

Notice of Intent No. DE-FOA-0003205

Notice of Intent to Issue Funding Opportunity Announcement No. DE-FOA-0003206

The Office of Energy Efficiency and Renewable Energy (EERE) intends to issue, on behalf of the Industrial Efficiency and Decarbonization Office (IEDO), a Funding Opportunity Announcement (FOA) entitled “IEDO Fiscal Year 2024 Cross-Sector Technologies FOA”.

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 improvements 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 in energy- and emissions-intensive industries and pursuing cross-sector challenges that are common across many industries.

This FOA will be focused on cross-sector decarbonization technologies and aims to address only part of the RD&D objectives that IEDO anticipates supporting in Fiscal Year 2024. IEDO expects additional funding opportunities to focus on transformational technologies to address subsector-specific challenges in energy- and emissions-intensive industries.

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”¹ to the benefit of all Americans. The U.S. Department of Energy (DOE) is committed to pushing the frontiers of science and engineering, catalyzing clean energy jobs through research, development, demonstration, and deployment (RDD&D), and ensuring environmental justice and inclusion of underserved communities.

In 2020, industry accounted for 33% of the nation’s primary energy use and 30% of energy-related carbon dioxide (CO₂) emissions.² In addition, 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, 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

¹ Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad,” January 27, 2021.

² U.S. Energy Information Administration, Annual Energy Outlook 2021 with Projections to 2050, 2021.

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>.

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The industrial sector is considered one of the most difficult to decarbonize due to the diversity and complexity of energy inputs, processes, and operations.⁴ Achieving net-zero emissions across the U.S. economy by 2050 will require an aggressive, multidimensional approach to eliminating industrial emissions. While some technologies are ready to deploy today, it's estimated that over 60% of emissions reductions needed in heavy industry currently cost more than \$50 per metric ton CO₂ to address.⁵ Additional RD&D can reduce these costs and unlock new pathways to reduce emissions.

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's 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.⁶ The TIEReD Program leverages resources, expertise, and investments from the Offices of Energy Efficiency and Renewable Energy (EERE), Fossil Energy and Carbon Management (FECM), Nuclear Energy (NE), ARPA-E, and Science (SC) to achieve deep decarbonization across the U.S. industrial sector. The program complements the demonstration and large-scale deployment efforts led by DOE's Offices of Clean Energy Demonstrations (OCED) and Manufacturing and Energy Supply Chains (MESCC) and the Loan Programs Office (LPO).

DOE's Industrial Decarbonization Roadmap identifies four cross-cutting pillars of decarbonization as a framework to reduce emissions in the industrial sector: energy efficiency; industrial electrification; low-carbon fuels, feedstocks, and energy sources (LCFFES); and carbon capture, utilization, and storage (CCUS). For each pillar, the roadmap identified the primary barriers and opportunities, as well as key RD&D needs. Key recommendations of the Roadmap include: advance early-stage RD&D and scale through demonstration; invest in multiple concurrent process strategies; address process and supply chain integration challenges for new technologies; conduct modeling and system analysis to ensure positive impact and commercial viability; decarbonize electricity sources to enable electrification pathways; and engage communities and develop a thriving workforce.

⁴ National Academies of Sciences, Engineering, and Medicine, Accelerating Decarbonization in the United States Energy Sector, February 2021. Available at: <https://www.nap.edu/catalog/25932/accelerating-decarbonization-of-the-us-energy-system>.

⁵ DOE. Pathway to Commercial Liftoff: Industrial Decarbonization, 2023, https://liftoff.energy.gov/wp-content/uploads/2023/10/LIFTOFF_DOE_Industrial-Decarbonization_v8.pdf.

⁶ DOE, Industrial Decarbonization Roadmap, 2022, <https://www.energy.gov/eere/industrial-decarbonization-roadmap>.

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The Industrial Decarbonization Roadmap also emphasizes the importance of addressing process heating efficiency and emissions across all sub-sectors. Industrial heat is responsible for 46% of all energy-related emissions in the manufacturing sector and is the largest single source of emissions. To address this opportunity, DOE launched the Industrial Heat Shot™, an Energy Earthshot™, aimed at dramatically reducing the cost, energy use, and carbon emissions associated with industrial heat demand.⁷ The Industrial Heat Shot™ seeks to develop cost-competitive solutions for industrial heat with at least 85% lower GHG emissions by 2035. If this target is achieved, the U.S. industrial sector will be on course to reduce its carbon equivalent emissions by 575 million metric tons by 2050, roughly equal to the annual emissions generated by all passenger cars currently on the road.

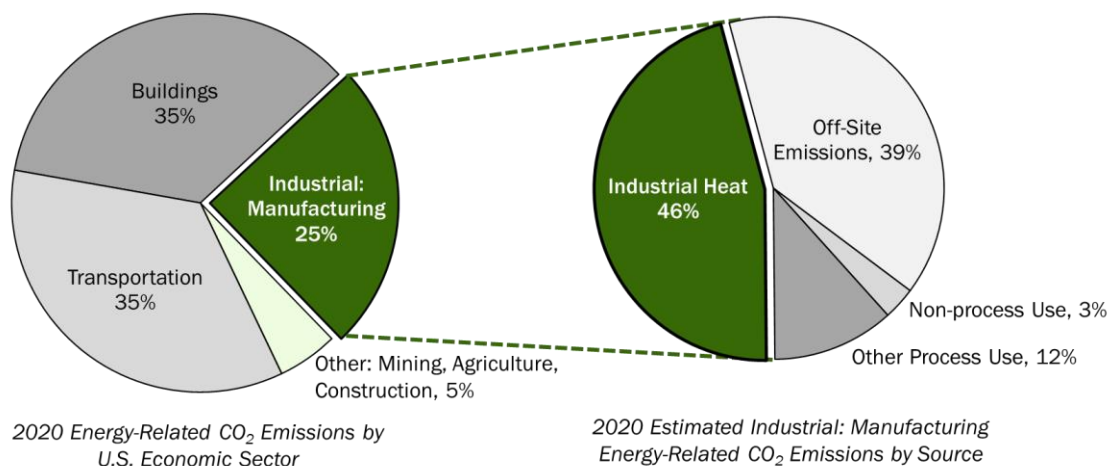


Figure 1. Estimated breakdown of U.S. energy-related emissions by sector and source, 2020.^{8,9}

This FOA will aim to advance the strategies identified in the Industrial Decarbonization Roadmap and support the goals of the Industrial Heat Shot™ through a focus on cross-sector approaches for industrial decarbonization. Cross-sector technologies are decarbonization-enabling components, equipment, and systems that underpin processes and products across the industrial sector. Key themes of IEDO’s strategy for cross-sector technologies include:

- Transforming electricity into useful industrial heat cost competitively and without putting undue stress on the grid;
- Developing combustion systems that enable fuel switching to hydrogen and other low-carbon fuels;
- Developing systems for the onsite production, storage, delivery, and recovery of energy;

⁷ DOE, Energy Earthshots – Industrial Heat Shot Fact Sheet, <https://www.energy.gov/sites/default/files/2022-09/earth-shot-industrial-heat-fact-sheet.pdf>.

⁸ EIA, Annual Energy Outlook 2021, 2022, https://www.eia.gov/outlooks/aeo/tables_side.php

⁹ DOE, Manufacturing Energy and Carbon Footprints, 2021, <https://www.energy.gov/eere/iedo/manufacturing-energy-and-carbon-footprints-2018-mecs>

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- Reducing barriers to the integration of low-carbon electricity with industrial loads;
- Improving the energy efficiency of industrial processes; and
- Reducing the energy used for industrial water and wastewater treatment.

This FOA will address a subset of these priorities, as described in the topics listed below. Topics 1 and 2 are anticipated to allow for multiple tiers of funding: a lower tier for research and development-only projects and a higher tier for projects that include scope for technology demonstration integrated into industrial operations. All topics are expected to allow applications between Technology Readiness Level (TRL) 3 and 7.

Topic 1: Electrification of Industrial Heat

Process heating, or thermal processing, is essential to the manufacture of a wide variety of industrial and consumer products, supplying the thermal energy needed to transform materials by drying, curing, melting, forming, sintering, calcining, and smelting. In 2018, process heating accounted for 31% of sectoral energy use and 51% of sectoral energy-related GHG emissions—trends that are mirrored across numerous manufacturing subsectors. This topic is anticipated to focus on high-impact opportunities in the development of equipment and components to decarbonize thermal processes across the industrial sector.

Topic 2: Next-Generation Energy Systems

Innovations in energy systems are needed at multiple levels to reduce the energy and emissions intensity of industrial operations. These innovations include both improvements to established, foundational technologies as well as development of totally new approaches to production. At the process level, new alternative process technologies are needed to reduce thermal demand and resulting emissions; plant-level energy use can be optimized through efficient management of materials and energy using integrated systems of advanced sensors, controls, data platforms, and efficient process equipment; and industrial facilities can contribute to energy systems outside the plant while simultaneously improving their own resiliency, emissions intensity, and operating economics by adopting technologies to enable more flexible operations. From this range of priorities, this topic is anticipated to focus on equipment for thermal management and for low thermal budget separations. Potential areas of interest include industrial heat exchangers and industrial membranes.

Topic 3: Decarbonizing Organic Wastewater and Wet Waste Treatment

The EPA estimates direct GHG emissions from water resource recovery facilities (WRRFs) at approximately 44 MMT CO₂e with additional indirect emissions from energy usage, sludge transportation, and associated methane releases from landfills. Agricultural organic wastes and wastewaters, which are significant contributors to agricultural GHG emissions, and food wastes, including both post-consumer wastes and

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wastes from food and beverage manufacturing, represent another set of energy recovery and GHG reduction opportunities. This topic is anticipated to focus on decarbonization of unit processes for treating wet organic waste from municipal, industrial, and agricultural sources, particularly those that have additional co-benefits such as nutrient recovery, energy neutrality, and cost minimization.

Some of the topics and areas of interest anticipated to be covered in this FOA are similar in scope to those included in DE-FOA-0002997 (Industrial Efficiency and Decarbonization Office (IEDO) FY23 Multi-Topic FOA, henceforth “FY23 MT FOA”). Full applications submitted to the FY23 MT FOA are currently under review. For the topic areas within this FOA with substantially similar areas of interest as the FY23 MT FOA, applicants who responded to the FY23 MT FOA are strongly discouraged from resubmitting similar applications to those currently under review.

EERE envisions awarding multiple financial assistance awards in the form of cooperative agreements. The estimated period of performance for each award will be approximately 24 to 36 months.

This Notice is issued so that interested parties are aware of the EERE’s intention to issue this FOA in the near term. All of 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 on or about November 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 being released, Applicants are advised to complete the following steps, 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](https://login.gov/) account. As part of the eXCHANGE registration process, new users are directed to create an account in [Login.gov](https://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.

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It is recommended that each organization or business unit, whether acting as a team or a single entity, use only one account as the contact point for each submission. 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: 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](#).

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

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