed compliant if:

- The applicant submitted a compliant Concept Paper;
- The Full Application complies with the content and form requirements in Section IV.D. of the FOA; and
- The applicant successfully uploaded all required documents and clicked the "Submit" button in EERE eXCHANGE by the deadline stated in the FOA.

c. Replies to Reviewer Comments

Replies to Reviewer Comments are deemed compliant if:

- The Reply to Reviewer Comments complies with the content and form requirements in Section IV.E. of the FOA; and
- The applicant successfully uploaded all required documents to EERE eXCHANGE by the deadline stated in the FOA.

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 Federally Funded Research and Development Centers 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. Value/Funding

The value of and funding for the FFRDC portion of the work will not normally be included in the award to a successful applicant. Usually, DOE will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal (WP) system and non-DOE/NNSA FFRDC through an interagency agreement with the sponsoring agency.

d. Cost Share

Although the FFRDC portion of the work is usually excluded from the award to a successful applicant, 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.

e. 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 contractor.

f. Limit on FFRDC Effort

The FFRDC effort, in aggregate, shall not exceed 25% of the total estimated cost of the project, including the applicant's and the FFRDC's portions of the effort.

g. Requirement for DOE/NNSA FFRDCs to Use a Cooperative Research and Development Agreement (CRADA) with the Prime Recipient

DOE/NNSA FFRDC project team members funded directly by DOE must work with their fellow project team members under a cooperative research and development agreement (CRADA), unless otherwise approved by the Contracting Officer, to ensure accountability for project work and appropriate management of intellectual property (IP), e.g., data protection and background IP.

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 provided that an eligible Concept Paper was submitted for each Full Application.

G. Questions Regarding Eligibility

EERE will not make eligibility determinations for potential applicants prior to the date on which applications to this FOA must be submitted. The decision whether to submit an application in response to this FOA lies solely with the applicant.

IV. Application and Submission Information

A. Application Process

The application process will include two phases: a Concept Paper phase, and a Full Application phase. **Only applicants who have submitted an eligible Concept Paper will be eligible to submit a Full Application**.

At each phase, EERE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of Section III. of the FOA. EERE will not review or consider submissions that do not meet the eligibility requirements of Section III. All submissions must conform to the following form and content requirements, including maximum page lengths (described below) and must be submitted via EERE eXCHANGE at https://eere-eXCHANGE.energy.gov, unless specifically stated otherwise. **EERE will not review or consider submissions submitted through means other than EERE eXCHANGE, submissions submitted after the applicable deadline, or incomplete submissions**. EERE will not extend deadlines for applicants who fail to submit required information and documents due to server/connection congestion.

A **Control Number** will be issued when an applicant begins the EERE eXCHANGE application process. This control number must be included with all application documents, as described below.

The Concept Paper, Full Application, and Reply to Reviewer Comments must conform to the following requirements:

- 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 inch 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;

- The Control Number must be prominently displayed on the upper right corner of the header of every page. Page numbers must be included in the footer of every page; 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.

Applicants are responsible for meeting each submission deadline. **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 in advance of the submission deadline), applicants should allow at least 1 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 urges applicants to carefully review their Concept Papers, Full Applications, and Replies to Reviewer Comments to allow sufficient time for the submission of required information and documents. All Full Applications that pass the initial eligibility review will undergo comprehensive technical merit review according to the criteria identified in Section V.A.ii. of the FOA.

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. Should applicants experience problems with EERE eXCHANGE, the following information may be helpful.

Applicants that experience issues with submission PRIOR to the FOA deadline: In the event that an applicant experiences technical difficulties with a submission, the applicant should contact the EERE eXCHANGE helpdesk for assistance (EERE-eXCHANGESupport@hq.doe.gov). The EERE eXCHANGE helpdesk and/or the EERE eXCHANGE system administrators will assist applicants in resolving issues.

B. Application Forms

The application forms and instructions are available on EERE eXCHANGE. To access these materials, 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 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB 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

C. Content and Form of the Concept Paper

To be eligible to submit a Full Application, applicants must submit a Concept Paper by the specified due date and time.

i. Concept Paper Content Requirements

EERE will not review or consider ineligible Concept Papers (see Section III. of the FOA).

Each Concept Paper must be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Concept Paper.

The Concept Paper must conform to the following content requirements:

Section	Page Limit	Description
Cover Page	1 page maximum	The cover page should include the project title, the specific announcement Topic Area being addressed, both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Technology Description	3 pages maximum	Applicants are required to describe succinctly: • The proposed technology or program, including its basic operating principles and how it is unique and innovative; • The proposed technology or program's target level of performance (applicants should provide data or other support to show how the proposed target(s) 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 or program 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; • The key technical risks/issues associated with the proposed plan; • Proposed measures and strategies to meet objectives for diversity, equity, inclusion; and • The impact that EERE funding would have on the proposed project.
Addendum	1 pages maximum	Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed Project Team, including: • Whether the Principal Investigator (PI) and Project Team have the skill and expertise needed to successfully execute the project plan; • Whether the applicant has prior experience which demonstrates an ability to perform tasks of similar risk and complexity; • Whether the applicant has worked together with its teaming partners on prior projects or programs; and • 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. • 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. An applicant who receives a "discouraged" notification may still submit a Full Application. EERE will review all eligible Full Applications. However, by discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project in an effort to save the applicant the time and expense of preparing an application that is unlikely to be selected for award negotiations.

EERE may include general comments provided from reviewers on an applicant's Concept Paper in the encourage/discourage notification posted on EERE eXCHANGE at the close of that phase.

D. Content and Form of the Full Application

Applicants must submit a Full Application by the specified due date and time to be considered for funding under this FOA. Applicants must complete the following application forms found on the EERE eXCHANGE website at https://eere-eXCHANGE.energy.gov/, in accordance with the instructions.

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. Applicants will receive a control number upon clicking the "Create Concept Paper" button in EERE eXCHANGE, and should include that control number in the file name of their Full Application submission (i.e., *Control number_Applicant Name_Full Application*).

i. Full Application Content Requirements

EERE will not review or consider ineligible Full Applications (see Section III. of the FOA).

Each Full Application shall be limited to a single concept or technology. Unrelated concepts and technologies shall not be consolidated in a single Full Application. Full Applications must conform to the following requirements:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	15 (Topics 1, 2, 4, 5) 25 (Topic 3)	ControlNumber_LeadOrganization_TechnicalVolume
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_DEIP
Resumes	PDF	2 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	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 3)	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 and Foreign Work Waivers *(if applicable)*	PDF	n/a	ControlNumber_LeadOrganization_Waiver
Buy America Requirements for Infrastructure Projects Waiver Requests *(if applicable)*	PDF	n/a	ControlNumber_LeadOrganization_BAWaiver
Current and Pending Support	PDF	n/a	ControlNumber_LeadOrganization_CPS

Note: The maximum file size that can be uploaded to the EERE eXCHANGE website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB 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 10MB.

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

ii. Technical Volume

The Technical Volume must be submitted in PDF format. The Technical Volume must conform to the following content and form requirements, including maximum page lengths. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages. This volume must address the Merit Review Criteria as discussed in Section V.A.ii. of the FOA. Save the Technical Volume in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_TechnicalVolume".

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

The Technical Volume to the Full Application may not be more than 15 pages (Topics 1, 2, 4, 5) or 25 pages (Topic 3), including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The applicant should consider the weighting of each of the evaluation 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. The Technical Volume must conform to the following content requirements:

SECTION/PAGE LIMIT	DESCRIPTION
Cover Page	The cover page should include the project title, the specific FOA Topic Area being addressed, both the technical and business points of contact, names of all team member organizations, names of the senior/key personnel and their organizations, 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 their organization, including the history, successes, and current research and development status (i.e., the baseline) relevant to the topic being addressed in the Full Application. • Project Goal: The applicant should explicitly identify the targeted improvements to the baseline technology, process, or program 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, process, or program, 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, process, or program and capability of achieving the anticipated performance targets, including a description of previous work done and prior results. • Innovation and Impacts: The applicant should describe the current state-of-the-art in the applicable field; the specific innovation of the proposed technology, process, or program; the advantages or benefits of the proposed technology, process, or program; ; and the overall impact of the project on the technical, social, environmental, economic, and market goals defined in the FOA.
Workplan and Market Transformation Plan (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. • Scope Summary: The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period. • WBS and Task Description Summary: The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the final project goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a standard WBS for any project. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as "we will then complete a proprietary process" is unacceptable). It is the applicant's responsibility to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA. The summary provided should be consistent with the SOPO. The SOPO will contain a more detailed description of the WBS and tasks. • Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a 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: The applicant should provide a summary of project-wide Go/No-Go decision points at appropriate points in the Workplan. A Go/No-Go decision point 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 actually beginning the execution of future phases. 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 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. • Project Management: The applicant should discuss the team's proposed management plan, including the following: o The overall approach to and organization for managing the work o The roles of each project team member o Any critical handoffs/interdependencies among project team members o The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices o The approach to project risk management o A description of how project changes will be handled o If applicable, the approach to Quality Assurance/Control o How communications will be maintained among project team members • Market Transformation Plan (**NOT** applicable to Topic 5): The applicant should provide a market transformation plan, including the following: o Identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including a mitigation plan. o 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. • Impact Assessment (applicable **ONLY** to Topic 5): The applicant should provide an impact assessment including the following:

	○ Identification of direct benefits that tribes, states, regions, and other stakeholders will receive through the proposed program along with known or perceived barriers, including a mitigation plan ○ Description of how the applicant will engage with stakeholders for the proposed program ○ Plan to improve the visibility and impact of the Consortium and to track the effectiveness of its activities ○ Description of how the proposed program's benefits to tribes, states, regions and other stakeholders will be self-sustaining upon completion of the award period ○ Description of how the proposed program benefits will help reach grid resilience and decarbonization goals
Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	The Technical Qualifications and Resources should contain the following information: • Describe the project team's unique qualifications and expertise, including those of key subrecipients. • Describe the project team's existing equipment and facilities 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. • This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives. • Describe the time commitment of the key team members to support the project. • Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable. • For multi-organizational or multi-investigator projects, describe succinctly: ○ The roles and the work to be performed by each PI/Key Participant and senior/key personnel; ○ Business agreements between the applicant and each PI/Key Participant and senior/key personnel; ○ How the various efforts will be integrated and managed; ○ Process for making decisions on scientific/technical direction; ○ Publication arrangements; ○ Intellectual Property issues; ○ Communication plans; and ○ Describe the ability of the proposed consortia/team to facilitate and expedite further development and commercial deployment of the proposed technologies or planning processes.

iii. Diversity, Equity and Inclusion Plan

As part of the application, applicants are required to describe how diversity, equity, and inclusion objectives will be incorporated in the project. Specifically, applicants are required to submit a Diversity, Equity, and Inclusion Plan that describes the actions the applicant will take to foster a welcoming and inclusive environment, support people from groups underrepresented in STEM, advance equity, and encourage the inclusion of individuals from these groups in the project; and the extent the project activities will be located in or benefit underserved communities (also see Section I.A.iii.).

The plan **should include at least one SMART milestone per Budget Period supported by metrics** to measure the success of the proposed actions, and will be incorporated into the award if selected. The Diversity, Equity, and Inclusion Plan should contain the following information:

- Equity Impacts: the impacts of the proposed project on underserved communities, including social and environmental impacts.
- Benefits: The overall benefits of the proposed project, if funded, to underserved communities; and
- How diversity, equity, and inclusion objectives will be incorporated in the project.

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

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

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

iv. Resumes

A resume provides information that can be used by reviewers to evaluate the individual's skills, experience, and potential for leadership within the scientific community. Applicants are required to submit two-page resumes for the Principal Investigator and all Senior/Key Personnel that include the following:

1. Contact Information;
2. Education and training: Provide 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 convention for citations (list only the first author) may be used for publications with more than 10 authors; and
6. Synergistic Activities: List up to five professional and scholarly activities related to the proposed effort.

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

In future FOAs, EERE may require a biographical sketch for the PI and senior/key personnel. In the meantime, in lieu of a resume, it is acceptable to use the biographical sketch format approved by the National Science Foundation. The biographical sketch format may be generated by the Science Experts Network Curriculum Vita, a cooperative venture maintained at https://www.ncbi.nlm.nih.gov/sciencv/, and is 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.

v. Letters of Commitment

Submit letters of commitment from all subrecipient and third party cost share providers. If applicable, also include any letters of commitment from partners/end users (one-page

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

vi. Statement of Project Objectives (SOPO)

Applicants are required to complete a SOPO. A SOPO template is available on EERE eXCHANGE at https://eere-eXCHANGE.energy.gov/. The SOPO, including the Milestone Table, must not exceed 10 pages when printed using standard 8.5 x 11 paper with 1" margins (top, bottom, left, and right) with font not smaller than 12 point (except in figures or tables, which may be 10 point font). Save the SOPO in a single Microsoft Word file using the following convention for the title "ControlNumber_LeadOrganization_SOPO".

vii. SF-424: Application for Federal Assistance

Applicants are required to complete the SF-424 Application for Federal Assistance. This form is available on EERE eXCHANGE at https://eere-eXCHANGE.energy.gov/. Complete all required fields in accordance with the instructions on the form. 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".

viii. Budget Justification Workbook

Applicants are required to complete the Budget Justification Workbook. This form is available on EERE eXCHANGE at https://eere-eXCHANGE.energy.gov/. Prime recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the prime recipient and its subrecipients and contractors. Applicants should include costs associated with required annual audits and incurred cost proposals in their proposed budget documents. The "Instructions and Summary" included with the Budget Justification Workbook will auto-populate as the applicant enters information into the Workbook. Applicants must carefully read the "Instructions and Summary" tab provided within the Budget Justification Workbook. Save the Budget Justification Workbook in a single Microsoft Excel file using the following convention for the title "ControlNumber_LeadOrganization_Budget_Justification".

ix. Summary/Abstract for Public Release

Applicants are required to submit a one-page summary/abstract of their project. The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (e.g., benefits, outcomes), and major participants (for collaborative projects). This

document must not include any proprietary or sensitive business information as DOE may make it available to the public after selections are made. The project summary must not exceed 1 page when printed using standard 8.5 x 11 paper with 1" margins (top, bottom, left, and right) with font not smaller than 12 point. Save the Summary for Public Release in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_Summary".

x. Summary Slide

Applicants are required to provide a single slide summarizing the proposed project. This slide is used during the evaluation process.

The Summary Slide template requires 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;
- Project title, prime recipient, Principal Investigator, and senior/key personnel information; and
- Requested EERE funds and proposed applicant cost share.

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

xi. Subrecipient Budget Justification (if applicable)

Applicants must provide a separate budget justification for each subrecipient that is expected to perform work estimated to be more than $250,000 or 25 percent of the total work effort (whichever is less). The budget justification must include the same justification information described in the "Budget Justification" section above. Save each subrecipient budget justification in a Microsoft Excel file using the following convention for the title "ControlNumber_LeadOrganization_Subrecipient_Budget_Justification".

xii. Budget for DOE/NNSA FFRDC (if applicable)

If a DOE/NNSA FFRDC contractor 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 3, available at: https://www.directives.doe.gov/directives-documents/400-series/0412.1-BOrder-a-chg1-AdmChg Save the WP in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_WP".

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

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

FFRDC must be consistent with the contractor's authority under its award. Save the Authorization in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FFRDCAuth".

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

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

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

- An officer or employee of any federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

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

xv. Waiver Requests: Foreign Entity and Foreign Work (if applicable)

a. Foreign Entity Participation:

As set forth in Section III.A.iii., all prime recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of 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 necessary information that must be included in a request to waive this requirement.

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

As set forth in Section IV.J.iii., all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the prime recipient should make every effort to purchase supplies and equipment within the United States. Appendix C lists the necessary information that must be included in a foreign work waiver request.

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

c. Waiver of the Buy America Requirement for Infrastructure Projects

As set forth in Section IV.J.vii., federally assisted projects which involve infrastructure, 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.

In limited circumstances, DOE may grant a waiver of this requirement. Appendix D to this FOA provides guidance on how "infrastructure work" is defined, explains the applicable justifications under which a waiver may be granted, and lists the information that must be included in the waiver request.

Save the Waivers in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_BAWaiver."

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 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 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 – end date)
- The person-months of effort per year being dedicated to the award or activity

If required 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.

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. 3729-3730 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 National Science Foundation, which may be generated by the Science Experts Network Curriculum Vita, a cooperative venture maintained at https://www.ncbi.nlm.nih.gov/sciencv/, and is 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".

E. Content and Form of Replies to Reviewer Comments

If replies to reviewer comments are applicable, EERE will provide applicants with reviewer comments following the evaluation of all eligible Full Applications. Applicants will have a brief opportunity to review the comments and to prepare a short Reply to Reviewer Comments responding to the comments however they desire or supplementing their Full Application. The Reply to Reviewer Comments is an optional submission; applicants are not required to submit a Reply to Reviewer Comments. 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 in the event that 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 Replies to Reviewer Comments.

EERE will not review or consider ineligible Replies to Reviewer Comments (see Section III. of the FOA). EERE will review and consider each eligible Full Application, even if no Reply is submitted or if the Reply is found to be ineligible.

Replies to Reviewer Comments must conform to the following content and form requirements, including maximum page lengths, described below. If a Reply to Reviewer Comments is more than three (3) pages in length, EERE will review only the first three (3) pages and disregard any additional pages.

SECTION	PAGE LIMIT	DESCRIPTION
Text	2 pages max	Applicants may respond to one or more reviewer comments or supplement their Full Application.
Optional	1 page max	Applicants may use this page however they wish; text, graphs, charts, or other data to respond to reviewer comments or supplement their Full Application are acceptable.

F. Post Selection Information Requests

If selected for award, EERE reserves the right to request additional or clarifying information regarding the following (non-exhaustive list):

- 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.D.xvi. and VI.B.xix. Current and Pending Support);
- An Intellectual Property Management Plan (if applicable) describing how the project team/consortia members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies in accordance with Section VI.B.x. Intellectual Property Management Plan;
- A Data Management Plan (if applicable) describing how all research data displayed in publications resulting from the proposed work will be digitally accessible at the time of publications, in accordance with Section VI.B.xxi.;
- Indirect cost information;
- Other budget information;
- Commitment Letters 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);

- 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) Be registered in the SAM at https://www.sam.gov before submitting its application; (2) provide a valid UEI in its application; and (3) continue to maintain an active SAM registration with current information at all times during which it has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable UEI and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, the 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.

H. Submission Dates and Times

All required submissions must be submitted in EERE eXCHANGE no later than 5 p.m. Eastern Time 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.

Refer to the following applicable federal cost principles for more information:

- Federal Acquisition Regulation (FAR) Part 31 for For-Profit entities; and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

ii. Pre-Award Costs

Selectees must request prior written approval to charge pre-award costs. Pre-award costs are those incurred prior to the effective date of the federal award directly pursuant to the negotiation and in anticipation of the federal award where such costs are necessary for efficient and timely performance of the scope of work. Such costs are allowable only to the extent that

they would have been allowable if incurred after the date of the federal award and **only** with the written approval of the federal awarding agency, through the Contracting Officer assigned to the award.

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

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

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

   EERE does not guarantee or assume any obligation to reimburse pre-award costs incurred prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that DOE determines may have an adverse effect on the environment or limit the choice of reasonable alternatives prior to receiving such written authorization from the Contracting Officer, the applicant is doing so at risk of not receiving federal funding for their project and such costs may not be recognized as allowable cost share. Nothing contained in the pre-award cost reimbursement regulations or any pre-award costs approval letter from the Contracting Officer override these NEPA requirements 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)

a. Requirement

All work performed under EERE awards must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment; however, the prime recipient should make every effort to purchase supplies and equipment within the United States. The prime recipient must flow down this requirement to its subrecipients.

b. 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.

c. Waiver

There may be limited circumstances where it is in the interest of the project to perform a portion of the work outside the United States. To seek a foreign work waiver, the applicant must submit a written waiver request to EERE. Appendix C lists the necessary information that must be included in a request for a foreign work waiver.

The applicant must demonstrate to the satisfaction of EERE that a waiver would further the purposes of the FOA and is in the economic interests of the United States. EERE may require additional information before considering a waiver request. 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 USC 40118), commonly referred to as the "Fly America Act," and implementing regulations at 41 CFR 301-10.131 through 301-10.143. The law and regulations require air transport of people or property to, from, between, or within a country other than the United States, the cost of which is supported under this award, to be performed by or under a cost-sharing arrangement with a U.S. 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. 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 award under this FOA, the recipient may take disposition action on the real property and equipment or continue to use the real property and equipment after the conclusion of the award period of performance. Recipients may continue to use the real property and equipment so long as the recipient:

a. Continues to use the property for the authorized project purposes;
b. Complies with the applicable reporting requirements and regulatory property standards; and
c. Requests continued use of the property with its final SF-428 Tangible Personal Property Report and/or SF-429 Real Property Status Report submission during award closeout.

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 where 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. 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.

During the award period of performance, recipients may request Contracting Officer approval to encumber real property and/or equipment acquired in whole or in part with project funds. DOE may, in its discretion, approve an encumbrance of such property and/or equipment if DOE has a first priority *pari passu* position with senior lenders to the recipient including in the event of a bankruptcy, reorganization, insolvency proceeding, or liquidation of project assets.

During any period of continued use, property disposition, or liquidation proceedings, project assets including real property and equipment shall not be sold to any entity, whether public or private, that is owned or controlled by a foreign entity[60] of a 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.

[60] For purposes of this FOA, "foreign entities" include: (1) any foreign government or foreign government agency or instrumentality thereof; (2) any international organization; (3) any form of business enterprise or legal entity organized, chartered or incorporated under the laws of any country other than the United States or its territories; (4) any form of business enterprise organized or incorporated under the laws of the United States or a State or other jurisdiction within the United States which is owned or controlled by a foreign government, agency, firm, corporation, or a person who is not a citizen or national of the United States; and (5) any person who is not a citizen or national of the U.S.

vii. Buy America Requirements for – Infrastructure Projects

Federally assisted projects which 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 that term is defined in Section 70914 of the Bipartisan Infrastructure Law, 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.

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

Prior to making a federal award, the DOE is required by 31 U.S.C. 3321 and 41 U.S.C. 2313 to review information available through any Office of Management and Budget (OMB)-designated repositories of government-wide eligibility qualification or financial integrity information, such as SAM Exclusions and "Do Not Pay."

In addition, DOE evaluates the risk(s) posed by applicants before they receive federal awards. This evaluation may consider: results of the evaluation of the applicant's eligibility; the quality

of the application; financial stability; quality of management systems and ability to meet the management standards prescribed in this part; history of performance; reports and findings from audits; and the applicant's ability to effectively implement statutory, regulatory, or other requirements imposed on non-federal entities.

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.

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.

V. Application Review Information

A. Technical Review Criteria

i. Concept Papers

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

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

This criterion involves consideration of the following factors:

- The applicant clearly describes the proposed technology, process, or program, describes how the technology, process, or program is unique and innovative, and how the technology, process, or program will advance the current state-of-the-art;

- The applicant has identified risks and challenges, 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 merit 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 program is innovative;
- Degree to which the current state of the technology, process, or program 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 detail in the application to assess whether the proposed work is meritorious and revolutionary, including relevant data, calculations and discussion of prior work in the literature with analyses that support the viability of the proposed work;

Impact of Technology Advancement

- How the project supports the topic area objectives and target specifications and metrics; and
- The potential impact of the project on advancing the state-of-the-art.

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 Risks

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

Baseline, Metrics, and Deliverables

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

*Market Transformation Plan (**NOT** applicable to Topic 5)*

- 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.

*Impact Assessment (applicable **ONLY** to Topic 5):*

- Identification of direct benefits that tribes, states, regions, and other stakeholders will receive through the proposed program along with known or perceived barriers, including a mitigation plan;
- Description of how the applicant will engage with stakeholders for the proposed program;
- Plan to improve the visibility and impact of the Consortium and to track the effectiveness of its activities;
- Description of how the proposed program's benefits to tribes, states, regions and other stakeholders will be self-sustaining upon completion of the award period; and
- Description of how the proposed program benefits will help reach grid resilienceand decarbonization goals.

Criterion 3: Team and Resources (15%)

This criterion involves consideration of the following factors:

- The 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;
- The sufficiency of the facilities to support the work;
- The degree to which the proposed consortia/team demonstrates the ability to facilitate and expedite commercial deployment of the proposed technologies or processes and/or further development of the program

- The level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the Workplan; and
- The reasonableness of the budget and spend plan for the proposed project and objectives.

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

- The quality and manner in which the measures incorporate diversity, equity and inclusion goals in the project; and
- Extent to which the project benefits underserved communities.

iii. Criteria for Replies to Reviewer Comments

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

B. Standards for Application Evaluation

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

C. Other Selection Factors

i. Program Policy Factors

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

- The degree to which the proposed project exhibits technological diversity when compared to the existing DOE project portfolio and other projects selected from the subject FOA;
- The degree to which the proposed project, including proposed cost share, optimizes the use of available EERE funding to achieve programmatic objectives;
- The degree to which the proposed project avoids duplication/overlap with other publicly or privately funded work;
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers;
- The degree to which the proposed project is likely to lead to increased 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 diversity, equity, and inclusion elements, including but not limited to team members from Minority Serving Institutions (e.g., Historically Black Colleges and Universities (HBCUs)/Other Minority Institutions), Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or members within underserved communities;
- The degree to which the proposed project provides benefits to disadvantaged communities and minimizes environmental impacts to disadvantaged communities; and
- The degree to which the proposed project avoids duplication/overlap with other publicly or privately funded work.

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.

EERE may obtain additional information through Pre-Selection Interviews that will be used to make a final selection determination. EERE may select applications for funding and make awards without Pre-Selection Interviews. Participation in Pre-Selection Interviews with EERE does not signify that applicants have been selected for award negotiations.

iii. Pre-Selection Clarification

EERE may determine that pre-selection clarifications are necessary from one or more applicants. Pre-selection clarifications are distinct from and less formal than pre-selection interviews. These pre-selection clarifications will solely be for the purposes of clarifying the application, and will be limited to information already provided in the application documentation. 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 Integrity and Performance Matters

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 information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. 2313).

The applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM.

DOE will consider any written comments by the applicant, in addition to the other information in the designated integrity and performance system, 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.

VI. Award Administration Information

A. Award Notices

i. Ineligible Submissions

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

ii. Concept Paper Notifications

EERE will notify applicants of its determination to encourage or discourage the submission of a Full Application. EERE will post these notifications to EERE eXCHANGE.

Applicants may submit a Full Application even if they receive a notification discouraging them from doing so. By discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project. Such assessments do not necessarily reflect judgments on the merits of the proposed project. The purpose of the Concept Paper phase is to save applicants the considerable time and expense of preparing a Full Application that is unlikely to be selected for award negotiations.

A notification encouraging the submission of a Full Application does not authorize the applicant to commence performance of the project. Please refer to Section IV.J.ii. of the FOA for guidance on pre-award costs.

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. Successful Applicants

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. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement, accessible by the prime recipient in FedConnect.

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

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

v. Alternate Selection Determinations

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

vi. Unsuccessful Applicants

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

B. Administrative and National Policy Requirements

i. Registration Requirements

There are several one-time actions before submitting an application in response to this FOA, and it is vital that applicants address these items as soon as possible. Some may take several weeks, and failure to complete them could interfere with an applicant's ability to apply to this FOA, or to meet the negotiation deadlines and receive an award if the application is selected. These requirements are as follows:

a. EERE Funding Opportunity Exchange (eXCHANGE)

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

Beginning on July 8, 2022,[61] eXCHANGE will be updated to integrate with Login.gov. As of August 5, 2022, potential applicants will be required to have a Login.gov account to access EERE eXCHANGE. 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.

It is recommended that each organization or business unit, whether acting as a team or a single entity, use only one account as the contact point for each submission. Applicants should also designate backup points of contact so they may be easily contacted if deemed necessary. **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.**

b. System for Award Management

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

Applicants must obtain a **Unique Entity Identifier (UEI)** from the SAM to uniquely identify the entity. The UEI is available in the SAM entity registration record. NOTE: Subawardees/subrecipients at all tiers must also obtain a UEI from the SAM and provide the UEI to the Prime Recipient before the subaward can be issued. See Section IV.H. for more information on the UEI.

c. FedConnect

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

[61] The July 8 and August 5 dates are tentative and subject to change.

d. Grants.gov

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

e. Electronic Authorization of Applications and Award Documents

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

ii. Award Administrative Requirements

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

iii. Foreign National Access

All applicants selected for an award under this FOA may be required to provide information to DOE in order to satisfy requirements for foreign nationals' access to DOE sites, information, technologies, equipment, programs or personnel. A foreign national is defined as any person who is not a U.S. citizen by birth or naturalization. If a selected applicant (including any of its subrecipients, contractors or vendors) anticipates involving foreign nationals in the performance of its award, the selected applicant may be required to provide DOE with specific information about each foreign national to ensure compliance with the requirements for access approval. National laboratory personnel already cleared for site access may be excluded.

iv. Subaward and Executive Reporting

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

v. National Policy Requirements

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

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

EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA (42 U.S.C. 4321, *et seq.*). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their

proposed actions. For additional background on NEPA, please see DOE's NEPA website, at https://www.energy.gov/nepa.

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

vii. Applicant Representations and Certifications

a. 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.

b. Corporate Felony Conviction and Federal Tax Liability Representations

In submitting an application in response 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 the following definitions apply:

A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

c. Nondisclosure and Confidentiality Agreements Representations

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

a. It **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise

restricting its employees or contactors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a federal department or agency authorized to receive such information.

b. It **does not and will not** use any federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:

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

(2) The limitation above shall not contravene requirements applicable to Standard Form 312 Classified Information Nondisclosure Agreement (https://fas.org/sgp/othergov/sf312.pdf), Form 4414 Sensitive Compartmented Information Disclosure Agreement (https://fas.org/sgp/othergov/intel/sf4414.pdf), or any other form issued by a federal department or agency governing the nondisclosure of classified information.

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

viii. 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.

ix. 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 as a whole. 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.

x. Intellectual Property Management Plan (IPMP)

An IPMP may be required for Topic Area 5 due to the consortium arrangement, and for Topic Area 3 in the case of complex teaming arrangements, to be determined by DOE at the time of award.

If an IPMP is required, the award will set forth the treatment of and obligations related to intellectual property rights between EERE and the individual members. The IPMP should describe how the members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies (see Sections VIII.J - VIII.M of this FOA for more details on applicable federal intellectual property laws and regulations).

The following is a non-exhaustive list of examples of items that the IPMP may cover:

- The treatment of confidential information between members (e.g., the use of NDAs);
- The treatment of background intellectual property (e.g., any requirements for identifying it or making it available);
- The treatment of inventions made under the award (e.g., any requirements for disclosing to the other members on an application, filing patent applications, paying for patent prosecution, and cross-licensing or other licensing arrangements between the members);

- The treatment of data produced, including software, under the award (e.g., any publication process or other dissemination strategies, copyrighting strategy or arrangement between members);
- Any technology transfer and commercialization requirements or arrangements between the members;
- The treatment of any intellectual property issues that may arise due to a change in membership of the consortia or team; and
- The handling of disputes related to intellectual property between the members.

xi. Subject Invention Utilization Reporting

In order to ensure that prime recipients and subrecipients holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, EERE may require that each prime recipient holding title to a subject invention submit annual reports for ten (10) years from the date the subject invention was disclosed to EERE on the utilization of the subject invention and efforts made by prime recipient or their licensees or assignees to stimulate such utilization. The reports must include information regarding the status of development, date of first commercial sale or use, gross royalties received by the prime recipient, and such other data and information as EERE may specify.

xii. Intellectual Property Provisions

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

xiii. Reporting

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

Specific reporting and meeting attendance requirements for projects selected from this FOA will include, but are not limited to:

- Quarterly Financial and Technical Reports
- Final Technical Report
- Yearly participation at the DOE Hydrogen Program Merit Review and Peer Evaluation (AMR) meeting, typically held in Washington, D.C.
- Yearly participation in one U.S. DRIVE Technical Team Meeting
- DOE may request that material samples, components, and/or prototype systems resulting from the R&D effort be sent for independent, standardized testing at a facility specified by DOE, as appropriate
- Work with independent system and/or cost analysis projects within DOE portfolio for independent performance and model validation as appropriate

- Project Safety Plan: Safe practices in the production, storage, distribution, and use of hydrogen are essential for the widespread acceptance of hydrogen and fuel cell technologies. The recipient must comply with the following requirements:

    1. The recipient is required to coordinate with the Hydrogen Safety Panel (HSP), a resource of the DOE Hydrogen and Fuel Cells Program, throughout the project life cycle. Examples of opportunities for HSP involvement include participation in post-award project kickoff meetings, project design and document reviews, risk assessments, and pre-startup reviews prior to beginning field demonstrations. To minimize project impacts, these engagements should be coordinated with regularly scheduled project activities rather than be unique efforts, and should be based on discussions with HSP.
    2. All projects are required to submit safety plans. Guidance for the creation of the Safety Plan can be found at https://h2tools.org/sites/default/files/Safety_Planning_for_Hydrogen_and_Fuel_Cell_Projects.pdf. The Safety Plan should cover the full scope of the project, including work by the prime as well as any subrecipients, and should be complete before the work is started. The Safety Plan is due to DOE within 90 days after the award is signed unless alternative timing is approved due to project constraints. The HSP will review the Safety Plan and provide feedback to the Recipient (through DOE) within approximately 30 days of receipt. The Recipient will then have 30 days to respond to the HSP's feedback (e.g., either by incorporating comments into the Plan or by providing rationale for not incorporating comments) and resubmit a revised Safety Plan to DOE.
    3. DOE may request HSP involvement in site visits or via teleconferences. If a safety-focused site visit/teleconference is requested, the HSP will provide a written site visit report to the recipient for review and comment, and may conduct a follow-up interview with the recipient and their project team. All such HSP reports are also provided to DOE.

For all of the items noted above, please ensure that estimated costs associated with the requirements are included within the proposed budget.

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

EERE's Go/No-Go decision; (7) the recipient's submission of a continuation application; 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, EERE may take appropriate action, including but not limited to, redirecting, suspending or terminating the award.

xv. Conference Spending

The recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the United States government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the United States government would otherwise exceed $20,000, thereby circumventing the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such conference.

xvi. Uniform Commercial Code (UCC) Financing Statements

Per 2 CFR 910.360 (Real Property and Equipment) when a piece of equipment is purchased by a for-profit recipient or subrecipient with federal funds, and when the federal share of the financial assistance agreement is more than $1,000,000, 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. Implementation of Executive Order 13798, Promoting Free Speech and Religious Liberty

States, local governments, or other public entities may not condition sub-awards in a manner that would discriminate, or disadvantage sub-recipients based on their religious character.

xviii. Participants and Collaborating Organizations

If selected for award negotiations, the selected applicant must submit a list of personnel who are proposed to work on the project, both at the recipient and subrecipient level and a list of collaborating organizations within 30 days after the applicant is notified of the selection. 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.

xix. Current and Pending Support

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

xx. 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 U.S. industry and labor. Therefore, in exchange for receiving taxpayer dollars to support an applicant's project, the applicant must agree to a U.S. Competitiveness provision requiring any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States unless the Recipient can show to the satisfaction of the Department of Energy (DOE) that it is not commercially feasible. Award terms, including possible restrictions around change of control and reassignment of subject inventions related to the U.S. Competitiveness Provision, are available at https://www.energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards.

A subject invention is any invention conceived or first actually reduced in performance of work under an award. An invention is any invention or discovery which is or may be patentable.

As noted in the U.S. Competitiveness Provision, at any time in which an entity cannot meet the requirements of the U.S. Competitiveness Provision, the entity may request a modification or waiver of the U.S. Competitiveness Provision. For example, the entity may propose modifying the language of the U.S. Competitiveness Provision in order to change the scope of the

requirements or to provide more specifics on the application of the requirements for a particular technology. As another example, the entity may request that the U.S. Competitiveness Provision be waived in lieu of a net benefits statement or U.S. manufacturing plan. The statement or plan would contain specific and enforceable commitments that would be beneficial to the U.S. economy and competitiveness. Commitments could include manufacturing specific products in the U.S., making a specific investment in a new or existing U.S. manufacturing facility, keeping certain activities based in the U.S. or supporting a certain number of jobs in the U.S. related to the technology. If DOE, in its sole discretion, determines that the proposed modification or waiver promotes commercialization and provides substantial U.S. economic benefits, DOE may grant the request and, if granted, modify the award terms and conditions for the requesting entity accordingly.

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

xxi. Data Management Plan (DMP)

Each applicant whose Full Application is selected for award negotiations will be required to submit a 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 in order 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.

VII. Questions/Agency Contacts

Upon the issuance of a FOA, EERE personnel are prohibited from communicating (in writing or otherwise) with applicants regarding the FOA except through the established question and answer process as described below. Specifically, questions regarding the content of this FOA must be submitted to: hftofoa@ee.doe.gov. Questions must be submitted not later than 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. **Please note that you must first select this specific FOA Number in order to view the questions and answers specific to this FOA**. EERE will attempt to respond to a question within 3 business days, unless a similar question and answer has already been posted on the website.

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

VIII. Other Information

A. FOA Modifications

Amendments to this FOA will be posted on the EERE eXCHANGE website 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 commercial or financial information that is privileged or confidential 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 information that is commercial or financial, or information that is confidential or privileged, it is furnished to the 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 Government's right to use the information if it is obtained from another source.

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

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

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

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

E. Evaluation and Administration by Non-Federal Personnel

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

F. Notice Regarding Eligible/Ineligible Activities

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

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

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

H. Requirement for Full and Complete Disclosure

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

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

I. Retention of Submissions

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

J. Title to Subject Inventions

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

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions;
- All other parties: The federal Non-Nuclear Energy Act of 1974, 42. U.S.C. 5908, provides that the government obtains title to new inventions unless a waiver is granted (see below);
- Class Patent Waiver: DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order 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 terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- DEC: On June 07, 2021, DOE approved a DETERMINATION OF EXCEPTIONAL CIRCUMSTANCES (DEC) UNDER THE BAYH-DOLE ACT TO FURTHER PROMOTE DOMESTIC MANUFACTURE OF DOE SCIENCE AND ENERGY TECHNOLOGIES. In accordance with this DEC, all awards, including sub-awards, under this FOA shall include the U.S. Competitiveness

Provision in accordance with Section VI.B.xx. U.S. Manufacturing Committments of this FOA. A copy of the DEC can be found at https://www.energy.gov/gc/determination-exceptional-circumstances-decs. Pursuant to 37 CFR § 401.4, any nonprofit organization or small business firm as defined by 35 U.S.C. 201 affected by any DEC has the right to appeal it by providing written notice to DOE within 30 working days from the time it receives a copy of the determination.

K. Government Rights in Subject Inventions

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

a. 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.

b. March-In Rights

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

DOE may exercise its march-in rights only if it determines that such action is necessary under any of the four following conditions:

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfied manner;
- The owner has not met public use requirements specified by federal statutes in a reasonably satisfied manner; or
- The U.S. 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, except for awards under Topic Area 5, 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 awards 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 U.S. government regulates the transfer of information, commodities, technology, and software considered to be strategically important to the U.S. 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". To ensure compliance with Export Controls, it is the prime recipient's responsibility to determine when its project activities trigger Export Controls and to ensure compliance.

Export Controls may apply to individual projects, depending on the nature of the tasks. When Export Controls apply, the recipient must take the appropriate steps to obtain any required governmental licenses, monitor and control access to restricted information, and safeguard all controlled materials. Under no circumstances may foreign entities (organizations, companies or

persons) receive access to export controlled information unless proper export procedures have been satisfied and such access is authorized pursuant to law or regulation.

O. Personally Identifiable Information (PII)

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

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

P. Annual Independent Audits

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

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

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

APPENDIX A – COST SHARE INFORMATION

Cost Sharing or Cost Matching

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

How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. FFRDC costs must be included in Total Project Costs. The following is an example of how to calculate cost sharing amounts for a project with $1,000,000 in federal funds with a minimum 20% non-federal cost sharing requirement:

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

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

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

What Qualifies For Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or even a couple of 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, then it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, then it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the federal government under another award unless authorized by federal statute to be used for cost sharing.

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

- FAR Part 31 for For-Profit entities, (48 CFR Part 31); and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

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

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

General Cost Sharing Rules on a DOE Award

1. Cash Cost Share – encompasses all contributions to the project made by the recipient or subrecipient(s), for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment for their own company with organizational resources. If the item or service is reimbursed for, 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, 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. If questions exist, consult your DOE contact before filling out the In-Kind cost share section of the Budget Justification.

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

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

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

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

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

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

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

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

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

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

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

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

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

(B) Valuing and documenting contributions

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

will be consumed in the performance of the award or fully depreciated by the end of the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

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

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

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

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

(4) Valuing property donated by third parties.

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

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

i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of comparable space and facilities in a privately-owned building in the same locality.

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

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

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

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

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

The following example shows the math for calculating required cost share for a project with $2,000,000 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 AND APPROVAL PROCESSES: 1. FOREIGN ENTITY PARTICIPATION AS THE PRIME RECIPIENT; AND 2. PERFORMANCE OF WORK IN THE UNITED STATES (FOREIGN WORK WAIVER)

1. Waiver for Foreign Entity Participation as the Prime Recipient

As set forth in Section III.A.iii., all prime recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a state or territory of the United States 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.

Overall, the applicant must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to have a foreign entity serve as the prime recipient. A request to waive the *Foreign Entity Participation as the prime recipient* requirement must include the following:

- Entity name;
- The rationale for proposing a foreign entity to serve as the prime recipient;
- Country of incorporation and the extent, if any, the entity is state owned or controlled;
- A description of the project's anticipated contributions to the US economy;
- How the project will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the project will promote domestic American manufacturing of products and/or services;
- A description of how the foreign entity's participation as the prime recipient is essential to the project;
- A description of the likelihood of Intellectual Property (IP) being created from the work and the treatment of any such IP; and
- Countries where the work will be performed (Note: if any work is proposed to be conducted outside the U.S., the applicant must also complete a separate request for waiver of the Performance of Work in the United States requirement).

EERE may require additional information before considering the waiver request.

The applicant does not have the right to appeal EERE's decision concerning a waiver request.

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

As set forth in Section IV.J.iii., all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the prime recipient should make every effort to purchase supplies and equipment within the United States. There may be limited circumstances where it is in the interest of the project to perform a portion of the work outside 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 EERE 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 to waive the *Performance of Work in the United States* requirement must include the following:

- The rationale for performing the work outside the U.S. ("foreign work");
- A description of the work proposed to be performed outside the U.S.;
- An explanation as to how the foreign work is essential to the project;
- A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the US economy;
- The associated benefits to be realized and the contribution to the project from the foreign work;
- How the foreign work will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the foreign work will promote domestic American manufacturing of products and/or services;
- A description of the likelihood of Intellectual Property (IP) being created from the foreign work and the treatment of any such IP;
- The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
- The countries in which the foreign work is proposed to be performed; and
- The name of the entity that would perform the foreign work.

EERE may require additional information before considering the waiver request.

The applicant does not have the right to appeal EERE's decision concerning a waiver request.

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, 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[62] —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.

In addition to the above, the infrastructure in question must be publicly-owned or must serve a public function; privately owned infrastructure that is solely utilized for private use is not considered "infrastructure" for purposes of Buy America applicability. 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, 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:

[62] BIL, § 70917(c)(1).

(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[63] are manufactured in the United States—this means that all manufacturing processes for the construction material occurred in the United States. The Buy America requirements only applies 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 a 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.

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

C. DOE Submission Requirements for Full Application

Within the first two pages of the Workplan, applicants must provide a short statement on whether the project will involve the construction, alteration, and/or repair of infrastructure in the United States. The ultimate determination about whether a project includes infrastructure remains with DOE, but the applicant's statement will assist project planning and integration of domestic preference requirements, which may impact the project's proposed budget.

D. Waivers

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

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

(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 percent.

If an applicant is seeking a waiver of the Buy America requirements, it must include a written waiver request with the Full Application. 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
- 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 https://www.energy.gov/management/financial-assistance

The applicant does not have the right to appeal DOE's decision concerning a waiver request.

APPENDIX E – GLOSSARY

Applicant – The lead organization submitting an application under the FOA.

Continuation application – 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 to EERE its continuation application, which includes the following information:

i. A report on the Recipient's progress towards meeting the objectives of the project, including any 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 negotiated Statement of Project Objectives and/or Milestone Summary Table.

Cooperative Research and Development Agreement (CRADA) – 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

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

Go/No-Go Decision Points: – A decision point at the end of a budget period that defines the overall objectives, milestones and deliverables to be achieved by the recipient in that budget period. As of a result of EERE's review, EERE may take one of the following actions: 1) authorize federal funding for the next budget period; 2) recommend redirection of work; 3) discontinue providing federal funding beyond the current budget period; or 4) place a hold on federal funding pending further supporting data.

Project – The entire scope of the cooperative agreement which is contained in the recipient's Statement of Project Objectives.

Recipient or "Prime Recipient" – A non-federal entity that receives a federal award directly from a federal awarding agency to carry out an activity under a federal program. The term recipient does not include subrecipients.

Subrecipient – A non-federal entity that receives a subaward from a pass-through entity to carry out part of a federal program; but does not include an individual that is a beneficiary of such program. A subrecipient may also be a recipient of other federal awards directly from a federal awarding agency. Also, a DOE/NNSA and non-DOE/NNSA FFRDC may be proposed as a subrecipient on another entity's application. See Section III.E.i.

APPENDIX F – 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 G – LIST OF ACRONYMS

AST	Accelerated Stress Test
AWS	Advanced Water Splitting
CHASE	Center for Hybrid Approaches in Solar Energy to Liquid Fuels
COI	Conflict of Interest
CSP	Concentrated Solar Power
DEC	Determination of Exceptional Circumstances
DEI	Diversity, Equity, and Inclusion
DER	Distributed Energy Resources
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier
EERE	Energy Efficiency and Renewable Energy
EMN	Energy Materials Network
FAR	Federal Acquisition Regulation
FFATA	Federal Funding and Transparency Act of 2006
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FFRDC	Federally Funded Research and Development Center
GAAP	Generally Accepted Accounting Principles
GHG	Greenhouse Gases
HBCU	Historically Black College or University
HFTO	Hydrogen and Fuel Cell Technologies Office
IPMP	Intellectual Property Management Plan
JCAP	Joint Center for Artificial Photosynthesis
LiSA	Liquid Sunlight Alliance
M&O	Management and Operating
MEA	Membrane Electrode Assembly
MPIN	Marketing Partner ID Number
MSI	Minority-Serving institution
MYPP	Multi-Year Program Plan
M2FCT	Million Mile Fuel Cell Truck Consortium
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Agency
OMB	Office of Management and Budget
OMI	Other Minority Institution
OSTI	Office of Scientific and Technical Information
PEC	Photoelectrochemical
PEMFC	Proton Exchange Membrane Fuel Cell
PGM	Platinum Group Metal
PI	Principle Investigator

PII	Personal Identifiable Information
ppm	Parts per million
ppb	Parts per billion
R&D	Research and Development
RD&D	Research, Development & Demonstration
RDD&D	Research, Development, Demonstration & Deployment
RFI	Request for Information
RFP	Request for Proposal
SAM	System for Award Management
SETO	Solar Energy Technologies Office
SOA	State-of-the-Art
SOPO	Statement of Project Objectives
SPOC	Single Point of Contact
STCH	Solar Thermochemical
STH	Solar-to-Hydrogen
STEM	Science, Technology, Engineering, and Mathematics
TIA	Technology Investment Agreement
TRL	Technology Readiness Level
UCC	Uniform Commercial Code
UEI	Unique Entity Identifier
URCGR	University Research Consortium on Grid Resilience
WBS	Work Breakdown Structure
WP	Work Proposal