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## Air Products Comments on Draft 2022 IEPR Update

Please find our comments attached

*Additional submitted attachment is included below.*

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November 30, 2022

Siva Gunda
Vice Chair
California Energy Commission (CEC)
715 P Street
Sacramento, CA 95814

**RE: Comments on the Draft 2022 Integrated Energy Policy Report (IEPR) Update Report**

Dear Vice Chair Gunda:

Thank you for the opportunity to comment on the Draft 2022 IEPR Update Report (Draft Report). We especially appreciate the focus on hydrogen as a decarbonization strategy in this Update and focus our comments on that element of the Draft Report.

**About Air Products: Leading the transition to clean hydrogen**

Air Products is the only U.S.-based global, industrial gas company and the world's largest hydrogen producer and supplier for use in numerous markets including transportation. We are committed to rapidly scaling and decarbonizing global hydrogen supplies, to support rapid decarbonization efforts in California and internationally. In just the last two years, Air Products has committed to investing at least $15 billion to support clean hydrogen development, including:

- The world's largest green hydrogen project, by far ($7 billion), requiring 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 $4.5 billion blue hydrogen clean energy complex in Louisiana, which represents the company's largest investment ever in the United States and will sequester more than 5 million tons of carbon dioxide ($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 on-stream in 2023 and will produce zero-carbon, liquid hydrogen for the transportation market. We appreciate that this project is referenced in the Draft IEPR (pg. 83) regarding an array of forthcoming green hydrogen projects to serve the California market.

Air Products is fully committed to developing world-scale solutions to address climate change. No individual technology will be able to do so, however, and the world – and California – will need multiple solutions to address this critical challenge. That is why Air Products pursues a diversity of solutions such as green hydrogen and blue hydrogen in locations and circumstances where a specific approach, technology and product makes sense.

**Hydrogen should be evaluated and supported through a technology-neutral, performance-based approach, based on carbon intensity**

We appreciate the discussion regarding colors of hydrogen, including notes that such schemes have limitations, sometimes miss established hydrogen pathways, and only provide high level insight into the comparison among pathways.[1] Lifecycle carbon intensity as a technology neutral indicator of greenhouse gas reductions is the best approach for comparing hydrogen pathways and should be central in any hydrogen definitions and discussions of end use going forward. All low carbon hydrogen pathways will be needed to attain the level of decarbonization that California needs to reach its climate goals. Indeed, as the report notes, biomass is not included in the color chart represented, despite the fact that it may provide the greatest climate benefits, especially when paired with carbon capture and sequestration. It is also missing from related discussion about deploying hydrogen to provide greenhouse gas benefits. This is despite the fact that CARB's Scoping Plan identifies hydrogen production from biomass with carbon capture and sequestration as one of three primary strategies to achieve Governor Newsom's carbon removal target of 20 $MMTCO_2$ by 2030 and 100 $MMTCO_2$ by 2045 and to help achieve carbon neutrality.[2]

We also appreciate the discussion of ammonia in the report, which is often left out of conversations on hydrogen at the state level. Green ammonia offers to be both a feedstock for green hydrogen production and potential derivative fuel or end use in agriculture or other applications. In this way, it is similar to methane in that it is both a common hydrogen feedstock but can also be synthesized from green hydrogen or other forms of low carbon hydrogen to provide an additional low carbon fuel option.

[1] Draft 2022 IEPR Update Report, pp. 72-73.
[2] For example, see 'Carbon Removal Target' worksheet in "AB 32 GHG Inventory Sectors Modeling Data Spreadsheet." https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents

Hydrogen production entails both feedstock and process energy. The feedstock serves as the source of hydrogen molecules, usually methane ($CH_4$), water ($H_2O$), ammonia ($NH_3$), or biomass. Process energy is used to split hydrogen from its feedstock molecules, and usually comes from methane, electricity, biomass or potentially another source. Methane, ammonia, and electricity as feedstock or process energy may come from renewable or fossil sources, or other zero-carbon resources like hydro or nuclear power, and water itself may be sustainably sourced or not, depending on geography and other parameters. The color-coding system of hydrogen production muddles this understanding about feedstock and process energy and is often applied to prioritize electrolysis over other production techniques that in some cases may offer greater environmental benefits.

The best way to compare hydrogen production pathways is through a technology neutral, carbon-intensity based accounting. This allows all technologies to compete, including those that get skipped in conventional color-coding schemes, based on cost and climate performance. This will drive the greatest level of innovation, cost reductions and emissions reductions. We recognize that in some programs, such as the Renewable Portfolio Standard, additional classifications may be appropriate. However, the State should not apply those limitations broadly across hydrogen pathways or end uses and should rather favor carbon intensity as a metric for hydrogen in any new programs that it may establish.

We recommend updating Table 5 to include all hydrogen pathways and clarify between feedstock and process energy, and encourage adjusting the related conversation on page 72 as follows:

> Emission reductions can be achieved through the use of renewable feedstocks and/or renewable process energy, resulting in zero or minimal fossil GHG emissions, by producing hydrogen from biomethane using SMR, cracking renewably derived ammonia, biomass gasification or pyrolysis, or by using renewable or zero-carbon electricity to make hydrogen using electrolysis. Emissions reductions are also possible by capturing and sequestering carbon emissions from non-renewable feedstocks, which has been identified in the Final 2022 Climate Change Scoping Plan as a strategy to reduce emissions "until such time as there is sufficient renewable power for electrolysis and an abundant water source."[3] Biomethane and biomass pathways, when paired with carbon capture, utilization and sequestration, can generate negative carbon emissions, or net carbon sequestration. The Scoping Plan identifies biomass-produced hydrogen with carbon capture a key carbon removal strategy to achieve carbon neutrality and net-negative GHG emissions by 2045.

**Hydrogen can serve to decarbonize all sectors, the State should enable it**

The Draft Report does a good job of identifying several use cases for hydrogen. Hydrogen uniquely can be deployed to decarbonize any and all economic sectors, and it should be fully enabled to do so.

[3] CARB (2022) 2022 Scoping Plan for Achieving Carbon Neutrality, California Air Resources Board, November 16, pg. 86. https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp.pdf

We encourage CEC and other state agencies to avoid pre-supposing or arbitrarily preferencing technology solutions on a sector-specific basis, including the potential for hydrogen to decarbonize light-duty transportation. There are valid concerns about transforming the entirety of the light-duty vehicle market to battery electric vehicles, based on access to charging, geographic or use case constraints, or simply consumer preference. In adopting regulations requiring the transition to 100% zero emission vehicle (ZEV) sales by 2035, CARB recognized these and reinforced that consumer challenges exist and need to be addressed.[4] Of course, many of these concerns can be addressed by fuel cell vehicles, and CEC should not assume they will not be part of the solution in the light-duty sector because of higher energy intensity, cost, or any other perception. Indeed, if such characteristics drove the car market, customers would not buy SUVs or pickup trucks today, yet many automakers are moving away from producing smaller vehicles altogether. CEC should enable both fuel cell vehicles and battery electric vehicles to compete on a level playing field, to foster competition and reach a wider array of car buyers with ZEVs more quickly.

Still, some sectors are especially ripe for hydrogen to support decarbonization efforts, and we support CEC's recognition of them, including heavy-duty transportation (including trucks, trains, ships, and aircraft), chemicals, industry, agriculture and the power sector. The state should take steps to immediately support the growth of clean hydrogen production by supporting growth in market demand across a wide array of priority sectors.

Supporting market certainty for hydrogen demand is the best way to accelerate clean hydrogen project development and cost reductions. This may take the form of ongoing and clear, long-term funding for fuel cell trucks, policies and planning to decarbonize existing natural gas power plants, industrial sector policies, and appropriate amendments to the Low Carbon Fuel Standard.

**Hydrogen blending in natural gas pipelines continues to raise scientific, technical and economic questions, which deserve, and are receiving, further analysis and scrutiny at the CPUC. Questions arising in that use case, or others, should not derail opportunities to deploy hydrogen where the use case is clear.**

Still, there may be some use cases where the role for hydrogen remains less clear. A clear case is deliberations around the role of hydrogen blending to decarbonize the existing natural gas pipeline. The CPUC has proposed ordering pilot projects while continuing to evaluate a number of technical questions related to hydrogen's impact on the natural gas system.

The Draft Report identifies some issues that have come up in that forum, such as hydrogen leakage or pipeline embrittlement, as items the state needs to address. To the extent that may be true in the context of hydrogen blending in the natural gas system, it

[4] CARB (2022) Public Hearing to Consider the Proposed Advanced Clean Cars II Regulations, Staff Report: Initial Statement of Reasons, California Air Resources Board, April 12. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/isor.pdf

should not hinder the State's approach to deploy hydrogen in other applications. Indeed, the Draft Report does not identify any issue with existing hydrogen operations, including the use of dedicated hydrogen pipelines, that over several decades have supplied the refining, chemicals, transportation, agriculture and other sectors.

Regarding the potential role of hydrogen as a climate forcer, Air Products notes 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 CO2 reductions, must be incorporated into any assessment of hydrogen's net climate impact. We look forward to supporting continued scientific evaluation of the issue and sharing our experience and expertise on the topic.

Throughout our operations, Air Products takes substantial measures to mitigate leakage. Hydrogen is a valuable product, and 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, as well.

**Response to Recommendations on Emerging Topics, Role of Hydrogen in California's Clean Energy Future**

We appreciate the Draft Report offering specific recommendations on the role of hydrogen in California's Clean Energy Future, and offer the following comments on them:

- **Develop an agreed-upon and standardized method to measure the climate benefits of hydrogen while accounting for varying feedstocks and production processes.** We strongly support the state moving towards a standardized method to measure climate benefits of hydrogen, which as described above, should be based on the carbon intensity of the fuel. This standardized method should be inclusive of all feedstocks and production processes, however the state should refrain from further limitations or

categorizations of hydrogen, except where a program requires them (such as to generate RECs under the Renewable Portfolio Standard).

- **Set targets for reducing GHG emissions from directly produced hydrogen production.** We are not opposed to setting targets for GHGs from hydrogen, but they should be set based on the principles of technological neutrality and cost-effectiveness and certainly not more stringent than requirements faced by the electricity sector. To ensure a smooth transition, target setting for existing legacy hydrogen plants will require different considerations whereas most new hydrogen projects, including those serving transportation markets, participating in hydrogen hub projects, or pursuant to the state's incentive programs will already be green, clean or otherwise low carbon. We also note that, even under SB 100, based on the latest modeling reflected in the 2021 SB 100 Joint Agency Report or Final Scoping Plan, significant GHG emissions are expected to persist in the electricity sector through mid-Century. The modeling in these reports shows emissions of ~24 $MMTCO_2e$ in the electricity sector in ~2045, even as the State complies with SB 100.[5] This would represent about a 45-60% reduction from current emissions in the sector and means electricity sector emissions in 2045 would be just slightly lower than emissions from the whole of the refining and hydrogen production sectors today.[6] Hydrogen production should not be held to a higher standard than the electricity sector, including a 100% renewable/zero carbon requirement if the electricity sector is hardly expected to meet that itself.

- **Expand Senate Bill 100 analysis of hydrogen**. We strongly support this recommendation. As just noted, the State's current approach to SB 100 and reliability is to continue relying on legacy natural gas power plants, with little effort to decarbonize them. These plants can be decarbonized, however, including through the use of hydrogen, and they can be decarbonized much more rapidly than in 2045 or later. We strongly support the CEC taking a deeper dive to evaluate how existing gas plants can be quickly decarbonized to significantly

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[5] Because SB 100 only applies to retail electricity sales, rather than all generation, modeling shows a continued reliance on existing natural gas power plants to bolster grid reliability even while achieving 100% clean energy in terms of retail sales. For example, in the "SB 100 Core" of the 2021 SB 100 Joint Agency Report, electricity sector emissions fall from 48 $MMTCO_2e$/year in 2027 to 24 $MMTCO_2e$/year in 2045. In the recently finalized Climate Change Scoping Plan, all existing natural gas power plants are assumed to remain in operation through at least 2045.
SB 100 Report: https://www.energy.ca.gov/sb100
Scoping Plan analysis: https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-PATHWAYS-data-E3.xlsx

[6] Electricity sector emissions are 24 $MMTCO_2e$/year in 2044, before declining to 7 $MMTCO_2e$/year in 2045 after CCS is added to some plants. For context, electricity sector emissions were 60 $MMTCO_2e$/year in 2020, the most recent data available, and the Scoping Plan modeling estimates emissions in the sector to be 43 $MMTCO_2e$/year in 2023. Refining and hydrogen production emitted 26 $MMTCO_2e$/year in 2020 and 29 $MMTCO_2e$/year in 2019 (2020 emissions in the sector were likely lower than normal due to the impacts of COVID).
GHG Inventory:
https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/ghg_inventory_scopingplan_sum_2000-20.pdf

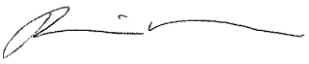
decarbonize the power sector above and beyond what is currently contemplated under SB 100. We hope CEC will begin taking a deep dive on these topics before the next SB 100 report is due, including over the next year as part of the SB 423 report and in future IEPRs.

- **Fully engage in the federal Hydrogen Hub initiative.** We strongly support this recommendation and again, appreciate reference to new and emerging opportunities, including green ammonia. We note that the opportunity there is not just production, but also use. Ammonia can also offer an exciting opportunity to export green hydrogen around the world, including from California and western states to markets in the Pacific or elsewhere. We encourage CEC to consider small changes to this recommendation, including the following:

> **"**A California Hydrogen Hub can leverage the significant investment the state has already made in hydrogen infrastructure to further the state's leadership in developing a low- carbon hydrogen economy that has potential to bring new types of industry, such as green ammonia production, use and trade, to California."

Thank you for the opportunity to comment on the Draft 2022 IEPR Update Report and thank you for including hydrogen as an important emerging topic. We appreciate your consideration of these comments and look forward to working with you on these issues moving forward.

Sincerely,



Miles Heller
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