DOE Hydrogen Program
Request for Information # DE-FOA-0002529

DATE: June 7, 2021

SUBJECT: Request for Information (RFI)

RESPONSES DUE: July 7, 2021 by 5:00 p.m. ET

Description:

This is a Request for Information (RFI) issued by the U.S. Department of Energy's (DOE) Hydrogen Program, which encompasses multiple offices within DOE, including the Energy Efficiency Renewable Energy (EERE), Fossil Energy (FE), Nuclear Energy (NE), Electricity (OE), and Science (SC). The intent of this RFI is to obtain public input in support of DOE's Hydrogen Energy Earthshot initiative to enable low cost, clean hydrogen at scale.

Hydrogen is the first in a series of Energy Earthshots launched by DOE to look beyond incremental advances and aim, instead, at the game-changing breakthroughs that will secure American leadership in enabling net-zero carbon technologies and support sustainable development around the world, to the benefit of all Americans.

The information being sought is intended to assist DOE's Hydrogen Program in further defining the scope and priorities of its initiatives to accelerate the production, storage, delivery, and end use of clean, affordable hydrogen in the United States. Specifically, this RFI seeks input on viable hydrogen demonstration and deployment projects that enable clean hydrogen production, infrastructure and end use to reduce emissions, create jobs, and enable a net-zero carbon emissions economy by 2050.

The RFI is being coordinated by DOE's Hydrogen and Fuel Cell Technologies Office (HFTO) across EERE, FE, NE, OE, and SC, and input will also be provided to other relevant offices within DOE, including the Loan Program Office, Office of Technology Transfer, Office of Indian Energy Policy and Programs, and Office of Economic Impact and Diversity. The information collected may be used for internal DOE planning and decision-making purposes across its research, development, demonstration, and deployment (RDD&D) portfolio, including but not limited to determining potential new areas of focus and innovations, challenges/gaps, funding opportunities, analyses, regional opportunities, the potential for sustainable careers, including consideration of diversity, equity, and inclusion, and other input. This is not a Funding Opportunity Announcement (FOA); DOE is not accepting applications.

Background:

DOE has been at the forefront of hydrogen RDD&D for decades to enable the commercial viability and adoption of hydrogen and related technologies including fuel cells, turbines, and various production, transport, and storage technologies. Hydrogen has the potential for use in diverse applications across multiple sectors, where it can provide substantial environmental and economic benefits, as well as improved energy security and resiliency. As a versatile energy carrier and chemical feedstock, hydrogen offers advantages that unite our nation's energy resources—renewables, nuclear, and fossil fuels with carbon capture and storage (CCS). It also enables innovations in energy production and end uses that can help decarbonize some of the most emissions-intensive sectors of our economy: transportation, electricity generation, and industrial applications, including chemicals production. Additional decarbonization opportunities exist for low-carbon hydrogen such as for combined heat and power (CHP) in building applications and through blending with natural gas.

The mission of the DOE Hydrogen Program is to research, develop, demonstrate, and validate transformational hydrogen and related technologies including fuel cells and turbines, and to address institutional and market barriers that will enable adoption across multiple applications and sectors. Development of hydrogen energy from diverse domestic resources will ensure that the United States has an abundant, reliable, and affordable supply of clean energy to maintain the nation's prosperity throughout the 21st century and beyond.

While cost challenges are being addressed through ongoing RD&D across hydrogen production, delivery, storage, and conversion technologies, additional efforts to address important crosscutting issues related to technology scale-up, manufacturing and supply chains, as well as hydrogen safety, codes and standards, are also key for achieving the economies of scale and widespread adoption envisioned in achieving hydrogen at scale. The scope also includes RD&D on hydrogen carriers such as ammonia that could be used to transport and store hydrogen or used as a fuel itself in certain applications. These and related activities within DOE are described in H2@Scale[1] – a DOE initiative that provides an overarching vision for enabling the large-scale production, delivery, storage and use of hydrogen across multiple sectors, to drive revenue opportunities, reduce costs, and reduce emissions.

The ultimate goal of H2@Scale is for clean hydrogen to be affordably produced and delivered for decarbonizing end uses utilizing several feedstocks, processing methods, and delivery options that are practical from an economic and logistical perspective for a given location and level of market demand. Large-scale, clean hydrogen production and co-location of end uses is one strategy to help drive cost reduction and enable the development of regional hydrogen infrastructure.

To better understand and develop the potential for hydrogen production, demand, and utilization in the United States, the Hydrogen Program conducts coordinated, comprehensive modeling and

[1] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Hydrogen and Fuel Cell Technologies Office. 2020. "H2@Scale," https://www.energy.gov/eere/fuelcells/h2-scale.

analysis efforts, which examine the options available, current and potential costs, energy efficiencies, environmental effects of these options, and tradeoffs between them. Results from these analyses have determined the availability of domestic resources for hydrogen production across the country. Figures 4 through 14 in the Hydrogen Program Plan[2] depict the locations and quantities of renewable and fossil energy resources throughout the United States, along with the locations of nuclear power plants and locations where hydrogen may be produced.

In addition to the Hydrogen Program's efforts, coalitions of stakeholders and industry partners are forming to address the opportunities provided by hydrogen. For example in 2020, a group of companies teamed together to develop an industry-led roadmap on the potential for hydrogen in the United States.[3] The roadmap report concludes that by 2030, the potential could be $140 billion in revenue and 700,000 jobs.[4] With appropriate policies and private sector scale up, the study projects that by 2050, the U.S. hydrogen economy could lead to an estimated $750 billion per year in revenue and a cumulative 3.4 million jobs, resulting in a 16% reduction in carbon dioxide emissions.[5]

Other analyses and projections continue to be made and industry is starting to invest in large-scale hydrogen projects in multiple regions. Examples include: hydrogen production, storage, and end use in turbines through the $1 billion Advanced Clean Energy Storage project in Utah; a 5 MW electrolyzer project planned in Washington State; first-of-a-kind nuclear-to-hydrogen projects in multiple states; a 20 MW electrolyzer plant to produce hydrogen from solar power in Florida; and the first GW-scale factory for electrolyzers announced in New York, with a 120 MW electrolyzer soon to be installed. Global plans, as documented by the Hydrogen Council, a group of over 100 companies, include over $70 billion in global government funding[6] and the potential for a 10-fold increase in hydrogen demand by 2050.[7]

As illustrated through the maps in the Hydrogen Program Plan,[8] there are extensive opportunities to produce hydrogen from diverse domestic resources, and both the Hydrogen Program and industry have identified opportunities for using that hydrogen across multiple applications and sectors. The Hydrogen Program is interested in hearing from stakeholders which of these areas

[2] U.S. Department of Energy. November 2020. "Department of Energy Hydrogen Program Plan." https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf
[3] U.S. hydrogenstudy.org. 2019. "Roadmap to a US Hydrogen Economy." www.ushydrogenstudy.org
[4] Ibid. at p. 7.
[5] Ibid.
[6] Hydrogen Council. February 2021. "Hydrogen Insights: A perspective on hydrogen investment, market development and cost competitiveness." Hydrogen-Insights-2021.pdf (hydrogencouncil.com)
[7] Hydrogen Council. November 2017. "Hydrogen Scaling Up: A sustainable pathway for the global energy transition." https://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf
[8] U.S. Department of Energy. November 2020. "Department of Energy Hydrogen Program Plan." https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf

would provide potential locations for ***near-term, large-scale, clean hydrogen demonstration projects***, where near-term refers to deployment in the next few years.

Purpose:

The purpose of this RFI is to solicit feedback from industry, investors, developers, academia, research laboratories, government agencies, and other stakeholders on potential hydrogen demonstration projects and their associated locations, including potentially ideal locations in the United States. Specifically, DOE is requesting input on the following categories:

- **Regional Hydrogen Production, Resources, and Infrastructure**
- **End Users for Hydrogen in the Region, Cost, and Value Proposition**
- **Greenhouse Gas and Pollutant Emissions Reduction Potential**
- **Diversity, Equity, Inclusion (DEI), Jobs, and Environmental Justice**
- **Science and Innovation Needs and Challenges**
- **Additional Information**

Regional Hydrogen Production, Resources, and Infrastructure

1. Please describe specific ideal regions to support a hydrogen demonstration project which have the necessary resources available for clean hydrogen production and infrastructure, including, but not limited to water, renewables, nuclear, natural gas (with CCS) or other energy resources captured from waste streams (e.g., landfill, flaregas, wastewater treatment).
    a. How much hydrogen could be produced (in tonnes per day and per year) and from what resources? State the amount of each resource available, including water as required.
    b. Is there any existing hydrogen infrastructure or infrastructure that could be repurposed as part of a hydrogen demonstration? State specific location if available.
    c. Is there large-scale hydrogen storage available such as geological storage, salt caverns, depleted oilfields, pipelines, or other appropriate options for hydrogen storage? If so, at what volumes?
    d. Are there existing hydrogen refueling stations or liquefaction plants in the region, or plans underway for such infrastructure? If so, at what scale?
    e. Describe any environmental or ecological impact, both positive and negative (e.g., are there any wetlands, NEPA issues, environmental justice communities, other considerations).
    f. Is the region a brownfield or greenfield site?
    g. What siting concerns, if any, need to be addressed? Would any mitigation plans be required (e.g., flood plain or other siting challenges such as hydrogen coupled with offshore wind)?

h. Are there carbon capture and sequestration facilities that may be utilized in the vicinity and what scale of hydrogen production and CO_2 storage could be achieved?
i. Are there any other considerations in the region for large-scale hydrogen production?
j. What are the demographics of the area immediately surrounding the site, including racial demographics and socio-economic characteristics?
k. What are the characteristics of the area immediately surrounding the site (e.g., residential, industrial, rural, urban)?

End Users for Hydrogen in the Region and Value Proposition

2. Please describe existing and potential future end users for the hydrogen in the region, such as industrial, transportation, chemicals manufacturing, heavy-duty trucks, and other end uses.
    a. Distinguish between existing and potential future end users and specify anticipated time frame.
    b. Specify the amount of hydrogen currently needed and potential future needs (tonnes per day and per year).
    c. Specify the proposed distribution network and geographical footprint required to reach end users.
    d. Are there any commitments already in place for off-takers or by when could there be commitments?
    e. If using existing transport infrastructure are there limitations to the amount of hydrogen that can be blended into these systems and/or will there be modifications to these systems necessary to carry hydrogen?

3. Please describe the business case, including the return on investment and timeframe.
    a. Include the costs for all stages of hydrogen use, including production, storage, delivery, infrastructure, and end use.
    b. What are the anticipated capital and operational costs?
    c. What local or regional policies or regulations, if available, would support the business case?
    d. Describe how the project is supported by or consistent with local or regional industrial cluster trends or initiatives.
    e. Describe, with specificity, anticipated economic opportunities for minority communities and/or underserved populations in the region.
    f. If already planned or available, describe financing mechanisms to be utilized or any other approaches.

4. What is the potential benefit to utilizing hydrogen to enable grid resiliency?
    a. Are there opportunities for hydrogen storage as backup power for the energy grid in case of power outages?

b. What are the challenges with storing and production of hydrogen from the project at scale to support grid resiliency?
c. Are there opportunities to utilize hydrogen power to ensure cybersecurity?

Greenhouse Gas (GHG) and Pollutant Emissions Reduction Potential

5. Please quantify the amount of emissions reduction anticipated and in what timeframe.
    a. What is the carbon dioxide emissions reduction potential (in tonnes per year) from cradle to plant gate and in what time frame?
    b. For complete pathway (production, delivery, storage, end use), specify total GHG reduction potential if available. Also, specify the boundary conditions for the life cycle emissions (upstream, within production plant gate, and downstream for end use).
    c. If there is potential for other emissions reduction (e.g., NOx, SOx, particulates), please specify anticipated amounts and in what time frame, as well as anticipated beneficiaries of the reductions.
    d. If there are caveats such as availability of CCUS facilities, please provide details.
    e. If there are offsets such as reforestation, renewable energy credits, etc. that may be provided as part of the project(s) in a region, please specify.

Diversity, Equity, Inclusion (DEI), Jobs, and Environmental Justice

6. Please describe any additional opportunities for DEI, as well as environmental justice and the potential to positively impact underserved communities.[9]
    a. Describe community stakeholder engagement opportunities.
    b. Describe opportunities to improve historically underserved communities.
    c. State whether the region is a considered a distressed community.[10] Would the project(s) be on tribal land?

[9] The term "underserved communities" refers to "populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life, as exemplified by the list of in the definition of "equity." Executive Order 13985, "Advancing Racial Equity and Support for Underserved Communities Through the Federal Government", 86 FR 7009 (Jan. 25, 2021). For purposes of this RFI, as applicable to geographic communities, applicants can refer to economically distressed communities identified by the Internal Revenue Service as Qualified Opportunity Zones; communities identified as disadvantaged or underserved communities by their respective States; communities identified on the Index of Deep Disadvantage referenced at https://news.umich.edu/new-index-ranks-americas-100-most-disadvantaged-communities/, and communities that otherwise meet the definition of "underserved communities" stated above.

[10] DOE defines "distressed communities" as "impoverished communities or areas that have a high unemployment rate, high mortgage foreclosure rates, and declining home prices." MDB Inc.. January 2020. "U.S. Department of Energy Public Engagement, Education, and Outreach Accomplishments Report: Making a Visible Difference in Environmentally Overburdened, Underserved, and Economically Distressed Communities (1994-2018)", at p. 3. https://www.energy.gov/sites/prod/files/2019/12/f69/DOE%20Making%20a%20Difference%20Report%20121119_508.pdf

d. Describe environmental and ecological impacts of land use, resources use, and disposal/emission/recycling of process waste and equipment at end of life.

7. Please specify the job opportunities in the region that would be available because of the proposed project(s).
    a. Indicate gross versus net jobs.
    b. Indicate the sustainability of the jobs.
    c. Indicate the number of jobs required for installation versus subsequent maintenance, manufacturing, or other ongoing service jobs in the region.
    d. Indicate any opportunity zones in the region, including tribal lands, Historically Black Colleges and Universities (HBCUs), or other minority serving institutions.[11]

8. In regard to environmental justice communities/neighborhoods that could make better use of minority serving institutions, or could benefit DEI/underrepresented groups (URG) through internships or training opportunities, please identify:
    a. Any challenges or barriers that need to be addressed.
    b. Any opportunities or innovations that could be implemented that are relevant to advancing hydrogen technologies in these communities/regions for positive impact.

Science and Innovation Needs and Challenges

9. Please provide input on any fundamental science, basic or applied research, and innovation needs and challenges that may be required for, or be informed by, the demonstration projects. In addition, please identify scientific user facilities or computational tools that would provide the required innovations or resolve the remaining challenges.[12]

10. Are there systems integration or prototyping facilities available or needed that could benefit the project and de-risk large-scale deployment? Please describe any testing facilities that could be used or are required.

Additional Information

[11] Minority Serving Institutions (MSIs), including HBCU and other minority institutions, are educational entities recognized by the Office of Civil Rights (OCR), U.S. Department of Education, and identified on the OCR's Department of Education U.S. accredited postsecondary minorities' institution list. See https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

[12] Computational: https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/ASCR; Light, Neutron, and Nanoscale Science facilities: https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/BES,

11. Please provide any other information that would be relevant to determining appropriate hydrogen demonstration projects and associated locations.

SUPPORTING DOCUMENTS:

Supporting documents for this RFI can be found on EERE Exchange at https://eere-Exchange.energy.gov/. Input is greatly desired from stakeholders across the hydrogen and fuel cell community and other relevant sectors. We anticipate that future RFIs will focus on more detailed research roadmaps for the HFTO.

DISCLAIMER AND IMPORTANT NOTES:

This RFI is not a FOA; therefore, DOE is not accepting applications at this time. DOE may or may not elect to issue a FOA in the future based on or related to the content and responses to this RFI. There is no guarantee that a FOA will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if DOE chooses to issue a FOA regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of DOE funded awards, will be subject to Congressional appropriations and direction.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. DOE will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. DOE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that DOE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind DOE to any further actions related to this topic.

PROPRIETARY INFORMATION:

Because information received in response to this RFI may be used to structure future programs and FOAs and/or otherwise be made available to the public, **respondents are strongly advised NOT to include any information in their responses that might be considered business sensitive, proprietary, or otherwise confidential.** If, however, a respondent chooses to submit business sensitive, proprietary, or otherwise confidential information, it must be clearly and conspicuously marked as such in the response.

Responses containing confidential, proprietary, or privileged information must be conspicuously marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The

U.S. Federal Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

If your response contains confidential, proprietary, or privileged information, you must include a cover sheet marked as follows identifying the specific pages containing confidential, proprietary, or privileged information:

> **Notice of Restriction on Disclosure and Use of Data:**
> Pages [*list applicable pages*] of this response may contain confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for the purposes described in this RFI #DE-FOA-0002529. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source.

In addition, (1) the header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: "Contains Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure" and (2) every line and paragraph containing proprietary, privileged, or trade secret information must be clearly marked with [[double brackets]] or highlighting.

EVALUATION AND ADMINISTRATION BY FEDERAL AND NON-FEDERAL PERSONNEL:

Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to the Office providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

REQUEST FOR INFORMATION:

Please respond with strategic and technical feedback to the new topics mentioned above in whichever format you find most appropriate.

REQUEST FOR INFORMATION RESPONSE GUIDELINES:

Responses to this RFI must be submitted electronically to HFTORFI@ee.doe.gov no later than **5:00 p.m. (ET) on July 7, 2021**. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25 MB be compressed (i.e., zipped) to ensure message delivery. Responses must be provided as a Microsoft Word (*.docx) or Adobe Acrobat (*.pdf) attachment to the email, 12-point font, 1-inch margins. Only electronic responses will be accepted.

DOE will not respond to individual submissions or publicly publish a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

DOE requests respondents provide the following information at the start of their response to this RFI:

- Company/institution name
- Company/institution contact
- Contact's address, phone number, and e-mail address.