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Rajinder Sahota, Deputy Executive Officer for
Climate Change & Research
California Air Resources Board 1001 I Street
Sacramento, CA 95814

Comments submitted electronically

RE: Comments Related to the 2022 AB-32 Scoping Plan Update November 2, 2021 Electricity Technical Workshop

Dear Ms. Sahota,

Air Products is pleased to provide comments in support of CARB's 2022 update of the AB 32 Scoping Plan. We support California's climate goals and believe that Air Products can help California with the energy transition needed to meet these challenges.

Air Products is the only U.S.-based global industrial gas company, in operation for over 80 years and with operations in more than 50 countries around the globe. 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 (including oxygen for COVID response). Approximately 20,000 employees globally work to make Air Products the world's safest and best performing industrial gases company, providing sustainable offerings and excellent service to our customers.

Worldwide, Air Products is the largest hydrogen producer with over 8,000 metric tons per day of production capacity and over 1,800 miles of industrial gas pipelines. Within California, the company safely operates 9 hydrogen production facilities, 35 miles of hydrogen pipeline and currently supplies a network of light-duty and heavy-duty transit bus hydrogen fueling stations, facilitating the transition to carbon-free transportation. In fact, Air Products has supplied a majority of the hydrogen used in the California mobility market to date.

Air Products is committed to meeting the world's carbon reduction and energy transition challenges at scale. As an example, we have announced the world's largest green hydrogen project – a $5 billion project that will deploy nearly five times more electrolyzer capacity than had been installed globally at the time the project was announced. Our company has committed an additional $2 billion to develop the distribution and refueling infrastructure to bring this fuel to mobility markets around the world.

We have also announced the world's largest carbon capture and sequestration (CCS) project in Louisiana, along with a net-zero carbon blue hydrogen project in Alberta, Canada. The Louisiana project represents a $4.5 billion investment in a new clean energy complex. This project

demonstrates Air Products' ability to not merely capture the carbon dioxide, purify, and compress for sequestration, but also includes the development of the sequestration site, injection wells, and compliance with all monitoring protocols by Air Products. The project in Canada represents a $1 billion investment and deploys CCS coupled with an innovative design and advanced technology to minimize emissions of both greenhouse gases and criteria air pollutants. Air Products' hydrogen supply and distribution capabilities stand ready to contribute to achieving California's air quality and greenhouse gas reduction goals.

Workshop Feedback

We appreciate the breadth and depth of information that was presented at the workshop, which covered numerous important aspects of decarbonizing the electricity grid and builds on CARB's thoughtful and deliberate public process related to development of the 2022 Scoping Plan Update. Still, we feel that hydrogen and CCS both deserve greater focus and evaluation in the electricity sector and all other sectors. Both hydrogen and CCS should play a role to more quickly decarbonize segments of the economy, including those that cannot be easily or quickly electrified, and they are essential to achieving carbon neutrality – and ultimately, net-negative greenhouse gas emissions. Specific comments on the workshop and slides are provided below.

Role of Hydrogen in Grid Decarbonization

Hydrogen and CCS are clearly important technologies to help decarbonize the electricity grid and meet SB 100 goals while ensuring reliability at the lowest possible cost. We were heartened to see initial carbon neutrality scenarios from CARB and E3 rely on hydrogen to decarbonize the electricity grid and achieve zero emissions from in the sector.[1] We encourage CARB to continue focusing on hydrogen as a key, zero carbon firm energy resource in its Scoping Plan modeling, and recommend that CEC and CPUC incorporate hydrogen more explicitly in their efforts, as well.

The presentations by CPUC and CEC did not include a specific focus on hydrogen in the electricity sector. The CPUC presentation titled "CPUC Perspectives on Electric Sector Decarbonization" indicates that power generated from hydrogen fuel cells is an imperceptible amount of the grid mix in slide 7 and direct combustion of hydrogen for power generation is not even contemplated. Similarly, in the CEC presentation titled "Achieving 100% Clean Electricity in California" illustrates this same outlook for hydrogen on slide 7 of their presentation. And yet, the CEC highlights that solar/wind build rates need to triple and battery build rates need to increase eight-fold. Hydrogen integration into the power grid can moderate these build rates and provide additional reliability.

In contrast, the presentation by Jack Brouwer from UCI, titled "Hydrogen & Fuel Cells for Zero Emissions Electricity" did an excellent job of discussing the role that hydrogen can play in decarbonizing the grid: and moreover, its role in the energy transition. Pursuing an

[1] E3 (2020) Achieving Carbon Neutrality in California: PATHWAYS Scenarios Developed for the California Air Resources Board, October. https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_report_oct2020_0.pdf

electrification-only pathway requires a tripling of the infrastructure and then doubling again to accommodate full electrification of transportation. This has been highlighted in a number of additional reports, as well, including the SB 100 report itself, which shows enabling firm, zero carbon resources cuts overall resources build significantly, as well as total costs associated with meeting SB 100 goals. And slide 11 of the CPUC's presentation indicates that "without clean firm power, the CAISO system would need a renewable build-out equivalent to half the existing generation capacity of the entire United States".

Hydrogen can and should play an important role in reducing emissions from firm and dispatchable power plants needed to balance the grid. Hydrogen can both replace fossil natural gas in direct power generation and provide longer-duration, multi-day and seasonal energy storage as more renewable resources are placed on the grid. Both roles improve grid reliability which makes hydrogen an essential energy resource for the state's electrical grid.

It can also serve to reduce emissions beyond current trajectories under SB 100. In the SB 100 report modeling[2], virtually all natural gas power plants are kept online through 2045 and beyond to provide grid reliability. The result, according to the analysis, is 24 $MMTCO_2$ emissions in the power sector in 2045 and beyond, even in an SB 100-compliant scenario. These power plants can be decarbonized, too, however, and we encourage CARB and other agencies to consider the role that hydrogen can play in more quickly and deeply decarbonizing the electricity sector, while ensuring grid reliability is maintained.

CARB Scoping Plan scenarios should include all available technologies, including the use of hydrogen in existing and new power plants, to quickly and reliably decarbonize the electricity sector. We also urge CARB to work with the CEC, CPUC and CAISO to incorporate hydrogen quickly and effectively into electricity sector planning and related programs.

<u>Role of Hydrogen Coupled with CCS</u>

We thank CARB for including the information from EFI-Stanford presentation, titled "An Action Plan for Carbon Capture and Storage in California: Opportunities, Challenges, and Solutions" regarding CCS opportunities in California as we believe that it will play an important role in meeting CARB's decarbonization goals. Specifically, for hydrogen, deployment of CCS can substantially reduce the carbon intensity of hydrogen regardless of whether the hydrogen is used to improve the carbon emissions profile of conventional fuels, renewable fuels, or as a direct substitute for those fuels in transportation or heavy industry sectors. It can deliver these significant, near-term GHG reductions without further straining the grid or competing with renewable power development needed to meet SB 100 goals.

As mentioned above, California is already facing challenges in grid reliability for the foreseeable future, and the energy agencies' SB 100 report suggests that "record-breaking" renewable energy development is needed over the next 25 years to meet SB 100 goals. What's more, in a 1.5°C

[2] 2021 SB 100 Joint Agency Report

climate scenario, Bloomberg New Energy Finance estimates that more electricity would be needed just to power electrolyzers than is currently produced in the world, and that many regions would lack sufficient land for the renewable power required, necessitating a global trade of green hydrogen.[3] If we require or expect hydrogen to be produced from renewable electricity in the near-term, or expect it to be produced in-state or even in the western United States, we will only be competing with the resources needed to maintain grid reliability now and meet our SB 100 goals, while limiting our opportunities to decarbonize our economy now – both in California and globally.

In contrast, hydrogen production with CCS can satisfy the near-term carbon reduction and air quality improvement goals while hydrogen demand and renewable energy supply can grow in parallel. Deployment of hydrogen produced using CCS concurrently with development of decarbonized electrolytic hydrogen will accelerate carbon reductions in multiple sectors sooner than if either technology were exclusively favored.

Hydrogen Blending in Legacy Natural Gas Pipeline Systems

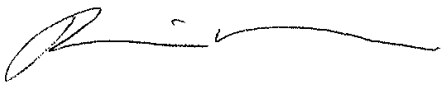
While the presentation from UCI touched on the research necessary with hydrogen blends, Air Products wants to reiterate comments made previously in our September 3, 2021 letter regarding modeling scenarios. Any assumptions that CARB contemplates in the Scoping Plan for blends of hydrogen into the natural gas system for residential and commercial use needs to recognize that limitations to this blending exist in terms of pipeline materials, component materials and function (i.e., meters) and impacts on end user equipment and appliances (different flame patterns, flame temperature with associated NOx increases, heat transfer requirements, etc.). Additionally, because of the lower energy density of hydrogen, more volume is needed which may create constraints in the system that require expensive retrofit.

As the world's largest and most experienced operator of hydrogen pipelines, we encourage the state to support a competitive marketplace for hydrogen production and delivery, and not assume that the use or conversion of the existing natural gas pipeline network is necessarily the most effective way to deliver zero-carbon hydrogen at scale. Safety, pipeline integrity and impacts to end-users of blending must be understood before incorporating this into planning documents.

Both hydrogen and CCS will play a key role to meet the State's deep decarbonization goals and can enhance grid reliability relative to a full electrification approach. It is important that CARB recognize the value of these technologies in their Scoping Plan scenario planning. Air Products appreciates the opportunity to provide this feedback and would be happy to meet with CARB to provide additional details related to scenario development. Please feel free to contact me by phone (916-860-9378) or email hellermt@airproducts.com.

[3] https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf

Respectfully,



Miles Heller
Director, Greenhouse Gas Government Policy