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Comments re hydrogen blending in natural gas pipelines research solicitation

Please find letter attached

Additional submitted attachment is included below.

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April 2,2021

California Energy Commission Docket 19-ERDD-01 Electronic Submittal

Scoping Workshop - Solicitation Regarding Pilot Test and Demonstration of Hydrogen Blending into Existing California Natural Gas System

Dear Yahui Yang:

Air Products is a world-leading industrial gases company, in operation for over 75 years. The company's core industrial gases business provides atmospheric and process gases and related equipment to manufacturing markets, including refining and petrochemical, metals, electronics, food and beverage and healthcare. Approximately 17,000 employees globally work to make Air Products the world's safest and best performing industrial gases company, providing sustainable offerings and excellent service to all customers.

The company has over 15 locations in California, including hydrogen production facilities and safely operates 20 miles of hydrogen pipelines in California. Worldwide, we are the largest hydrogen producer with over 3.7 MMscfd capacity and over 700 miles of pipelines safely operating. Lastly, Air Products has designed, installed, and supplies a fleet of hydrogen fueling stations across California, facilitating the transition to carbon-free transportation.

Air Products has a strong history of application development for various industries including energy, power, chemicals, glass, metals, iron and steel. With that application experience, Air Products has proprietary designs for hydrogen blending and storage equipment and has applied its unsurpassed safety record in the safe production, storage, handling and distribution of hydrogen and other gases to its development of application equipment. Air Products has exceptional in-house combustion expertise with state-of-the-art combustion laboratories and strong computational simulation capabilities with which Air Products has developed burner technology for multiple industries. AP has collaborated in the past and continues to work with several government agencies, research institutes (DOE, NASA, EPRI etc.) and major industry partners.

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Hydrogen Pipeline Integrity and Safety

Modern gas pipeline systems are optimized to transport natural gas. To adapt to transporting a hydrogen blend, the distribution system needs a thorough systematic, component by component review to ensure safe operation. Research in this area needs to ensure the sustained durability of the pipeline system at proposed hydrogen blend levels.

Hydrogen is known to cause embrittlement or cracking in the welds of transmission pipelines. Hydrogen gas reduces the fracture toughness, crack propagation resistance and ductility, and increases the fatigue crack growth rates for pipeline steels and their welds. Research commissioned by the CEC needs to carefully examine this failure mechanism and recommend materials and inspection protocol to safeguard the public against this risk.

Natural gas is used in homes for cooking and heating. Hydrogen has a wider flammability range and lower minimum ignition energy compared to natural gas. These facts coupled with the higher propensity to leak (due to molecule size) could create more dangerous conditions in residential applications where such leaks may go undetected. Odorants, like mercaptan, are used so homeowners can detect natural gas, but are not yet approved for hydrogen. Moreover, hydrogen burns almost invisibly creating unique risks to the public that do not need to be addressed for natural gas. There needs to be more research done in this area to determine the best public safeguards for these characteristics of hydrogen gas.

System Capacity and Reliability

Hydrogen blends can impact the accuracy of existing gas meters, which, in turn, would impact the billing process for gas supplies. Hydrogen has a lower energy density than natural gas and at higher blend levels, gas meters will show a higher volume of use for the same energy supply.

Because of the lower heating value of natural gas, more volume of hydrogen is needed for the same energy requirements. In some cases, this will limit the peak flow in high demand scenarios. These bottlenecks and potential mitigation need to be identified as part of this research project.

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Impacts on Industrial End Users

While research to ensure public safety is of the utmost importance, we suggest that the CEC also prioritize research on the impacts to industrial users. Some areas for further research to both quantify and mitigate impacts include:

- Hydrogen blends used in equipment like gas turbines will alter the combustion characteristics (due to different combustion air requirements index and a low ignition energy) and can lead to higher local flame temperatures in burners. This can increase NOx emissions in existing equipment without retrofit which will exacerbate federal air quality attainment issues in some regions of California (like Southern California). The costs of these retrofits to mitigate NOx emissions must also be included any cost-effectiveness analysis as discussed below.

- Higher, localized flame temperatures in combustion equipment must also be studied for its impact on equipment lifespan.

- Hydrogen's lower energy density requires more volume of hydrogen to generate the same amount of energy as natural gas. This fact could cause existing industrial equipment to become rate limited. This could be a significant impact on industrial users and production that needs to be evaluated and quantified.

- Because heat transfer mechanisms from hydrogen flames are different when compared to natural gas flames, a change in burners may be necessary to provide the heat profile needed by the industrial application.

Costs & Cost-Effectiveness

The lower heat content of hydrogen relative to natural gas will require more volume of gas used to maintain the same heating requirements. The impact of this additional volume of gas and its associated costs needs to be quantified for the benefit of ratepayers. This is in addition to the need to quantify the costs of all the system and end user impacts discussed above.

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The CO2 reduction benefit from the combustion of these blends needs to be quantified, along with the system upgrade costs, to determine the cost per metric ton of CO2 reduction. By doing so, you can assess the cost-effectiveness of this use of hydrogen which can be compared to other potential uses with associated CO2 reductions.

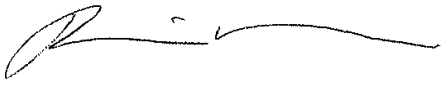
To the extent that natural gas-hydrogen blends are being contemplated for energy storage, research needs to be done to compare the round-trip efficiency of the blend to other storage options (like battery or pumped storage) and to quantify any incremental costs associated with the lower efficiency.

Going Forward

There is no question that hydrogen will play a key role in the low carbon energy future that California envisions. Given that companies like Air Products already have the expertise to cost-effectively produce and distribute hydrogen to the best low carbon opportunities, we think it would be prudent to rely on that expertise to help inform your decisions. We request that the CEC staff include us in this effort and the use of Hydrogen as a clean energy source in the state of California.

Air Products appreciates the opportunity to provide feedback for this research solicitation. Please feel free to contact me by phone (916-860-9378) or email hellermt@airproducts.com.

Respectfully,



Miles Heller
Director, Greenhouse Gas Government Policy

cc: Yahui Yang - CEC