Air Products and Chemicals, Inc.
1940 Air Products Blvd.
Allentown, PA 18106-5500
www.airproducts.com

November 14, 2022

Via Electronic Submission to: Cleanh2standard@ee.doe.gov

U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re: Comments of Air Products and Chemicals, Inc. to the U.S. Department of Energy's Clean Hydrogen Production Standard Draft Guidance

To Whom It May Concern:

Please find below and attached the comments of Air Products and Chemicals, Inc. ("Air Products") on the U.S. Department of Energy's ("DOE") Clean Hydrogen Production Standard ("CHPS") Draft Guidance, issued on September 22, 2022.[1]

I. Background on Air Products

Air Products is a global leader that provides essential industrial gases, related equipment, and applications expertise to over 150,000 customers across over 30 industries, including refining, chemical, metals, electronics, manufacturing, water treatment, and food and beverage. Founded over eight decades ago, the company now has over 750 production facilities and over 21,000 employees in 50 countries around the world. It is headquartered in Allentown, Pennsylvania, with significant operations throughout the United States.

Air Products is the world's largest producer of hydrogen, with over 60 years of experience in the industry. Air Products has a proven record of innovation—including researching, piloting, and adopting the best technologies available. Indeed, the company has invested billions of dollars in low-carbon hydrogen projects and focuses on delivering safe end-to-end solutions, developing clean energy projects at scale, and driving the industry forward to a cleaner future. Air Products leads efforts to decarbonize heavy transportation such as trucks, buses and ships, as well as industrial sectors that are difficult to electrify or where hydrogen is used as feedstock, such as steelmaking and chemicals processing.

[1] A Notice of Availability for the Draft Guidance was published in the Federal Register. *Notice of Availability of Draft Guidance on Hydrogen and Fuel Cell Program*, 87 Fed. Reg. 58,776 (Sept. 28, 2022). The complete Draft Guidance document is located at https://www.hydrogen.energy.gov/pdfs/clean-hydrogen-production-standard.pdf.

On July 25, 2022, Air Products announced[2] that it will spend or commit at least $4 billion in additional new capital for the transition to clean energy over the next five years. In the two years preceding this announcement, Air Products had announced approximately $11 billion in clean energy investments, including:

- A multi-billion-dollar project, which will be the world's largest green hydrogen project by far and require more electrolyzer capacity than has been deployed throughout the world to date. This project alone will serve to scale global electrolyzer production capacity and manufacturing, helping to bring down the costs of this important technology.

- An innovative $1.6 billion net-zero carbon hydrogen production complex in Alberta, Canada, which achieves net-zero emissions through the combination of advanced hydrogen reforming technology, carbon capture and storage, and hydrogen-fueled electricity generation. Air Products recently won the Best Carbon Management Initiative Award for this project at the 2021 *Chemical Week* Sustainability Awards.

- A $4.5 billion blue hydrogen clean energy complex in Louisiana, which represents the company's largest investment ever in the United States and will sequester more than 5 million tons of CO_2 per year. This project will capture 95% of the facility's CO_2 emissions and produce blue hydrogen with near-zero carbon emissions.

- A green hydrogen facility based in Casa Grande, Arizona, just outside Phoenix, which is expected to be onstream in 2023 and will produce zero-carbon liquid hydrogen for the transportation market.

- A $2 billion major expansion project with World Energy to develop North America's largest sustainable aviation fuel production facility in Paramount, California. The project will expand the site's total fuel capacity to 340 million gallons annually, and among other investments, includes an extension and capacity increase of Air Products' existing hydrogen pipeline network in Southern California. The project is scheduled to be onstream in 2025.

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[2] Air Products, *Air Products Announces Additional "Third by '30" CO_2 Emissions Reduction Goal, Commitment to Net Zero by 2050, and Increase in New Capital for Energy Transition to $15 Billion* (July 25, 2022), https://www.airproducts.com/news-center/2022/07/0725-air-products-announces-additional-sustainability-commitments.

In the most recent example of Air Products' role as the world leader in hydrogen production, Air Products announced plans to invest about $500 million in a large-scale facility to produce clean hydrogen at a greenfield site in Massena, New York.[3] The facility will be powered by 94 MW of low-cost St. Lawrence River hydroelectric power and create 90 permanent jobs in New York.

II. Air Products Supports DOE's Effort to Set the CHPS

Air Products applauds DOE for moving forward with a proposed CHPS. That standard is vital to driving the federal investments enacted in the Infrastructure Investment and Jobs Act ("Bipartisan Infrastructure Law" or "BIL") and the Inflation Reduction Act ("IRA"). It will also serve as a foundation to determine domestic competitiveness in the energy transition taking place throughout the American economy in the years to come.

Air Products seeks to emphasize three key points: (1) regulatory certainty is needed soon; (2) the CHPS has key implications related to the BIL and IRA; and, (3) DOE is correct to emphasize that the CHPS is not a regulatory standard. Air Products' specific responses to the questions DOE poses in its Draft Guidance are included in the Attachment, below.

A. Regulatory Certainty Is Urgently Needed

Time is of the essence. If DOE seeks to promote the use of clean hydrogen as a meaningful part of the energy transition, it must establish the CHPS soon. Without it, investment decisions and important projects will be delayed. To that end, Air Products encourages DOE to ensure that the CHPS includes clear guidelines to increase investor confidence. Finally, the CHPS should avoid overly prescriptive restrictions and accommodate future innovation by allowing multiple appropriate paths to adhere to the guidance—for instance, in the approach to bio-feedstocks discussed in the Attachment.

B. The CHPS Has Key Implications Related to the BIL and IRA

As the DOE correctly explains, the CHPS will guide important DOE clean hydrogen programs stemming from the BIL, including the Regional Clean Hydrogen Hubs Program and the Clean Hydrogen Research and Development Program.[4] In parallel, the IRA created a new hydrogen production tax credit under section 45V of the Internal Revenue Code ("Code") for "qualified

[3] Air Products, *Air Products to Invest About $500 Million to Build Green Hydrogen Production Facility in New York* (Oct. 6, 2022), https://www.airproducts.com/news-center/2022/10/1006-air-products-to-build-green-hydrogen-production-facility-in-new-york.

[4] Draft Guidance at 2.

clean hydrogen" that is produced after December 31, 2022.[5] The IRA also provides the taxpayer with an option to elect to claim the section 45V credit as an investment tax credit under Code section 48 equal to a percentage of the cost of the capital expenses of building a new facility.[6] These new tax credits will help drive down the cost of new hydrogen projects to meet the demand for clean electricity and clean transportation, as well as to help decarbonize the industrial sector.

As the Treasury Department and the Internal Revenue Service begin to implement the hydrogen tax credits under Code sections 45V and 48, DOE's efforts to establish the CHPS will have significant consequences for these tax credits and the domestic low-carbon hydrogen industry. A taxpayer's eligibility to claim the credits, as well as the amount of the credits, will depend on the lifecycle greenhouse gas ("GHG") emissions rate of the hydrogen production process used at the facility, as determined under Code section 45V(c)(1). As acknowledged by the Draft Guidance, the proposed lifecycle target aligns with the 4 kilograms of carbon dioxide equivalent per kilogram of hydrogen threshold imposed under section 45V(c)(2)(A).[7] As further acknowledged by the Draft Guidance, the proposed CHPS uses the same "well-to-gate" lifecycle analysis system boundary as section 45V(c)(1), thus creating alignment between the two statutory provisions.[8] The Treasury Department and the Internal Revenue Service will need to draw on DOE's deep expertise in the standards for evaluating lifecycle GHG emissions in order to properly implement these hydrogen credits, as has been done in the context of carbon sequestration tax credits under Code section 45Q. Accordingly, the CHPS should be developed with an eye toward how it may be applied in the context of conducting a lifecycle analysis for the hydrogen tax credits, among other uses for the standard.

C. DOE Is Correct that the CHPS Is Not a Regulatory Standard

Air Products supports and agrees with DOE's statement that the CHPS is "not a regulatory standard."[9] Instead, the CHPS *guides* certain DOE clean hydrogen programs, but projects under those programs need not meet the CHPS.

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[5] Inflation Reduction Act of 2022, Pub. L. No. 117-169, § 13204, 136 Stat 1818, 1936 (modifying 26 U.S.C. § 45V).

[6] *Id.*

[7] Draft Guidance at 2.

[8] *Id.* at 4.

[9] *Id.* at 2.

For instance, under the BIL's Regional Clean Hydrogen Hubs program, the DOE must "support the development of" the hubs.[10] Accordingly, this *support* could entail projects that do not themselves meet the CHPS but would ultimately promote development of the clean hydrogen hubs—such as projects that are part of a pathway to attaining the CHPS. Further, DOE "may make grants to [the hubs] to accelerate commercialization of, and demonstrate the production, processing, delivery, storage, and end-use of, clean hydrogen."[11] Similarly, this provision does not restrict the grants to, for example, directly and only producing hydrogen that satisfies the CHPS. Instead, it allows grants to "accelerate commercialization," and similar steps, that may include projects that do not yet satisfy the CHPS but could assist in meeting the standard.

The Clean Hydrogen Research and Development Program[12] likewise is not restricted solely to funding projects that meet the CHPS. Instead, DOE need only "conduct activities to advance and support" clean hydrogen goals.[13] Similarly, these could include funding R&D that functions as a stepping stone on the path to attaining the CHPS.

Air Products also agrees with DOE that the statutory "definition of clean hydrogen is a component of the CHPS but is not the sole component of the CHPS."[14] Under Section 16166(a), CHPS governs "the carbon intensity of clean hydrogen production," which does not preclude a different carbon intensity for the rest of the lifecycle.

* * *

Air Products appreciates the opportunity to comment on the Draft Guidance and stands ready to assist DOE in its important efforts to spur the development of clean hydrogen. Please do not hesitate to contact me with any questions or if Air Products or I can otherwise be of assistance.

Sincerely,

Eric Guter
Vice President, Hydrogen for Mobility

Attachment

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[10] 42 U.S.C. § 16161a(b).

[11] *Id.* § 16161a(c)(4).

[12] *Id.* § 16154.

[13] *Id.* § 16154(e).

[14] Draft Guidance at 2.

Attachment
Air Products' Response to Questions in DOE CHPS Draft Guidance

1) Data and Values for Carbon Intensity

a) Many parameters that can influence the lifecycle emissions of hydrogen production may vary in real-world deployments. Assumptions that were made regarding key parameters with high variability have been described in footnotes in this document and are also itemized in the attached spreadsheet "Hydrogen Production Pathway Assumptions." Given your experience, please use the attached spreadsheet to provide your estimates for values these parameters could achieve in the next 5-10 years, along with justification.

Answer: Air Products generally applauds DOE's stated assumptions and the resulting values for lifecycle greenhouse gas emissions. Air Products appreciates that the assumptions are estimates and that hydrogen technology is a growing industry that will change over the coming years. The CHPS will also evolve over the next decade as better information becomes available.[1]

The variable labeled "Other" may benefit from refinement. Primarily, a purity value that considers non-carbon species is unnecessarily restrictive and, when it comes to non-carbon species content, provides no benefit. For instance, with hydrogen used for ammonia production, removing nitrogen is detrimental because the nitrogen would need to be re-added to synthesize ammonia. Removing non-carbon impurities from the value would not impact climate-related benefits and would better serve the purpose of CHPS. As a result, Air Products proposes to limit the impurity level to only carbon-containing impurities and allow at least 2 mole % carbon containing impurities. This limit on carbon-containing impurities will limit the downstream CO_2 emission impact of using the hydrogen while allowing for flexible hydrogen production configurations for a variety of end-use applications.

b) Lifecycle analysis to develop the targets in this draft CHPS were developed using GREET. GREET contains default estimates of carbon intensity for parameters that are not likely to vary widely by deployments in the same region of the country (e.g., carbon intensity of regional grids, net emissions for biomass growth and production, avoided emissions from the use of waste-stream materials). In your experience, how accurate are these estimates, what are other reasonable values for these estimates and what is your justification, and/or what are the uncertainty ranges associated with these estimates?

Answer: Air Products supports the use of the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies Model ("GREET") to supply default estimates of carbon intensity for input parameters such as feedstock production and power generation. Providing default estimates allows producers to meet the regulatory burden for their pathways quickly and affordably. Use of the GREET model would also align the CHPS with the statutory requirements of the hydrogen production tax credit.[2]

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[1] 42 U.S.C. § 16166(b)(2) (providing for 5-year review).

[2] *See* Section 45V(c)(1)(B) of the Internal Revenue Code of 1986, as amended ("Code").

Additionally, DOE should consider allowing hydrogen producers to provide project-specific data to meet the CHPS, so long as it is accurate and verifiable. DOE could require a certain level of analysis and data, certification, or reference to a similar, previously approved pathway. The California Air Board uses modified GREET values for lifecycle analysis and has a similar optional mechanism to ensure that producers benefit from maximizing carbon reduction.[3] Individualized estimates of emissions can often be superior, including for hydrogen production site emissions and CO_2 sequestration. There are many methods of hydrogen production, and each method will have different emissions given the configurations of unique plants. Accordingly, individualized emissions estimates can often be necessary to achieve credible results, spur innovation, and encourage private investment.

c) Are any key emission sources missing from Figure 1? If so, what are those sources? What are the carbon intensities for those sources? Please provide any available data, uncertainty estimates, and how data/measurements were taken or calculated.

Answer: Air Products agrees that Figure 1 captures the appropriate system boundaries for lifecycle emissions from hydrogen. Air Products recommends a minor clarification of the term "Extraction of feedstock" to include "Extraction or Production of Feedstock." Modifying this term provides clarity that *produced* feedstocks such as bio-propane are intended to be treated similarly to *extracted* feedstocks like natural gas for the purpose of lifecycle analysis.[4]

d) Mitigating emissions downstream of the site of hydrogen production will require close monitoring of potential CO_2 leakage. What are best practices and technological gaps associated with long-term monitoring of CO_2 emissions from pipelines and storage facilities? What are the economic impacts of closer monitoring?

Answer: Air Products continues to review these questions and may provide responsive information to this question to DOE in the future.

[3] *See* Cal. Code Regs. tit. 17 § 95486.1(a)(2) ("[T]he carbon intensity of the fuel or blendstock [is] measured in gCO2e/MJ, determined by a CA-GREET pathway *or a custom pathway* and incorporates a land use modifier."); *see also* Cal. Code Regs. tit. 17 § 95488.5; California Air Resources Board, *Lookup Table for Gasoline and Diesel and Fuels that Substitute for Gasoline and Diesel* (undated), https://www.arb.ca.gov/fuels/lcfs/ca-greet/lut.pdf?_ga=2.206902739.1996625755.1665685540-791193252.1659095599.

[4] *See* Draft Guidance at 4 ("The lifecycle system boundary accounts for these tradeoffs by including all key emissions sources associated with feedstock *extraction* or production, generation of electricity, feedstock delivery, hydrogen production, potential releases during CO2 transport, and carbon capture and sequestration of GHGs generated by the production process." (emphasis added)).

e) Atmospheric modeling simulations have estimated hydrogen's indirect climate warming impact (for example, see Paulot 2021). The estimating methods used are still in development, and efforts to improve data collection and better characterize leaks, releases, and mitigation options are ongoing. What types of data, modeling or verification methods could be employed to improve effective management of this indirect impact?

Answer: Air Products agrees that the estimating methods are still in development and that data collection and information related to detection, leak rates, emission inventory, and mitigation methods need to be studied and better characterized. The reports published to date on this topic contain various assumptions and results that indicate a high level of uncertainty. Further research on natural hydrogen sources and sinks, along with dispersion mechanisms is also required.

Any potential impacts from hydrogen cannot be assessed in isolation. Because of the indirect interaction with other atmospheric emissions, like methane, which will be reduced over time based on both climate regulations targeting methane emissions and by displacement of fossil fuels like natural gas with clean hydrogen and electrification, any potential atmospheric impact from hydrogen will diminish. The positive impact of hydrogen displacing fossil fuels over time, and the associated methane and CO_2 reductions, must be incorporated into any assessment of hydrogen's net climate impact. Not only will the impact from released hydrogen diminish over time as climate pollutant emissions decrease, there is an overall climate benefit from using hydrogen, relative to the petroleum-based alternatives, for example, in heavy-duty transportation.

Air Products also takes substantial measures to mitigate leakage. Because hydrogen is a valuable product, Air Products designs and operates its production systems to minimize hydrogen losses—in accordance with international, national, and industry standards and best practices. Potential fugitive emissions are minimized through the equipment and techniques Air Products uses, such as leak-tight valves, welded connections, operational measures to detect leaks, and system maintenance and repairs—all of which are also important safety measures. Most of Air Products' hydrogen is transported by pipelines, which greatly minimizes potential emissions. When hydrogen is transported by truck, Air Products takes steps to mitigate venting, which is done to pressure balance for safety, by improving distribution and planning design options to recover vented hydrogen.

Further, excluding any suggested indirect climate impact from hydrogen would be consistent with the Environmental Protection Agency's greenhouse gas reporting standards and with the lifecycle analysis standards that have been adopted under the carbon sequestration tax credit under Code section 45Q.[5]

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[5] *See* Table A-1 of 40 C.F.R. Part 98 (omitting hydrogen from the list of compounds with global warming potential used to calculate metric tons of CO_2 equivalents emitted under the reporting standards); Treas. Reg. § 1.45Q-4(c)(1) (relying under Table A-1 to determine the scope of "all greenhouse gases" for the purposes of performing a lifecycle emissions analysis under Code section 45Q).

f) How should the lifecycle standard within the CHPS be adapted to accommodate systems that utilize CO_2, such as synthetic fuels or other uses?

<u>Answer</u>: Air Products recognizes that use of synthetic fuels produced from clean hydrogen and captured CO_2 are removing actual and verifiable emissions from the environment. Without capture or utilization, those emissions would otherwise be released into the environment, with associated climate impact. Congress has recognized the substantial benefit of this alternative lifecycle in reducing lifecycle emissions of greenhouse gases in related law.[6] Air Products supports methodologies that permit hydrogen producers to account for these benefits under the CHPS, and any industrial carbon dioxide should be recognized—DOE can look to the definition of qualified carbon dioxide under Code section 45Q as that which "(i) is captured from an industrial source[;]…(ii) would otherwise be released into the atmosphere as industrial emission of greenhouse gas or lead to such release, and (iii) is measured at the source of capture and verified at the point of disposal, injection, or utilization."[7]

<u>2) Methodology</u>

a) The IPHE HPTF Working Paper (https://www.iphe.net/iphe-working-paper-methodology-doc-oct-2021) identifies various generally accepted ISO frameworks for LCA (14067, 14040, 14044, 14064, and 14064) and recommends inclusion of Scope 1, Scope 2 and partial Scope 3 emissions for GHG accounting of lifecycle emissions. What are the benefits and drawbacks to using these recommended frameworks in support of the CHPS? What other frameworks or accounting methods may prove useful?

<u>Answer</u>: Air Products supports the use of the ISO 14000 family of standards. The generally accepted frameworks within the ISO 14000 series carry several benefits for lifecycle analysis under CHPS. These benefits include standardized reporting, use of internationally accepted standards, and consistent application of concepts such as allocation, system boundary, inventory analysis, and impact assessment. Indeed, other regimes, such as GREET, the tax credits for carbon sequestration under Code section 45Q, and the Canada's Fuel Life Cycle Assessment Model, follow the ISO 14000 series standards.[8]

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[6] 26 U.S.C. § 45Q(c)(1) (defining qualified carbon dioxide as that which "(i) is captured from an industrial source[;]…(ii) would otherwise be released into the atmosphere as industrial emission of greenhouse gas or lead to such release, and (iii) is measured at the source of capture and verified at the point of disposal, injection, or *utilization*" (emphasis added)) ; *id.* § 45Q(f)(5) (providing that utilization means "the use of such qualified carbon oxide for any other purpose for which a commercial market exists").

[7] *Id.*

[8] Treasury Regulations § 1.45Q-4(c)(3).

b) Use of some biogenic resources in hydrogen production, including waste products that would otherwise have been disposed of (e.g., municipal solid waste, animal waste), may under certain circumstances be calculated as having net zero or negative CO_2 emissions, especially given scenarios wherein biogenic waste stream-derived materials and/or processes would have likely resulted in large GHG emissions if not used for hydrogen production. What frameworks, analytic tools, or data sources can be used to quantify emissions and sequestration associated with these resources in a way that is consistent with the lifecycle definition in the IRA?

Answer: Air Products supports recognizing the potentially negative carbon intensity of hydrogen production from biogenic resources, so long as it is supported by a robust lifecycle analysis approach. Production of hydrogen from biogenic resources (used as feedstock and/or fuel for processing of other feedstocks) frequently results in net removal of lifecycle carbon from the environment, and this benefit should be accounted for.

In this area, DOE should accommodate both co-feedstock accounting methods— (1) recognizing them separately or (2) recognizing them as a blend. Under both approaches, a bio-feedstock like renewable natural gas would be combined with a feedstock such as natural gas. The methodologies diverge, however, in how the produced hydrogen is analyzed. When the co-feedstocks are recognized separately, a portion of the hydrogen would be classified as meeting the CHPS, while the rest would not. This approach allows the production of clean hydrogen at existing facilities with at-scale unit economics. When the co-feedstocks are recognized as a blend, then the resulting hydrogen would be treated as a single output with a mass-averaged carbon intensity. The Draft Guidance appears to propose allowing this approach.[9] Failing to accommodate both approaches will stifle innovation and make it more difficult for hydrogen producers to tailor projects to customer needs. Certain customers may look for negative-CI clean hydrogen while others seek low positive-CI hydrogen. Allowing both methods will enable the fastest transition to clean hydrogen. DOE should also consider a geographic limitation for the feedstocks to the North American pipeline system.

c) How should GHG emissions be allocated to co-products from the hydrogen production process? For example, if a hydrogen producer valorizes steam, electricity, elemental carbon, or oxygen co-produced alongside hydrogen, how should emissions be allocated to the co-products (e.g., system expansion, energy-based approach, mass-based approach), and what is the basis for your recommendation?

Answer: The CHPS should adopt GREET's set of several methods of allocating emissions to co-products from the hydrogen production process. This set includes allowing system expansion

[9] Draft Guidance at 3 (proposing, for instance, that certain systems "could also achieve emissions lower than 4.0 $kgCO_{2e}/kgH_2$ through optimized design choices, such as the *use of greater shares* of clean electricity and low-*carbon forms of biomass*") (emphasis added).

to the co-product as a way to calculate carbon intensity. Retaining the full optionality of the set of GREET methods will best promote the development of clean hydrogen production capabilities and accurately reflect the true greenhouse gas reduction aspect of projects. In particular, the displacement method is important to preserve because it can effectively recognize that when, for instance, a steam co-product from hydrogen product is used, then that typically would obviate or diminish the need for a facility to run a CO_2-emitting boiler fueled by natural gas. In other words, to properly account for the steam generated from a hydrogen plant, it is important to use the displacement method because that steam normally displaces fossil energy resulting in reduced carbon dioxide emissions.

d) How should GHG emissions be allocated to hydrogen that is a by-product, such as in chlor-alkali production, petrochemical cracking, or other industrial processes? How is by-product hydrogen from these processes typically handled (e.g., venting, flaring, burning onsite for heat and power)?

Answer: Air Products recommends that whenever hydrogen is extracted from hydrogen-containing offgases, it should carry the carbon intensity of the fuels that displaced these offgases. This is necessary because offgases are ordinarily used for a productive purpose and if they are redirected to hydrogen, then replacement of the fuel and CO_2 emissions would occur.

3) Implementation

a) How should the GHG emissions of hydrogen commercial-scale deployments be verified in practice? What data and/or analysis tools should be used to assess whether a deployment demonstrably aids achievement of the CHPS?

Answer: Air Products believes all producers must properly establish a GHG baseline and track GHG reduction relative to it. Air Products continues to engage in substantial efforts to ensure its products demonstrate verifiable climate benefits.

Air Products also believes the CHPS should account for natural variations in carbon intensity for commercial-scale deployments. Actual carbon intensity values "vary over time due to a variety of factors, including but not limited to seasonality, feedstock properties, plant maintenance, and unplanned interruptions and shutdowns."[10] Such normal variations would not necessarily include major plant modifications, changes in feedstock, or new, permanent energy inputs, which may require a new lifecycle analysis and carbon intensity certification. Small temporary changes can cause large relative variations, especially when emissions are low. As a result, the CHPS should account for natural variation by evaluating over a suitable averaging period, which would reduce the regulatory burden for producers and create greater predictability. Periods based on multiple

[10] *See* Cal. Code Regs. tit. 17 § 95488.4(a).

years of data are already in use in other jurisdictions.[11] Moreover, adopting an annual period will prevent producers from benefiting or being punished for temporary variation that does not reflect the overall carbon reduction benefits of a facility. In any event, producers should also be allowed to demonstrate their own methodology for approval, given sufficient robustness and verifiability.

b) DOE-funded analyses routinely estimate regional fugitive emission rates from natural gas recovery and delivery. However, to utilize regional data, stakeholders would need to know the source of natural gas (i.e., region of the country) being used for each specific commercial-scale deployment. How can developers access information regarding the sources of natural gas being utilized in their deployments, to ascertain fugitive emission rates specific to their commercial-scale deployment?

Answer: Air Products supports DOE's efforts to develop robust mechanisms to trace fugitive emissions to natural gas sources. Extraction accounts for 60 percent of the total methane emissions for the oil and natural gas industries in the United States.[12] For example, this would provide an opportunity to use and recognize Responsibly Sourced Gas ("RSG"), which would allow producers to receive the benefit of reducing their lifecycle greenhouse gas emissions.[13] Accordingly, the lifecycle analysis under the CHPS should recognize responsibly sourced gas.

c) Should renewable energy credits, power purchase agreements, or other market structures be allowable in characterizing the intensity of electricity emissions for hydrogen production? Should any requirements be placed on these instruments if they are allowed to be accounted for as a source of clean electricity (e.g. restrictions on time of generation, time of use, or regional considerations)? What are the pros and cons of allowing different schemes? How should these instruments be structured (e.g. time of generation, time of use, or regional considerations) if they are allowed for use?

Answer: Air Products supports allowing these market structures in characterizing the intensity of electricity emissions, so long as they do not negatively impact grid stability. Air Products supports the use of renewable energy credits accompanied by geographical constraints to minimize congestion on the transmission grid. For example, the geographical constraints could be drawn based on the territories of Regional Transmission Organizations and similar entities.

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[11] *See, e.g.*, *id.* § 95488.10.

[12] EPA, *Estimates of Methane Emissions by Segment in the United States* (last accessed Oct. 13, 2022), https://www.epa.gov/natural-gas-star-program/estimates-methane-emissions-segment-united-states.

[13] RSG standards are designed to ensure that gas has minimal fugitive emissions in extraction.