Notice of Intent No. DE-FOA-0003438

Notice of Intent to Issue
Notice of Funding Opportunity No. DE-FOA-0003439

The Office of Energy Efficiency and Renewable Energy (EERE) intends to issue, on behalf of the Hydrogen and Fuel Cell Technologies Office (HFTO), a Notice of Funding Opportunity (NOFO) entitled "Advanced Hydrogen and Fuel Cell Technologies to Drive National Decarbonization."

Clean hydrogen and fuel cell technologies are important elements of a comprehensive energy portfolio, particularly for use in hard-to-decarbonize sectors of the economy (such as heavy-duty transportation and industrial applications) and to enable long duration energy storage for a clean electric grid. Advancing clean hydrogen and fuel cell technologies directly supports the Biden-Harris Administration's goals of achieving carbon pollution-free electricity by 2035 and net-zero emissions economy-wide by no later than 2050, benefiting all Americans.[1]

This NOFO supports the vision outlined in the *U.S. National Clean Hydrogen Strategy and Roadmap*:[2] affordable clean hydrogen for a net-zero carbon future and a sustainable, resilient, and equitable economy. The NOFO will target research, development, and demonstration (RD&D) topics critical to scaling hydrogen infrastructure and enabling increased adoption of clean hydrogen across sectors, particularly in heavy-duty (HD) vehicles and other heavy-duty transportation applications, which supports the *U.S. National Blueprint for Transportation Decarbonization.*[3] Increased adoption of hydrogen technologies will help achieve economies of scale and drive down costs, directly supporting the Department of Energy's (DOE) Regional Clean Hydrogen Hubs (H2Hubs) Program,[4] an $8 billion federal investment to create networks of hydrogen producers, consumers, and local connective infrastructure to accelerate the use of hydrogen as a clean energy carrier and a carbon-free input to a number of chemical and industrial processes. Improvements in clean hydrogen technologies will also contribute to the long-term viability of the H2Hubs and other commercial-scale deployments. Activities funded under this NOFO will also align with the H2@Scale Initiative,[5] which aims to advance affordable hydrogen production, transport, storage, and utilization to enable decarbonization and revenue

[1] Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021
[2] U.S. Department of Energy, "DOE National Clean Hydrogen Strategy and Roadmap", https://www.hydrogen.energy.gov/library/roadmaps-vision/clean-hydrogen-strategy-roadmap
[3] "The U.S. National Blueprint for Transportation Decarbonization" https://www.energy.gov/eere/us-national-blueprint-transportation-decarbonization-joint-strategy-transform-transportation
[4] Regional Clean Hydrogen Hubs | Department of Energy
[5] https://www.energy.gov/eere/fuelcells/h2scale

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opportunities across multiple sectors. The NOFO's objectives support DOE's Hydrogen Shot goal,[6] which targets affordable clean hydrogen production at $1/kg within a decade.

Hydrogen and fuel cells can provide benefits and create opportunities for communities that have been historically underserved—such as improving air quality, providing resiliency, and creating jobs, including good-paying union jobs. Consistent with DOE's commitment to benefit all Americans, this anticipated NOFO will encourage the participation of underserved communities and underrepresented groups. Applicants will be encouraged to form meaningful and substantial partnerships with Minority Serving Institutions (e.g., Historically Black Colleges and Universities, Tribal Colleges and Universities, and Other Minority Institutions).

To support the goal of building a clean and equitable energy economy, projects funded under this NOFO will be expected to (1) advance diversity, equity, inclusion, and accessibility (DEIA); (2) contribute to the Justice40 Initiative[7] and other considerations linked with energy and/or environmental justice; and (3) invest in America's workforce. To ensure these objectives are met, applications must include an RDD&D Community Benefits Plan (CBP) that addresses the three objectives stated above.

It is anticipated that the NOFO may include the following areas of interest:

Topic 1: Photoelectrochemical Water Splitting Device Scale Up
This topic aligns with HFTO's priorities to pursue R&D for component integration and reactor concepts and complements HFTO's Bipartisan Infrastructure Law (BIL) Funding Opportunity Announcement by focusing on a production pathway other than electrolysis, which does not depend on the cost of electricity and has potential to meet the Hydrogen Shot goal. Specifically, Topic 1 seeks proposals to develop and demonstrate photoelectrochemical (PEC) water splitting devices using low-cost, scalable synthesis and fabrication techniques. Previously, PEC devices have been demonstrated to produce hydrogen from sunlight at benchtop and small demonstration scales. Typical materials for PEC devices, such as III-V light absorbers, have relied on low-throughput, high-cost fabrication steps that are not amenable to scaled-up manufacturing. This topic seeks to reduce the cost and advance the technology status of PEC devices through the use and development of commercially relevant, facile synthesis and fabrication techniques and innovative system designs.

[6] https://www.energy.gov/eere/fuelcells/hydrogen-shot

[7] 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 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). See https://www.whitehouse.gov/wp-content/uploads/2023/01/M-23-09_Signed_CEQ_CPO.pdf.

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The outcome of these projects will be final reactor demonstrations with device areas of at least 0.25 m^2 that operate over a two-week diurnal period at hydrogen production rates that are at least an order of magnitude higher than previous demonstrations. Projects will need to demonstrate a pathway to future scale up to over 1 m^2 device area with technoeconomic analysis showing projected at-scale manufacturing costs. Both planar and particle PEC systems will be considered, excluding any systems where hydrogen and oxygen are co-evolved. Projects should not primarily focus on materials discovery but should instead address challenges associated with scaling up existing PEC materials. Solar concentrators may also be included, but the area of the solar concentrator should not be included in the device area requirement. In addition, HFTO seeks system design perspectives and analyses to enable optimized, large-scale, and efficient systems for large volumes of hydrogen production using PEC approaches. Applicants coordinating with industry partners with manufacturing expertise in relevant materials spaces, such as the solar industry, are preferred.

Topic 2: High-Performance Materials for Hydrogen Service, Including Cryogenic and/or High-Pressure Conditions

This topic seeks proposals to develop advanced materials for use in hydrogen transportation and storage infrastructure applications, including high-pressure hydrogen storage tanks, cryogenic service conditions, and fiber reinforced polymer hydrogen pipelines. As the scale up of hydrogen production and end use progresses, it is important to establish the required hydrogen storage and delivery infrastructure at a complementary pace. Today, high-pressure hydrogen storage tanks for onboard vehicles use high-tensile-strength carbon fiber composites, and the costs of these tanks are high. Although there are over 1,600 miles of dedicated hydrogen pipelines in the United States, they are primarily steel-based and have both high installation and material costs. Alternative storage tank and pipeline materials that will enable lower manufacturing costs, improved performance and reliability, and the recovery and reuse of materials at end-of-life are key to advancing commercially viable storage and infrastructure technologies at scale.

This topic may include RD&D of storage-tank and pipeline materials, such as the continuous reinforcing fibers and resins necessary for tank and/or pipeline composite overwraps. Projects proposed under this topic will be required to develop and demonstrate lightweight, high-strength materials at low-cost with additional properties, including low hydrogen permeability and enhanced fatigue life. Materials that facilitate rapid manufacturing and reduced energy consumption would also be of value. Applicants may be required to demonstrate how their proposed material system outperforms that of the incumbent fiber and/or composite and liner material systems. This topic may also include a subtopic on materials compatibility and coordination with the H-Mat consortium.[8] Areas of interest could include better-performing,

[8] https://www.energy.gov/eere/fuelcells/h-mat-hydrogen-materials-consortium

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lower-cost advanced metal and polymer materials (e.g., for seals, hoses, and other infrastructure components) for use under cryogenic, high-temperature, and/or variable pressure conditions. Activities under this topic will also help to assess industry needs for material development, simulation, and final testing, including with pure hydrogen for critical components in the hydrogen manufacturing and distribution ecosystem.

Topic 3: Sustainable High-Temperature Proton Exchange Membranes and Ionomers for Heavy-Duty Transportation Applications

This topic aims to develop sustainable, non-perfluorosulfonic acid membrane and ionomer technologies suitable for high temperature (up to 120° C) operation in heavy-duty fuel cell applications. To address the potential concerns of environmental sustainability for state-of-the-art incumbent proton-exchange membrane (PEM) materials, as well as high-temperature performance for heavy-duty PEM fuel cells, this topic supports novel chemistries that could result in cost-competitive, scalable, and durable membranes that can reach performance targets and would contribute to meeting 2030 heavy-duty fuel cell system targets (25,000-hour lifetime and $80/kW fuel cell system cost). Membranes and ionomers are critical components with a large impact on the overall performance and durability of a fuel cell, especially under high-power conditions with high-temperature and low relative humidity.

Higher temperature fuel cell operation (up to 120 °C) can improve stack efficiency and power output and more effectively reject heat. However, operating at high temperature presents challenges for established materials, such as accelerated membrane degradation and reduced membrane proton conductivity and performance. This topic solicits innovative projects that will develop membranes and ionomers that can demonstrate the capability of reaching 25,000-hour durability with suppressed gas crossover while maintaining high fuel cell efficiency and performance. These membranes and ionomers will also need to effectively operate at temperatures up to 120 °C and low relative humidity (<30%). Projects should explore the relationships between operating conditions and membrane performance (conductivity and durability). Approaches that target fluorine-free ionomers and membranes are strongly encouraged. While membrane support materials are not the primary focus of the topic, approaches that also include the development of supporting e-PTFE (expanded polytetrafluoroethylene) alternatives are encouraged. This topic continues HFTO's emphasis on developing alternative membranes to enable meeting cost and durability targets across heavy-duty applications.

Topic 4: Domestic Hydrogen Fuel Cell Electric Motorcoach Bus Development and Demonstration

This topic seeks to enable the development and demonstration of domestically produced, long range hydrogen fuel cell electric motorcoach buses (i.e., over-the-road-bus, coach, or charter bus). Like previous HFTO-funded RD&D of hydrogen fuel cell forklifts, motorcoach buses offer a

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targeted, niche application for which there are limited zero-emissions options for full decarbonization of the market segment. Systems development, integration, and demonstration of such niche applications can help de-risk hydrogen and fuel cell technologies and offer opportunities to gather data to help guide future RD&D as well as catalyze system developers, component suppliers, and future domestic manufacturing.

The overall objective of this topic is to demonstrate an economical and scalable hydrogen fuel cell electric motorcoach bus that can meet incumbent motorcoach performance without compromising space or passenger comfort, including >300-mile driving range, >75-mph maximum speed, fueling rates <20 minutes, >50-passenger capacity, underneath cargo storage, and seating-space to provide the same passenger comfort and convenience provided by conventional motorcoaches produced today. As part of the proposal, the applicant should include performance metrics for a baseline reference motorcoach vehicle and fleet profile, as well as goals for the hydrogen fuel cell electric motorcoach bus they propose to develop. Once developed, each project will be required to demonstrate operation of a hydrogen fuel cell electric motorcoach bus in a real-world operational environment at a suitable location. Operation and performance validation is encouraged to be conducted at a site with potential for follow-on fleet applications. This topic also encourages activities that help validate fuel cell functionality and hydrogen-related infrastructure in different climates as well as rural conditions.

EERE envisions awarding multiple financial assistance awards in the form of cooperative agreements. The estimated period of performance for each award is anticipated to be 24 to 48 months.

This Notice is issued so that interested parties are aware of the EERE's intention to issue this NOFO 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 NOFO has been released, EERE will provide an avenue for potential Applicants to submit questions.

EERE plans to issue the NOFO on or about October 2024 via the EERE eXCHANGE website https://eere-eXCHANGE.energy.gov/. If Applicants wish to receive official notifications and information from EERE regarding this NOFO, they should register in EERE eXCHANGE. When the NOFO is released, applications will be accepted only through EERE eXCHANGE.

In anticipation of the NOFO 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 NOFOs that are currently in EERE

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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 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 NOFO 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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