FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

U.S. Department of Energy (DOE)
Office of Fossil Energy and Carbon Management (FECM)

Bipartisan Infrastructure Law (BIL) - Clean Fuels & Products Shot: Supporting Carbon Utilization Products via Electrochemical Conversion and Refinery and Petrochemical Facilities Retrofitting

Funding Opportunity Announcement (FOA) Number: DE-FOA-0003018
FOA Type: Initial
Assistance Listing Number: 81.089 - Fossil Energy Research and Development

FOA Issue Date:	06/27/2024
Submission Deadline for Full Applications:	08/27/2024 5:00 pm ET
Expected Date for DOE Selection Notifications:	01/15/2025
Expected Timeframe for Award Negotiations:	05/30/2025

- To apply to this FOA, applicants must register with and submit application materials through NETL eXCHANGE at https://NETL-Exchange.energy.gov/.

Questions about this FOA? Email DE-FOA-0003018@netl.doe.gov.
Problems with NETL eXCHANGE? Email NETL-ExchangeSupport@hq.doe.gov
Include FOA number and Topic Area Number in subject line.

- Applicants must designate primary and backup points-of-contact in eXCHANGE with whom DOE 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.

SUMMARY OVERVIEW OF KEY INFORMATION

Issuing Agency	Department of Energy, Office of Fossil Energy and Carbon Management (FECM)
Program Overview	This program will provide funding to support the Department's Clean Fuels & Products Shots initiative, which was established to support the national goal of achieving net-zero emissions by 2050 by developing the sustainable feedstocks and conversion technologies necessary to produce crucial fuels, materials, and carbon-based products that are better for the environment than current petroleum-derived components.
Objective	This FOA seeks applications to address carbon conversion challenges across two areas: engineering-scale electrochemical conversion with a focus on system durability and feasibility studies for refinery and petrochemical facility retrofits.
Topic Areas	• Topic Area 1: "Engineering-Scale Testing of Electrochemical Systems for the Conversion CO_2 into Value-Added Products" • Topic Area 2: "Feasibility Studies for Retrofitting of Refineries and Petrochemical Facilities for Carbon Conversion"
Eligible Applicants	• Domestic Entities (Institutions of higher education; for-profit entities; non-profit entities; state and local governmental entities and Indian Tribes) • Foreign Entities (with an approved waiver)
Funding	It is anticipated that this FOA will provide Federal funding of $16,000,000. • Topic Area 1: approximately $12,000,000 Federal funding; 20% cost share requirement • Topic Area 2: approximately $4,000,000 Federal funding; 20% cost share
Deadlines	August 27, 2024 at 5:00 pm ET: Full Application Due

Questions about this FOA? Email DE-FOA-0003018@netl.doe.gov.
Problems with NETL eXCHANGE? Email NETL-ExchangeSupport@hq.doe.gov.
Include FOA number and Topic Area Number in subject line.

Notice to Applicants of Registration Requirements

There are several one-time actions that must be completed before submitting an application in response to this Funding Opportunity Announcement (FOA) (e.g., register with the System for Award Management (SAM), obtain a Unique Entity Identifier (UEI) number, register with Grants.gov, register with NETL eXCHANGE, and register with FedConnect.net. 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.

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

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

- **UEI** – Applicants must obtain an UEI from the SAM to uniquely identify the entity. The UEI is available in the SAM entity registration record.

  NOTE: First tier Subawardees/subrecipients must also obtain an UEI from the SAM and provide the UEI to the Prime Recipient before the subaward can be issued. Full registration in SAM is not required to obtain an UEI for subaward reporting.

- **Grants.gov** – Applicants must register with Grants.gov at https://www.grants.gov/register to receive automatic updates about this FOA.

- **NETL eXCHANGE** - Applicants must register through the NETL eXCHANGE at https://NETL-Exchange.energy.gov/. This account will allow the user to apply to any open FOAs that are currently in eXCHANGE.

- **FedConnect** – Applicants must register with FedConnect at https://www.fedconnect.net/ to receive notification that a funding agreement has been executed by the Contracting Officer and to obtain a copy of the executed funding agreement, if applicable.

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I. Funding Opportunity Description

A. Background and Context

The Office of Fossil Energy and Carbon Management (FECM) in collaboration with the National Energy Technology Laboratory (NETL) is issuing this Funding Opportunity Announcement (FOA). Awards made under this FOA will be funded, in whole or in part, with funds appropriated by the Infrastructure Investment and Jobs Act[1], more commonly known as the Bipartisan Infrastructure Law (BIL).

The BIL is a once-in-a-generation investment in modernizing and upgrading American infrastructure to enhance United States competitiveness, drive the creation of good-paying union jobs, tackle the climate crisis, and ensure stronger access to economic, environmental, and other benefits for disadvantaged communities.[2]. BIL appropriates more than $62 billion to the Department of Energy (DOE)[3] to invest in American manufacturing and workers; expand access to energy efficiency and clean energy; deliver reliable, clean, and affordable power to more Americans; and demonstrate and deploy the technologies of tomorrow through clean energy demonstrations.

DOE's BIL investments will support efforts to build a clean and equitable energy economy that achieves a carbon pollution-free electricity sector by 2035, and to put the United States on a path to achieve net-zero emissions economy-wide by no later than 2050[4] to benefit all Americans.

BIL will invest appropriations up to $16 million for the two (2) year period encompassing fiscal years (FYs) 2024 through 2026 for research and

[1] Infrastructure Investment and Jobs Act, Public Law 117-58 (November 15, 2021). https://www.congress.gov/bill/117th-congress/house-bill/3684. This FOA uses the more common name Bipartisan Infrastructure Law.

[2] Pursuant to Executive Order (EO) 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021, and the Office of Management and Budget's Interim Justice40 Implementation Guidance M-21-28 and Addendum M-23-09, DOE recognizes disadvantaged communities as the census tracts identified as disadvantaged by the White House Council on Environmental Quality's Climate and Economic Justice Screening Tool (CEJST), located at https://screeningtool.geoplatform.gov/, as well as all Federally Recognized Tribes (whether or not they have land). DOE's Justice40 Implementation Guidance is located at https://www.energy.gov/sites/default/files/2022-07/Final%20DOE%20Justice40%20General%20Guidance%20072522.pdf and addendum M-23-09 (see https://www.whitehouse.gov/wp-content/uploads/2023/01/M-23-09_Signed_CEQ_CPO.pdf),.

[3] 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

[4] Executive Order (EO) 14008E.O. 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021.

development (R&D) of carbon conversion technologies in two areas: 1) engineering-scale electrochemical conversion systems that demonstrate durability sufficient to warrant further scale up and 2) feasibility studies to investigate retrofitting refineries for carbon conversion to value-added products.

The activities to be funded under this FOA support BIL section 40302 "Carbon Utilization Program" (which amended Section 969A of the Energy Policy Act of 2005) and the broader government-wide approach to strengthen critical adoption, domestic manufacturing, and supply chains for carbon conversion[5] products to maximize the benefits of the clean energy transition as the nation works to curb the climate crisis, empower workers, and advance environmental justice. Funding under BIL section 40302 supports carbon utilization projects under 42 USC 16298a which includes R&D projects to identify and assess novel uses for carbon, including the conversion of carbon and carbon oxides for commercial and industrial products and other products with potential market value.

i. Program Purpose

DOE-FECM's Carbon Conversion Program is developing technologies for converting Carbon Dioxide (CO_2) into environmentally responsible, equitable, and economically valuable products. The Carbon Conversion Program supports Research, Development, and Demonstration (RD&D) across three broad conversion approaches: catalytic pathways, mineralization, and biological uptake. This FOA will support RD&D for the catalytic pathways approach, which focuses on the conversion of CO_2 into value-added products such as fuels and chemicals, polymers, solid carbons, and syngas. Catalytic processes offer tremendous flexibility for end products, but require the addition of energy (whether chemical, thermal, or electrical).

RD&D funded under this FOA will support the Department's Clean Fuels & Products Energy Earthshot™ (hereinafter, the Shot), which was established to support the national goal of achieving net-zero emissions by 2050 by developing the sustainable feedstocks and conversion technologies necessary to produce crucial fuels, materials, and carbon-based products that are better for the environment than current petroleum-derived components. It aims to meet projected 2050 net-zero emissions demands for 100% of aviation fuel; 50% of maritime, rail, and off-road fuel; and 50% of carbon-based chemicals by using sustainable carbon resources.

The effort aligns with the interagency Sustainable Aviation Fuel Grand Challenge, as well as DOE's broader Energy Earthshots™ portfolio, leveraging breakthroughs

[5] This FOA uses carbon utilization and carbon conversion interchangeably.

in critical energy technologies from the Carbon Negative Shot™, the Hydrogen Shot™, and the Industrial Heat Shot™. The Shot also advances goals within the White House Executive Order 13985, White House Executive Order 14091 and the Justice40 initiative (White House Executive Order 14008) which sets a goal that 40% of the overall benefits from certain federal investments flow to disadvantaged communities.

As part of the whole-of-government approach to advance equity and encourage worker organizing and collective bargaining,[6, 7, 8] and in alignment with BIL section 40302, this FOA and any related activities will seek to encourage meaningful engagement and participation of workforce organizations, including labor unions, as well as underserved communities and underrepresented groups, including Federally Recognized Indian Tribes [9]. Consistent with Executive Order 14008, this FOA is designed to help meet the goal of the Justice40 Initiative that 40% of the benefits of the Administration's investments in clean energy and climate solutions be delivered to disadvantaged communities, as defined pursuant to the Executive Order[10], and to drive creation of accessible, good-paying jobs with the free and fair chance for workers to join a union.

ii. Technology Space and Strategic Goals

This FOA seeks applications to address carbon conversion challenges across two areas: engineering-scale electrochemical conversion and refinery/petrochemical facility retrofits. R&D in electrochemical conversion will address the challenge of extending system durability to a point where further scale-up is warranted under future efforts. Feasibility studies of refinery and petrochemical facility retrofits will examine pathways for retrofitting of petrochemical refineries for carbon utilization and production of value-added products. It is anticipated that responses and results of these studies could inform follow-on funding opportunities to advance proposed retrofit or renovations for carbon conversion. Detailed technical descriptions of the specific Topic Areas are provided in the sections that follow.

B. Topic Areas

[6] EO 13985, "Advancing Racial Equity and Support for Underserved Communities Through the Federal Government" January 20, 2021. EO 14091, "Further Advancing Racial Equity and Support for Underserved Communities Through the Federal Government, February 16, 2023.
[7] EO 14025, "Worker Organizing and Empowerment," April 26, 2021.
[8] EO 14052, "Implementation of the Infrastructure Investment and Jobs Act," November 18, 2021.
[9] EO 13175, November 6, 2000 "Consultation and Coordination With Indian Tribal Governments", charges all executive departments and agencies with engaging in regular, meaningful, and robust consultation with Tribal officials in the development of Federal policies that have Tribal implications.
[10] EO 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021.

i. Topic Area 1 (TA-1) – "Engineering-Scale Testing of Electrochemical Systems for the Conversion CO_2 into Value-Added Products"

a. Research Sought

Electrochemical conversion processes are challenged with long-term durability issues, which are typically caused by catalyst materials, balance of plant issues, and maldistributions in heat and material flows resulting from scale-up. The pursuit of higher activity catalysts, which usually possess less stable surface structures, will be a net-negative for long-term operation if long-term catalyst stability is not demonstrated. There are also integration (balance of plant) issues and flow maldistributions that can push the electrochemical conversion out of its preferred operational envelope as the scale of operation increases from cell level through stack level and finally system level systems.

TA-1 will support engineering-scale Technology Readiness Level (TRL) 6 R&D for electrochemical conversion of CO_2 into value-added products [ideally a minimum value of $1 per kilogram of product ($1/kg)] with a specific focus on electrolyzer material set durability (See Appendix D for definition of TRLs). Value-added products of interest include but are not limited to: engineering polymer/resin precursors, specialty chemicals, and commodity chemicals ideally with a minimum value of $1/kg. Proposed concepts should demonstrate lifecycle greenhouse gas emissions that are at least 10% (and preferably 25%) lower than equivalent incumbent processes.

Supported R&D will validate performance across the operational envelope through testing at the cell and stack level and should culminate in at least one medium-term test (minimum 2000 hours) at the scale of a 10 kilowatts-electric (kWe) system. The cells and stacks utilized in the aforementioned medium-term test must be representative of those that would be used commercially, i.e., the 10 kWe system should represent a smaller building block of a larger system. In addition to identifying the electrochemical conversion product, applications should identify the proposed source of CO_2. Acceptable CO_2 sources are point sources such as power plants, industrial facilities, and concentrated CO_2 from capture technologies (including direct air capture). Lab-scale testing should utilize synthetic gasses that are representative of the proposed CO_2 source (e.g., temperature, pressure, composition, impurities/contaminants). Applications should identify and discuss challenges around integration with the CO_2 source, and how these integration challenges would be addressed at scale. The discussion of integration challenges should include: the optimal CO_2 concentration for transport and delivery; practical limits on how much CO_2 can be utilized from any single source; overall CO_2 mitigation potential; system connection footprint including capture and processing systems; and the ultimate fate of heavy metals and other possible flue gas impurities.

Value-Added products should offer value to both manufacturers and consumers of these products. Applications should present a preliminary techno-economic analysis (TEA) of the value-added product in its intended end-use, including: (1) market size, (2) required selling price of the product, (3) gross revenue, (4) predicted compound annual growth rate (CAGR) of the market, and (5) potential CO_2 mitigation potential.

Applications should also present a preliminary life cycle analysis (LCA) discussing environmental sustainability of the proposed technology and potential reductions in greenhouse gas emissions over incumbent products. Applicants will need to provide a preliminary discussion and metrics within the performance data table. Metrics such as the required CO_2 purchase price, applicable tax credits, and the avoided CO_2 equivalent emissions should be calculated and reported. Applicants must plan for performing ongoing TEA and LCA throughout the project, using NETL guidance documents and tools.[11] [12]

b. Technical Requirements of the Application

For TA-1, the following technical elements must be included within the Technical Volume section of submitted Applications:

1) Detailed discussion of electrolyzer and stack material set durability concerns.
2) Detailed discussion of how R&D will address electrolyzer and stack material set durability.
3) A block flow diagram illustrating the process flows and highlighting the elements discussed in the technical narrative, including how the system integrates with a proposed CO_2 source.
4) A justification of the range of gas compositions and conditions tested, including concentrations of impurities such as nitrogen, water, sulfur, and oxygen.
5) A description of the 10 kWe medium-term stack test, including:
    - Cell size
    - Number of cells per stack
    - Number of stacks
    - General description of the Balance of Plant (BOP): e.g., gas pre-treatment, enclosure, inverter, and heat exchanger
6) An identification of knowledge gaps and key technical challenges, including, but not limited to, CO_2 source integration at scale.

[11] NETL CO_2U LCA Guidance Toolkit (https://netl.doe.gov/LCA/CO2U). June 17, 2022.

[12] NETL Quality Guidelines for Energy System Studies: Performing a Techno-Economic Analysis for Carbon Conversion Technologies (https://netl.doe.gov/energy-analysis/details?id=5dcaf750-0620-4dde-8dba-fa42b79e333b). June 8, 2023.

7) High-level TEA discussion, following NETL Quality Guidelines as applicable: Energy Analysis - TEA | netl.doe.gov, with discussion of the below elements:
    - Market size
    - Required selling price of the product
    - Gross revenue
    - Predicted compound annual growth rate (CAGR) of the market
    - Potential CO_2 mitigation potential
8) High-level LCA discussion, following NETL Guidance as applicable: Energy Analysis - LCA | netl.doe.gov, with discussion of the below elements:
    - Environmental sustainability of the proposed technology, including potential impacts on public health
    - Potential reductions in greenhouse gas emission with comparison to incumbent processes
    - Calculated metrics for the required CO_2 purchase price and the avoided CO_2 equivalent emissions

c. Anticipated Technology Readiness Level

Beginning of project = TRL 5:
Laboratory scale, similar system validation in relevant environment. The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Examples include testing a high-fidelity, laboratory scale system in a simulated environment with a range of simulants.

End of project = TRL 6:
Engineering/pilot-scale, similar (prototypical) system validation in relevant environment. Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing an engineering scale prototypical system with a range of simulants.

d. Project Activities

Projects selected under TA-1 will perform the activities including, but not limited to, those listed below:

- **Laboratory-scale testing** at the cell and stack level utilizing synthetic gasses that are representative of the proposed CO_2 source (e.g., temperature, pressure, composition, impurities/contaminants).
- **Medium-term testing** (at least one test with a minimum of 2000 hours) at the scale of a 10 kilowatts-electric (kWe) system using cells and stacks which are representative of what would be used commercially (i.e., the

10 kWe system should represent a smaller building block of a larger system).

- **Product production**, characterization, and discussion of the product's value to both manufacturers and consumers.
- **Detailed process description** of the resulting technology, including electrolyzer and stack material set durability, CO_2 source integration, process flow diagram, balance of plant.
- **Identification of a commercialization pathway** highlighting technical hurdles but also potential permitting steps and external factors such as consumer preference and potential co-benefits or negative impacts this pathway could have on local communities, including communities with environmental justice concerns.[13]
- **R&D Community Benefits Plan (CBP)** activities and reports, described further in Section D.
- **Technology Maturation Plan (TMP)** development and update following the template in Appendix I.
- **Preliminary Techno-Economic Analysis (TEA)** following NETL guidance documents, detailed in Appendix J.
- **Preliminary Life Cycle Analysis (LCA)** following NETL guidance documents, detailed in Appendix K.
- **State Point Data Table** following the template in Appendix L.

e. Success Metrics

At the end of the project, success will be quantified by a test demonstrating that the technology has achieved TRL 6. Success will also be qualified by conducting life cycle and techno-economic analyses commensurate to the technology readiness of the proposed technology, as informed by the results of testing. The objective of the analyses is to determine the environmental sustainability and economic viability of the proposed technology and the market penetration possibilities. Metrics such as the required CO_2 purchase price and the avoided CO_2 equivalent emissions will be determined. The results of these studies will be submitted at the end of the projects in the project deliverables.

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

[13] EO14096, "Revitalizing Our Nation's Commitment to Environmental Justice for All," April 21, 2023.

ii. Topic Area 2 (TA-2) – "Feasibility Studies for Retrofitting of Refineries and Petrochemical Facilities for Carbon Conversion"

a. Research Sought

It is anticipated that global demand for petrochemical feedstocks will continue to grow and include products such as ethane, liquid petroleum gas (LPG), and naphtha. These are primarily used in the production of polymers for plastics, synthetic fibers, and other petrochemical intermediates; however, refineries typically produce these as no more than 10 percent of total output.[14] World Resources Institute has outlined a conceptual model of a "Semi-Circular Refinery",[15] which proposes how refineries could operate in a decarbonized economy. A recent paper published in Nature also discusses the "Refinery of the Future" and the role of carbon dioxide as a fossil-free feedstock.[16]

TA-2 will support R&D for proposed refinery and petrochemical facility retrofits of existing, operational facilities, as well as model or sample facilities representative of operating facilities. In the case of model facilities, feasibility studies must note determinant metrics such as capacity, geography, and end markets. Applications should describe existing components of the facility that can be repurposed for carbon oxide conversion, as well as describe what new equipment is required. Given the unique and particular configurations of petrochemical refineries, applications should outline the specific geographic needs and advantages of the facility's location, capacity, and the customer and market base for resulting products.

Applications of interest may include but are not limited to:

- Recycling of chemicals with CO_2 inputs to create new, value-added chemicals, including chemical intermediaries.
- Conversion of select unit operations within petrochemical refineries which currently use shale/domestic oil to those that utilize carbon dioxide as their feedstock.
- Focus on refinery and petrochemical process emissions with carbon capture and conversion to products or storage.

[14] Fitzgibbon, T., Simons, T. J., Szarek, G., & Varpa, S. From crude oil to chemicals: How refineries can adapt to shifting demand. McKinsey & Company. (https://www.mckinsey.com/industries/chemicals/our-insights/from-crude-oil-to-chemicals-how-refineries-can-adapt-to-shifting-demand). June 30, 2022.

[15] Byrum, Z. & Dellesky, C. A low-carbon future in the US depends on decarbonizing petroleum refineries. World Resources Institute. (https://www.wri.org/insights/technologies-decarbonize-petroleum-refineries). October 21, 2021.

[16] Vogt, E.T.C., Weckhuysen, B.M. The refinery of the future. *Nature* 629, 295–306 (2024). (https://doi.org/10.1038/s41586-024-07322-2). May 8, 2024.

Value-added products should offer value to both manufacturers and consumers of these products. Applications should present a preliminary techno-economic analysis of the value-added product in its intended end-use, including: (1) market size, (2) required selling price of the product, (3) gross revenue, (4) predicted compound annual growth rate (CAGR) of the market, and (5) potential CO_2 mitigation potential.

Applications should also present a preliminary life cycle analysis discussing environmental sustainability of a proposed retrofitting and potential reductions in greenhouse gas emissions over existing facility operations. Applicants will need to provide a preliminary discussion and metrics within the performance data table. Metrics such as the required CO_2 purchase price and the avoided CO_2 equivalent emissions should be calculated and reported. Applicants must plan for performing ongoing TEA and LCA throughout the project, using NETL guidance documents and tools.[17,18]

b. Technical Requirements

For TA-2, the following technical elements must be included within the Technical Volume section of submitted Applications:

1) Description of the proposed refinery or petrochemical facility to be retrofitted (either existing or model facility), including the below elements:
    - specific geographic and community needs (social site characterization)
    - advantages of the facility's location
    - facility capacity
    - customer and market base for resulting products
2) Detailed discussion of what retrofits are required, estimated costs, and anticipated challenges. This should include any additional equipment that would need to be purchased, and new workforce capabilities or trainings that would be required.
3) A block flow diagram illustrating the process flows and highlighting the elements discussed in the technical narrative, including how the system integrates with a proposed CO_2 source.
4) An identification of knowledge gaps and key technical challenges.
5) High-level TEA discussion, following NETL Quality Guidelines as applicable: Energy Analysis - TEA | netl.doe.gov, with discussion of the below elements:

[17] NETL CO_2U LCA Guidance Toolkit (https://netl.doe.gov/LCA/CO2U). June 17, 2022.

[18] NETL Quality Guidelines for Energy System Studies: Performing a Techno-Economic Analysis for Carbon Conversion Technologies (https://netl.doe.gov/energy-analysis/details?id=5dcaf750-0620-4dde-8dba-fa42b79e333b). June 8, 2023.

- Market size
- Required selling price of the product
- Gross revenue
- Predicted compound annual growth rate (CAGR) of the market
- Potential CO_2 mitigation potential

6) High-level LCA discussion, following NETL Guidance as applicable: Energy Analysis - LCA | netl.doe.gov, with discussion of the below elements:
   - Environmental sustainability of the proposed technology, including potential impacts on public health
   - Potential reductions in greenhouse gas emission with comparison to incumbent processes
   - Calculated metrics for the required CO_2 purchase price and the avoided CO_2 equivalent emissions

c. Anticipated Technology Readiness Level (TRL)

Not applicable.

d. Project Activities

Projects selected under TA-2 will perform the activities including, but not limited to, those listed below:

- **Concept description** including an overview of the proposed refinery or petrochemical facility (either existing or model facility), detailed description of the components to be retrofitted, process flow diagram showing CO_2 source integration, carbon conversion technology description, and value-added product description with a discussion of the market penetration possibilities.
- **Feasibility study** outlining the opportunities, challenges, and estimated costs of a model or actual refinery or petrochemical facility retrofit. In the case of model facilities, feasibility studies must note determinant metrics such as capacity, geography, and end markets.
- **Identification of a commercialization pathway** highlighting technical hurdles but also potential permitting steps and external factors such as consumer preference and potential co-benefits or negative impacts this pathway could have on local communities including communities with environmental justice concerns.
- **R&D Community Benefits Plan (CBP)** activities and reports.
- **Preliminary Techno-Economic Analysis (TEA)** following NETL guidance documents, detailed in Appendix J.
- **Preliminary Life Cycle Analysis (LCA)** following NETL guidance documents, detailed in Appendix K.

e. Success Metrics

At the end of the project, success will be quantified by a feasibility study which clearly outlines the opportunities, challenges, and estimated costs of a sample or actual refinery or petrochemical facility retrofit for carbon conversion production. Success will also be qualified by conducting life cycle and techno-economic analyses, as informed by the outcomes of the feasibility study. The objective of the analyses is to determine the environmental sustainability and economic viability of the proposed retrofit and the market penetration possibilities. Metrics such as the required CO_2 purchase price and the avoided CO_2 equivalent emissions will be determined. The results of these analyses will be submitted at the end of the projects in the project deliverables which will include a publicly available summary of findings and results of the feasibility study.

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

C. Applications Specifically Not of Interest

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

- Applications that fall outside the technical parameters specified in Sections I.A. and I.B. of the FOA.
- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics).
- Pre-combustion CO_2 capture technologies.
- Oxy-combustion and chemical looping.
- CO_2 compressor development.
- CO_2 transport and geological storage.
- Conversion of non-anthropogenic sources of CO_2.
- Direct air capture technologies.
- Cultivation of terrestrial plants and biological sequestration.
- Enhanced oil recovery.

The following are additional research scopes not of interest to TA-1 applications:

- Applications addressing durability issues caused by balance of plant components including but not limited to: inverters, heat exchangers, blowers, and gas pre-treatment equipment.
- Post-combustion CO_2 capture technologies.

The following are additional research scopes not of interest to TA-2 applications:

- Fugitive emissions controls.

- Retrofits for the production of fuels from biomass feedstocks.

D. Research and Development (R&D) Community Benefits Plan

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

To support the goal of building a clean and equitable energy economy, projects funded under this BIL FOA are expected to (1) advance diversity, equity, inclusion, and accessibility (DEIA); (2) contribute to the Justice40 Initiative[19] and other considerations linked with energy and/or environmental justice; and (3) invest in quality jobs. To ensure these objectives are met, applications must include a Research and Development Community Benefits Plan (R&D Community Benefits Plan) that addresses the three objectives stated above. See Section IV.C.xviii for the more information on the R&D Community Benefits Plan content requirements.

E. Authorizing Statutes

The programmatic authorizing statute are:

- DOE Organization Act, 42 U.S.C. § 7101, et seq. (Public Law 95-91), as amended.
- Energy Policy Act of 2005 (Public Law 109-58), Title IX, Subtitle F, Sec. 969A, as amended by the Infrastructure Investment and Jobs Act (Public Law 117-58), Sec. 40302 (codified at 42 U.S.C. § 16298a).

Awards made under this announcement will fall under the purview of 2 Code of Federal Regulation (CFR) Part 200 as adopted and supplemented by 2 CFR Part 910.

[19] The Justice40 Initiative, established by EO 14008, sets a goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities. Consistent with Justice40 guidance, DOE recognizes disadvantaged communities as the census tracts defined and identified as disadvantaged by the Climate and Economic Justice Screening Tool (CEJST), located at https://screeningtool.geoplatform.gov/, as well as all Federally Recognized Tribes (whether or not they have land). See https://www.whitehouse.gov/wp-content/uploads/2023/01/M-23-09_Signed_CEQ_CPO.pdf.

F. Notice of Bipartisan Infrastructure Law-Specific Requirements

Be advised that special terms and conditions apply to projects funded by the BIL relating to:

- Davis-Bacon Act
- Reporting, tracking and segregation of incurred costs;
- Reporting on job creation and preservation;
- Publication of information on the Internet;
- Access to records by Inspectors General and the Government Accountability Office;
- Requiring all of the iron, steel, manufactured goods, and construction materials used in the infrastructure activities of applicable projects are produced in the United States;
- Protecting whistleblowers and requiring prompt referral of evidence of a false claim to an appropriate inspector general; and
- Certification and Registration.

Recipients of funding appropriated by the BIL must comply with requirements of all applicable Federal, State, and local laws, regulations, DOE policy and guidance, and instructions in this FOA. Recipients must flow down the requirements to subrecipients to ensure the recipient's compliance with the requirements.

II. Award Information

A. Award Overview

i. Estimated Funding

DOE expects to make a total of approximately $16,000,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. DOE anticipates making approximately 6 awards under this FOA.

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

Topic Area	Total Value			Anticipated No. of Awards	Anticipated Individual Award Size		
	DOE Share	Cost Share	Total		Maximum DOE Share*	Cost Share**	Total
1	$12,000,000	$3,000,000	$15,000,000	0-2	$6,000,000	$1,500,000	$7,500,000
2	$4,000,000	$1,000,000	$5,000,000	0-4	$1,000,000	$250,000	$1,250,000
Total	**$16,000,000**	**$4,000,000**	**$20,000,000**	**0-6**			

*** The DOE share listed under the anticipated individual award size is the maximum amount of DOE funding that can be proposed for each Topic Area. Applications that propose a DOE share in excess of these limits will not be evaluated.**

** Applicants may propose cost share in excess of 20% which could result in higher total award values than those stated above.

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

ii. Period of Performance

DOE anticipates making awards for TA-1 that will run for 24 months in length, consisting of two, 12-month budget periods. Projects awarded under TA-2 are anticipated to run for 18 months in length, consisting of two, 9-month budget periods. Budget periods should be separated by a logical decision point. Project continuation will be contingent upon several elements, including satisfactory performance and DOE's Go/No-Go decision. For a complete list and more information on the Go/No-Go review, see Section VI.B.xiv.

iii. New Applications Only

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

B. DOE Funding Agreements

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

i. Cooperative Agreements

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

Through cooperative agreements, DOE 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.

DOE 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.

III. Eligibility Information

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

A. Eligible Applicants

i. Domestic Entities

Domestic entities are eligible to apply as prime recipients or subrecipients. The following types of domestic entities are eligible to participate as a prime recipient or subrecipient of this FOA:

1. Institutions of higher education;
2. For-profit entities;
3. Non-profit entities; and
4. State and local governmental entities; and
5. Indian Tribes, as defined in section 4 of the Indian Self-Determination and Education Assistance Act, 25 U.S.C. § 5304[20]

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

DOE/NNSA Federally Funded Research and Development Centers (FFRDCs)[21] are eligible to apply for funding as a subrecipient but are not eligible to apply as a prime recipient. **NETL is not eligible for award under this announcement and may not be proposed as a subrecipient on another entity's application. An**

[20] "**Indian Tribe**," for the purposes of this FOA and as defined in in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. § 5304), [1]means any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act (85 Stat. 688) [43 U.S.C. § 1601, et seq.], which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians. Federally Recognized Indian Tribes are also considered disadvantaged communities for the purposes of Justice40 requirements in this FOA per https://www.whitehouse.gov/wp-content/uploads/2023/01/M-23-09_Signed_CEQ_CPO.pdf.

[21] FFRDCs are public-private partnerships that conduct research for the United States government. A listing of FFRDCs can be found at http://www.nsf.gov/statistics/ffrdclist/.

application that includes NETL as a prime recipient or subrecipient will be considered non-responsive.

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

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

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

Nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995, are **not** eligible to apply for funding.

ii. Foreign Entities

In general, foreign entities are not eligible to apply as either a prime recipient or subrecipient. In limited circumstances, DOE may approve a waiver to allow a foreign entity to participate as a prime recipient or subrecipient. A foreign entity may submit a Full Application to this FOA, but the Full Application must be accompanied by an explicit written waiver request. Likewise, if the applicant seeks to include a foreign entity as a subrecipient, the applicant must submit a separate explicit written waiver request in the Full Application for each proposed foreign subrecipient.

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

B. Cost Sharing

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

The cost share must be at least 20% of the total project costs[22] for research and development projects.[23] The cost share must come from non-federal sources unless otherwise allowed by law.

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

i. Legal Responsibility

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

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

ii. Cost Share Allocation

Each project team is free to determine how best to allocate the cost share requirement among the team members. The amount contributed by individual project team members may vary, as long as the cost share requirement for the 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.H.i. of the FOA. In addition, cost share must be verifiable upon submission of the Full Application. Cost share may be provided in the form of cash or cash equivalents, or in-kind contributions. Cost share must come from non-federal sources (unless otherwise allowed by law), such as project participants, state or local governments, or other third-party financing. DOE Loan Guarantee cannot be leveraged by applicants to provide the required cost share or otherwise support the same scope that is proposed under a project.

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

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

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

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

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

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

The prime recipient and subrecipient(s) may not use the following sources to meet its cost share obligations:

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

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

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

DOE understands that projects selected under this FOA may require the use of existing data. For purposes of this FOA, DOE will consider data that is commercially available at an established price to be an allowable cost under the project (either as DOE share or non-federal cost share) but DOE will not consider

in-kind data (e.g., data, owned by an entity, that is not routinely sold commercially but is instead donated to the project and assigned a value) to be an allowable cost under the project, including as Recipient cost share. Estimation methods used by the Recipient to assign a value to in-kind data cannot be objectively verified by DOE and therefore will not be accepted by DOE as an allowable cost under any project selected from this FOA. Consequently, DOE will not recognize in-kind data costs in any resulting approved DOE budget.

Applicants are encouraged to refer to 2 CFR 200.306 and 2 CFR 910.130 for additional cost sharing requirements.

iii. Cost Share Contributions by FFRDCs

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

iv. Cost Share Verification

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

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

C. Compliance Criteria

All applicant submissions must:

- comply with the applicable content and form requirements listed in Section IV. of the FOA;
- include all required documents;
- propose a project cost with a DOE share less than or equal to the maximum allowable amount for individual awards under this FOA ($6,000,000 for TA-1 and $1,000,000 for TA-2);
- be successfully uploaded to NETL eXCHANGE at https://NETL-Exchange.energy.gov/, including clicking the "Submit" button; and
- be submitted by the deadline stated in the FOA.

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

Applicants are strongly encouraged to submit their Full Applications at least 48 hours in advance of the submission deadline. Under normal conditions (i.e., at least 48 hours in advance of the submission deadline), applicants should allow at least 1 hour to submit a Full Application. Once the Full Application is submitted in NETL 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 Full Application, before the applicable deadline. DOE will not extend the submission deadline for applicants that fail to submit required information by the applicable deadline due to server/connection congestion.

D. Responsiveness Criteria

Full Applications are deemed responsive if:

- The Applicant/application meets the Eligibility Criteria in Section III, "Eligibility Information" of the FOA.
- All "Applications Specifically Not of Interest," as described in Section I.C. of the FOA, are deemed nonresponsive and are not reviewed or considered.

Only compliant/responsive applications will be eligible for a comprehensive merit review.

E. Other Eligibility Requirements

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

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

i. 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.

ii. 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.

iii. Funding, Cost Share, and Subaward with FFRDCs

DOE will NOT fund DOE/NNSA FFRDCs participating as a subrecipient through the DOE field work authorization process. DOE will NOT fund non-DOE/NNSA FFRDCs through an interagency agreement with the sponsoring agency. Therefore, the prime recipient and FFRDC are responsible for entering into an appropriate subaward that will govern, among other things, the funding of the FFRDC portion of the work from the prime recipient under its DOE award. Such an agreement must be entered into before any project work begins.

The applicant should prepare the budgets using rates appropriate for funding the FFRDCs through subawards. 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.

iv. 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.

v. Limit on FFRDC Effort

The scope of work to be performed by the FFRDC may not be more significant than the scope of work to be performed by the applicant.

F. Limitation on Number of Full Applications Eligible for Review

An entity may submit more than one Full Application to this FOA, provided that each application describes a unique, scientifically distinct project.

G. Questions Regarding Eligibility

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

IV. Application and Submission Information

A. Application Process

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

- Each must be submitted in Adobe PDF format unless stated otherwise;
- Each must be written in English;
- All pages must be formatted to fit on 8.5 x 11 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;
- A control number will be issued when an applicant begins the NETL eXCHANGE application process. The control number must be included with all application documents. Specifically, the control number must be prominently displayed on the upper right corner of the header of every page and included in the file name (i.e., ControlNumber_Applicant Name_Full Application).
- Page numbers must be included in the footer of every page; and
- Each submission must not exceed the specified maximum page limit, including cover page, charts, graphs, maps, and photographs when printed using the formatting requirements set forth above and single spaced. If applicants exceed the maximum page lengths indicated below, DOE will review only the authorized number of pages and disregard any additional pages.

i. Additional Information on NETL eXCHANGE

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

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

B. Application Forms

To access application forms and instructions available on NETL eXCHANGE, go to https://NETL-Exchange.energy.gov/ and select the appropriate funding opportunity number.

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

TechnicalVolume_Part_1
TechnicalVolume_Part_2

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

C. Content and Form of the Full Application

Applicants must complete the following application forms found on the NETL eXCHANGE website at https://NETL-Exchange.energy.gov/.

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

i. Full Application Content Requirements

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

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_Technical Volume
Resumes	PDF	3 pages each	ControlNumber_LeadOrganization_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_LOCs

Component	File Format	Page Limit	File Name
Community Partnership Documentation	PDF	10	ControlNumber_LeadOrganization_PartnerDocs
Impacted Indian Tribes Documentation	PDF	n/a	ControlNumber_LeadOrganization_ImpactedTribes
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_SOPO
Project Management Plan	MS Word	10	ControlNumber_LeadOrganization_PMP
SF-424: Application for Federal Assistance	PDF	N/A	ControlNumber_LeadOrganization_App424
Budget Justification Workbook	MS Excel	N/A	ControlNumber_LeadOrganization_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide	MS PowerPoint	1	ControlNumber_LeadOrganization_Slide
Subrecipient Budget Justification	MS Excel	N/A	ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
Authorization from cognizant Contracting Officer for FFRDC	PDF	N/A	ControlNumber_LeadOrganization_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF	N/A	ControlNumber_LeadOrganization_SF-LLL
Foreign Entity Waiver Requests and Foreign Work Waiver Requests	PDF	N/A	ControlNumber_LeadOrganization_Waiver
Data Management Plan	PDF	10	ControlNumber_LeadOrganization_DMP
R&D Community Benefits Plan	PDF	10	ControlNumber_LeadOrganization_CBP
Current and Pending Support	PDF	N/A	ControlNumber_LeadOrganization_CPS
Location(s) of Work	PDF	N/A	ControlNumber_LeadOrganization_LOW
Transparency of Foreign Connections	PDF	n/a	BusinessSensitive_ControlNumber_LeadOrganization_TFC
Potentially Duplicative Funding Notice (if applicable)	PDF	N/A	ControlNumber_LeadOrganization_PDFN
Environmental Questionnaire	PDF	N/A	ControlNumber_LeadOrganization_ENV
State Point Data Table (**TA-1 only**)	PDF	N/A	ControlNumber_LeadOrganization_SPDT

Note: The maximum file size that can be uploaded to the NETL eXCHANGE website is 50MB.

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

ii. Technical Volume

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

using the following convention for the title "ControlNumber_LeadOrganization_TechnicalVolume."

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

The Technical Volume to the Full Application may not be more than **25** pages, 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 technical review criterion (see Section V. of the FOA) when preparing the Technical Volume.

Technical Volume Content Requirements	
SECTION/PAGE LIMIT	**DESCRIPTION**
Cover Page	The cover page should include the project title, the specific FOA Topic Area being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, names of project managers, senior/key personnel and their organizations, the project location(s), and any statements regarding confidentiality.
Project Overview (Approximately 10% of the Technical Volume)	The Project Overview should contain the following information: • Background: The applicant should discuss the background of their organization, including the history, successes, and current research and development status (i.e., the technical baseline) relevant to the technical topic being addressed in the Full Application. • Project Goal: The applicant should explicitly identify the targeted improvements to the baseline technology and the critical success factors in achieving that goal. • DOE Impact: The applicant should discuss the impact that DOE funding would have on the proposed project. Applicants should specifically explain how DOE funding, relative to prior, current, or anticipated funding from other public and private sources, is necessary to achieve the project objectives.

Technical Description, Innovation, and Impact (Approximately 40% of the Technical Volume)	The Technical Description should be formatted to address all subcriteria under Merit Review Criterion 1 (Scientific and Technological Merit) and should contain the following information: • Relevance and Outcomes: The applicant should provide a detailed description of the technology or focus area, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project. **For TA-1**, the applicant should include a detailed discussion of electrolyzer and stack material set durability concerns and how the proposed R&D will address these concerns. **For TA-2**, the applicant should include a description of the proposed refinery or petrochemical facility to be retrofitted (including the specific geographic and community needs (social site characterization), advantages of the facility's location, facility capacity, and customer/market base for resulting products) and a discussion of what retrofits are required, estimated costs and anticipated challenges (including any additional equipment that would need to be purchased and new workforce capabilities or trainings that would be required). **For both TA-1 and TA-2**, the requirements for interfacing/integrating the proposed technology with the proposed CO_2 source should be discussed, and a block flow diagram illustrating how the CO_2 is converted to the final product should be provided. • Feasibility: The applicant should demonstrate the technical feasibility of the proposed technology and capability of achieving the anticipated performance targets, including a description of previous work done and prior results, if applicable. The Applicant should also identify and discuss knowledge gaps and key technical challenges for the proposed technology. **For TA-1**, evidence should also be provided to demonstrate that the proposed technology has achieved the minimum required starting TRL of 5. • Innovation and Impacts: When applicable, the applicant should describe the current state-of-the-art in the applicable field, the specific innovation of the proposed technology or focus area, the advantages of proposed technology over current and emerging technologies, the carbon uptake and carbon efficiency of the proposed technology, and the overall impact on advancing the state-of-the-art/technical baseline if the project is successful. The justification for the proposed project should include a clear statement of the importance of the project in terms of the utility of the outcomes and the target community of beneficiaries.

	• Preliminary Life Cycle and Techno-economic Analyses (LCA & TEA): The applicant should present a high-level LCA and TEA discussion. The LCA should include a discussion of the environmental sustainability of the proposed technology and the potential reductions in greenhouse gas emissions, with a comparison to incumbent processes, and calculated metrics for the required CO_2 purchase price and the avoided CO_2 equivalent emissions. The TEA should include (1) market size, (2) required selling price of the product, (3) gross revenue, (4) predicted compound annual growth rate (CAGR) of the market, and (5) potential CO_2 mitigation potential.
Workplan (Approximately 30% of the Technical Volume)	The Workplan should be formatted to address all subcriteria under Merit Review Criterion 2 (Technical Approach and Understanding), when those criteria are not already addressed in other required documents, i.e., documents that are required to be submitted under unique file names and have stated page limits. A detailed Statement of Project Objectives (SOPO) and Project Management Plan (PMP) are included as other required documents. The Workplan should contain the following information: • Project Objectives: The applicant should provide a clear and concise (high-level) statement of the goals and objectives of the project as well as the expected outcomes. • Technical Scope Summary: The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period, including activities in the Community Benefits Plan. • Work Breakdown Structure (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. **For TA-1**, this applicant should include a description of the 10 kWe medium-term stack test, including cell size, number of cells per stack, number of stacks, general description of the balance of plant, and a

	justification of the range of gas compositions and conditions to be tested, including impurities. • Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a Specific, Measurable, Achievable , Relevant, and Timely (SMART) technical milestone. The summary provided should be consistent with the Milestone Summary Table in the PMP. • Go/No-Go Decision Points (See Section VI.B.xiv. for more information on the Go/No-Go Review): The applicant should provide a summary of project-wide Go/No-Go decision points at appropriate points in the Workplan. At a minimum, each project must have at least one project-wide SMART Go/No-Go decision point for each budget period of the project. The applicant should also provide the specific technical and community benefits plan criteria to be used to evaluate the project at the Go/No-Go decision point. The summary provided should be consistent with the SOPO. • 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. • Buy America Requirements for Infrastructure Projects: Within the first 2 pages of the Workplan, include a short statement on whether the project will involve the construction, alteration, and/or repair of infrastructure in the United States. See Appendix C for applicable definitions and other information to inform this statement.
Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	The Technical Qualifications and Resources should be formatted to address all subcriteria under Merit Review Criterion 3 (Technical and Management Capabilities), when those criteria are not already addressed in other required documents, i.e., documents that are required to be submitted under unique file names and have stated page limits. Resumes are included as other required documents. The Technical Qualifications and Resources section should contain the following information: • A description of the project team's unique qualifications and expertise, including those of key subrecipients. • A description of the project team's existing equipment and facilities, or equipment or facilities already in place on the proposed project site, that will facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project. • Relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives. • The time commitment of the key team members to support the project.

	• A description of the technical services to be provided by DOE/NNSA FFRDCs, if applicable.
	• For multi-organizational projects, describe succinctly:
	  ○ The roles and the work to be performed by each project manager and senior/key personnel at the prime and sub levels;
	  ○ Business agreements between the applicant and sub;
	  ○ How the various efforts will be integrated and managed;
	  ○ Process for making decisions on technical direction;
	  ○ Publication arrangements;
	  ○ Intellectual Property issues; and
	  ○ Communication plans.

Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers (Not included in the page limitation)	Provide the following information in this section: • Collaborators and Co-editors: List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this application. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this application. If there are no collaborators or co-editors to report, state "None." • Graduate and Postdoctoral Advisors and Advisees: List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s) during the last 5 years. Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates.
Bibliography (Not included in the page limitation)	If applicable, provide a bibliography for any references cited in the Technical Volume. This section must include only bibliographic citations.

iii. 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 must submit a resume (limited to three-pages) for each Principal Investigator or Lead Project Manager and 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 (PRL) convention for citations (list only the first author) may be used for publications with more than 10 authors;
6. Patents, copyrights, and software systems developed may be provided in addition to or substituted for publications;
7. Synergistic Activities: List up to five professional and scholarly activities related to the proposed effort; and
8. There should be no lapses in time over the past ten years or since age 18, which ever time period is shorter.

As an alternative to a resume, it is acceptable to use the biographical sketch format approved by the National Science Foundation (NSF). The biographical sketch format may be generated by the Science Experts Network Curriculum Vitae (SciENcv), a cooperative venture maintained at https://www.ncbi.nlm.nih.gov/sciencv/, also available at https://www.nsf.gov/bfa/dias/policy/researchprotection/commonform_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.

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

iv. Letters of Commitment

Submit letters of commitment from all subrecipient and third-party cost share providers. If applicable, the letter must state that the third party is committed to providing a specific minimum dollar amount or value of in-kind contributions allocated to cost sharing. The following information for each third party contributing to cost sharing should be identified: (1) the name of the organization; (2) the proposed dollar amount to be provided; and (3) the proposed cost sharing type (cash or in-kind contributions). Each letter must not exceed 1 page. Save the letters of commitment in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_LOCs".

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

v. Community Partnership Documentation

In support of the Community Benefits Plan, applicants may submit documentation to demonstrate existing or planned partnerships with community entities, such as organizations that work with local stakeholders most vulnerable to or affected by the project. Examples of such entities include organizations that carry out workforce development programs, labor unions, Tribal organizations, and community-based organizations that work with disadvantaged communities. The Partnership Documentation can be a letter on a partner's letterhead outlining the planned partnership and signed by an officer of the entity, a Memorandum of Understanding, or another similar agreement. Such letters must state the specific nature of the partnership and must not be general letters of support. If the applicant intends to enter into Workforce and Community Agreements as part of the Community Benefits Plan, they should include letters from proposed partners. Each letter must not exceed one page. In total, the partnership documentation must not exceed 10 pages.

Save the partnership documentation in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_PartnerDoc".

vi. Impacted Indian Tribes Documentation

For any application that potentially impacts Indian Tribes or is on Tribal land[24], including when the potentially impacted Indian Tribe is the applicant, applicants are required to submit additional documentation at the time of application, and possibly during negotiation and prior to award. For any project that potentially impacts Indian Tribes, applicants are required to submit documentation demonstrating that an authorized representative[25] of each potentially impacted Indian Tribe is, at a minimum, aware of the nature of the application and its potential impacts to the relevant Indian Tribes. The notified authorized representative must be holding their position while the award is open for applications, and documentation must demonstrate affirmative awareness of the application (e.g. a delivery record from certified mail, a reply by the authorized representative).

[24] Tribal land is as defined in 25 U.S.C. §§ 3501(2), (3), (4)(A) and (13)

[25] An authorized representative must be an elected official or designated leader according to the traditions, constitution, or charter of the Indian Tribe, or someone with relevant delegated authority within the Tribal government. Examples include: Chief, Chairman, Chairwoman, Governor, Nation Representative, President, Chief Executive Officer, Chief Financial Officer, Speaker of the Council, Speaker of the Congress, Tribal administrator

For any project intended to be sited on Tribal land(s) or intersecting with Tribal subsurface rights, applicants are required to submit documentation demonstrating support from the relevant Indian Tribes at the time of application. Documentation of support submitted at the time of application will be considered to also demonstrate awareness of an Indian Tribe (specified above). Documentation may include either:

- A letter of support from Tribal leadership. The letter must be signed by an authorized representative of the Indian Tribe. The signer(s) must be holding their position while the award is open for applications or negotiations.
- A Tribal Council Resolution, Board resolution (including the Board of Directors of an Alaska Native Corporation (ANC)), or similar act passed by the legislative body of the Tribal government or Board of Directors of an ANC, expressing support for the project.

Applicants are encouraged to reference or include any applicable community benefits agreements in the Tribal support documentation, and to integrate any Tribal support documentation in the community benefits plan as appropriate, For projects not intended to be sited on Tribal land(s) or intersecting with Tribal subsurface rights, but that may have other potential impacts on Tribal resources or reserved rights, letters of support or resolutions of support are strongly encouraged and, depending on the nature of the impact, may be required if selected for negotiation of an agreement. Applicants are encouraged to reach out to Indian Tribes as early as possible in the application process to give Indian Tribes ample time to evaluate and respond.

The following resources may be useful to help determine if a project may impact an Indian Tribe(s) resources or reserved rights and the appropriate contacts. These resources are not exhaustive, and many Indian Tribes have resources or reserved rights which extend beyond their Tribal lands, or are covered within treaties, statutes, or case-law. Applicants are encouraged to do additional research:

- Map of Indian Lands: https://bia-geospatial-internal.geoplatform.gov/indianlands/
- Tribal Treaties Database: https://treaties.okstate.edu/
- Directory of federally recognized Tribes and Tribal leaders: https://www.bia.gov/service/tribal-leaders-directory
- Best Practices for Identifying and Protecting Tribal Treaty Rights, Reserved Rights, and other similar rights in federal regulatory actions: https://www.bia.gov/sites/default/files/dup/inline-files/best_practices_guide.pdf

To help determine if an Indian Tribe's resources or reserved rights may be impacted by the project, applicants must address the following elements. If the applicant is an Indian Tribe, these elements should be addressed to ascertain impacts to Indian Tribes other than the applicant. Applicants do not need to reveal specific details about sacred sites such as specific location or specific ceremonies:

- Identify any proposed actions which may impact an Indian Tribe(s) resources or reserved rights. Tribal resources and reserved rights include, and are not limited to, an Indian Reservation or Land (as defined in 25 U.S.C. § 3501) [or intersecting Tribal sub-surface rights], historic homelands from which they were removed, cultural sites, sacred sites, water rights, mineral and other subsurface rights, fishing rights, and hunting rights. Identify the Tribe(s) potentially impacted and any sources of uncertainty or confidentiality.
- Explain any actions taken by the applicant to mitigate or address any potential impacts identified above, including engaging with the potentially impacted Indian Tribe(s), in the application.

Applicants are required to document any efforts taken to identify any potential impacts to Indian Tribes, Indian lands, Alaska Native regional and village land, traditional homelands, Tribal rights, or Tribal historic sites, or sacred sites. This includes any correspondence with Indian Tribes. These documents should be available on request to DOE. An applicant's failure to submit documentation of an Indian Tribe's awareness, or a letter of support, when required as described above, may constitute grounds for determining an application ineligible, non-responsive to the FOA/OT solicitation, not subject to further review and/or not otherwise subject to selection or award.

Any application that may potentially impact Indian Tribe(s) may be shared with the potentially impacted Indian Tribe(s). Applicants should include a Notice of Restriction on Disclosure and Use of Data identifying any business sensitive, trade secrets, proprietary, or otherwise confidential information. Such information shall be used or disclosed only for evaluation of the application or to determine whether the proposed project affects an Indian Tribe(s). If an applicant determines an Indian Tribe(s) will be impacted, the applicant must provide information on the project location, potential impacts and how the applicant will engage with Indian Tribe(s), during the period of performance of the agreement, and, if necessary, after the end of the agreement. Approval by DOE must be obtained before any activities take place that could impact Tribal resources or reserved rights, including but not limited to lands, cultural sites, sacred sites, water rights, mineral rights, fishing rights, and hunting rights. DOE will determine if formal government-to-government consultation is needed, and

DOE will conduct that consultation accordingly, in addition to any engagement by applicant.

Save any required documents (if applicable) in a single PDF file using the following convention for the title:
"ControlNumber_LeadOrganization_ImpactedTribes".

vii. Statement of Project Objectives (SOPO)

Applicants are required to complete a SOPO. A SOPO template is available in Appendix F of the FOA. The SOPO must not exceed 10 pages. Save the SOPO in a single Microsoft Word file using the following convention for the title: "ControlNumber_LeadOrganization_SOPO".

viii. Project Management Plan (PMP)

Applicants are required to complete a PMP. A PMP template is available in Appendix G of the FOA. The PMP must not exceed 10 pages. Save the PMP in a single Microsoft Word file using the following convention for the title: "ControlNumber_LeadOrganization_PMP".

ix. SF-424: Application for Federal Assistance

Applicants must complete the SF-424: Application for Federal Assistance, which is available on NETL eXCHANGE at https://NETL-Exchange.energy.gov/. The list of certifications and assurances in Field 21 can be found at https://www.energy.gov/management/financial-assistance-forms-and-information-applicants-and-recipients, under Certifications and Assurances.

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

Note: The dates and dollar amounts on the SF-424 are for the complete project period of performance and not just the first project year, first phase, or other subset of the project period. Save the SF-424 in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_424".

x. Budget Justification Workbook

For your convenience, a Budget Justification Workbook template is available on NETL eXCHANGE at https://NETL-Exchange.energy.gov/. Applicants are strongly encouraged to use the suggested template. If applicants choose not use the suggested template, you must also submit an SF-424A Budget Information form (available on grants.gov) and include a breakdown of all costs by Budget Category as outlined in the SF-424A and the Budget Justification suggested template, including all work to be performed by the prime recipient and its subrecipients and contractors. Applicants should include costs associated with implementing award requirements (e.g., Buy America requirements for infrastructure projects, Davis-Bacon, Community Benefits Plan, reporting, oversight, construction signage[26]) and with required annual audits and incurred cost proposals in their proposed budget documents. Such costs may be reimbursed as a direct or indirect cost. The "Instructions and Summary" and "SF-424A" tabs 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".

xi. Summary/Abstract for Public Release

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

xii. Summary Slide

Applicants must provide a single slide summarizing the proposed project.

[26] After receiving a DOE award, recipients are encouraged to display DOE Investing in America signage during and after construction. Guidance can be found at: (https://www.energy.gov/design). Proposed signage costs that meet these specifications are an allowable cost and should be included in the proposed project budget.

The Summary Slide must include the following information:

- A technology summary;
- A description of the technology's impact;
- Proposed project goals;
- Any key graphics (illustrations, charts and/or tables);
- The project's key idea/takeaway;
- Topline community benefits;
- Project title, prime recipient, Principal Investigator/Lead Project Manager, and senior/key personnel information; and
- Requested DOE 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".

xiii. Subrecipient Budget Justification (if applicable)

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

xiv. Authorization from Cognizant Contracting Officer for FFRDC (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".

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

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

Recipients and subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (https://www.grants.gov/forms/forms-repository/sf-424-individual-family) 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".

xvi. Waiver Requests (if applicable)

i. Foreign Entity Waiver Request

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

ii. Foreign Work Waiver Request

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

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

xvii. Data Management Plan

Applicants are required to submit a Data Management Plan as part of their Full Application. The Data Management Plan is a document that outlines the proposed plan for data sharing or preservation. Submission of this plan is required with the Full Application, and failure to submit the plan may result in rejection of the application without further consideration. Applicants shall prepare the DMP in the format provided in Appendix H of this FOA. The DMP must not exceed 10 pages. Save the Data Management Plan in a single PDF file using the following convention for the title:
"ControlNumber_LeadOrganization_DMP".

xviii. R&D Community Benefits Plan

The R&D Community Benefits Plan must set forth the applicant's approach to ensuring the federal investments advance the following three objectives: (1)

advancing DEIA; (2) contributing to energy equity, the Justice40 Initiative, and other considerations ; and (3) investing in quality jobs. Applicants must address all three sections.

For your convenience, a Community Benefits Plan Template is available on NETL eXCHANGE. Applicants are strongly encouraged to use the template to complete their specific Plan. If the template is not used, the Plan must address all of the elements described below, and as outlined in the template.

The applicant's R&D Community Benefits Plan should include at least one Specific, Measurable, Achievable, Relevant, and Timely (SMART) milestone per budget period to measure progress on the proposed actions. The R&D Community Benefits Plan will be evaluated as part of the technical review process. If a project is selected, the selectee is responsible for developing a Community Benefits Outcomes and Objectives (CBOO) document. DOE will incorporate the CBOO into the award and the recipient must implement the CBOO when carrying out its project. Public transparency around the plan and SMART commitments ensure accountability. As such, DOE plans to make the content of each CBOO available publicly. DOE will evaluate the recipient's progress throughout the life of the award, including as part of the Go/No-Go review process.

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

The R&D Community Benefits Plan must not exceed 10 pages. Save the R&D Community Benefits Plan in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_CBP".

The R&D Community Benefits Plan must address the following three sections:

1) **Diversity, Equity, Inclusion, and Accessibility:**
   To build a clean and equitable energy economy, it is important that there are opportunities for people of all racial, ethnic, socioeconomic, and

geographic backgrounds, sexual orientation, gender identity, persons with disabilities, and those re-entering the workforce from incarceration. This section of the plan must demonstrate how DEIA is incorporated in the technical project objectives. The plan must identify the specific action the applicant would take that integrates into the research goals and project teams. Submitting an institutional DEIA plan without specific integration into the project will be deemed insufficient.

2) **Energy Equity, the Justice40 Initiative, and other considerations:**
This section must articulate the applicant's consideration of long-term equity implications of the research. It must identify how the specific project integrates equity considerations into the project design to support equitable outcomes if the innovation is successful. Like cost reductions and commercialization plans, the R&D Community Benefits Plan requires description of the equity implications of the innovation. This section should also include information on how the project will advance the Justice40 Initiative's goal

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

See the Community Benefits Plan Template and About Community Benefits Plans for more guidance.

xix. Current and Pending Support

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

For every activity, list the following items:

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

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

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

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

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

The information may be provided in the approved common disclosure format available at Common Form for Current and Pending (Other) Support (nsf.gov).

Regardless of the format used, the individual must include a signature, date, and a certification statement using the language included in the paragraph above.

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

Definitions:

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

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

complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

Senior/key personnel – an individual who contributes in a substantive, meaningful way to the scientific development or execution of a research, development and demonstration (RD&D) project proposed to be carried out with DOE award.[27]

xx. Location(s) of Work

For your convenience, a Locations of Work template is available on NETL eXCHANGE at https://NETL-Exchange.energy.gov/. Applicants are strongly encouraged to use the template. If the template is not used, the submission must include all of the elements described above, and as outlined in the template. Save the completed documentation as a Microsoft Excel file using the following convention for the title: "ControlNumber_LeadOrganization_LOW."

xxi. Transparency of Foreign Connections

Applicants must provide the following as it relates to the proposed recipient and subrecipient(s). Include a separate disclosure for the applicant and each proposed subrecipient. U.S. National Laboratories, domestic government entities, and institutions of higher education are only required to respond to items 1, 2 and 9, and if applying as to serve as the prime recipient, must provide complete responses for project team members that are not U.S. National Laboratories, domestic government entities, or institutions of higher education.

1. Entity name, website address, and physical address;
2. The identity of all owners, principal investigators, project managers, and senior/key personnel who are a party to any *Foreign Government-Sponsored Talent Recruitment Program* of a foreign country of risk (i.e., China, Iran, North Korea, and Russia);
3. The existence of any joint venture or subsidiary that is based in, funded by, or has a foreign affiliation with any foreign country of risk, including the People's Republic of China;
4. Any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity;

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

5. Percentage, if any, that the proposed recipient or subrecipient has foreign ownership or control;
6. Percentage, if any, that the proposed recipient or subrecipient is wholly or partially owned, directly or indirectly, by an entity in a foreign country of risk;
7. Percentage, if any, of venture capital or institutional investment by an entity that has a general partner or individual holding a leadership role in such entity who has a foreign affiliation with any foreign country of risk;
8. Any technology licensing or intellectual property sales to a foreign country of risk, during the 5-year period preceding submission of the proposal;
9. Any foreign equipment that will be used on the project:
    a. Equipment originally made or manufactured in a foreign country of risk (including relabeled or rebranded equipment).
    b. Coded equipment where the source code is written in a foreign country of risk.
    c. Equipment from a foreign country of risk that will be connected to the internet or other remote communication system.
    d. Any companies from a foreign country of risk that will have physical or remote access to any part of the equipment used on the project after delivery.
10. Any foreign business entity, offshore entity, or entity outside the United States related to the proposed recipient or subrecipient;
11. Complete list of all directors (and board observers), including their full name, citizenship and shareholder affiliation, date of appointment, duration of term, as well as a description of observer rights as applicable;
12. Complete capitalization table for your entity, including all equity interests (including LLC and partnership interests, as well as derivative securities). Include both the number of shares issued to each equity holder, as well as the percentage of that series and all equity on a fully diluted basis.
13. Identify the principal place of incorporation (or organization) for each equity holder. If the equity holder is a natural person, identify the citizenship(s). If the recipient or subrecipient is a publicly traded company, provide the above information for shareholders with an interest greater than 5%;
14. A summary table identifying all rounds of financing, the purchase dates, the investors for each round, and all the associated governance and information rights obtained by investors during each round of financing; and
15. An organization chart to illustrate the relationship between your entity and the immediate parent, ultimate parent, and any intermediate parent, as well as any subsidiary or affiliates. Identify where each entity is incorporated.

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

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

xxii. Potentially Duplicate Funding Notice

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

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

xxiii. Environmental Questionnaire

Applicants and sub-recipients must submit an environmental questionnaire (NETL Form 451.1-1/3) for each work location proposed in the application. The environmental questionnaire is available at http://www.netl.doe.gov/File%20Library/Business/forms/451_1-1-3.pdf . Save the questionnaire in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_ENV".

xxiv. State Point Data Table (TA-1 Only)

The State Point Data Table lists both measured and projected performance data for the proposed technology. The measured data is intended to help demonstrate that the required technology readiness level has been attained, and what, if any, important differences exist between the environments of the prior

tests and the proposed project. The State Point Data Table was designed to guide applicants in providing information to assess the technical validity of the technology being developed within the selected project. The data provided will be used as the basis for review and discussion and will be considered the project's baseline. As such, it is expected the project will be able to reproduce the measure/current data, if necessary for any verification. It is also expected the data will have been experimentally produced by the applicant in the applicant's facilities. However, if literature data needs to be used for parts of the process, those metrics based on literature data should be marked appropriately. The projected performance data is intended to show what improvements, if any, still need to be attained for success at the next scale (which may be commercial scale). Applicants shall prepare the State Point Data Table for conditions similar to the ones in the proposed performance of the award, in the format provided in Appendix L. Any notable differences between the test conditions used in prior work and the conditions expected in the proposed performance of the award should be discussed.

Save the State Point Data Table in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_SPDT".

D. Post Selection Information Requests

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

- Personnel proposed to work on the project and collaborating organizations (See Section VI.B.xviii. Participants and Collaborating Organizations);
- Current and Pending Support (See Sections IV.C.xix. and VI.B.xix. Current and Pending Support);
- Community Benefits Outcomes and Objectives (See Section IV.C.xviii.)
- 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 Appendix H.
- Indirect cost information;
- Other budget information;
- Letters of Commitment from third parties contributing to cost share, if applicable;

- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5);
- Information for the DOE Office of Civil Rights to process assurance reviews under 10 CFR 1040;
- Representation of Limited Rights Data and Restricted Software, if applicable;
- Information related to Davis-Bacon Act Requirements;
- Information related to any proposed Workforce and Community Agreement, as defined above in "Community Benefits Plan: Job Quality and Equity," that applicants may have made with the relevant community;
- Any proposed or required Project Labor Agreements or Collective Bargaining Agreements; and
- Environmental Questionnaire.

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

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

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

F. Submission Dates and Times

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

G. Intergovernmental Review

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

H. Funding Restrictions

i. Allowable Costs

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

ii. Pre-Award Costs

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

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

Pre-award expenditures are made at the selectee's risk. DOE 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**

   DOE'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 DOE completing the NEPA review process.

DOE 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 the requirement to obtain the written authorization from the Contracting Officer prior to taking any action that may have an adverse effect on the environment or limit the choice of reasonable alternatives. Likewise, if an application is selected for negotiation of award, and the prime recipient elects to undertake activities that are not authorized for federal funding by the Contracting Officer in advance of DOE completing a NEPA review, the prime recipient is doing so at risk of not receiving federal funding and such costs may not be recognized as allowable cost share.

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

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

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

3. **Waiver**
   To seek a foreign work waiver, the applicant must submit a written waiver request to DOE. Appendix B lists the information that must be included in a request for a foreign work waiver.

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

iv. Construction (if applicable)

Recipients are required to obtain written authorization from the Contracting Officer before incurring any major construction costs. Recipients are encouraged to display DOE Investing in America signage during and after construction. Guidance can be found at: (https://www.energy.gov/design). Proposed signage costs that meet these specifications are an allowable cost and should be included in the proposed project budget.

v. Foreign Travel

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

vi. Equipment and Supplies

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

vii. Build America Buy America Requirements for Infrastructure Projects

Pursuant to the Build America Buy America Act, subtitle IX of BIL (Buy America, or "BABA"), and in accordance with 2 CFR Part 184, no funds for federal financial assistance which is subject to BABA requirements may be used for a project unless:

- All iron and steel used in the infrastructure work are produced in the United States;
- All manufactured products used in the project 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 C 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.

BABA requirements apply to DOE prime recipients that are "non-Federal entities." In accordance with OMB Memorandum M-24-02 and 2 CFR 200.1, the term "non-Federal entity" includes states, local governments, territories, Indian Tribes, Institutes of Higher Education or non-profit organizations. DOE does not apply BABA requirements to for-profit entities.

Subawards should conform to the terms of the prime award from which they flow; in other words, for-profit prime recipients are not required to flow down these Buy America requirements to subrecipients, even if those subrecipients are non-Federal entities as defined above. Conversely, prime recipients which are non-Federal entities must flow the Buy America requirements down to all subrecipients, even if those subrecipients are for-profit entities.

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

Applicants are strongly encouraged to consult Appendix C and 2 CFR Part 184 for more information.

viii. Davis-Bacon Act Requirements

Projects awarded under this FOA will be funded under Division D of the Bipartisan Infrastructure Law. Accordingly, per section 41101 of that law, all laborers and mechanics employed by the recipient, subrecipients, contractors or subcontractors in the performance of construction, alteration, or repair work funded in whole or in part under this FOA shall be paid wages at rates not less than those prevailing on similar projects in the locality, as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code commonly referred to as the "Davis-Bacon Act" (DBA).

Applicants shall provide written assurance acknowledging the DBA requirements above, and confirming that the laborers and mechanics performing construction, alteration, or repair work on projects funded in whole or in part by awards made as a result of this FOA are paid or will be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by subchapter IV of Chapter 31 of Title 40, United States Code (Davis-Bacon Act).

Applicants acknowledge that they will comply with all of the Davis-Bacon Act requirements, including but not limited to:

(1) Ensuring that the wage determination(s) and appropriate Davis-Bacon clauses and requirements are flowed down to and incorporated into any applicable subcontracts or subrecipient awards.
(2) Ensuring that if wage determination(s) and appropriate Davis-Bacon clauses and requirements are improperly omitted from contracts and subrecipient awards, the applicable wage determination(s) and clauses are retroactively incorporated to the start of performance.
(3) Being responsible for compliance by any subcontractor or subrecipient with the Davis-Bacon labor standards.
(4) Receiving and reviewing certified weekly payrolls submitted by all subcontractors and subrecipients for accuracy and to identify potential compliance issues.
(5) Maintaining original certified weekly payrolls for three years after the completion of the project and making those payrolls available to DOE or the U. S. Department of Labor (DOL) upon request, as required by 29 CFR 5.6(a)(2).
(6) Conducting payroll and job-site reviews for construction work, including interviews with employees, with such frequency as may be necessary to assure compliance by its subrecipients or contractors and as requested or directed by DOE.
(7) Cooperating with any authorized representative of the DOL in its inspection of records, interviews with employees, and other actions undertaken as part of a DOL investigation.

(8) Posting in a prominent and accessible place the wage determination(s) and DOL Publication: WH-1321, Notice to Employees Working on Federal or Federally Assisted Construction Projects.
(9) Notifying the Contracting Officer of all labor standards issues, including all complaints regarding incorrect payment of prevailing wages and/or fringe benefits, received from the recipient, subrecipient, contractor, or subcontractor employees; significant labor standards violations, as defined in 29 CFR 5.7; disputes concerning labor standards pursuant to 29 CFR parts 4, 6, and 8 and as defined in FAR 52.222-14; disputed labor standards determinations; DOL investigations; or legal or judicial proceedings related to the labor standards under this award, subrecipient award, contract or subcontract; and
(10) Preparing and submitting to the Contracting Officer, the Office of Management and Budget Control Number 1910-5165, Davis Bacon Semi-Annual Labor Compliance Report, by April 21 and October 21 of each year.

Recipients of funding under this FOA will also be required to undergo Davis-Bacon Act compliance training and to maintain competency in Davis-Bacon Act compliance. The Contracting Officer will notify the recipient of any DOE sponsored Davis-Bacon Act compliance trainings. The DOL offers free Prevailing Wage Seminars several times a year that meet this requirement, at https://www.dol.gov/agencies/whd/government-contracts/construction/seminars/events.

For additional guidance on how to comply with the Davis-Bacon provisions and clauses, see https://www.dol.gov/agencies/whd/government-contracts/construction and https://www.dol.gov/agencies/whd/government-contracts/protections-for-workers-in-construction.

Recipients of funding under this FOA must ensure the timely submission of weekly certified payrolls as part of its compliance with the Davis-Bacon Act.

DOE has contracted with LCPtracker, a third-party DBA electronic payroll compliance software application. A waiver for the use of LCPtracker may be granted to a particular recipient if they are unable or limited in their ability to use or access the system. LCPtracker allows for certified payroll reports and workforce data to be uploaded electronically, 24 hours a day, 7 days per week and currently partners with several commercially available payroll systems. If a recipient uses a different payroll system, LCPtracker provides a free, spreadsheet template they can use to map out their payroll file, which would allow them to upload their employee and payroll data into the system. LCPtracker validation system checks payrolls for federal Davis-Bacon prevailing wage requirements by

flagging mathematical errors or omission discrepancies for the recipient to review on a report. Examples include base hourly rate, total hourly rate, overtime, doubletime, apprentice approval, and fringe benefit contributions. Additionally, LCPtracker utilizes industry standard eSignature technology, thus allowing recipients to electronically sign payroll reports versus using a wet signature. Individual program offices will coordinate with recipients on access and training.

For more information, visit Davis-Bacon Act Requirements for Recipients of Bipartisan Infrastructure Law Funding

ix. 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.

x. Risk Assessment

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

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

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

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

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

Further, as DOE invests in critical infrastructure and funds critical and emerging technology areas, DOE also considers possible threats to United States research, technology, and economic security from undue foreign government influence when evaluating risk. If high risks are identified and cannot be sufficiently mitigated, DOE may elect to not fund the applicant. As part of the research, technology, and economic security risk review, DOE may contact the applicant and/or proposed project team members for additional information to inform the review. This risk review is conducted separately from the technical merit review.

xi. 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;
- Proof of compliance with Davis-Bacon and electronic submittals of certified payroll reports;
- 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.

xii. Prohibition related to Foreign Government-Sponsored Talent Recruitment Programs

a. Prohibition

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

b. Definitions

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

future compensation, or other types of remuneration or consideration, including in-kind compensation.

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

xiii. Affirmative Action and Pay Transparency Requirements

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

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

(1) Recipients, subrecipients, contractors, and subcontractors are prohibited from discriminating in employment decisions on the basis of race, color, religion, sex, sexual orientation, gender identity or national origin.
(2) Recipients and contractors are required to take affirmative action to ensure that equal opportunity is provided in all aspects of their employment. This includes flowing down the appropriate language to all subrecipients contractors, and subcontractors.
(3) Recipients, subrecipients, contractors, and subcontractors are prohibited from taking adverse employment actions against applicants and employees for asking about, discussing, or sharing information about their pay or, under certain circumstances, the pay of their co-workers.

The Department of Labor's (DOL) Office of Federal Contractor Compliance Programs (OFCCP) uses a neutral process to schedule compliance evaluations. Consult OFCCP's Technical Assistance Guide[28] to gain an understanding of the requirements and possible required actions the recipients, subrecipients, contractors, and subcontractors must take. Additional guidance may also be found in the National Policy Assurances, produced by DOE.

xiv. Foreign Collaboration Considerations

[28] See OFCCP's Technical Assistance Guide at: https://www.dol.gov/sites/dolgov/files/ofccp/Construction/files/ConstructionTAG.pdf?msclkid=9e397d68c4b111ec9d8e6fecb6c710ec Also see the National Policy Assurances http://www.nsf.gov/awards/managing/rtc.jsp

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

V. Application Review Information

A. Technical Review Criteria

i. Full Applications

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

Criterion 1: Scientific and Technological Merit (40%)

This criterion involves consideration of the following factors:

- Thoroughness of the description of the proposed technology and degree to which the proposed technology or methodology meets the stated objectives of the Topic Area, including how the proposed R&D will address electrolyzer and stack material set durability concerns (**TA-1**) or how the proposed refinery or petrochemical facility will be retrofitted with a discussion of estimated costs and anticipated challenges (**TA-2**).
- Degree to which the Applicant comprehensively advances arguments and provides details that clearly distinguishes the proposed R&D and why it is needed now relative to prior work.
- Feasibility of the proposed concept; the degree to which the proposed work is based on sound scientific and engineering principles.
- Thoroughness and completeness of the identification of knowledge gaps and key technical challenges.
- Quality and completeness of preliminary life cycle analysis discussing environmental sustainability of the proposed technology with comparison to incumbent processes.
- Quality and completeness of the preliminary techno-economic analysis of the product in its intended end use application, including (1) market size, (2) required selling price of the product, (3) gross revenue, (4) predicted compound annual growth rate (CAGR) of the market, and (5) potential CO_2 mitigation potential.
- Degree to which the applicant conveys its understanding of the requirements to interface/integrate the proposed technology with the proposed CO_2 source.
- Degree to which the proposed technology utilizes CO_2 in the product, including carbon uptake and carbon efficiency.
- Degree to which the block flow diagram illustrates how the CO_2 is converted into the final product, including a quantification of process inputs and outputs for both material and energy of the process.

- Degree to which product offers at least a 10% (preferably 25%) reduction in carbon dioxide emissions as compared to incumbent products.
- **TA-1 Only**: Quality and completeness of the State Point Data Table and extent to which the application provides evidence that the proposed technology or methodology has achieved the minimum required starting TRL.

Criterion 2: Technical Approach and Understanding (25%)
This criterion involves consideration of the following factors:

- Adequacy and feasibility of the Applicant's approach to achieving the objectives of the Topic Area.
- Feasibility, appropriateness, rationale, and completeness of the proposed Statement of Project Objectives, such that there is a logical progression of work.
- The adequacy and completeness of the Project Management Plan (PMP) in establishing baselines (technical scope, budget, schedule) and in managing project performance relative to those baselines; defining the actions that will be taken when these baselines must be revised; and identification of project risks and strategies for mitigation.
- **TA-1 Only**: Thoroughness of the description of the planned 10 kWe medium-term stack test, including cell size, number of cells per stack, number of stacks, general description of the balance of plant, and a justification of the range of gas compositions and conditions to be tested, including impurities.

Criterion 3: Technical and Management Capabilities (20%)
This criterion involves consideration of the following factors:

- Demonstrated experience of the applicant, subrecipients, and partnering organizations in the technology areas addressed in the application and in managing projects of similar size, scope, and complexity.
- Credentials, capabilities, and experience of key personnel, including experience in electrolyzer development (**TA-1**) or refinery/petrochemical facility design (**TA-2**).
- Clarity and likely effectiveness of the project organization, including sub-recipients and/or partners, to successfully complete the project.
- Adequacy and availability of proposed personnel, facilities, and equipment to perform project tasks.

Criterion 4: Community Benefits Plan (R&D) (15%)
This criterion involves consideration of the following factors:

Diversity, Equity, Inclusion, and Accessibility

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

Energy Equity (the Justice 40 Initiative and other considerations)

- Clear workplan tasks, staffing, research, and timeline for engaging energy equity stakeholders and/or evaluating the possible near- and long-term implications of the project for the benefit of the American public, including but not limited to public health and public prosperity benefits;
- Approach, methodology, and expertise articulated in the plan for addressing energy equity and justice issues associated with the technology innovation;
- Description of how the project will advance the Justice40 Initiative's goal of having 40% of the overall benefits of covered investments flow to disadvantaged communities; and
- Likelihood that the plan will result in improved understanding of distributional public benefits and costs related to the innovation if successful.

Quality Jobs

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

B. Standards for Application Evaluation

Applications that are determined to be eligible will be evaluated in accordance with this FOA 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 supports complementary efforts or projects, which, when taken together, will best achieve the research goals and objectives;
- The degree to which the proposed project collectively represents a diversity of applicant types and sizes of applicant organizations;
- The degree to which the proposed project, including proposed cost share, optimizes the use of available DOE funding to achieve programmatic objectives;
- The level of industry involvement and demonstrated ability to accelerate demonstration and commercialization and overcome key market barriers;
- The degree to which the proposed project is likely to lead to increased high-quality employment and manufacturing in the United States;
- The degree to which the proposed project will accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty;
- The degree to which the proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications);
- The degree to which the proposed project incorporates applicant or team members from Minority Serving Institutions (e.g., Historically Black Colleges and Universities (HBCUs)/Other Minority Serving Institutions (OMIs)); and partnerships with underrepresented businesses or Indian Tribes;
- The degree to which the proposed project, when compared to the existing DOE project portfolio and other projects to be selected from the subject FOA, contributes to the total portfolio meeting the goals reflected in the Community Benefits Plan criteria;

- The degree to which the proposed project, or group of projects, presents lesser schedule risk, lesser budget risk, lesser technical risk, and/or lesser environmental risks. Environmental risk includes, but is not limited to, an adverse impact to air, soil, water, or public health, or increase in overall cradle to grave greenhouse gas footprint (carbon dioxide equivalent, CO_2e); and
- The degree to which the proposed project will employ procurement of U.S. iron, steel, manufactured products, and construction materials.

D. Evaluation and Selection Process

i. Overview

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

ii. Recipient Responsibility and Qualifications

DOE, prior to making a federal award with a total amount of federal share greater than the simplified acquisition threshold, is required to review and consider any responsibility and qualification information about the applicant that is in the entity information domain in SAM.gov (see 41 U.S.C. § 2313).

The applicant, at its option, may review information in the entity information domain in SAM.gov and comment on any information about itself that a federal awarding agency previously entered and is currently in the entity information domain in SAM.gov.

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

iii. Selection

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

E. Anticipated Notice of Selection and Award Negotiation Dates

DOE 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 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 NETL eXCHANGE. The notification letter will state the basis upon which the Full Application is ineligible and not considered for further review.

ii. Full Application Notifications

DOE 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 NETL eXCHANGE. The notification letter will inform the applicant whether or not its Full Application was selected for award negotiations. Alternatively, DOE 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.

iii. Applicants Selected for Award Negotiations

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

The award negotiation process takes approximately 60 days. Applicants must designate a primary and a backup point-of-contact in NETL eXCHANGE with whom DOE 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, DOE will cancel the award negotiations and rescind the Selection. DOE reserves the right to terminate award negotiations at any time for any reason.

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

iv. Alternate Selection Determinations

In some instances, an applicant may receive a notification that its application was not selected for award and DOE designated the application to be an alternate. As an alternate, DOE 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. DOE may ultimately determine to select or not select the Full Application for award negotiations.

v. Unsuccessful Applicants

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

B. Administrative and National Policy Requirements

i. Registration Requirements

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

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

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

   Each organization or business unit, whether acting as a team or a single entity, should use only one account as the contact point for each submission. Applicants should also designate backup points of contact. This step is required to apply to this FOA. The eXCHANGE registration does not have a delay; however, the remaining registration requirements

below could take several weeks to process and are necessary for a potential applicant to receive an award under this FOA.

2. **System for Award Management**
   Register with the SAM at https://www.sam.gov. Please update your SAM registration annually.

3. **FedConnect**
   Register in FedConnect at https://www.fedconnect.net. Registration is required to receive notification that a funding agreement has been executed by the Contracting Officer and to obtain a copy of the executed funding agreement, if applicable. Only individuals who are designated as EBiz POC in SAM can create a new company account. For more information about registration requirements, review the FedConnect *Ready, Set, Go! Guide* at https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.

4. **Grants.gov**
   Register in Grants.gov at https://www.grants.gov/ to receive automatic updates when Amendments to this FOA are posted. However, please note that Full Applications will **not** be accepted through Grants.gov.

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

ii. Award Administrative Requirements

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

iii. Foreign National Participation

All applicants selected for an award under this FOA and project participants (including subrecipients and contractors) who anticipate involving foreign nationals in the performance of an award, may be required to provide DOE with specific information about each foreign national to satisfy requirements for foreign national participation. A "foreign national" is defined as any person without U.S. citizenship or nationality (may include a stateless person). The volume and type of information collected may depend on various factors associated with the award. DOE concurrence may be required before a foreign national can participate in the performance of any work under an award.

Approval for foreign nationals in Principal Investigator/Co-Investigator roles, from countries of risk (i.e., China, Iran, North Korea, and Russia), or from countries identified on the U.S. Department of State's list of State Sponsors of Terrorism (https://www.state.gov/state-sponsors-of-terrorism/) may require written authorization from DOE before they can participate in the performance of any work under an award.

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

iv. Subaward and Executive Reporting

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

v. National Policy Requirements

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

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

DOE'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. DOE will independently evaluate the environmental document and will take responsibility for the contents, including ensuring the professional integrity of the discussion and analysis, as required by NEPA.

National Historic Preservation Act (NHPA)

DOE must comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA) prior to deciding whether or how to distribute federal funds. Section 106 requires DOE to identify and consider adverse effects to historic properties that are listed in or eligible for listing in the National Register of Historic Places. If applicable, DOE will perform a NHPA review under the umbrella of its NEPA review and will require applicants to assist in this review and consider impacts to historic, Tribal, and cultural resources.

vii. Applicant Representations and Certifications

1. **Lobbying Restrictions**

   By accepting funds under this award, the prime recipient agrees that none of the funds obligated on the award shall be expended, directly or indirectly, to influence Congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. § 1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

2. **Corporate Felony Conviction and Federal Tax Liability Representations**

   In submitting an application 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.

3. **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

DOE will exercise normal federal stewardship in overseeing the project activities performed under DOE 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

DOE has substantial involvement in work performed under awards made as a result of this FOA. DOE does not limit its involvement to the administrative requirements of the award. Instead, DOE 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. DOE shares responsibility with the recipient for the management, control, direction, and performance of the project.
2. DOE 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. DOE may redirect or discontinue funding the project based on the outcome of DOE's evaluation of the project at the Go/No-Go decision point(s).
4. DOE participates in major project decision-making processes.

x. Subject Invention Utilization Reporting

To ensure that prime recipients, subrecipients, and contractors holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, DOE requires that each prime recipient and subrecipient holding title to a subject invention submit annual reports for ten (10) years from the date the subject invention was disclosed to DOE 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 DOE may specify.

xi. 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.

xii. Energy Data eXchange (EDX) Requirements

The DOE is required to improve access to federally funded research results, proper archiving of digital data, and expanded discovery and reuse of research datasets per DOE and Executive Orders. The Energy Data eXchange (EDX) is a data laboratory developed and maintained by NETL to find, connect, curate, use, and re-use data to advance fossil energy and environmental research and development (R&D).

Data products generated under the resulting award will be required to be submitted in the EDX at https://edx.netl.doe.gov/. Data products include but are not limited to software code, tools, applications, webpages, portfolios, images, videos, and datasets.

EDX uses federation and web services to elevate visibility for publicly approved assets in the system, including connections with DOE's Office of Scientific and Technical Information (OSTI) systems, Data.gov, and Re3Data. This ensures compliance with federal requirements, while raising visibility for researcher's published data products to promote discoverability and reuse.

EDX supports a wide variety of file types and formats including: 1) data, 2) metadata, 3) software/tools, and 4) articles (provided that there is an accompanying Government use license). A partial list of file formats accepted by EDX is provided below, however, EDX is designed for flexibility and accepts all types of file formats.

- Common Data Product Submission Formats: ASC, AmiraMesh, AVI, CAD, CSV, DAT, DBF, DOC, DSV, DWG, GIF, HDF, HTML, JPEG2000, JPG, MOV, MPEG4, MSH/CAS/DAT, NetCDF, PDF, PNG, PostScript, PPT, RTF, Surface, TAB, TIFF, TIFF Stacks, TXT, XLS, SML, Xradio, ZIP, and others.
- Geographic Formats: APR, DBF, DEM, DLG, DRG, DXF, E00, ECW, GDB, GeoPDF, GeoTIFF, GML, GPX, GRID, IMG, KML, KMZ, MOB, MrSID, SHP, and others.

Information provided to EDX will be made publicly available, unless authorized under the resulting award. Additional information on EDX is available at https://edx.netl.doe.gov/about.

When data products are submitted to EDX, the data product will need to be registered with a digital object identifier (DOI) through OSTI to ensure more visibility in other search repositories (i.e., osti.gov, data.gov, Google Scholar, etc.). The OSTI DOI can be established through an application programming interface (API) by completing just a few additional fields.

The Recipient or subrecipient should coordinate with the Project Manager on an annual basis to assess if there is data that should be submitted to EDX and identify the proper file formats prior to submission. All final data products shall be submitted to EDX by the Recipient prior to the completion of the project.

xiii. Reporting

Reporting requirements are identified on the Federal Assistance Reporting Checklist and Instructions, DOE F 4600.2, attached to the award agreement.

Additional reporting requirements apply to projects funded by BIL. DOE may require specific data collection to track progress toward key departmental goals: ensuring justice and equity, investing in quality jobs, boosting domestic manufacturing, reducing greenhouse gas emissions, and advancing a pathway to private sector deployment. Examples of data that may be collected include:

- New manufacturing production or recycling capacity
- Jobs data including
    - Number and types of jobs provided, wages and benefits paid
    - Workforce demographics, including local hires
    - Efforts to minimize risks of labor disputes and disruptions
    - Dollar value of contributions to worker training; number of new employee certificates and training credentials; ratio of apprentice- to journey-level workers employed
    - Number individuals trained, number of trainees placed in new full-time employment, number of trainings partnering with community-based organizations or labor unions
- Justice and Equity data, including:
    - Underrepresented businesses acting as vendors and sub-contractors for bids on supplies, services and equipment.
    - Value, number, and type of partnerships with MSIs
    - Stakeholder engagement events, consent-based siting activities
    - Other relevant indicators from the Community Benefits Plan
- Number and type of energy efficient and clean energy equipment installed
- Funding leveraged, follow-on-funding, Intellectual Property (IP) generation utilization

xiv. Go/No-Go Review

Each project selected under this FOA will be subject to a periodic project evaluation referred to as a Go/No-Go Review. A Go/No-Go Review is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success in future phases or periods of performance is evaluated, prior to beginning the execution of future phases. At the Go/No-Go decision points, DOE will evaluate project performance, project schedule adherence, the extent milestone objectives are met, compliance with reporting requirements, and overall contribution to the program goals and objectives. Federal funding beyond the Go/No-Go decision point (continuation funding) is contingent upon (1) availability of federal funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority; (3) recipient's technical progress compared to the Milestone Summary Table stated in Attachment 1 of the award; (4) recipient's submittal of required reports; (5) recipient's compliance with the terms and conditions of the award; (6) DOE's Go/No-Go decision; (7) the recipient's submission of a continuation application[29]; and (8) written approval of the continuation application by the Contracting Officer.

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

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

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

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

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

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.C.xix.

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 United States 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 that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States unless the Recipient can show to the satisfaction of DOE that it is not commercially feasible. Award terms, including the specific U.S. Competitiveness Provision applicable to the various types of Recipients and projects, are available at https://www.energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards.

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

As noted in the U.S. Competitiveness Provision, if an entity cannot meet the requirements of the U.S. Competitiveness Provision, the entity may request a modification or waiver of the U.S. Competitiveness Provision. For example, the

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

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

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

xxi. Interim Conflict of Interest Policy for Financial Assistance

The DOE interim Conflict of Interest Policy for Financial Assistance (COI Policy)[30] is applicable to all non-Federal entities applying for, or that receive, DOE funding by means of a financial assistance award (e.g., a grant, cooperative agreement, or technology investment agreement) and, through the implementation of this policy by the entity, to each Investigator who is planning to participate in, or is participating in, the project funded wholly or in part under the DOE financial assistance award. The term "Investigator" means the PI and any other person, regardless of title or position, who is responsible for the purpose, design, conduct, or reporting of a project funded by DOE or proposed for funding by DOE. Recipients must flow down the requirements of the interim COI Policy to

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

any subrecipient non-Federal entities. Further, for DOE funded projects, the recipient must include all financial conflicts of interest (FCOI) (i.e., managed and unmanaged/unmanageable) in their initial and ongoing FCOI reports.

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

xxii. Fraud, Waste and Abuse

The mission of the DOE Office of Inspector General (OIG) is to strengthen the integrity, economy and efficiency of the Department's programs and operations including deterring and detecting fraud, waste, abuse and mismanagement. The OIG accomplishes this mission primarily through investigations, audits, and inspections of DOE activities to include grants, cooperative agreements, loans, and contracts.

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

Additionally, recipients of DOE awards must be cognizant of the requirements of 2 CFR 200.113 Mandatory disclosures, which states:

> The non-Federal entity or applicant for a Federal award must disclose, in a timely manner, in writing to the Federal awarding agency or pass-through entity all violations of Federal criminal law involving fraud, bribery, or gratuity violations potentially affecting the Federal award. Non-Federal entities that have received a Federal award including the term and condition outlined in appendix XII of 2 CFR Part 200 are required to report certain civil, criminal, or administrative proceedings to SAM. Failure to make required disclosures can result in any of the remedies described in

2 CFR 200.339. (See also 2 CFR part 180, 31 U.S.C. § 3321, and 41 U.S.C. § 2313.) [85 FR 49539, Aug. 13, 2020]

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

xxiii. Human Subjects Research

Research involving human subjects, biospecimens, or identifiable private information conducted with DOE funding is subject to the requirements of DOE Order 443.1C, Protection of Human Research Subjects, 45 CFR Part 46, Protection of Human Subjects (subpart A which is referred to as the "Common Rule"), and 10 CFR Part 745, Protection of Human Subjects.

Additional information on the DOE Human Subjects Research Program can be found at: HUMAN SUBJECTS Human Subjects Pr... | U.S. DOE Office of Science (SC) (osti.gov).

xxiv. Construction Signage

After receiving a DOE award, recipients are encouraged to display DOE Investing in America signage during and after construction. Guidance can be found at: (https://www.energy.gov/design). Proposed signage costs that meet these specifications are an allowable cost and should be included in the proposed project budget.

xxv. 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 (1) take disposition action on the real property and equipment; or (2) continue to use the real property and equipment after the conclusion of the award period of performance, with Contracting Officer approval.

The recipient's written Request for Continued Use must identify the property and include: a summary of how the property will be used (must align with the authorized project purposes); a proposed use period, (e.g., perpetuity, until fully depreciated, or a calendar date 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 from DOE. 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. However, pursuant to the FY23 Consolidated Appropriations Act (Pub. L. No. 117-328), Division D, Title III, Section 309, the Secretary or a designee of the Secretary may, at their discretion, vest unconditional title or other property interests acquired under this project regardless of the fair market value of the property at the end of the award period.

VII. Questions/Agency Contacts

Upon the issuance of a FOA, DOE 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. Questions regarding this FOA must be submitted to DE-FOA-0003018@netl.doe.gov no later than three business days prior to the application due date. 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 the NETL eXCHANGE at https://NETL-Exchange.energy.gov/. You must first select the FOA Number to view the questions and answers specific to this FOA. DOE will attempt to respond to a question within three 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 NETL eXCHANGE website should be submitted to NETL-ExchangeSupport@hq.doe.gov.

VIII. Other Information

A. FOA Modifications

Amendments to this FOA will be posted on NETL eXCHANGE and the Grants.gov systems. 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. DOE 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

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

C. Commitment of Public Funds

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

D. Treatment of Application Information

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

If an application includes trade secrets or business sensitive, proprietary, or otherwise confidential information, it is furnished to the Federal Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, DOE 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.

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

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

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

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

E. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation, the Go/No-Go Reviews and Peer Reviews, the government may seek the advice of qualified non-federal personnel as reviewers. The government may also use non-federal personnel to conduct routine, nondiscretionary administrative activities, including DOE 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

DOE 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

DOE expects to retain copies of all Full Applications and other submissions. No submissions will be returned. By applying to DOE for funding, applicants consent to DOE'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 DOE within the timeframes set forth in the award's intellectual property data terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- Determination of Exceptional Circumstance (DEC): On June 07, 2021, DOE approved a 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.xxii, U.S. Manufacturing Commitments of this FOA. A copy of the DEC can be found at https://www.energy.gov/gc/determination-exceptional-circumstances-decs. Pursuant to 37 CFR 401.4, any nonprofit organization or small business firm as defined by 35 U.S.C. § 201 affected by any DEC has the right to appeal it by providing written notice to DOE within 30 working days from the time it receives a copy of the determination.
- DOE may issue and publish further DECs on the website above

prior to the issuance of awards under this FOA. DOE may require additional submissions or requirements as authorized by any applicable DEC.

K. Government Rights in Subject Inventions

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

Government Use License

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

March-In Rights

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

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

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfied manner;
- The owner has not met public use requirements specified by federal statutes in a reasonably satisfied manner; or
- The United States manufacturing requirement has not been met.

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

L. Rights in Technical Data

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

"Limited Rights Data": The United States 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 United States 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 DOE awards may be protected from public disclosure for up to five years after the data is generated ("Protected Data"). For awards permitting Protected Data, the protected data must be marked as set forth in the award's intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

M. Copyright

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

N. Export Control

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

States Export Control Laws and regulations relating to any work performed under a resulting award.

The recipient must immediately report to DOE any export control investigations, indictments, charges, convictions, and violations upon, at the recipient or subrecipient level, and provide the corrective action(s) to prevent future violations.

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

As set forth in 2 CFR 200.216, recipients and subrecipients are prohibited from obligating or expending project funds (federal funds and recipient cost share) to procure or obtain; extend or renew a contract to procure or obtain; exercise an option to procure; or enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses *covered telecommunications equipment or services* as a substantial or essential component of any system, or as critical technology as part of any system. As described in section 889 of Public Law 115-232, *covered telecommunications equipment* is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

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

P. Personally Identifiable Information (PII)

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

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

Q. Annual Independent Audits

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

If an educational institution, non-profit organization, or state/local government is a prime recipient or subrecipient and has expended $750,000 or more of federal awards during the non-federal entity's fiscal year, 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. DOE 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. DOE 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 a DOE 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, DOE 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, DOE generally does not allow pre-award costs prior to the signing of the Selection Statement by the DOE 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 – WAIVER REQUESTS FOR: 1. FOREIGN ENTITY PARTICIPATION; AND 2. FOREIGN WORK

1. Waiver for Foreign Entity Participation

Many of the technology areas DOE funds fall in the category of critical and emerging technologies (CETs). CETs are a subset of advanced technologies that are potentially significant to United States national and economy security.[31] For projects selected under this FOA, all recipients and subrecipients must be organized, chartered or incorporated (or otherwise formed) under the laws of a state or territory of the United States; have majority domestic ownership and control; and have a physical location for business operations in the United States. To request a waiver of this requirement, an applicant must submit an explicit waiver request in the Full Application.

Waiver Criteria

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

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

Content for Waiver Request

A Foreign Entity waiver request must include the following:

a. Information about the entity: name, point of contact, and proposed type of involvement in the project;
b. Country of incorporation, the extent of the ownership/level control by foreign entities, whether the entity is state owned or controlled, a summary of the ownership breakdown of the foreign entity and the percentage of ownership/control by foreign entities, foreign shareholders, foreign state or foreign individuals;
c. The rationale for proposing a foreign entity participate (must address criteria above);

[31] See Critical and Emerging Technologies List Update (whitehouse.gov).

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

DOE may also require:

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

DOE may require additional information before considering the waiver request.

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

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

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

Overall, a waiver request must demonstrate to the satisfaction of DOE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to perform work outside of the United States. A request for a foreign work waiver must include the following:

1. The rationale for performing the work outside the United States ("foreign work");
2. A description of the work proposed to be performed outside the United States;

3. An explanation as to how the foreign work is essential to the project;
4. A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the United States economy;
5. The associated benefits to be realized and the contribution to the project from the foreign work;
6. How the foreign work will benefit the United States, including manufacturing, contributions to employment in the United States and growth in new markets and jobs in the United States;
7. How the foreign work will promote manufacturing of products and/or services in the United States;
8. A description of the likelihood of Intellectual Property (IP) being created from the foreign work and the treatment of any such IP;
9. The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
10. The countries in which the foreign work is proposed to be performed; and
11. The name of the entity that would perform the foreign work.

DOE may require additional information before considering the waiver request.

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

Appendix C – Buy America Requirements for Infrastructure Projects
Required Use of American Iron, Steel, Manufactured Products, and Construction Materials

A. Definitions
For purposes of the Buy America Requirement, the following definitions apply:

Components See 2 CFR 184.3 Definitions

Construction Materials See 2 CFR 184.3 Definitions

"Buy America Preference," "Buy America Requirement," or "domestic content procurement preference" means the requirements set forth in section 70914 of the Build America, Buy America Act, which requires the head of each Federal agency to ensure that none of the funds subject to the requirements are made available for a Federal award for an infrastructure project may be obligated unless all of the iron, steel, manufactured products, and construction materials incorporated into the project are produced in the United States.

Infrastructure See 2 CFR 184.4(c) and (d).

Manufactured Products See 2 CFR 184.3 Definitions

Predominantly of iron or steel See 2 CFR 184.3 Definitions.

Infrastructure project See 2 CFR 184.3 Definitions

B. Buy America Requirement for Infrastructure Projects (Buy America Requirement)
None of the award funds (includes federal share and recipient cost share) may be used for a project for infrastructure unless:

(1) all iron and steel used in the project is 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. See 2 CFR 184.5 for determining the cost of components for manufactured products; and

(3) all construction materials[32] are manufactured in the United States—this means that all manufacturing processes for the construction material occurred in the United States. See 2 CFR 184.6 for construction material standards.

The Buy America Requirement only applies to those articles, materials, and supplies that are consumed in, incorporated into, or affixed to the infrastructure in the project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does the Buy America Requirement 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.

The Buy America Requirement only applies to an article, material, or supply classified into one of the following categories* based on its status at the time it is brought to the work site for incorporation into an infrastructure project:

(i) Iron or steel products;
(ii) Manufactured products; or
(iii) Construction materials;

The Buy America Requirement only applies to the iron or steel products, manufactured products, and construction materials used for the construction, alteration, maintenance, or repair of public infrastructure in the United States when those items are consumed in, incorporated into, or permanently affixed to the infrastructure. An article, material, or supply incorporated into an infrastructure project should not be considered to fall into multiple categories, but rather must meet the Buy America Preference Requirement for only the single category in which it is classified.

The Buy America Requirement applies to public infrastructure projects in the United States. For purposes of this guidance, applicants should consider whether the infrastructure project will serve a public function. Infrastructure projects should generally be considered "public" if the infrastructure is: publicly owned, privately owned but operated on behalf of the public, or is a place of public accommodation. Review the implementation guidance in OMB Memorandum OMB Memorandum M-24-02 and consult with DOE if you are unsure if your project is subject to Buy America requirements.

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

All iron and steel, manufactured products, and construction materials used in the infrastructure project must be produced in the United States.

** Section 70917(c) Materials* are cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives as provided in section 70917(c) of BABA. Section 70917 (c) materials are excluded from Construction materials. Asphalt concrete pavement mixes are typically composed of asphalt cement (a binding agent) and aggregates such as stone, sand, and gravel. Accordingly, asphalt is also excluded from the definition of Construction materials.

Section 70917(c) materials, on their own, are not manufactured products. Further, Section 70917(c) materials should not be considered manufactured products when they are used at or combined proximate to the work site—such as is the case with wet concrete or hot mix asphalt brought to the work site for incorporation. However, certain Section 70917(c) materials (such as stone, sand, and gravel) may be used to produce a manufactured product, such as is precast concrete. Precast concrete is made of components, is processed into a specific shape or form, and is in such state when brought to the work site. Furthermore, wet concrete should not be considered a manufactured product if not dried or set prior to reaching the work site.

Further clarification is provided in 2 CFR Part 184 on the circumstances under which a determination is made that Section 70917(c) materials should be treated as components of a manufactured product. That determination is based on consideration of: (i) the revised definition of the "manufactured products" at 2 CFR 184.3; (ii) a new definition of "section 70917(c) materials" at 2 CFR 184.3; (iii) new instructions at 2 CFR 184.4(e) on how and when to categorize articles, materials, and supplies; and (iv) new instructions at 2 CFR 184.4(f) on how to apply the Buy America preference by category.

The recipient is responsible for flowing the Buy America Requirement down to all subawards, contracts, subcontracts, and purchase orders for work performed under the proposed infrastructure project, including to For-Profit Entities when the For-Profit Entity is a subrecipient or subawardee.

Recipients must certify or provide equivalent documentation for proof of compliance that a good faith effort was made to solicit bids for domestic products used in the infrastructure project under this award.

Recipients must also maintain certifications or equivalent documentation for proof of compliance that those articles, materials, and supplies that are consumed in, incorporated into, affixed to, or otherwise used in the infrastructure project, not covered by an approved waiver or an exemption provided in 2 CFR 184.8, are produced in the United States. The certification or proof of compliance must be provided by the suppliers or manufacturers of the iron, steel, manufactured products and construction materials and flow up from all subawardees,

contractors and vendors to the recipient. Recipients must keep these certifications with the award/project files and be able to produce them upon request from DOE, auditors or Office of Inspector General.

C. DOE Submission Requirements for Full Application

Within the first two pages of the workplan or project description, applicants must provide a short statement on whether the project will involve the construction, alteration, maintenance 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 the Buy America Requirement, which may impact the project's proposed budget and/or schedule.

D. Waivers

In limited circumstances, DOE may waive the application of the Buy America Requirement in an award where DOE determines that:

> (1) applying the Buy America requirements would be inconsistent with the public interest (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 (Non-Availability); 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 (Unreasonable Cost).

DOE will only process waiver requests after an award has been made but prior to any purchase of items the recipient is seeking to waive, and for which the requests have been submitted in accordance with the term and conditions of the award. Waiver requests must be reviewed by DOE and the Office of Management and Budget's Made in America Office and are subject to a public comment period of no less than 15 calendar days.

DOE or OMB may request additional information for consideration of the wavier. DOE may reject or grant waivers in whole or in part depending on its review, analysis, and/or feedback from OMB or the public. DOEs final determination regarding approval or rejection of the waiver request may not be appealed by a recipient.

Requests to waive the Buy America Requirement must include the following:

- Waiver type (Public Interest, Non-Availability, or Unreasonable Cost);
- Recipient name and Unique Entity Identifier (UEI);

- Award information (Federal Award Identification Number, Assistance Listing number);
- A brief description of the project, its location, and the specific infrastructure involved;
- Total estimated project cost, with estimated federal share and recipient cost share breakdowns;
- Total estimated infrastructure costs, with estimated federal share and recipient cost share breakdowns;
- List and description of iron or steel item(s), manufactured goods, and/or construction material(s) the recipient seeks to waive from the Buy America Requirement, including name, cost, quantity(ies), country(ies) of origin, and relevant Product Service Codes (PSC) and North American Industry Classification System (NAICS) codes for each;
- A detailed justification as to how the non-domestic item(s) is/are essential the project;
- A certification that the recipient made a good faith effort to solicit bids for domestic products supported by terms included in requests for proposals, contracts, and non-proprietary communications with potential suppliers;
- A justification statement—based on one of the applicable justifications outlined above—as to why the listed items cannot be procured domestically, including the due diligence performed (e.g., market research, industry outreach, cost analysis, cost-benefit analysis) by the recipient to attempt to avoid the need for a waiver. This justification may cite, if applicable, the absence of any Buy America-compliant bids received for domestic products in response to a solicitation;
- A description of the market research conducted that includes who conducted the market research, when it was conducted, sources that were used, and the methods used to conduct the research; and Anticipated impact to the project if no waiver is issued.

APPENDIX D – 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 E – LIST OF ACRONYMS

BABA	Build America Buy America Act
BIL	Bipartisan Infrastructure Law
BOP	Balance of Plant
CAGR	Compound Annual Growth Rate
CBOO	Community Benefits Outcomes and Objectives
CBP	Community Benefits Plan
CCUS	Carbon Capture, Utilization, and Storage
CETs	Critical and Emerging Technologies
CEJST	Climate and Economic Justice Screening Tool
CFR	Code of Federal Regulations
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CO2U	NETL Carbon Dioxide Utilization LCA Guidance Toolkit
COI	Conflict of Interest
CRADA	Cooperative Research and Development Agreement
DBA	Davis-Bacon Act
DEC	Determination of Exceptional Circumstances
DEIA	Diversity, Equity, Inclusion, and Accessibility
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier
DOL	Department of Labor
EDX	Energy Data eXchange
EOR	Enhanced Oil Recovery
ES&H	Environment, Safety, and Health
FAR	Federal Acquisition Regulation
FCOI	Financial Conflicts of Interest
FECM	Fossil Energy and Carbon Management
FFATA	Federal Funding and Transparency Act of 2006
FFRDC	Federally funded research and development center
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FY	Fiscal Year
FFRDC	Federally Funded Research and Development Center
GHG	Greenhouse Gas
HBCUs	Historically Black Colleges and Universities
IP	Intellectual Property
LCA	Lifecycle Analysis / Assessment
LPG	Liquid Petroleum Gas
MFA	Multi-Factor Authentication
MPIN	Marketing Partner ID Number

MSI	Minority-Serving institution
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NETL	National Energy Technology Lab
NNSA	National Nuclear Security Administration
NSF	National Science Foundation
OFCCP	Office of Federal Contractor Compliance Program
OIG	Office of Inspector General
OMB	Office of Management and Budget
OSS	Open-Source Software
OSTI	Office of Scientific and Technical Information
PI	Principal Investigator
PII	Personal Identifiable Information
PLA	Project labor agreements
PMP	Project Management Plan
POC	Point of contact
PRL	Physical Review Letter
R&D	Research and Development
RD&D	Research, Development, and Demonstration
RPP	Required Purchase Price of CO_2
SABP	Systems analysis best practice
SAF	Sustainable Aviation Fuel
SAM	System for Award Management
SciENcv	Science Experts Network Curriculum Vita
SF	Standard Form
SMART	Specific, Measurable, Achievable, Relevant, and Timely
SOPO	Statement of Project Objectives
SPDT	State Point Data Table
SSN	Social Security Number
STEM	Science, Technology, Engineering, and Mathematics
TA	Topic Area
TEA	Techno-economic Analysis / Assessment
TMP	Technology Maturation Plan
TRA	Technology Readiness Assessment
TRL	Technology Readiness Level
UCC	Uniform Commercial Code
UEI	Unique Entity Identifier
WBS	Work Breakdown Structure
WP	Work Proposal

APPENDIX F – STATEMENT OF PROJECT OBJECTIVES TEMPLATE

STATEMENT OF PROJECT OBJECTIVES
Title of Project
(Insert the title of the work to be performed. Be concise and descriptive)

This should be a standalone document that states the work to be conducted and should not include any proprietary/confidential information. Document instructions are written in italics and should be removed prior to submission.

A. OBJECTIVES

Include one paragraph on the overall objective(s) of the work. Note: if the project will be performed in phases, include specific objective(s) for each phase of the work.

B. SCOPE OF WORK

This section should not exceed one-half page and should summarize the effort and approach to achieve the objective(s) of the work. Note: if the project will be performed in phases, includes specific scope statement(s) for each phase.

C. TASKS TO BE PERFORMED

This section provides a brief summary of the planned approach to this project. Tasks/subtasks, concisely written, should be provided in a logical sequence and should be divided into the phases of the project, as appropriate. In writing the Statement of Project Objectives (SOPO), avoid 1) the use of proper nouns to minimize SOPO modifications in the event of changes to the project team, facilities, etc.; 2) figures and equations; 3) references to other documents and publications; and 4) details about past work and discussion of technical background (which should be covered elsewhere in the application narrative).

Task 1.0 - Project Management and Planning *(REQUIRED; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES)*
"The Recipient shall manage and direct the project in accordance with a Project Management Plan to meet all technical, schedule and budget objectives and requirements. The Recipient will coordinate activities in order to effectively accomplish the work. The Recipient will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied."

Subtask 1.1 - Project Management Plan (PMP) *(REQUIRED; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES)*

"The Recipient shall update the Project Management Plan 30 days after award and as necessary throughout the project to accurately reflect the current status of the project. Examples of when it may be appropriate to update the Project Management Plan include: (a) project management policy and procedural changes; (b) changes to the technical, cost, and/or schedule baseline for the project; (c) significant changes in scope, methods, or approaches; or (d) as otherwise required to ensure that the plan is the appropriate governing document for the work required to accomplish the project objectives.

Management of project risks will occur in accordance with the risk management methodology delineated in the Project Management Plan in order to identify, assess, monitor and mitigate technical uncertainties as well as schedule, budgetary and environmental risks associated with all aspects of the project. The results and status of the risk management process will be presented during project reviews and in quarterly progress reports with emphasis placed on the medium- and high-risk items."

Subtask 1.2 - Technology Maturation Plan (TMP) *(REQUIRED FOR **TA-1 ONLY**; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES)*
"The Recipient shall develop a TMP that describes the current technology readiness level (TRL) of the proposed technology/technologies, relates the proposed project work to maturation of the proposed technology, describes the expected TRL at the end of the project, and describes any known post-project research and development necessary to further mature the technology. The initial TMP is due 90 days after award and should be updated as needed throughout the project period of performance. A final TMP is due within 90 days of project completion." *(See Appendix I for a TMP template.)*

Subtask 1.3 – State Point Data Table (SPDT) *(REQUIRED FOR **TA-1 ONLY**; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES)*
"The Recipient shall prepare an updated State Point Data Table, which is due within 45 days of project completion." *(See Appendix L for a SPDT template.)*

APPLICANT continue with tasks/sub-tasks as necessary. Clearly delineate which tasks/subtasks occur in each Budget Period. Be sure to include task(s) for the TEA and LCA work (See Appendix J and Appendix K for guidelines).

BUDGET PERIOD 1:
Task 2.0 - (Title)
Task descriptions should include a concise description of the work to be conducted for each task. If the task includes subtasks, provide a general description of how each subtask is related to the overall scope of the task.

Subtask 2.1 - (Title)

Subtask descriptions should include a concise description of the work to be conducted for each subtask.

Subtask 2.2 - (Title)

CONTINUATION/DECISION POINT *(REQUIRED; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES)*
"DOE funding is not authorized beyond Budget Period 1 without the written approval of the Contracting Officer. The Recipient shall submit a Continuation Application 90 days prior to the end of Budget Period 1."

BUDGET PERIOD 2:
APPLICANT continue with tasks/sub-tasks as necessary.

D. DELIVERABLES (*REQUIRED; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES AND CONTINUE TO COMPLETE*.)

"The periodic and final reports shall be submitted in accordance with the "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist. In addition to the reports specified in the "Federal Assistance Reporting Checklist", the Recipient must provide the following to the NETL Project Manager (identified in Block 15 of the Assistance Agreement as the Program Manager)."

Task / Subtask Number	Deliverable Title	Due Date
1.1	Project Management Plan (PMP)	Update due 30 days after award. Revisions to the PMP shall be submitted as requested by the NETL Project Manager.
1.2	Technology Maturation Plan (TMP) **(TA-1 only)**	The initial TMP is due 90 days after award. Updates to the TMP shall be submitted, as needed, throughout the project period of performance. A final TMP is due within 90 days of project completion.
1.3	State Point Data Table **(TA-1 only)**	Final state point data table is due 45 days prior to project completion.
X	Techno-economic Analysis (TEA)	The initial TEA is due 120 days after award. A final TEA is due 45 days prior to project completion.
X	Life Cycle Analysis (LCA)	The initial LCA is due 120 days after award. A final LCA is due 45 days prior to project completion.

X	Feasibility Study Report **(TA-2 only)**	A report detailing the results of the feasibility study is due 45 days prior to project completion.

APPLICANT continue to identify deliverables (other than those identified on the "Federal Assistance Reporting Checklist") that will be delivered using the format provided in the table above. Ensure the delivery date to NETL is also identified. For examples: Delivery to NETL X months after completion of task/subtask X.

NOTE: If the application is selected for award, DOE may require the Recipient to include additional deliverables, provided that such deliverables are consistent with the budget, schedule, and scope of the project.

E. BRIEFINGS/TECHNICAL PRESENTATIONS (*REQUIRED; APPLICANT INSERT THE LANGUAGE PROVIDED BELOW IN QUOTES AND CONTINUE TO COMPLETE*.)

"The Recipient shall prepare detailed briefings for presentation to the NETL Project Manager at their facility located in Pittsburgh, PA, Morgantown, WV, Albany, OR, or virtually. The Recipient shall make a presentation to the NETL Project Manager at a project kick-off meeting held within 90 days of the project start date. At a minimum, the Recipient shall provide one annual public briefing at an NETL sponsored meeting to explain the plan, progress, and results of the technical effort. A final project briefing at the close of the project shall also be given."

At the Applicant's discretion, other briefings/presentations may be added to Section E of the SOPO.

NOTE: If the application is selected for award, DOE may require the Recipient to include additional briefings/presentations, provided that such briefings/presentations are consistent with the budget, schedule, and scope of the project.

APPENDIX G – PROJECT MANAGEMENT PLAN TEMPLATE

REMINDER: APPLICANTS SHOULD DOUBLE SPACE THE PROJECT MANAGEMENT PLAN IN ACCORDANCE WITH THE FORM AND CONTENT REQUIREMENTS IN SECTION IV, "APPLICATION AND SUBMISSION INFORMATION" AND REMOVE THIS BLOCK PRIOR TO SUBMISSION.

The Applicant's Project Management Plan (PMP) is an approved document that defines how the Applicant will execute, monitor, and control the project to accomplish the objectives. The specific contents, level of detail, and inclusion of subsidiary planning documents are tailored according to the needs of the project. Consequently, every PMP will be different based on the risk, visibility, and/or complexity of the project and the Recipient's established processes, procedures, and systems.

Title Page:

PROJECT MANAGEMENT PLAN

{Insert Project Title}

{Date Prepared}

SUBMITTED BY
{Organization Name}
{Organization Address}
{City, State, Zip Code}

PRINCIPAL INVESTIGATOR
{Name}
{Phone Number}
{E-mail}

SUBMITTED TO
U.S. Department of Energy National Energy Technology Laboratory

This plan should be formatted to include the following sections with each section to include the information as described below:

A. Executive Summary:

Provide a description of the project that includes the objective, project goals, and expected results. For purposes of the application, this information is included in the Project Technical Volume and should be simply copied to this document for completeness, so that the Project Management Plan is a stand-alone document.

B. Project Organization and Structure:

Provide the following information in this section:

- Organizational Chart(s): Include a complete project organizational chart and sub-organization charts (if applicable), accompanied by a discussion of how the organizational structure will facilitate the performance of the Tasks and achievement of the objectives described in the SOPO within the time frame specified in the application.
- Roles and Responsibilities of Participants: Provide a discussion of key project team members, and the capacity in which each team member will assist in achieving the overall objective(s) of the proposed project. For multi- organizational or multi-investigator projects, describe the roles to be performed by each participant/investigator within the context of the Task/subtask structure contained in the SOPO. Include descriptions of any business agreements or intellectual property issues between the applicant and other members of the project team, and how these agreements will be integrated and managed.
- Decision-making and Communication Strategy: Provide a discussion of how communication and decision-making will occur within the context of the organizational structure, with particular emphasis on scientific/technical direction and mechanisms for controlling project scope, cost, and schedule. Include a discussion of how the project team will communicate with DOE and external stakeholders during the performance of the project.
- Management Capabilities: Provide information relevant to the capabilities and experience of the PI and key project team members in managing technical projects of similar nature and complexity. If applicable, include examples that demonstrate the ability to successfully meet research objectives within scope, budget and schedule.

C. Risk Management Plan:

Provide a summary description of the proposed approach to identify, analyze, and respond to perceived risks associated with the proposed project. Project risk events are uncertain future events that, if realized, impact the success of the project. Risk is inherent to all projects

regardless of complexity, cost, or visibility. An effective Risk Management Plan will identify perceived risks and explain mitigation strategies for each risk. At a minimum, the Risk Management Plan shall include the initial identification of significant financial, cost/schedule, technical/scope, management, planning and oversight, Environment Safety and Health (ES&H), external factors, and management issues that have the potential to impede project progress and strategies to minimize impacts from those issues.

The following table format is provided but is not required:

Perceived Risks and Mitigation Strategies

Perceived Risk	**Risk Rating**			**Mitigation/Response Strategy**
	Probability (Low, Med, High)	**Impact**	**Overall**	
Financial Risks:				
Cost/Schedule Risks:				
Technical/Scope Risks:				
Management, Planning, and Oversight Risks:				
ES&H Risks:				
External Factor Risks:				

D. Milestone Log:

Provide milestones for each budget period of the project. Each milestone should be linked to a specific Task or Subtask and include a title, planned completion date, and a description of the method/process/measure used to verify completion. Milestones should be quantitative and

show progress toward budget period and/or project goals. Conversely, periodic, mandatory progress reports are not considered to be Milestones.

Milestones are presumed to lie on the critical path of the project, i.e., unless all milestones are achieved, the Objectives as defined in the SOPO cannot be met completely. Applicants must provide at least two milestones per year throughout the course of the project.

Milestone Format

Task/ Subtask	Milestone Title & Description	Planned Completion Date	Verification method

[Note: During project performance, the Recipient will report the Milestone Status as part of the required quarterly progress report as prescribed under the Federal Assistance Reporting Checklist. The Milestone Status will present actual performance in comparison with Planned Milestones, and include:

1. the actual status and progress of the project,
2. specific progress made toward achieving the project's milestones, and,
3. any proposed changes in the project's schedule required to complete milestones.]

E. Costing Profile:

Provide a table (the Spend Plan) that projects the expenditures of government funds by fiscal year for each project team member.

Spend Plan by Fiscal Year Format

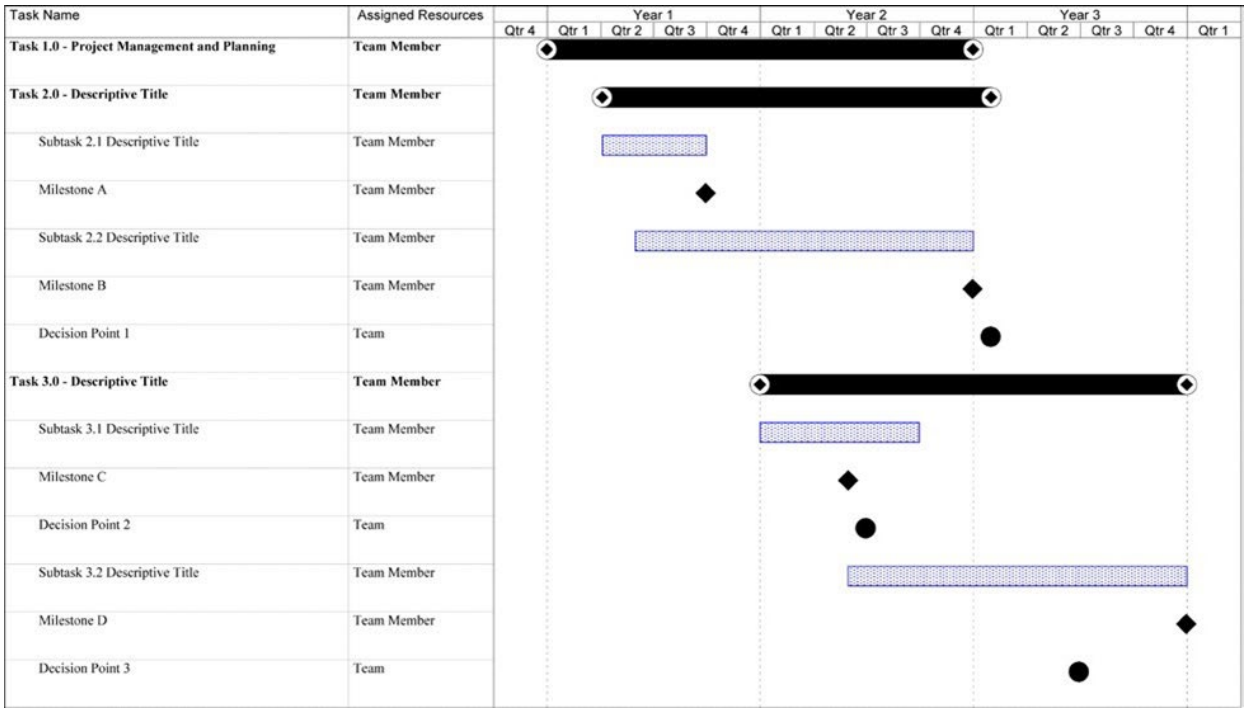
	FY 20XX		FY 20XX		FY 20XX		FY 20XX		Total	
	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share
Applicant										
Subrecipient A, if proposed										
Subrecipient B, if proposed										
FFRDC/NL, if proposed										
Total ($)										

Total Cost Share %										

F. Project Timeline:

Provide a timeline of the project (similar to a Gantt chart) broken down by each task and subtask, as described in the Statement of Project Objectives. The timeline should include for each task, a start date, and end date. The timeline should show interdependencies between tasks and include the milestones that are identified in the Milestone Log (Section C).

Project Timeline (Gantt Chart) Example



G. Success Criteria:

Success criteria are used by the DOE to determine if specific goals and objectives were met at the end of budget period(s), go/no-go decision points, and/or project completion. The success criteria should be objective and stated in terms of specific, measurable, and repeatable data. Usually, the success criteria pertain to desirable outcomes, results, and observations from the project.

[Note: As the first task in the Statement of Project Objectives, successful applicants will revise the version of the Project Management Plan that is submitted with their applications by including details from the negotiation process. This Project Management Plan will be updated

by the Recipient as the project progresses, and the Recipient must use this plan to report scope, schedule, and budget variances.]

APPENDIX H – DATA MANAGEMENT PLAN

A Data Management Plan ("DMP") explains how data generated in the course of the research or work performed under an assistance award will be shared and preserved or, when justified, explains why data sharing or preservation is not possible or scientifically appropriate.

DMP Requirements

In order for a DMP to be considered acceptable, the DMP must address the following:

At a minimum, the DMP must describe how data sharing and preservation will enable validation of the results from the proposed work, or how results could be validated if data are 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 publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible in accordance with the principles stated above. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.

The DMP should consult and reference available information about data management resources to be used in the course of the proposed work. In particular, a DMP that explicitly or implicitly commits data management resources at a facility beyond what is conventionally made available to approved users should be accompanied by written approval from that facility. In determining the resources available for data management at DOE User Facilities, researchers should consult the published description of data management resources and practices at that facility and reference it in the DMP. Information about other DOE facilities can be found in the additional guidance from the sponsoring program.

The DMP must protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; avoid significant negative impact on innovation, and U.S. competitiveness; and otherwise be consistent with all laws (i.e., export control laws), and DOE regulations, orders, and policies.

Data Determination for a DMP

The Principal Investigator should determine which data should be the subject of the DMP and, in the DMP, propose which data should be shared and/or preserved in accordance with the DMP Requirements noted above.

For data that will be generated through the course of the proposed work, the Principal Investigator should indicate what types of data should be protected from immediate public disclosure by DOE (referred to as "protected data") and what types of data that DOE should be able to release immediately. Similarly, for data developed outside of the proposed work at private expense that will be used in the course of the proposed work, the Principal Investigator should indicate whether that type of data will be subject to public release or kept confidential (referred to as "limited rights data"). Any use of limited rights data or labeling of data as "protected data" must be consistent with the DMP Requirements noted above.

Suggested Elements for a DMP

The following list of elements for a DMP provides suggestions regarding the data management planning process and the structure of the DMP:

Data Types and Sources: A brief, high-level description of the data to be generated or used through the course of the proposed work and which of these are considered digital research data necessary to validate the research findings or results.

Content and Format: A statement of plans for data and metadata content and format including, where applicable, a description of documentation plans, annotation of relevant software, and the rationale for the selection of appropriate standards. Existing, accepted community standards should be used where possible. Where community standards are missing or inadequate, the DMP could propose alternate strategies for facilitating sharing, and should advise the sponsoring program of any need to develop or generalize standards.

Sharing and Preservation: A description of the plans for data sharing and preservation. This should include, when appropriate: the anticipated means for sharing and the rationale for any restrictions on who may access the data and under what conditions; a timeline for sharing and preservation that addresses both the minimum length of time the data will be available and any anticipated delay to data access after research findings are published; any special requirements for data sharing, for example, proprietary software needed to access or interpret data, applicable policies, provisions, and licenses for re-use and re-distribution, and for the production of derivatives, including guidance for how data and data products should be cited; any resources and capabilities (equipment, connections, systems, software, expertise, etc.) requested in the research proposal that are needed to meet the stated goals for sharing and preservation (this could reference the relevant section of the associated research proposal and budget request); and whether/where the data will be preserved after direct project funding ends and any plans for the transfer of responsibilities for sharing and

preservation. A description of how the recipient intends to make the results of any resulting DOE-funded work available to the public, including the relevant technical community.

Protection: A statement of plans, where appropriate and necessary, to protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; and avoid significant negative impact on innovation, and U.S. competitiveness.

Rationale: A discussion of the rationale or justification for the proposed data management plan including, for example, the potential impact of the data within the immediate field and in other fields, and any broader societal impact.

Additional Guidance

In determining which data should be shared and preserved, researchers must consider the data needed to validate research findings as described in the Requirements and are encouraged to consider the potential benefits of their data to their own fields of research, fields other than their own, and society at large.

DMPs should reflect relevant standards and community best practices and make use of community accepted repositories whenever practicable.

Costs associated with the scope of work and resources articulated in a DMP may be included in the proposed research budget as permitted by the applicable cost principles.

To improve the discoverability of and attribution for datasets created and used in the course of research, DOE encourages the citation of publicly available datasets within the reference section of publications, and the identification of datasets with persistent identifiers such as Digital Object Identifiers (DOIs). In most cases, DOE can provide DOIs free of charge for data resulting from DOE-funded research through its Office of Scientific and Technical Information (OSTI) DataID Service.

Definitions

Data Preservation: Data preservation means providing for the usability of data beyond the lifetime of the research activity that generated them.

Data Sharing: Data sharing means making data available to people other than those who have generated them. Examples of data sharing range from bilateral communications with colleagues, to providing free, unrestricted access to anyone through, for example, a web-based platform.

Digital Research Data: The term digital data encompasses a wide variety of information stored in digital form including: experimental, observational, and simulation data; codes, software and algorithms; text; numeric information; images; video; audio; and associated metadata. It also encompasses information in a variety of different forms including raw, processed, and analyzed data, published and archived data.

Research Data: The recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, or communications with colleagues. This 'recorded' material excludes physical objects (e.g., laboratory samples). Research data also do not include:

(A) Trade secrets, commercial information, materials necessary to be held confidential by a researcher until they are published, or similar information which is protected under law; and

(B) Personnel and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy, such as information that could be used to identify a particular person in a research study."

Validate: In the context of DMPs, validate means to support, corroborate, verify, or otherwise determine the legitimacy of the research findings. Validation of research findings could be accomplished by reproducing the original experiment or analyses; comparing and contrasting the results against those of a new experiment or analyses; or by some other means.

APPENDIX I – TECHNOLOGY MATURATION PLAN (TA-1 ONLY)

A technology maturation plan (TMP) is a planning tool that summarizes the necessary research and development (R&D) steps to advance the maturation of a specified technology to a targeted technology readiness level (TRL) and defines the key performance metrics that will be used to determine if the targeted TRL has been successfully achieved. A TMP also documents the current TRL of the specified technology, defines the ultimate commercial application of the technology, and conceptualizes a future commercialization pathway in terms of additional R&D, resources and schedule. A TMP is a high-level summary document. It is not a collection of detailed test plans. An initial and final TMP are required as part of the deliverables for projects awarded under DE-FOA-0003018.

The National Energy Technology Laboratory (NETL) uses TMPs to enhance its stewardship of R&D project portfolios and improve the value of the technologies it develops. TMPs help NETL to:

- ensure that research questions are resolved in the least expensive and least risky R&D setting (i.e., scale, degree of integration, environment, fidelity)
- focus technology development on the performance metrics that are most important for technical and economic success (at component and system levels)
- identify R&D gaps and critical components that are lagging in maturity
- ensure that R&D projects address what is required for integration into higher-level systems
- make informed decisions at critical stages of research (e.g., moving a technology from a laboratory project to a larger-scale pilot project)
- improve the balance of project portfolios in terms of technology types, pathways, TRLs, redundancy, etc., to mitigate risks and increase the likelihood of R&D success, and
- forecast the cost and duration of technology development through demonstration and commercialization.

The below template should be used to complete a TMP. Instructions, shown in italics, should be deleted/replaced in the completed TMP. Section 3 is provided solely for reference but should be retained as-is in the completed TMP.

TECHNOLOGY MATURATION PLAN
for *{insert project title}*
{Date Prepared}

SUBMITTED UNDER FUNDING OPPORTUNITY ANNOUNCEMENT

DE-FOA-#######

SUBMITTED BY

{Organization Name}
{Organization Address}
{City, State, Zip Code}

PRINCIPAL INVESTIGATOR

{Name}
{Phone Number}
{E-mail}

SUBMITTED TO

U.S. Department of Energy
National Energy Technology Laboratory

1.0 INTRODUCTION

1.1 Purpose of the Project

Provide a brief summary of the project's objectives as related to maturation of the proposed technology.

1.2 Technology Readiness Assessment System

Technology maturation is quantified by a performing a technology readiness assessment (TRA) on the specified technology system.

- *Identify the specified "TRA System" and describe all the critical components and/or subsystems that comprise it. See "TRA System" definition under Section 3.1.*
- *State whether the current project will test: (1) the total, integrated TRA System, or (2) one or more critical subsystems or components of the TRA System. If the latter, identify which critical subsystems and/or components will be tested.*

1.3 Commercial Application

Provide a one-paragraph description of the targeted commercial application(s) of the TRA System.

2.0 MATURATION OF THE TRA SYSTEM

2.1 Beginning Technology Readiness Level (TRL) of the TRA System

Briefly summarize the prior research that matured the technology to its current state.

Using the Technology Readiness Levels (TRL) descriptions in Sections 3.2 and 3.3, specify the current (i.e., pre-project) TRL of the TRA System. To attain a certain TRL, all aspects of the associated TRL description must be met.

Justify the specified TRL by explaining how all the required TRL aspects have been achieved.

2.2 Proposed Research to Mature the TRA System

Identify the TRL that the project plans to attain.

- *Note that the targeted TRL could be the same as the beginning TRL if the project is aimed at making only incremental progress toward achieving the next TRL.*
- *If the project proposes to advance the TRL by more than one level, explain if that will be accomplished in stages (i.e., first one TRL, then the next) or by skipping a TRL. If the*

latter, explain how any increased technical, cost and schedule risks associated with skipping a TRL will be mitigated.

Identify each of the key performance attributes that will be assessed during the research along with the corresponding, quantifiable performance requirements that must be achieved to attain the targeted TRL(s). Explain how the key performance attributes were selected and how the corresponding requirements were determined. Be as specific as practical on any supporting technical/economic assessments (see Section 3.4 for NETL's Systems Analysis Best Practices). As a general principle, all key performance requirements that may be appropriately tested at a particular TRL must be substantially met, thereby supporting the feasibility of commercial success/goal achievement, prior to proceeding to the subsequent TRL.

Briefly summarize the proposed research steps and how they will mature the TRA System to the targeted TRL(s).

2.3 Potential Post-Project Maturation and Commercialization of the TRA System

Assuming the project successfully attains the targeted TRL(s), describe what additional (post-project) work would be required to mature the TRA System to the next TRL. Identify the key performance requirements and goals/measures that would need to be achieved. If possible, provide rough estimates of the cost and duration of the research required to attain the next TRL.

Describe your organization's potential role in a commercialization strategy for the TRA system.

3.0 REFERENCE MATERIAL

3.1 Definition of TRA System

NETL's interpretation (Section 3.2) of the DOE TRL definitions (Section 3.3) is based on a view of technology maturation in which "components" are integrated into a "system" that is being assessed for its technology readiness. To clearly and consistently apply the DOE TRL definitions, one must first precisely identify what "system" is being assessed, defined herein as the "Technology Readiness Assessment (TRA) System." Since most technologies can be viewed as subsystems within larger systems, multiple choices are available for defining the TRA System. However, note that the choice of the "level" of the TRA System affects how TRLs are assessed:

- A TRL 3 is achieved for the specified TRA System when analytical performance predictions for each of the TRA System's critical[33] components have been validated in

[33] A component or subsystem of a TRA System is considered critical if it is new, novel, and necessary for the TRA System to meet its anticipated operational performance requirements or poses major cost, schedule, or performance

separate experiments (i.e., without integration across components). Accordingly, the table in Section 3.2 shows the required scope of TRL 3 as "single component" and the required integration of TRL 3 as "none."

- A TRL 4 or 5 is achieved for a given TRA System when the targeted performance requirements for each of its critical, multi-component subsystems (or the entire TRA system) have been validated in a laboratory environment (TRL 4) or relevant environment (TRL 5) with integration of some or all components.
- Achieving TRLs 6 to 9 requires testing of the entire, fully integrated, TRL system.

To further clarify, consider, for example, a fuel cell stack. Its critical components are multiple, identical fuel cells. In turn, the critical components of each fuel cell are an anode, cathode and electrolyte. If one wished to assess the technology readiness of the fuel cell stack, the TRA System would be defined as an integrated system of multiple fuel cell subsystems, and a TRL 6 could only be achieved by successfully testing an entire stack of integrated fuel cells. However, if one instead wished to assess the technology readiness of only the fuel cell, the TRA System would be defined as an integrated system of cathode, anode and electrolyte components, and a TRL 6 could be achieved by successfully testing just a single, integrated fuel cell. In both cases, achievement of TRL 6 could be claimed, but only in the context of the properly specified TRA System.

risk during design or demonstration. Note that a component that is fully mature and non-critical for an established application or operational environment may be considered critical if it is incorporated into a new application or operational environment.

3.2 NETL Interpretations of DOE Technology Readiness Levels in the Context of Fossil Energy and Carbon Management R&D

<table>
<tr><th rowspan="2">TRL</th><th rowspan="2">DOE Definition</th><th colspan="6">Minimum Simultaneous Requirements to Achieve TRL
based on NETL Interpretation of DOE Definitions & Descriptions</th></tr>
<tr><th>Scope</th><th>Integration</th><th>Fidelity</th><th>Scale</th><th>Environment</th><th>Metrics</th></tr>
<tr><td>1</td><td>Basic principles observed and reported</td><td colspan="5" rowspan="2">Any experimentation is limited to discovery and validation of fundamental scientific principles. Formulation of the technology that applies the fundamental science is initiated in conceptual paper studies but experiments on the applied technology have not begun.</td><td>NA</td></tr>
<tr><td>2</td><td>Technology concept and/or applications formulated</td><td rowspan="8">Project-specific TMPs should define cost and/or performance metrics for relevant TRLs. To attain a given TRL, the technology must achieve the metrics for that TRL (or show a likely potential to do so).</td></tr>
<tr><td>3</td><td>Analytical and experimental critical function and/or characteristic proof of concept</td><td>Single Component</td><td>None</td><td>Low (ad-hoc hardware)</td><td rowspan="3">Lab</td><td>Lab (simulated conditions)</td></tr>
<tr><td>4</td><td>Component and/or system validation in laboratory environment</td><td rowspan="2">Total system or multi-component subsystem</td><td rowspan="2">Integration of some or all components</td><td rowspan="2">High (nearly a prototype)</td><td rowspan="3">Relevant (regulated expected conditions)</td></tr>
<tr><td>5</td><td>Laboratory scale, similar system* validation in relevant environment</td></tr>
<tr><td>6</td><td>Engineering/pilot-scale, similar (prototypical) system validation in relevant environment</td><td rowspan="3">Total system

(The total system is equivalent to the "TRA System," which is the system or subsystem for which technology readiness is being assessed)</td><td rowspan="3">All components and subsystems integrated</td><td rowspan="2">Prototype</td><td>Small Pilot**</td></tr>
<tr><td>7</td><td>Full-scale, similar (prototypical) system demonstrated in relevant environment</td><td>Large Pilot or Full**</td></tr>
<tr><td>8</td><td>Actual system completed and qualified through test and demonstration. Technology has been proven to work in its final form and under expected conditions.</td><td>Actual system in final form</td><td rowspan="2">Full</td><td rowspan="2">Operational (unregulated actual conditions)</td></tr>
<tr><td>9</td><td>Actual operation of the technology in its final form, under the full range of conditions.</td><td>Commercially warranted</td><td>NA</td></tr>
<tr><td colspan="8">* The DOE TRL 5 description states that the "similar system" matches the final application in "almost all respects" and is "almost prototypical." This table interprets the similar, but not fully prototypical, system as being either: a) the total system for which readiness is being evaluated, or b) a multi-component subsystem of the total system. This interpretation is supported by the DOE TRL 6 description which states that "TRL 6 begins true engineering development of the technology as an operational system."
** DOE defines TRL 6 as a pilot-scale prototype and TRL 7 as a full-scale prototype. DOE defines TRLs 8 and 9 as involving "actual" systems at full scale. This table assumes that the scale of the TRL 7 full-scale prototype could be less than or equal to the scale of the TRL 8 full-scale actual system. At a minimum, the scale of the TRL 7 prototype must be sufficiently large to support subsequent testing of a TRL 8 full-scale actual system without the need for testing at an intervening scale.</td></tr>
</table>

3.3 Description of DOE Technology Readiness Levels

Source: U.S. Department of Energy, "Technology Readiness Assessment Guide". Office of Management. 2011.

Relative Level of Technology Development	TRL	TRL Definition	Description
System Operations	**9**	Actual system operated over the full range of expected mission conditions.	The technology is in its final form and operated under the full range of operating mission conditions. Examples include using the actual system with the full range of wastes in hot operations.
System Commissioning	**8**	Actual system completed and qualified through test and demonstration.	The technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental testing and evaluation of the system with actual waste in hot commissioning. Supporting information includes operational procedures that are virtually complete. An Operational Readiness Review (ORR) has been successfully completed prior to the start of hot testing.
	7	Full-scale, similar (prototypical) system demonstrated in relevant environment	This represents a major step up from TRL 6, requiring demonstration of an actual system prototype in a relevant environment. Examples include testing full-scale prototype in the field with a range of simulants in cold commissioning (1). Supporting information includes results from the full-scale testing and analysis of the differences between the test environment, and analysis of what the experimental results mean for the eventual operating system/environment. Final design is virtually complete.

continued on next page

Technology Demonstration	**6**	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing an engineering scale prototypical system with a range of simulants.(1) Supporting information includes results from the engineering scale testing and analysis of the differences between the engineering scale, prototypical system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. TRL 6 begins true engineering development of the technology as an operational system. The major difference between TRL 5 and 6 is the step up from laboratory scale to engineering scale and the determination of scaling factors that will enable design of the operating system. The prototype should be capable of performing all the functions that will be required of the operational system. The operating environment for the testing should closely represent the actual operating environment.
Technology Development	**5**	Laboratory scale, similar system validation in relevant environment	The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Examples include testing a high-fidelity, laboratory scale system in a simulated environment with a range of simulants (1) and actual waste (2). Supporting information includes results from the laboratory scale testing, analysis of the differences between the laboratory and eventual operating system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. The major difference between TRL 4 and 5 is the increase in the fidelity of the system and environment to the actual application. The system tested is almost prototypical.
Technology Development	**4**	Component and/or system validation in laboratory environment	The basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system. Examples include integration of ad hoc hardware in a laboratory and testing with a range of simulants and small scale tests on actual waste (2). Supporting information includes the results of the integrated experiments and estimates of how the experimental components and experimental test results differ from the expected system performance goals. TRL 4-6 represent the bridge from scientific research to engineering. TRL 4 is the first step in determining whether the individual components will work together as a system. The laboratory system will probably be a mix of on hand equipment and a few special purpose components that may require special handling, calibration, or alignment to get them to function.

continued on next page

Research to Prove Feasibility	**3**	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development (R&D) is initiated. This includes analytical studies and laboratory-scale studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative tested with simulants.(1) Supporting information includes results of laboratory tests performed to measure parameters of interest and comparison to analytical predictions for critical subsystems. At TRL 3 the work has moved beyond the paper phase to experimental work that verifies that the concept works as expected on simulants. Components of the technology are validated, but there is no attempt to integrate the components into a complete system. Modeling and simulation may be used to complement physical experiments.
Basic Technology Research	**2**	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are still limited to analytic studies. Supporting information includes publications or other references that outline the application being considered and that provide analysis to support the concept. The step up from TRL 1 to TRL 2 moves the ideas from pure to applied research. Most of the work is analytical or paper studies with the emphasis on understanding the science better. Experimental work is designed to corroborate the basic scientific observations made during TRL 1 work.
	1	Basic principles observed and reported	This is the lowest level of technology readiness. Scientific research begins to be translated into applied R&D. Examples might include paper studies of a technology's basic properties or experimental work that consists mainly of observations of the physical world. Supporting Information includes published research or other references that identify the principles that underlie the technology.

1 Simulants should match relevant chemical and physical properties.
2 Testing with as wide a range of actual waste as practicable and consistent with waste availability, safety, ALARA, cost and project risk is highly desirable.

3.4 NETL Systems Analysis Best Practices

NETL has developed Systems Analysis Best Practices (SABP) as an accompaniment to the DOE Technology Readiness Level (TRL) definitions. The SABP serve as a guide for the Principal Investigator/researcher to inform on the level of systems and economic analysis rigor appropriate at each TRL.

System and economic analyses are an essential component of research and development (R&D). They are used to determine appropriate experimental conditions, inform R&D targets

and technology maturation plans, assess R&D progress, and estimate the benefits of successful technology development in commercial applications.

Systems analysis is the analytic process used to evaluate the behavior and performance of processes, equipment, subsystems, and systems. Such analyses serve to characterize the relationships between independent (e.g., design parameters and configurations, material properties, etc.) and dependent variables (e.g., thermodynamic state points, output, etc.) through the creation of models representative of the envisioned process, equipment, subsystem, or system. These analyses are used to determine the important variables (i.e., performance attributes) and the associated targets (i.e., performance requirements) that must be achieved through R&D and testing to realize commercial and/or program goals.

The performance requirements are selected such that the equipment, subsystem, or system meets the envisioned objectives in the target commercial application. The target commercial application refers to one specific use for the advanced technology, at full commercial scale. A project may include more than one target commercial application. For example:

1. Technologies that reduce the cost of gasification may be useful for both liquid fuels and power production.
2. Technologies that may be useful to monitor CO_2 storage in more than one type of storage site.

The modeling and simulation effort may use one or more of a variety of tools, such as Excel, MATLAB, Aspen Plus, Aspen Plus Dynamics, Thermoflow, CHEMCAD, etc., depending upon suitability to the specific processes, the scope of the development effort, and the stage of development.

An integral part of systems analysis is economic analysis - the process of estimating and assigning costs to equipment, subsystems, and systems corresponding to models of and specifications for the commercial embodiment of the technology. Such analyses include the estimation of capital costs, as well as operating and maintenance costs. Component service life and corresponding replacement costs are often a crucial aspect of these analyses. See Performing a Techno-economic Analysis for Power Generation Plants, DOE/NETL-2015/1726, July 2015, for further guidance.

As a technology matures, the systems analyses are frequently updated, and are expected to increase in fidelity and complexity commensurate with the available technical understanding, experimental data, and overall level of effort (cost of R&D). The results are used to inform the next stage of development and provide specific experimental and analysis success criteria (the performance requirements).

As a general principle, the performance requirements that may be appropriately tested at a particular TRL must be substantially met, thereby supporting the feasibility of commercial

success/goal achievement, prior to proceeding to the subsequent TRL. Note that, as with the TRL descriptions, these SABP are "gate-in;" that is, prerequisites to achieving the associated TRL.

NETL supports a wide range of RD&D projects, from small, short-duration materials development and property characterization projects up to large-scale power plant demonstrations. The nature and complexity of the technology under development and the scope of the project must be taken into account when applying the SABP – they may not be strictly applicable as written to every project. For example, it is an unreasonable expectation for a project developing a sensor, or fuel cell cathode, or thermal boundary coating for a turbine airfoil to perform a full-scale power plant simulation to determine the performance requirements of the specific technology in the course of pursuing TRL 4. However, the project must explicitly tie the quantitative goals/objectives for the technology to referenced system studies as well as relevant industry and/or market requirements in such a manner that their pedigree is readily traceable. On the other hand, a project endeavoring to develop a full system concept incorporating novel components and process integration is expected to perform more robust, extensive analyses.

Descriptions of the SABP associated with each TRL are provided in the table below.

TRL	DOE Definition	Systems Analysis Best Practices
1	Basic principles observed and reported	Assessment: Perform an assessment of the core technology resulting in (qualitative) projected benefits of the technology, a summary of necessary R&D needed to develop it into the actual technology, and principles that support of the viability of the technology to achieve the projected benefits.
2	Technology concept and/or applications formulated	White Paper: A white paper describing the intended commercial application, the anticipated environment the actual technology will operate in, and the results from the initiation of a detailed analysis (that will at least qualitatively justify expenditure of resources versus the expected benefits and identify initial performance attributes).
3	Analytical and experimental critical function and/or characteristic proof of concept	Performance Model and Initial Cost Assessment: This performance model is a basic model of the technology concept, incorporating relevant process boundary conditions, that provides insight into critical performance attributes and serves to establish initial performance requirements. These may be empirically- or theoretically-based models represented in Excel or other suitable platforms. In addition, an initial assessment and determination of performance requirements related to cost is completed.

4	Component and/or system validation in laboratory environment	System Simulation and Economic Analysis: These models incorporate a performance model of the technology (may be a simple model as developed for TRL 3, or something more detailed – either should be validated against empirical data gathered in the laboratory) into a model of the intended commercial system (e.g., power plant). In addition, an economic analysis (e.g., cost-of- electricity) of the technology is performed, assessing the impact of capital costs, operating and maintenance costs, and life on the impact of the technology and its contributions to the viability of the overall system in a commercial environment. These analyses serve to assess the relative impact of known performance attributes (through sensitivity analyses) and refine performance requirements in the context of established higher-level technical and economic goals (e.g., programmatic or DOE R&D goals). These models are typically created in process simulation software (e.g., ASPEN Plus) or other suitable platforms. DOE maintains guidance on the execution of techno-economic analyses.
5	Laboratory scale, similar system* validation in relevant environment	System Simulation and Economic Analysis Refinement: A more detailed process model for the technology, validated against empirical data gathered in the laboratory, will be developed and incorporated into system simulations. This provides greater fidelity in the performance and cost estimation for the technology, facilitating updates to performance attributes and requirements (including updates to the economic analysis). This also allows greater evaluation of other process synergy claims (e.g., state-of-the-art technology is improved by the use of the new technology). Cost estimation should be either vendor-based or bottom-up costing approaches for novel equipment.
6	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	System Simulation and Economic Analysis Refinement: Performance and cost models are refined based upon relevant environment laboratory results, leading to updated performance attributes and requirements. Preliminary steady-state and dynamic (if appropriate for the technology) modeling of all critical process parameters (i.e., upper and lower operating limits) of the system prototype is completed. Cost estimation should be either vendor-based or bottom-up costing approaches for novel equipment. Key process equipment should be specified to the extent that allows for bottom-up estimating to support a feasibility study of the integrated system.
7	Full-scale, similar (prototypical) system demonstrated in relevant environment	System Simulation and Economic Analysis Refinement: Performance and cost models are refined based upon relevant environment and system prototype R&D results. The refined process, system and cost models are used to project updated system performance and cost to determine if the technology has the potential to meet the project goals. Performance attributes and requirements are updated as necessary. Steady-state and dynamic modeling all critical process parameters of the system prototype covering the anticipated full operation envelope (i.e., upper and lower operating limits) is completed. Cost models should be based on vendor quotes and traditional equipment estimates should be minimal.

8	Actual system completed and qualified through test and demonstration. Technology has been proven to work in its final form and under expected conditions.	System Simulation and Economic Analysis Validation: The technology/system process models are validated by operational data from the demonstration. Economic models are updated accordingly.
9	Actual operation of the technology in its final form, under the full range of conditions.	Commercial Use: Models are used for commercial scaling parameters.

APPENDIX J – BASIS FOR TECHNO-ECONOMIC ANALYSIS

The Techno-Economic Analysis (TEA) required as part of the final deliverables for projects awarded under DE-FOA-0003018 shall follow the analysis procedures documented in NETL's "*Quality Guidelines for Energy System Studies: Performing a Techno-Economic Analysis for Carbon Conversion Technologies*"[34] to the greatest extent possible. Adjustments to the guidelines can be made due to the nature of the carbon conversion technology being assessed, and all deviations/assumptions should be specifically detailed.

As specifically outlined in the document, the primary requirement for a TEA is a well-defined system concept. Results of a TEA will be increasingly informative with increasing technical design data. The objective of the technology must be clearly defined, with supporting references for design assumptions and target performance and/or cost metrics. Specific elements of a complete TEA include:

- General block flow diagram identifying all major process equipment for the carbon conversion technology and accompanying stream tables
- Material and energy balances around the complete process, including electric power requirements, heating and/or cooling requirements, etc.
- Complete stream tables showing operating pressures, temperatures, compositions, and enthalpies for all streams entering or leaving major process equipment
- System performance summary including relevant metrics, such as the CO_2 conversion efficiency, potential, and intensity.
- Economic analysis including capital cost estimation, operation and maintenance costs, and required purchase price; include list of equipment used to develop capital cost estimate including
    - Key parameters and their value for equipment costing (e.g. height, diameter, heat duty, delta temperature, power consumption, etc.)
    - Individual component cost (e.g. carbonation chamber, humidifiers, etc.)
- Emissions summary including metrics for CO_2 emissions and emissions reduction potential
- Market summary including metrics for product supply-demand and market value
- Commercialization plan
- Final summary report

For reference, the Quality Guidelines document includes additional pertinent information including, but not limited to:

[34] S. Hughes, S. Henry, M. Turner, A. Zoelle, N. Kuehn, M. Adams, A. Eggleston, M. Woods, & G. Hackett. Quality Guidelines for Energy System Studies: Performing a Techno-Economic Analysis for CO2 Conversion Technologies, DOE/NETL-2023/3870, National Energy Technology Laboratory, June 2023 (https://netl.doe.gov/energy-analysis/details?id=5dcaf750-0620-4dde-8dba-fa42b79e333b)

- Description of common missteps and omissions
- Guidance on system boundaries
- Example performance summary and cost tables

Sensitivity analysis identifying critical carbon conversion system processes, associated operating parameters, and their impact on overall conversion system performance (such as carbon conversion rates, capacity, and energy use efficiencies) and economics should be performed. The analysis shall be conducted to be representative of a commercial embodiment with performance assumptions informed by performance data generated during the enacted project.

From a performance perspective, in addition to the process values required in the State Point Data Table (provided in Appendix L of the FOA), the total amount of CO_2 converted per unit product and time shall be reported. From an economic perspective the required purchase price of CO_2 (RPP) shall be reported at a minimum. The RPP is the price at which the carbon conversion process can pay for CO_2 to remain competitive with state-of-the-art production methods based on product sale price, capital, and variable costs of production.

APPENDIX K – BASIS FOR LIFE CYCLE ANALYSIS

The LCA shall follow the analysis documented in the NETL report "Carbon Dioxide Utilization Life Cycle Analysis Guidance for the U.S. DOE Office of Fossil Energy and Carbon Management,"[35] known as the CO2U LCA Guidance Document, or simply, the guidance document. The guidance document is part of the NETL LCA CO2U Guidance Toolkit, which provides additional support for the creation of the required LCA. The guidance document outlines the analysis requirements and how to use the supporting data and tools.

As outlined in the guidance document, the goal of the LCA is to compare the life cycle GHG impact of the project, as part of a Proposed Product System, to a Comparison Product System to understand how the environmental impact of the technology life cycle compares to the life cycle of a system that produces the same products. The scope of environmental impacts should include all additional impact categories listed in Section 2.1.8.2 of the guidance document. To accomplish this, the environmental inventory will need to include data beyond greenhouse gas emissions, as discussed in Section 2.2.2.2 of the guidance document. The LCAs should also specify the version of the CO2U toolkit used for the analysis. To complete this comparison, the LCA may be modeled in one of three ways:

Option 1: open LCA (strongly recommended)

a. Modified NETL CO2U openLCA LCI Database with project LCA and sensitivity/uncertainty analysis
b. Completed NETL CO2U openLCA Results Contribution Tool
c. Completed NETL CO2U LCA Report Template

Option 2: PI spreadsheet model

a. Completed NETL CO2U LCA Documentation Spreadsheet and supporting materials used outside of the software (e.g., results interpretation spreadsheets)
b. Completed NETL CO2U LCA Report Template

Option 3: Third-party LCA software (not openLCA)

a. Submit LCA data via one of the two methods:
    i. Provide final LCA model database file and supporting materials used outside of the spreadsheet model (e.g., results interpretation spreadsheets) with NETL
    ii. If PIs do not want to provide the LCA model database for public release, submit completed NETL CO2U LCA Documentation Spreadsheet and supporting materials used outside of the software (e.g., results interpretation spreadsheets)

[35] T. J. Skone, M. Mutchek, M. Krynock, S. Moni, S. Rai, J. Chou, D. Carlson, M. Jamieson, E. Dale, G. Cooney, and A. Kumar, "Carbon Dioxide Utilization Life Cycle Analysis Guidance for the U.S. DOE Office of Fossil Energy and Carbon Management Version 2.0" National Energy Technology Laboratory, Pittsburgh, January 2022. (https://netl.doe.gov/energy-analysis/details?id=30f43c4f-2e95-4afa-8a0e-e49168ada191)

b. Completed NETL CO2U LCA Report Template

Support is provided for all three modeling options within the NETL CO2U Guidance Toolkit. All materials, including the guidance document can be accessed at www.netl.doe.gov/LCA/CO2U.

APPENDIX L – STATE POINT DATA TABLE (TA-1 ONLY)

The State Point Data Table on the subsequent page contains data fields that must be populated with data provided by the Applicant and included as an attachment for TA-1 Applications. The State Point Data Table must also be updated and submitted as a deliverable for TA-1 projects awarded under DE-FOA-0003018. The table format on the subsequent page is provided for the Applicant's convenience to ensure that all the requested elements are included. If the Applicant proposes a concept outside of the example described, they may selectively modify rows to include information of comparable detail and relevance to the elements in the table provided.

Applicants must provide current measured or estimated performance data, along with projected R&D targets. The data provided, unless indicated otherwise, must be at or near to the operating conditions being proposed for the CO_2 utilization technology being offered. However, measured data at different conditions are preferred over estimations. If selected for award, progress toward meeting the targets provided will become the basis for judging performance improvements over the course of the project. While not specifically requested in the tables, Applicants are required to provide measured/estimated data and projected/target performance data for other materials or equipment relevant to their process development effort within the technical volume.

It is understood that at the time that the application is submitted, the Applicant may not have achieved optimal performance for the materials, equipment, or processes to be developed and tested at bench or field scales. This is not considered a fatal flaw in any given application, as long as the concept is sufficiently well along the path of development and has demonstrated real potential.

Short narratives in bullet form must accompany the table and must describe the sources for the individual data provided. Such sources may include measurements made directly by the Applicant and should identify the apparatus and methodology used in the measurement(s). Other acceptable sources of data are open literature (with citation and description), or estimated or extrapolated data (with description of method/model used for the estimate, or the procedure used for extrapolation). Arguments supported by theory/mechanisms should be provided for projected performance for new, advanced catalysts or other materials, equipment, and processes.

Synthesis of Value-Added Organic Products

	Units	Measured/Current Performance	Projected/Target Performance
Synthesis Pathway Steps[1]			
Step 1 (based on CO_2)	mol^{-1}	Balanced chemical equation	
Step 2	mol^{-1}	Balanced chemical equation	
Step n	mol^{-1}	Balanced chemical equation	
Source of external intermediate 1		(e.g., natural gas, oil, renewable energy, etc)	
Source of external intermediate 2		(e.g., natural gas, oil, renewable energy, etc)	
Source of external intermediate n		(e.g., natural gas, oil, renewable energy, etc)	
Reaction Thermodynamics[2,3]			
Reaction[4]			
ΔH^o_{rxn}	KJ/mol	Calculated from standard enthalpies of formation	
ΔG^o_{rxn}	KJ/mol	Calculated from standard free energies of formation	
Conditions		(range)	(range)
CO_2 Source[5]			
Catalyst[6]			
Pressure	bar		
CO_2 Partial Pressure	bar		
Temperature	^oC		
Performance		(range)	(minimum)
Nominal Residence Time[7]	sec		
Selectivity to Desired Product[8]	%		
Product Composition[9]		(range)	(optimal)
Desired Product	mol%		
Desirable Co-Products	mol%		
" "	mol%		
Unwanted By-Products	mol%		
" "	mol%		
Grand Total	**mol%**	**--**	**100%**

Notes:

1 Balanced equations for each step in the synthesis pathway. Intermediates provided from external sources (e.g., ethane, methane, hydrogen, etc.) should be shown in **BOLD** type. Intermediates generated as part of the synthesis pathway should be in standard type.

2 *STP* – Standard Temperature and Pressure (25°C, 1 atm)

[3] If Standard Enthalpies and Gibbs Free Energies of Formation cannot be found for some chemical species in the proposed chemical reaction(s), they should be estimated; however, *the method used must be clearly referenced or described*.

[4] Identify the type reaction for example, thermochemical, electrochemical, photochemical, etc.

[5] Identify the CO_2 source for example, coal-fired flue gas, natural gas-fired flue gas, pure CO_2, etc.

[6] Identify the catalyst composition

[7] Reactor residence times are difficult to quantify, especially early in any laboratory-scale development effort. Definitions vary based on whether the reaction is being carried out in a batch or continuous reactor and whether a homogeneous, heterogeneous or no catalyst is being used. For the calculation of Nominal Residence Time, the applicant should use the following equations:

For experimental systems involving batch reactors:

{Nominal Residence Time} = {Length of Time Reactor is Operated}

For continuous reactors operated at steady state, employing a solid catalyst:

{Nominal Residence Time} = {Mass of Catalyst in Reactor} / {Total Mass Flowrate into Reactor}

For continuous reactors operated at steady state, employing a homogenous or no catalyst:

{Nominal Residence Time} = {Volume of Reactor} / {Total Volume Flowrate into Reactor}

[8] Selectivity to Desired Product is the fraction of the carbon in the Desired Product (see definition below) to the total amount of available carbon reacted, expressed as mole-percent.

[9] Applicant should define the primary product of interest. Normally, this is either the highest value or largest volume compound or material produced. Desirable co-products are any other reaction products of sufficient value that they would be profitable for the producer to recover, purify, transport and market. Whether to maximize or minimize production of these co-products is an economic decision. Unwanted by-products are produced from undesired side reactions, which may result from system upsets or may be an unavoidable consequence of the current state of technology development.