Identifying Priorities for Reducing Barriers to Deployment of Hydrogen Infrastructure

(DE-FOA-0001948)

DATE POSTED: June 13, 2018

SUBJECT: Request for Information (RFI) DE-FOA-0001948

Description

The U.S. Department of Energy's (DOE), Office of Energy Efficiency and Renewable Energy, Fuel Cell Technologies Office (FCTO) is issuing this RFI on behalf of its Hydrogen and Fuel Cell Program (referred to herein as the "Program") which includes coordinated activities across all offices within DOE that are engaged in hydrogen and fuel cell activities. The Program seeks input on priority research and development (R&D) areas for reducing regulatory barriers to deployment of hydrogen technologies, with a particular focus on hydrogen infrastructure. In addition to a focus on transportation and streamlining private sector roll out of hydrogen fueling stations, the Program seeks input relating to large-scale hydrogen deployments for applications such as energy storage, grid services, hydrogen transport, natural gas blending or other end uses. As such, the RFI is aligned with Administration priorities for improving energy affordability and security, as well as resiliency and reliability of the nation's energy infrastructure. To ensure coordination across relevant organizations, this RFI included input from the Interagency Working Group on Hydrogen and Fuel Cell Technologies, which is authorized by the Energy Policy Act of 2005 and led by the FCTO within the DOE Office of Energy Efficiency and Renewable Energy.[1] In addition, input was included from subject experts in the Department of Transportation (DOT). The Interagency Working Group coordinates hydrogen and fuel cell technology related activities among Federal organizations.

Hydrogen is a unique energy carrier due to the diversity of its potential feedstocks, which include, but are not limited to, natural gas, coal, biomass, water, electricity, and sunlight. As a result, distributed hydrogen production can enhance energy security and electricity grid stability while also supporting many domestic industrial processes and transportation. Hydrogen is already an essential feedstock in the U.S. oil refining and ammonia production industries and is emerging in other applications, such as the chemical and food industries, transportation, ironmaking, and backup power. While much of this hydrogen is currently produced from natural gas, a rapidly growing alternative is to produce affordable hydrogen by splitting water (e.g. electrolysis or thermochemical cycles). Nuclear, fossil and renewable power generators can provide the necessary electricity and/or heat to drive the electrolysis process where hydrogen can be consumed in manufacturing of chemicals and fuels. In addition to producing hydrogen, electrolyzers have the potential to supply marketable "grid services" due to their ability to rapidly respond to fluctuations in

[1] The Hydrogen and Fuel Cell Program, which includes the DOE Fuel Cell Technologies Office as well as other offices within DOE, leads an Inter-Agency Working Group which consists of relevant Federal Agencies, including Department of Transportation and Environmental Protection Agency. *See* 42 U.S.C. §16155.

power supply. Hydrogen produced in this fashion can ultimately be distributed regionally or potentially nationwide for use in the diverse range of industries mentioned above. The Program is supporting research in a number of the areas described above through the H2@Scale concept.[2]

Background and Purpose

Under Executive Order 13771, "Reducing Regulations and Controlling Regulatory Costs," Executive Branch agencies such as DOE are directed to manage the costs associated with the imposition of expenditures required to comply with Federal regulations.[3] The DOE does not regulate the deployment of hydrogen technologies; however, the deployment of hydrogen technologies across a broad variety of sectors is inherently tied to regulation. The goals of this RFI, in the context of developing and using hydrogen as an energy carrier across sectors and for diverse applications, is to:

- Understand the effects of regulations imposed on industry, particularly the parts of industry responsible for hydrogen infrastructure;
- Identify Federal regulations, codes, and state/local laws and identify the related compliance costs; and
- Recommend actions to reduce the burdens of regulatory requirements.

The Program is responsible for coordination and collaboration with other Federal agencies consistent with the direction in EPACT 2005, Title VIII.[4] This responsibility has resulted in interagency research collaborations for various hydrogen and fuel cell technology analyses, research, and validation activities including evaluation and application of Federal, state and local regulations.[5]

Current Code Background

The National Fire Protection Association (NFPA) 2 Hydrogen Technologies Code, alongside the International Code Council (ICC), provides the requirements that govern most hydrogen installations in the United States. The decision to adopt this code is made on a jurisdiction basis (e.g., Orange County Fire Authority). This was enabled through a concerted effort between government and industry, starting in 2003, with DOE's rollout of a national code template in coordination with relevant code and standards organizations. The intent was to disseminate relevant information to enable the safe deployment of hydrogen technologies without overburdening the private sector with cumbersome or difficult-to-navigate and jurisdiction-specific compliance or approval processes. Per the NFPA, "a code is a model, a set of rules…it is not a law, but can be adopted into law."[6] The current edition of NFPA 2 was released in 2016 and was considered a major accomplishment that could contribute to jumpstarting a nascent

[2] More information on H2@Scale can be found at https://energy.gov/DOE/fuelcells/h2-scale
[3] Reducing Regulation and Controlling Regulatory Costs. Executive Order 13771 of January 30, 2017. https://www.whitehouse.gov/presidential-actions/presidential-executive-order-reducing-regulation- controlling-regulatory-costs/
[4] PUBLIC LAW 109–58—AUG. 8, 2005, Title VIII (42 USC §16155) Section 806 "HYDROGEN AND FUEL CELL TECHNICAL TASK FORCE." https://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf
[5] Hydrogen and Fuel Cells Interagency Working Group. https://hydrogen.gov/
[6] Reporter's Guide: About codes and standards. https://www.nfpa.org/News-and-Research/News-and-media/Press-Room/Reporters-Guide-to-Fire-and-NFPA/About-codes-and-standards

energy technology in the U.S as well as serve as a template for international deployments.[7]

The separation distances for bulk gaseous and bulk liquid hydrogen storage in NFPA 2 are a key limiting factor in the ability to site a hydrogen installation within a determined area.[8] An up-to-50% reduction in the required separation distances for bulk gaseous storage in NFPA 2 has been achieved in recent editions as a result of R&D activities within the Program and which has had a significant impact on the number of locations where hydrogen infrastructure may be sited. Another major limiting factor in the deployment of hydrogen technologies is the time required for development and approval of permits. For example, while the overall time to operational status for a hydrogen station installation in California has decreased over time, the time to approval segment of the process still has significant impact on the total time to deployment.[9] As hydrogen technologies are deployed in new regions with authorities having jurisdiction (AHJs) (e.g., fire officials, permitting officers, regional transportation authorities) who may be unfamiliar with the code requirements, it becomes increasingly necessary to identify a means to streamline the process of permitting these installations. The Program seeks feedback on potential means of reducing barriers to siting hydrogen installations in order to ease the burden on both industry and AHJs. This is solely a request for information and not a Funding Opportunity Announcement (FOA). DOE is not accepting applications.

Specific Areas of Interest

This RFI solicits feedback from industry, academia, research laboratories, government agencies, and other stakeholders on critical barriers to the deployment of hydrogen infrastructure. Previous feedback collected during reviews identified the need for updated codes and standards as one of the top six barriers to hydrogen infrastructure.[10] The goal of this RFI is to identify these barriers and potential courses-of-action to address them to reduce deployment time and cost in implementing hydrogen technologies and to support the rollout of large-scale applications. Deployment of hydrogen station regulatory compliance costs and time for regulatory processing have been shown to be substantial.[11] Courses-of-action may include areas such as: identifying gaps in existing regulations, codes and standards (RCS); streamlining regulatory, permitting, and certification processes; reducing unneeded compliance actions; or consolidating regulatory requirements.

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[7] NFPA 2 Hydrogen Technologies Code (2016). https://www.nfpa.org/codes-and-standards/all-codes-and- standards/list-of-codes-and-standards/detail?code=2

[8] Harris, A. P., Dedrick, D. E., LaFleur, C., & San Marchi, C. (2014, April). Safety, Codes and Standards for Hydrogen Installations: Hydrogen Fueling System Footprint Metric Development (SAND2014-3416). http://energy.sandia.gov/wp-content/gallery/uploads/SAND_2014-3416-SCS-Metrics-Development_distribution.pdf

[9] California Energy Commission and California Air Resources Board. (December 2015). Joint Agency Staff Report on Assembly Bill 8: Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California. (CEC-600-2015-016). http://www.energy.ca.gov/2015publications/CEC-600-2015-016/CEC-600-2015-016.pdf

[10] Cross-cutting Hydrogen station infrastructure review report. (June 2016). https://www.energy.gov/sites/prod/files/2016/07/f33/fcto_x-cutting_h2_stn_infrastr_review_report.pdf

[11] California Energy Commission and California Air Resources Board. (January 2017). Joint Agency Staff Report on Assembly Bill 8: 2016 Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California. (CEC-600-2017-002). http://www.energy.ca.gov/2017publications/CEC-600-2017-002/CEC-600-2017-002.pdf

Areas of interest are:

I. Infrastructure for Near-Term Transportation Applications
II. Large-scale Applications
III. Large-scale Hydrogen Delivery and Storage
IV. Grid Support
V. Other

The Program is interested in input on the topics described below and through responses to the following questions (as applicable). ***Note**: stakeholders should feel free to respond only to those topics relevant to their expertise; it is not necessary to respond to all topics.*

Please be sure to provide your company/organization and any relevant background regarding your interest and/or involvement in hydrogen technologies.

I. **Infrastructure for Near-Term Transportation Applications:** As current and near-term technologies are deployed (i.e., light duty vehicles, medium duty vehicles, heavy duty vehicles) and as hydrogen technologies are more widely adopted, existing issues within the codes and standards and permitting community begin to have a greater impact. The Program is interested in identifying barriers to implementation of hydrogen technologies and potential solutions to those barriers consistent with safe practices.
   a. Hydrogen Infrastructure Barriers: The intent of this topic area is to identify key barriers such as permitting hydrogen installations including siting hydrogen installations as well as the permitting process. A comprehensive summary of existing hydrogen codes and standards can be found in multiple DOE programmatic documents.[12,13] Detailed input on R&D needs in this area is requested. Specifically, the Program is interested in feedback on the following questions:
      i. In your involvement with the deployment of hydrogen installations, what have you seen as the greatest barriers preventing an efficient deployment schedule and cost, specifically as it pertains to the associated regulations, codes and standards?
      ii. What areas of the existing codes and standards do you see as limiting? Please be specific.
      iii. What are the greatest barriers to improving the process for developing, reviewing, and approving applications for hydrogen installations?
      iv. Who are the stakeholders (AHJs, regional organizations, others) you feel are key to the streamlining of the permitting process? Please provide a reason for your answer.

[12] Hydrogen Safety, Codes and Standards Multi-Year Research, Development, & Demonstration Plan (Revised June 2015). https://energy.gov/sites/prod/files/2015/06/f23/fcto_myrdd_safety_codes.pdf
[13] U.S. DRIVE Hydrogen Codes and Standards Technical Team Roadmap. (August 2017). Appendix B-2. https://energy.gov/sites/prod/files/2017/09/f36/2017%20CSTT%20Roadmap_FINAL.pdf

v. If a standard permit for hydrogen installations was developed, what are the key areas that you feel should be included in such a permit template? What are the implications this type of template would have for hydrogen installation developers, AHJs, regional proponents, etc.?
vi. What are the greatest barriers in existing regulations to deployment of hydrogen infrastructure?
vii. What R&D challenges (e.g. embrittlement, safety) must be addressed to adequately overcome or reduce regulatory barriers in the near term? In the long term?
viii. What do you see as the benefits of reducing barriers to deployment of hydrogen infrastructure? Please provide quantitative responses (e.g., reduced costs on resulting deployment projects, projected jobs, and economic growth).
ix. What are the priority R&D areas needed to amend/modify current RCS or develop new RCS for this area of application?
x. Are there specific areas (e.g., safety R&D, lessons learned, best practices) that would be appropriate for federal agencies and their national labs? Would your organization be willing to share relevant information/data for these types of resources if compiled with no attribution?

b. Related Regulatory Needs:
   i. Do you feel there is Federal action needed to remove barriers to infrastructure deployment? If so, be specific.
   ii. What regulatory barriers can industry address on their own? What actions to address regulatory barriers do you see as the responsibility of federal agencies? For non-regulatory agencies, what supporting activities do you see as the role of those agencies and their national labs? Be specific.
   iii. What opportunities do you see for collaboration between Federal agencies, states, industry, research organizations, or other stakeholders to work together to overcome these barriers?

II. **Large-scale Applications:** To realize widespread, nationwide hydrogen use, new challenges in terms of meeting regulatory and permit requirements are expected to lead to needed revisions in terms of codes and standards and safety. One such example is in the area of large-scale hydrogen storage i.e. greater than 1,000 kilograms stored or used per day: these large-scale needs are frequently beyond the scope of existing codes and would likely necessitate new courses-of-action prior to their deployment. The Program requests input on barriers relating to the implementation of the applications such as heavy-duty vehicles, marine or rail power, and information processing centers, including but not limited to the needs relating to large-scale storage. Specifically, the Program is interested in feedback on the

following questions:

i. What large-scale applications do you see as being limited by the existing codes and standards and in what time frame?
ii. What do you see as the greatest barrier(s) to the implementation of large-scale applications concept, specifically in terms of codes and standards, permitting, and safety needs? What are the greatest barriers in existing regulations?
iii. How could the permitting process for large-scale applications be streamlined?
iv. What changes to existing codes and standards are essential for large-scale application implementation (consistent with safe practices)?
v. What are the priority R&D areas needed to amend current RCS or develop new RCS for this area of application?
vi. What other courses-of-action such as model analysis, technology R&D, etc. are needed to overcome barriers to large-scale applications?
vii. What do you see as the benefits of reducing barriers to deployment of hydrogen infrastructure for large-scale applications? Please provide quantitative responses (e.g., reduced costs on resulting deployment projects, projected jobs, and economic growth).
viii. Do you feel there is Federal action needed to remove barriers to infrastructure deployment? If so, be specific.
ix. What regulatory barriers can industry address on their own? What actions to address regulatory barriers do you see as the responsibility of federal agencies? For non-regulatory agencies, what supporting activities do you see as the role of those agencies and their national labs? Be specific.
x. Are there specific areas (e.g., safety R&D, lessons learned, best practices) that would be appropriate for federal agencies and their national labs? Would your organization be willing to share relevant information or data for these types of resources if compiled with no attribution?
xi. What opportunities do you see for collaboration between Federal agencies, states, industry, research organizations, or other stakeholders to work together to overcome these barriers?

III. **Large-scale Hydrogen Delivery and Storage:** Large-scale hydrogen usage inherently leads to unique needs in terms of codes and standards, permitting, and safety. One such example is the area of large-scale hydrogen storage and delivery: these needs are frequently beyond the scope of existing codes and would likely necessitate R&D prior to their deployment. The Program requests input on barriers relating to the implementation of the large-scale hydrogen applications, including but not limited to the needs relating to bulk storage and delivery.

a. Pipelines: Gaseous hydrogen can be transported through pipelines much the way natural gas is today. Approximately 1,600 miles of hydrogen pipelines are currently operating in the United States. Owned by merchant hydrogen producers, these pipelines are located where large hydrogen users, such as petroleum refineries and chemical plants, are concentrated such as the Gulf Coast region.
    i. What are the regulatory processes that could be streamlined (consistent with safe practices) to reduce deployment time and costs for laying hydrogen pipeline and commissioning operations? For long distance lines? For local distribution lines? What are the greatest barriers in existing regulations?
    ii. What R&D challenges (e.g., embrittlement, safety) must be addressed to adequately overcome or reduce regulatory barriers in the near term? In the long term?
    iii. Are there specific areas (e.g., safety R&D, lessons learned, best practices) that would be appropriate for federal agencies and their national labs? Would your organization be willing to share relevant information or data for these types of resources if compiled with no attribution?
    iv. What do you see as the greatest barrier(s) to deployment of hydrogen pipeline infrastructure? Please provide quantitative responses (e.g., reduced costs on resulting deployment projects, projected jobs, and economic growth).
b. Hydrogen tanker trucks: Vessel shipments of hydrogen are conducted via tube trailers and liquid tankers. Tube trailers with pressures of 250 bar (3,626 psi) and up to 800-kg capacity are commonly used to distribute gaseous hydrogen within 320 km (200 miles) of the source.
    i. What are the regulatory and code permitting processes (consistent with safe practices) that could be streamlined to reduce deployment time and costs for transporting bulk hydrogen via highway road vehicles? What are the greatest barriers in existing regulations?
    ii. What R&D challenges (e.g., embrittlement, safety) must be addressed to adequately overcome or reduce regulatory barriers in the near term? In the long term?
    iii. Are there specific areas (e.g., safety R&D, lessons learned, best practices) that would be appropriate for federal agencies and their national labs? Would your organization be willing to share relevant information or data for these types of resources if compiled with no attribution?
    iv. What do you see as the greatest barrier(s) to deployment of hydrogen tanker trucks? Please provide quantitative responses (e.g., reduced costs, projected jobs, economic growth).
c. Additionally, the Program is interested in feedback on the following questions relating to large-scale storage:

i. What do you see as the greatest barrier(s) to the implementation of large-scale storage specifically in terms of codes and standards or permitting needs? What are the greatest barriers in existing regulations?
ii. What R&D challenges (e.g., embrittlement, safety) must be addressed to adequately overcome or reduce regulatory barriers in the near term? In the long term?
iii. Are there specific areas (e.g., safety R&D, lessons learned, best practices) that would be appropriate for federal agencies and their national labs? Would your organization be willing to share relevant information/data for these types of resources if compiled with no attribution?
iv. What changes to existing codes and standards do you see as essential to the deployment of large-scale hydrogen storage and delivery?
v. How could the permitting process for large-scale storage be streamlined?
vi. What are the primary R&D needs to overcome barriers to large-scale hydrogen storage?
vii. What are the priority R&D areas needed to amend current RCS or develop new RCS for this area of application?
viii. Do you feel there is Federal action needed to remove barriers to infrastructure deployment? If so, be specific.
ix. What regulatory barriers can industry address on their own? What actions to address regulatory barriers do you see as the responsibility of federal agencies? For non-regulatory agencies, what supporting activities do you see as the role of those agencies and their national labs? Be specific.
x. What opportunities do you see for collaboration between Federal agencies, states, industry, research organizations, or other stakeholders to work together to overcome these barriers?

IV. **Grid Support:** Hydrogen can be produced via water electrolysis or other hydrogen production methods for electric power grid support providing storage and/or ancillary services to grid operators (e.g., by supplying regulation - frequency control - and ramping services). By converting surplus power generation into hydrogen for later reconversion to electric power, this type of grid support is particularly useful for variable power generation characteristics associated with renewables such as wind and solar power. In particular, the Program is seeking feedback on the following questions:

i. What do you see as the greatest barrier(s) to the implementation of hydrogen use for grid support, specifically in terms of codes and standards or permitting needs?
ii. What changes to current codes and standards do you see as essential to the

deployment of hydrogen for grid support? Please give specific examples.

iii. How could the permitting process for these types of applications be streamlined?

iv. What are the primary R&D needs to overcome barriers to deployment of hydrogen for grid support?

v. Do you feel there is Federal action needed to remove barriers to infrastructure deployment? If so, be specific.

vi. What regulatory barriers can industry address on their own? What regulatory barriers do you see as the responsibility of DOE, national labs, other agencies? Be specific.

vii. What opportunities do you see for collaboration between Federal agencies, states, industry, research organizations, or other stakeholders to work together to overcome these barriers?

viii. Are there specific areas (e.g., safety R&D, lessons learned, best practices) that would be appropriate for federal agencies and their national labs? Would your organization be willing to share relevant information/data for these types of resources if compiled with no attribution?

V. **Other:**

i. DOE has authority to run prize competitions whereby DOE can issue innovation inducement prizes to incentivize stakeholders in key topic areas. Please comment on topics related to the issues within this RFI that could be considered for future prizes.

ii. Are there any additional comments you would like to make relating to the topics addressed above, or topics you feel were not addressed?

Disclaimer and Important Notes

This RFI is not a Funding Opportunity Announcement (FOA); therefore, DOE is not accepting applications at this time. DOE may issue a FOA in the future based on or related to the content and responses to this RFI; however, DOE may also elect not to issue a FOA. 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 to NOT 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-0001948]. 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 DOE 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 Response Guidelines

Responses to this RFI must be submitted electronically to FY18FCTOBARRIERSRFI@EE.DOE.GOV no later than 5:00pm (ET) on August 10, 2018. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. Responses must be provided as a Microsoft Word (.docx) attachment to the email, and 12 point font, 1 inch margins. Only electronic responses will be accepted.

Please identify your answers by responding to specific questions and/or topics listed, as applicable. Respondents may answer as many or as few questions as they wish.

Please include the category that best describes your company/organization, for instance:

- Hydrogen station developer
- Original equipment manufacturer (OEM) for hydrogen station equipment
- Engineering/construction company with experience in hydrogen infrastructure installation
- Financial investor
- Utility or power generation company
- National laboratory
- Academia
- State or local government
- Trade association
- Codes and standards body
- Owner of personal FCEV
- Owner of FCEV fleet
- Other (please specify)

DOE will not respond to individual submissions or publish publicly 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.

Respondents are requested to 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.

On behalf of the DOE FCTO, thank you in advance for providing your input on this important topic and contributing to DOE FCTO's success in achieving its programmatic objectives