Notice of Intent No. DE-FOA-0003218

Notice of Intent to Issue
Funding Opportunity Announcement No. DE-FOA-0003219

The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) intends to issue a funding opportunity announcement (FOA) on behalf of the Industrial Efficiency and Decarbonization Office (IEDO), in support of IEDO's Energy- and Emissions-Intensive Industries (EEII) program. The solicitation will be titled "FY24 Energy- and Emissions-Intensive Industries FOA."

The industrial sector is considered one of the most difficult to decarbonize because of the diversity and complexity of energy inputs, processes, and operations.[1] Achieving net-zero emissions across the U.S. economy by 2050 will require an aggressive, multidimensional approach to eliminating industrial emissions. This FOA will advance the Biden Administration's goals to "deliver an equitable, clean energy future, and put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050"[2] to the benefit of all Americans.

To attain these goals, IEDO provides funding, management, and the strategic direction necessary for a balanced national program of research, development, and demonstration (RD&D), as well as technical assistance and workforce development, to drive transformative innovation in energy, materials, and production efficiency and to accelerate decarbonization across the industrial sector. IEDO's RD&D strategy focuses on two complementary approaches: tackling subsector-specific decarbonization challenges through the energy- and emissions-intensive industries and pursuing cross-sector challenges that are common across many industries.

This FOA will be focused on subsector-specific decarbonization approaches for the highest emitting and most challenging to address industrial subsectors. IEDO expects to provide additional funding opportunities that focus on cross-sector approaches for industrial decarbonization, specifically, DE-FOA-0003206 Fiscal Year 2024 Cross-Sector Technologies FOA (hence forth FY24 CST FOA).

IEDO is committed to pushing the frontiers of science and engineering; catalyzing clean energy jobs through research, development, demonstration, and deployment (RDD&D); and ensuring environmental justice and inclusion of underserved communities. In addition to consuming significant amounts of energy, resulting in greenhouse gas (GHG) emissions, many processes

[1] National Academies of Sciences, Engineering, and Medicine, *Accelerating Decarbonization in the United States Energy Sector*, February 2021, https://www.nap.edu/catalog/25932/accelerating-decarbonization-of-the-us-energy-system.

[2] Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021.

used in industrial facilities produce air pollutants with harmful impacts on respiratory and cardiovascular health, including nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM). In the United States, disadvantaged communities are disproportionately exposed to these types of emissions, resulting in social, economic, and health burdens beyond those of the general population. Addressing pollution from industrial energy use to remediate these burdens is an integral step toward achieving environmental justice.[3]

The EEII program within IEDO focuses on improving efficiency and decarbonizing industries with the largest energy use and GHG emissions (i.e., chemicals and refining, iron and steel, cement and concrete, forest and paper products, food and beverage, and other industries such as glass and aluminum). Together, these industries account for over 65% of the U.S. and global industrial manufacturing emissions, and products from these industries are inputs to other subsectors. Therefore, decarbonizing these industries will have both significant immediate impacts on manufacturing overall and far-reaching impacts on supply chains in many areas of the economy.

These "hard-to-abate" industries present very specific challenges spanning technology, market, economics, and supply chains. Reaching net-zero goals cost-effectively will require more than broad decarbonization tools (e.g., fuel switching, electrification, and carbon capture). Fully decarbonizing the U.S. industrial sector in a way that is environmentally sustainable and maintains our competitive edge will require technology solutions that are not yet commercially available or economically viable.

The EEII program takes an industry-specific approach to decarbonization while also leveraging knowledge and opportunities between industries. In addition, the program seeks to identify and develop emerging technologies with transformative potential for industrial decarbonization that are technically and economically advantageous. Technology development as part of this program involves partnerships between industry, universities, national laboratories, and federal agencies. IEDO's vision is to support U.S. industries as leaders in competitive low-carbon manufacturing, thereby gaining a broader position of global leadership in manufacturing. To this end, the United States must advance and adopt innovative low-energy and low-emitting technologies that have cost, performance, and resource efficiency advantages over traditional manufacturing.

This FOA will focus on applied R&D and pilot demonstration for the highest GHG-emitting subsectors, specifically: chemicals and fuels; iron and steel; food and beverage; building and infrastructure materials (including cement and concrete, asphalt pavements, and glass); and forest products. Technology approaches include achieving cost and emissions savings through

[3] DOE Office of Economic Impact and Diversity. "How Energy Justice, Presidential Initiatives, and Executive Orders Shape Equity at DOE." January 3, 2022. https://www.energy.gov/diversity/articles/how-energy-justice-presidential-initiatives-and-executive-orders-shape-equity.

increased circularity and sustainability across manufacturing to reduce waste and decrease the need for resource extraction. The FOA will fund research, development, and prototype or pilot-scale technology validation and demonstration activities that will accelerate the development and adoption of sustainable technologies that increase efficiency and eliminate industrial GHG emissions for the most energy- and emissions- intensive industrial subsectors. These activities will contribute to a clean and equitable energy economy, bolster the technological and economic competitiveness of domestic manufacturing, and boost the viability and competitiveness of U.S. industrial technology exports.

To accelerate the development of these emerging industrial decarbonization technologies, DOE created the Technologies for Industrial Emissions Reduction Development (TIEReD) Program. This program leverages resources across DOE applied research offices to invest in fundamental science, research, development, initial pilot-scale demonstrations projects, and technical assistance and workforce development. Rooted in the principles identified in the 2022 Industrial Decarbonization Roadmap, DOE is building an innovation pipeline to accelerate the development and adoption of industrial decarbonization technologies.[4] The TIEReD Program leverages resources, expertise, and investments from the DOE Offices of Energy Efficiency and Renewable Energy (EERE), Fossil Energy and Carbon Management (FECM), Nuclear Energy (NE), Advanced Research Projects Agency-Energy (ARPA-E), and the Office of Science (SC) to achieve deep decarbonization across the U.S. industrial sector. The program complements the demonstration and large-scale deployment efforts led by the DOE Offices of Clean Energy Demonstrations (OCED) and Manufacturing and Energy Supply Chains (MESC) and the Loan Programs Office (LPO).

In support of the TIEReD program, this FOA is anticipated to include a joint topic with the Hydrogen and Fuel Cell Technologies Office (HFTO) and the Office of Fossil Energy and Carbon Management (FECM) soliciting pre-Front-End Engineering and Design (pre-FEED) studies for the integration of clean hydrogen and carbon capture in the industrial sector. This topic will allow industry to explore opportunities to integrate transformational process technologies with carbon capture and hydrogen technologies, supporting the development of integrated, decarbonized industrial processes to enable net-zero industrial generation of products while understanding the impacts of these technologies on costs and emissions.

To support the industrial decarbonization approaches, DOE launched several Energy Earthshots™, including two supported by this FOA: the Clean Fuels and Products Shot™ and the Industrial Heat Shot™. The Clean Fuels and Products Shot is an initiative to reduce emissions from the fuels and chemicals industry through alternative sources of carbon. This initiative aims

[4] DOE, *Industrial Decarbonization Roadmap*, 2022, https://www.energy.gov/eere/doe-industrial-decarbonization-roadmap.

to lower GHG emissions at least 85% compared to fossil-based sources by 2035.[5] The Industrial Heat Shot™ is aimed at dramatically reducing the cost, energy use, and carbon emissions associated with industrial heat demand.[6] By reaching the targets of these Energy Earthshots™, the U.S. industrial sector will be on course to reduce its carbon-equivalent emissions by 650 million metric tons by 2050.[7]

This FOA will address a subset of these priorities, as described in the topics listed below. Topics 1 through 5 are anticipated to allow for multiple tiers of funding including initial laboratory validations to seed future work, a tier for research and development-only projects, and a tier for projects that include scope for technology demonstration for research and development-only projects and a tier for projects that include scope for technology demonstration integrated into industrial operations. Topics may allow applications between Technology Readiness Level (TRL) 2 and 7. Topic 6 is anticipated to support preliminary front-end engineering (Pre-FEED) projects.

Topic 1: Decarbonizing Chemicals and Fuels

The chemicals industry supports over 25% of the U.S. GDP and emits the most carbon of any U.S. manufacturing subsector. This topic is anticipated to focus on addressing challenges specific to chemical processes and related to improving energy and material efficiency, utilizing low-carbon energy sources, and advancing technologies that utilize sustainable chemical feedstocks. Potential areas of interest include advanced processes to enable conversion of sustainable feedstocks for high-volume energy- and emissions-intensive hydrocarbon chemicals and fuels, advanced processes for production of non-hydrocarbon products, and chemical value chain decarbonization through alternative chemical pathways for fuels and products.

Topic 2: Decarbonizing Iron and Steel

Steel is a vital material for many economic sectors, with uses in transportation, buildings, infrastructure, and industrial equipment. This topic is anticipated to focus on decarbonization opportunities in iron and steel production. Potential areas of interest include RD&D in alternative ironmaking, iron ore quality improvements including ore beneficiation, improving circularity through minimizing/removing elemental contamination, and low-carbon steelmaking technologies.

[5] DOE, Energy Earthshots – Clean Fuels and Products Shot Fact Sheet, May 2023, https://www.energy.gov/sites/default/files/2023-05/EERE-Earthshots_CleanFuels-Products-Factsheet-508-v3.pdf.
[6] DOE, Energy Earthshots – Industrial Heat Shot Fact Sheet, September 2022, https://www.energy.gov/sites/default/files/2022-09/earth-shot-industrial-heat-fact-sheet.pdf.

Topic 3: Decarbonizing Food and Beverage Products

The food and beverage industry employed 1.7 million workers to produce and ship nearly $900 billion of products in 2018, making this industry an important employment and economic driver. Potential areas of interest for this topic include innovations in food packaging, low-energy and low-carbon innovations in commercial foodservice, decarbonization of alternative protein production, energy recombination in food and beverage processing, and reduction of energy consumption and GHG emissions during post-harvesting activities.

Topic 4: Decarbonizing Cement and Concrete, Asphalt Pavements, and Glass

Glass, asphalt, cement, and concrete play an essential role in the U.S. economy and are used in buildings, roadways, infrastructure, and consumer products. Potential areas of interest include: low-carbon asphalt pavement materials; novel concrete binders and formulations; novel portland cement production processes; and glass decarbonization through alternative feedstocks, more tolerant formulation, and enhanced post-consumer recycling.

Topic 5: Decarbonizing Forest Products

The U.S. forest products industry is the third-largest energy consumer in the U.S. manufacturing sector and contributes 8% of total energy-related emissions from U.S. manufacturing. This topic is anticipated to focus on decarbonization opportunities. Potential areas of interest include novel dewatering or drying technologies and innovative fiber preparation, pulping, and chemical recovery processes.

Topic 6 Industrial Pre-FEED Studies

Net-zero carbon emissions by 2050 for the industrial sector will be achieved through implementing complementary and integrated approaches and technologies. It is anticipated that this topic, co-funded by FECM, HFTO, and IEDO, would include pre-Front-End Engineering and Design (pre-FEED) studies that support the development of decarbonized industrial processes using approaches that include pre-commercial technologies. Potential pre-FEED areas of interest could include: (a) integration of green hydrogen as a feedstock in chemicals, iron, and steel production; (b) carbon capture for select industrial sectors; and (c) integrated process and capture for chemical production, mineral processing, and iron and steel.

EERE envisions awarding multiple financial assistance awards in the form of cooperative agreements. The estimated period of performance for each award will be approximately one to three years.

Many of the topics and areas of interest covered in this anticipated FOA are similar in scope to those included in DE-FOA-0002997 (IEDO FY23 Multi-Topic FOA, henceforth “FY23 MT FOA”) and considered in the recently released notice of intent for FY24 CST FOA. Applicants who

responded to the FY23 MT FOA or who plan to respond to the FY24 CST FOA are strongly discouraged from resubmitting largely identical applications to those currently under review.

DOE is compiling a Teaming Partner List to facilitate the formation of new project teams for the FOA. All entities interested in participating as part of an applicant team can provide their contact information for the Teaming Partner List. The list allows organizations to express their interest and to explore potential partnerships.

- Updates to the Teaming Partner List will be available on the EERE eXCHANGE website. The Teaming Partner List will be regularly updated to reflect new teaming partners who have provided their organization's teaming partner information.
- SUBMISSION INSTRUCTIONS: Any organization that would like to be included on this list should submit information to the Teaming Partner List via the EERE eXCHANGE.
- DISCLAIMER: By submitting a request to be included on the Teaming Partner List, the requesting organization consents to the publication of the above-referenced information. By facilitating the Teaming Partner List, DOE is not endorsing, sponsoring, or otherwise evaluating the qualifications of the individuals and organizations that self-identify for placement on this Teaming Partner List. DOE will not pay for the provision of any information, nor will it compensate any applicants or requesting organizations for the development of such information.

This notice of intent is issued so that interested parties are aware of EERE's intention to issue this FOA in the near term. All the information contained in this notice is subject to change. EERE will not respond to questions concerning this notice. Once the FOA has been released, EERE will provide an avenue for potential applicants to submit questions.

EERE plans to issue the FOA in or about December 2023 via the EERE eXCHANGE website: https://eere-eXCHANGE.energy.gov/. If applicants wish to receive official notifications and information from EERE regarding this FOA, they should register in EERE eXCHANGE. When the FOA is released, applications will be accepted only through EERE eXCHANGE.

In anticipation of the FOA's release, applicants are advised to complete the steps explained below, which are required for application submission.

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

  To access EERE eXCHANGE, potential applicants will be required to have a Login.gov account. As part of the eXCHANGE registration process, new users are directed to create an account in Login.gov. Please note that the email address associated with Login.gov must match the email address associated with the eXCHANGE account. For more

information, refer to the Exchange Multi-Factor Authentication (MFA) Quick Guide in the Manuals section of eXCHANGE.

It is recommended that each organization or business unit, whether acting as part of a team or as a single entity, use only one account as the contact point for each submission. Questions related to the registration process and use of the EERE eXCHANGE website should be submitted to EERE-eXCHANGESupport@hq.doe.gov.

- Register with the System for Award Management (SAM) at https://www.sam.gov. Designating an electronic business point of contact (EBiz POC) and obtaining a special password, called an MPIN, are important steps in SAM registration. Please update your SAM registration annually. Upon registration, SAM will automatically assign a Unique Entity ID (UEI).

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

- Register in FedConnect at https://www.fedconnect.net. Creating an organization account requires the organization's SAM MPIN. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide: https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.
- Register in Grants.gov (http://www.grants.gov/) to receive automatic updates when amendments to an FOA are posted. However, please note that applications will not be accepted through Grants.gov. All applications must be submitted through EERE eXCHANGE.