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Hydrogen and Fuel Cell Technologies Office
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585–0121

RE: AGA's Comments on Hydrogen and Fuel Cell Technologies Office Research and Development Strategy Request for Information, DE–FOA–0002379, 85 Fed. Reg. 48682 (Aug. 12, 2020)

Hydrogen and Fuel Cell Technologies Office:

The American Gas Association ("AGA") appreciates the opportunity to comment on the U.S. Department of Energy's ("DOE") Request for Information ("RFI") number DE–FOA–0002379[1] regarding the Hydrogen and Fuel Cell Technologies Office ("HFTO") Research and Development Strategy. HFTO issued the RFI to obtain public input on its efforts to accelerate research, development, demonstration, commercialization, and adoption of hydrogen and fuel cell technologies. As discussed in these comments, AGA believes that America's gas pipeline network can and should be leveraged to enable hydrogen energy delivery to all customers, including distribution customers. Furthermore, it is important for federal agencies, stakeholders, and funding priorities to adapt to changing needs of the market, and evolve as technological innovation makes new things possible.

I. Introduction

The American Gas Association, founded in 1918, represents more than 200 local energy companies that deliver clean natural gas throughout the United States. There are more than 75 million residential, commercial and industrial natural gas customers in the U.S., of which 95 percent — more than 71 million customers — receive their gas from AGA members. Today, natural gas meets more than 30 percent of the United States' energy needs, all enabled by a pipeline delivery network that stretches more than 2.5 million miles across the U.S. It was this infrastructure that enabled the accessibility of shale gas to customers across the country and ushered in the historic era of energy abundance and affordability which we still enjoy today. As gas utilities look to the future, reimagining pipeline infrastructure for deliveries of energy sources beyond geologic natural gas, is just one of the many steps AGA members are taking to promote

[1] *Hydrogen and Fuel Cell Technologies Office Research and Development Strategy Request for Information*, 85 Fed. Reg. 48682 (Aug 12, 2020). *See also*, https://eere-exchange.energy.gov/.

sustainability, reduce emissions, and maintain commitments to deliver safe, affordable, reliable energy.

AGA is committed to reducing greenhouse gas emissions through smart innovation, new and modernized infrastructure, and advanced technologies that maintain reliable, resilient, and affordable energy service choices for consumers. As part of this effort, gas utilities recognize the integral role that hydrogen can play in reducing the carbon footprint of their operations and their customers.[2] AGA strongly supports the role of DOE's HFTO in expanding hydrogen research to accelerate widespread applicability and adoption of this clean energy source. Many AGA members have already begun demonstrating their commitment to integrating hydrogen into their existing gas networks. For example, AGA members have:

- Initiated hydrogen production pilot programs,[3]
- Researched hydrogen blending,[4] and
- Researched the impact of hydrogen on end use appliances.[5]

As DOE aptly recognizes in its RFI, the "***Development of an affordable and reliable hydrogen infrastructure to fuel all these applications is increasingly critical.***" AGA, through the comments and suggestions offered below, elaborates on this observation, and emphasizes why a cohesive approach to research and development of the hydrogen value chain is critical. Failure to adequately research and address any one point in the hydrogen value chain, could indefinitely delay widescale hydrogen technology adoption, creating potentially insurmountable cost barriers, and relegating hydrogen energy usage to limited economic sectors.

Technological innovation in hydrogen is progressing at a rapid pace and leading to expanded market interest worldwide. Efforts to include hydrogen as an element of decarbonization strategies are already underway throughout Europe and in parts of Asia.[6] The United States, with its plentiful natural gas reserves and growing deployments of renewable electricity, is well positioned to

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[2] *See* "Utility executives plot renewable hydrogen's future in US decarbonization," S&P Global, August 25, 2020, available at https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/utility-executives-plot-renewable-hydrogen-s-future-in-us-decarbonization-60070401.

[3] *See* History of Hawaii Gas' Hydrogen Activities, available at https://www.hawaiigas.com/clean-energy/hydrogen/; Southern California Gas, "Power-To-Gas Technology," available at https://www.socalgas.com/smart-energy/renewable-gas/power-to-gas.

[4] *See*, PG&E Gas R&D and Innovation Whitepaper Pipeline Hydrogen, available at https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/interconnection-renewables/interconnections-renewables/Whitepaper_PipelineHydrogen.pdf; Southern California Gas 2019 Annual Report Research, Development and Demonstration Program, available at https://www.socalgas.com/sites/default/files/2020-04/2019%20SoCalGas%20RDD%20Annual%20Report.pdf.

[5] *Id*.

[6] *See, e.g.*, "South Korea pushes energy transition dream with liquid hydrogen plant plan" S&P Global, May 5, 2020, available at https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/050520-south-korea-pushes-energy-transition-dream-with-liquid-hydrogen-plant-plan; France's Hydrogen Plan: "making our country a world leader in this technology," available at https://www.gouvernement.fr/en/hydrogen-plan-making-our-country-a-world-leader-in-this-technology-0.

become a major supplier of low to zero-carbon hydrogen.[7] AGA supports the expanding of HFTO's strategic focus and funding initiatives to better align with the technology and research needs of this growing domestic and global market, which includes production, delivery, and end-use.

AGA supports DOE's efforts to collect information related to advancing the development of hydrogen and hydrogen technologies, and we believe this RFI is a step in the right direction. AGA further encourages DOE and the HFTO to expand its commitment to hydrogen, strengthening its cross-departmental coordination, and embracing a commitment to leveraging current and future energy systems and technologies in the transition to hydrogen energy. To that end, AGA recommends that DOE expand its hydrogen scope and priorities to include leveraging and enabling today's gas pipeline infrastructure to support a hydrogen delivery system of tomorrow.

II. HFTO's Priorities Should Include Enabling the Existing Gas System to Deliver Hydrogen

AGA believes that infrastructure matters should become a more pronounced focus of the HFTO's efforts. AGA strongly encourages HFTO to specifically focus its efforts on the hydrogen delivery network, *i.e.*, transporting hydrogen from points of production to points of consumption, through pipeline infrastructure. AGA recognizes that some recent focus has been directed to these issues, as evidenced by the H2@Scale 2020 Cooperative Research and Development Agreement (CRADA) Call,[8] however we believe more funding and research initiatives are warranted.

While much attention has been directed to hydrogen production technologies and hydrogen applications, less focus has been directed toward safe, cost efficient and more universal distribution of hydrogen for end-use consumption. Sustainable transportation has been a clear focus of HFTO's research and priorities, however as commitments to reduce carbon emissions and expand renewable energy continue, interest in hydrogen's applicability beyond the transportation sector has grown exponentially. AGA recognizes HFTO's acknowledgment of this evolution, and applauds DOE and HFTO for seeking to revisit and adapt its strategic focus and research priorities through this RFI to better align with the changing needs of energy and consumer markets.

AGA believes that to fully enable a widespread hydrogen market, DOE and HFTO should be explicit in its intent to direct funding toward enabling existing gas pipeline infrastructure to deliver hydrogen to the numerous end-use markets also being researched and funded through HFTO. Without reliable, affordable, and safe hydrogen delivery networks, the true market potential for hydrogen will never be fully realized. It should therefore be a central tenant for HFTO that existing gas infrastructure is an essential enabling component of the future hydrogen economy. This acknowledgement is not sufficiently represented in the RFI, but it must become a significant part of DOE's consideration and approach to a hydrogen economy.

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[7] *See* Hydrogen Strategy Enabling a Low-Carbon Economy, Office of Fossil Energy U.S. Department of Energy (July 2020), at pp. 4 and 15, available at https://www.energy.gov/sites/prod/files/2020/07/f76/USDOE_FE_Hydrogen_Strategy_July2020.pdf. *See also*, https://afdc.energy.gov/fuels/hydrogen_benefits.html.

[8] *See* https://www.nrel.gov/hydrogen/assets/pdfs/h2-at-scale-2020-crada-call-072320.pdf.

The country's gas network transports and distributes natural gas from production areas and storage facilities to retail, commercial, and industrial customers across the country. Therefore, using the existing natural gas infrastructure to reach as many customers as possible would truly allow widespread hydrogen usage, further leveraging economies of scale to maximize the efficiency of hydrogen delivery, and drive down costs for all customers.

Moreover, natural gas itself is also a critical enabling component to accelerating widespread hydrogen use throughout the country because it can be used as a hydrogen carrier, *i.e.*, blended with hydrogen and delivered to customers via the existing distribution network. While research is underway to consider other chemical compounds as hydrogen carriers in the future, natural gas and natural gas infrastructure is available today, making it an optimal pathway for hastening hydrogen usage.

For the reasons discussed above, AGA recommends that HFTO focus more of its Research and Development Strategy on enabling the existing gas system to deliver hydrogen to consumers.

III. Additional Funding and Research Areas for HFTO

As discussed herein, AGA supports DOE's efforts on developing a broader hydrogen economy, and offers the following more specific research, development and demonstration suggestions.

A. Hydrogen Production

AGA recommends that HFTO continue supporting research on hydrogen production technologies, particularly blue and green hydrogen which can offer zero-carbon energy solutions. Research areas should include, *inter alia*, power-to-gas and carbon capture. Power-to-gas is the conversion of renewable electricity into hydrogen gas. In short, renewable electricity can be transformed into storable hydrogen or methane, if combined with a source of carbon, and blended into the gas pipeline system for delivery to various customers including power generation. Affordable hydrogen storage to support power-to-gas facilities, in both distributed and large single-point production facilities, is needed. Furthermore, HFTO should support research regarding methanation reactors and the overall power-to-gas process. Additionally, DOE should provide research funding for carbon capture technology to support steam methane reformation hydrogen production.

B. Hydrogen Transportation, Distribution, and Storage

HFTO should fund research on the feasibility and practical implications of injecting hydrogen at various levels, into existing high and low-pressure natural gas pipelines. It is critical to ascertain hydrogen's potential impact on gas facilities and operations,[9] such as:

- Hydrogen blending impacts on various pressurized pipes and compression stations.

[9] *See* Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues, National Renewable Energy Laboratory (March 2013), available at https://www.nrel.gov/docs/fy13osti/51995.pdf.

- Hydrogen blending impacts on the integrity of pipeline materials (metallurgy and plastic studies), gaskets, seals, greases and lubricants, aluminum components, *etc*.
- Hydrogen blending impact on current natural gas odorant practices, and the development of appropriate hydrogen odorants and sensors.
- Hydrogen's effect on gas meters. Whether natural gas is being moved via the interstate, intrastate, or distribution system, it is accounted for with the use of meters. The most visible are the meters at homes and businesses, but various others are in use upstream of local distribution as well. It is important that these meters be as accurate as possible; HFTO should research to what extent potential flowrate changes might occur with the blending of different amounts of hydrogen into the gas system.
- An important aspect of the nation's natural gas system is the various storage facilities that can be used to provide service when needed. Therefore, a further topic that HFTO should research is the impact of blending hydrogen on both above ground and underground storage facilities, specifically:
    - The impact of hydrogen blends on existing porous rock gas storage facilities.
    - The impact of hydrogen blends on LNG storage facilities, and recommendations for best practices when blending hydrogen at LNG storage sites.

C. Hydrogen End-Use Appliances & Equipment

Gas systems throughout the country are designed to meet the thermal energy needs of their customers, which can vary between commercial, residential and industrial customers, and the types of gas appliances they use. Hydrogen's potential impact on gas piping behind the meter and gas appliances should not be ignored. As noted above, AGA and its members have expended considerable effort conducting research in this area, but outstanding research topics remain; therefore, AGA recommends that HFTO continue research in the following areas:

- Engaging with industry, including manufacturers of appliances and equipment and fuel suppliers, to expand hydrogen fuel blend testing on additional appliances and equipment, including commercial equipment.
- Specific research should be dedicated to higher mixtures of hydrogen blended with natural gas, namely formulations of 50 percent hydrogen and above.
- Development of accelerated test methods for natural gas/hydrogen mixtures at end-use equipment and customer-owned delivery pressures, and accelerated testing once consensus on test methods is achieved.
- HFTO should study the long-term impacts the use of hydrogen may have on end-use equipment such as boilers and electric generation turbines, *i.e*., does the blending of hydrogen affect performance, useful life, or emissions, *etc*.

Additionally, to help encourage and streamline hydrogen blending and widespread usage, AGA suggests the development of a hydrogen evaluation system to audit existing gas pipeline systems including behind the meter gas piping and end-user customer appliances, to determine and guide maximum hydrogen blends, including risks and potential bottlenecks.

D. Hydrogen Codes and Standards

An expanded reliance upon hydrogen as a zero-carbon energy source will only be possible if and when undisputed confidence in the safety of hydrogen delivery and usage is achieved. Therefore, HFTO should continue its focus and research related to hydrogen safety and the development of hydrogen codes and standards related to safety. Specifically, research must be focused on the following matters:

- Risk assessment around hydrogen safety, including accumulation in unventilated spaces and impacts on customer owned infrastructure such as piping in homes and business (and any related costs).
- Development of universal international standards for hydrogen and hydrogen blended gas to decrease costs, increase safety, and increase the availability of universal parts and appliances.
- Possible conflicts emerging as a result of hydrogen blends on a variety of existing codes, such as piping and plumbing codes, welding codes, electrical codes and compression station codes.

To reaffirm the recommendation that HFTO focus on the cohesive hydrogen value chain, as discussed in this section, AGA recommends that DOE and HFTO establish hydrogen pilot projects that integrate various aspects of the hydrogen economy, *i.e.*, fully integrated hydrogen production, transportation and delivery, and direct-use and consumption of the commodity. This largescale comprehensive testing facility must be capable of infinitely variable hydrogen blends with natural gas, to validate existing models, create safety limits, and fully test and understand the interactions and impacts of hydrogen on all materials, components and end-use equipment.

IV. Additional Recommendations

As part of the overall effort to advance hydrogen and fuel cell technologies, AGA recommends that DOE enhance both internal agency coordination and expand coordination with international partners. Increased coordination between HFTO and the Office of Fossil Energy would ensure a more comprehensive understanding of how the system can be used to transport hydrogen. For example, the Office of Fossil Energy has institutional knowledge of the country's natural gas infrastructure and how it currently provides energy to consumers. Greater communication and coordination between various DOE offices and other federal agencies, such as the Department of Transportation's Pipeline and Hazardous Materials Safety Administration and the Federal Energy Regulatory Commission, for example, can support mutual learning and policy development, and assist in the development of a future hydrogen economy.

The pursuit of next generation technologies and zero-carbon energy is a global endeavor; therefore, AGA recommends that DOE coordinate and share information with international partners. Via this effort, governmental entities could work on formulating and establishing international standards related to hydrogen safety, transport and storage. For example, Canada is

in the process of developing a national hydrogen strategy.[10] Across the Atlantic in Germany, the government has agreed on a long-term strategy for increasing production and use of hydrogen as part of a plan to cut the country's greenhouse gas emissions.[11] While it is critical for the United States to be a leader in the development of a hydrogen economy, such efforts do not need to be undertaken in isolation. AGA encourages HFTO to coordinate domestically and internationally on its hydrogen efforts as such efforts would both benefit the United States and its allies.

V. Conclusion

The American Gas Association respectfully requests that DOE consider these comments in response to the RFI. As noted above, HFTO should focus on the mechanisms that could be used to transport and ultimately deliver hydrogen to consumers, such as the current natural gas distribution system. AGA looks forward to working with the HFTO and DOE as a willing partner in advancing funding, research and development of hydrogen and related technologies.

Respectfully submitted,

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[10] *See* 2019 Hydrogen Pathways – Enabling a Clean Growth Future for Canadians, https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/resource-library/2019-hydrogen-pathways-enabling-clean-growth-future-canadians/21961. *See Also,* https://www.spglobal.com/platts/en/market-insights/latest-news/coal/060520-feature-canada-developing-national-hydrogen-strategy-us-taking-different-approach.

[11] The National Hydrogen Strategy, https://www.bmbf.de/files/bmwi_Nationale%20Wasserstoffstrategie_Eng_s01.pdf. *See* also "German Government Agrees on National Hydrogen Strategy," U.S. News and World Report, available at https://www.usnews.com/news/business/articles/2020-06-10/german-government-to-agree-national-hydrogen-strategy#:~:text=BERLIN%20(AP)%20%E2%80%94%20The%20German,the%20country's%20greenhouse%20gas%20emissions.&text=It%20set%20a%20goal%20of,to%20five%20Gigawatts%20by%202030 (July 10, 2020).