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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 September 30, 2021 Scenario Inputs 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 US based global industrial gas company, in operation for over 80 years 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 19,000 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 supplies ~80% of the hydrogen currently used in the California mobility market.

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 in Saudi Arabia. This $5 billion project 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 carbon capture and sequestration (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 California's achievement of its carbon reduction goals.

California is a recognized global leader in setting policies to reduce carbon. With strong policies combined with its large market, California can create the global-scale projects needed to achieve cost-effective scale for low- and zero-carbon hydrogen. As part of a global decarbonized hydrogen market, California can support projects in and around the state's ports and in all applications where hydrogen is used. **All scenarios CARB considers for the Scoping Plan Update should provide for this future and include hydrogen as a zero-emission fuel and clean energy resource.**

Specific Scenario Comments

In addition to the feedback, we provided in our letter related to the Scoping Plan scenarios dated September 3rd, 2021, Air Products offers the following feedback on select scenario proposals referencing the draft Scoping Plan Scenarios Assumption Document.

Overall Approach:

Air Products supports CARB's proposal to evaluate a range of implementation timeframes for achieving carbon neutrality in the modeling. It is important for CARB and all stakeholders to understand the opportunities and impacts associated with an accelerated schedule. "No regrets" policies that enable near-term reductions, but also create opportunities for the future energy transition, should be integral to the modeling. One thing that is clear, is that the faster the state moves to decarbonize industry and other hard-to-abate sectors through strategies like green hydrogen and CCS, the faster the state can achieve carbon neutrality. Further, ultimately achieving net-negative emissions, per Executive Order B-55-18, unequivocally requires the state to support and advance strategies including CCS.

Support for solutions that increase demand for hydrogen is one clear example of a no-regrets strategy. Hydrogen produced today using conventional steam methane reforming technology and natural gas provides over a 30% improvement in carbon intensity when compared to conventional transportation fuels,[1] and zero criteria and toxic vehicle exhaust emissions – bringing much needed air quality and health benefits to disadvantaged communities. Scenarios and policies that encourage additional hydrogen production, infrastructure, and use today provide both near-term emission reductions and enable a faster transition to even lower carbon hydrogen energy in the future.

Scenario Specific Comments and Questions:

[1] Union of Concerned Scientist "How Clean Are Hydrogen Fuel Cell Electric Vehicles" Fact Sheet (September 2014)

We appreciate that CARB has recognized a role for hydrogen in many source categories across multiple sectors and modeling alternatives, signaling that it will play a key role in the energy transition. Hydrogen currently plays an important role in improving the environmental performance of conventional fuel and is a key feedstock for production of renewable fuels. Going forward, hydrogen should be the primary energy carrier for medium and heavy-duty transport, high heat industrial applications, firm power production, long duration and seasonal energy storage, low carbon fertilizer, and decarbonized aviation, shipping and rail.

Because hydrogen currently plays such an important role in the energy mix and will only grow in demand as the state decarbonizes, it would be helpful in the alternative scenarios to include a distinct industrial source category for hydrogen production and that can link to the other source categories where demand is predicted over the modeling analysis period. This would support a broader assessment of hydrogen and a strategy to decarbonize it – which, while SB 18 ultimately did not pass, is still appropriate and would help to position California among global leaders in planning around hydrogen development.

Additionally, it is not clear in the proposed alternatives whether existing hydrogen production plants are included in the "chemicals and allied products, pulp and paper" category or the "other industrial manufacturing" category. Specifying the desired emission reduction technology for existing plants and improvements in the carbon intensity of hydrogen for the various end uses would help inform the modeling over this planning horizon.

There are also important interactions with other source category impacts. For example, if it is assumed that all existing and new hydrogen production is replaced with hydrogen produced electrolytically with in-state with renewables, then the impact on the grid, demand for renewable power, and associated land use and other impacts would be significantly greater than if some hydrogen is produced utilizing CCS. Similarly, the role of imported hydrogen relative in-state production should be explored in the modeling scenarios based on the substantive demand predicted. Separately specifying a range of hydrogen production options and related carbon intensity in the alternatives will improve the modeling output and enable greater visibility into the possible market interactions between different energy carriers.

<u>Alternative 1</u>

While we understand CARB's intention to model an aggressive scenario as outlined in Alternative 1, we suggest that for any source category where reduced production or forced relocation out of state is assumed that the modeling analysis include quantification of associated emission leakage and inclusion of technology alternatives that could mitigate such leakage and reduce emissions from these sources in-state. For example, low carbon hydrogen should absolutely play a role in decarbonizing those industries that require very high heat (e.g., cement, steel, glass, tile) and that currently use natural gas as their fuel. California should not forgo the emission reductions and the fossil fuel displacement in these industries that can be achieved with a suitable fuel like low carbon hydrogen or assume that the state will impose any remaining emissions associated with its consumption of these

products on other jurisdictions, even in CARB's most extreme scenario. Allowing, assuming, or requiring this production to move out of state will not achieve the desired climate benefits.

Similarly, in the power sector, hydrogen should be available as a fuel source for power production in all alternative cases – even as a combustion fuel in alternative 1. The SB 100 Joint Agency Report asserts that most of the State's natural gas fired power plants will continue to be needed - even through 2045 - to provide grid reliability. Hydrogen can replace this natural gas demand consistent with the decarbonization goals of the state to provide firm power and should not be excluded from consideration because it is used in an existing or new thermal power plant.

Light Duty Vehicles and Trucks

Air Products is supportive of the modeling scenario options proposed by CARB and the emphasis placed on true zero-emission technologies for transport. It is important to send a strong policy signal for these markets to flourish and provide the emission reductions in disadvantaged communities; and not dilute this signal by providing near-zero emission vehicle equivalency for natural gas-powered vehicles.

Regulations requiring the production and sale of all classes of zero emission vehicles (ZEV) are only part of the equation. If CARB is to model accelerated ZEV scenarios, it is important to make sure policies are in place to support deployment on an accelerated scale, including appropriate incentives and infrastructure. With respect to hydrogen fuel cell electric vehicles (FCEV), refueling infrastructure must include dedicated hydrogen fuel production for the transportation market as well as hydrogen refueling station coverage and capacity.

Aviation

None of the alternative scenarios 2-4 mention the use of renewable jet fuel. Is this assumed to be the balance of what is not specified and offset with carbon dioxide removals, or is this covered in the "low carbon fuels for transportation category"?

Ocean-Going Vessels

We are supportive of CARB's scenarios to advance zero-emission technologies in shipping – particularly in alternatives 2 and 3. Because hydrogen fuel cell technology does not involve combustion, we suggest that Alternative 1 rely on fuel cell technology for portion of the unmet fuel demand in 2035 at a level at least consistent with Alternative 2. Secondly, we question the localized grid impacts in Alternatives 1 and 2 from the significant reliance on 100% shore power, particularly considering the increased reliance on electrification for many other source categories. CARB should provide a more balanced penetration of technologies between hydrogen fuel cell technologies and electrification for these alternative scenarios in the modeling.

Lastly, CARB should include an option for low-carbon ammonia (NH_3) for use in shipping, as well as other sectors like agriculture. Many shipping companies are already looking to convert to ammonia to reduce both climate and criteria emissions impacts from their operations. As an example, 23

companies across diverse industries, including Kawasaki Kisen Kaisha (K Line), Genco Shipping & Trading, Anglo American, Itochu, Mitsui E&S, Nihon Shipyard, Trafigura, TotalEnergies, Equinor and DNV have joined forces to initiate a joint study on ammonia as an alternative marine fuel.[2] Additionally, the Global Maritime Forum has an initiative to study opportunities, including ammonia, to decarbonize shipping via their Getting to Zero Coalition work.[3] For the agriculture sector, companies like Nutrien[4] are looking to lower the carbon intensity of fertilizers via low carbon ammonia. The Scoping Plan scenarios should promote opportunities for low carbon ammonia in both the shipping and agriculture sectors.

Freight and Passenger Rail

Air Products appreciates the specific inclusion of hydrogen fuel cell technology for line haul and passenger rail. While we recognize that CARB is limited in its ability to directly regulate interstate rail, we do note that the descriptions of the scenarios focus solely on sales targets. Because locomotive engines have a long lifespan, we encourage CARB to include financial incentives in the alternatives to spur fleet turnover faster than what would otherwise occur.

Role of Carbon Capture and Sequestration (CCS)

Air Products supports CARB's inclusion of CCS in the alternatives for scenario modeling for large stationary sources. All carbon emission mitigation, including removal, is going to be needed to meet CARB's climate goals and it is indisputable that support for CCS will accelerate achievement of carbon neutrality in the state and maximize potential net-negative emissions opportunities to begin to undo the impacts of climate change

We encourage CARB to fully explore the air pollution co-benefits associated with CCS in its Scoping Plan and associated air quality modeling, and to avoid assuming that stationary sources of combustion are incompatible with the state's environmental goals. A hydrogen power plant or production facility with CCS may have zero or de minimis levels of toxic air contaminant and particulate matter emissions, and significantly lower NOx emissions. CCS and hydrogen used in stationary sources can deliver significant criteria and GHG reductions to help CARB meet its climate and air quality goals. In fact, hydrogen produced using biomass coupled with CCS is the only hydrogen production technology that can produce negative carbon emissions. Additional analysis will help elucidate these benefits further.

Industrial Sources

We note that "construction" is listed as an industrial source category, though much of the emissions in the construction industry are associated with mobile sources that are already covered in distinct categories. Please clarify what type of sources are covered by this category and why electrification is the sole technology specified for emission reduction.

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[2] Cross-industry players team up to unlock ammonia as marine fuel - Splash247

[3] Getting to Zero Coalition (globalmaritimeforum.org)

[4] Low-Carbon Fertilizer | Our 2030 Commitment | Nutrien

For the "combined heat and power category", what types of facilities are included? Does this include industrial cogeneration facilities? For alternative 1, the statement requiring 50% waste heat demand electrified is confusing. In some cases, waste heat is converted to electricity creating power supply, but does not add to demand. Please clarify what is meant in Alternative 1 for this category of sources.

Low Carbon Fuels for Transportation

Please clarify if the hydrogen fuel use referenced in Alternatives 2-4 is only in respect to hydrogen produced from biomass or all low carbon hydrogen production methods.

Low Carbon Fuels for Buildings and Industry

Since other source categories indicate that both residential and commercial buildings will essentially be electrified in all alternatives over the same time-horizon, please clarify what buildings are being addressed for the use of hydrogen blended into natural gas for this category.

We note that Alternatives 2-4 suggest a 7% blend level for hydrogen in natural gas that is "ramping up between 2030 and 2040". Is it ramping up to 7% between 2030 and 2040, or starting at 7% and ramping up to some unspecified blend percentage in that same time-period? In the first case, it would be important to know when blending is first envisioned to begin and at what level. For the latter case, it would be important to know what level to which it is expected to ramp?

For Alternative 1, what hydrogen production process is envisioned for converting RNG to hydrogen to produce the electrification needed for the buildings and industrial uses?

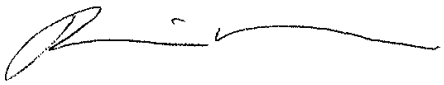
We want to reiterate that any scenarios that CARB contemplates involving blending of hydrogen into natural gas for residential and commercial use needs to recognize that limitations to this blending exist in terms of pipeline materials, component materials and function (i.e., meters) and impacts on end 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.

Lastly, Air Products strongly supports the inclusion of dedicated hydrogen supply for industrial clusters as a replacement for natural gas. In fact, we safely operate several hydrogen hubs today where hydrogen production is connected via dedicated pipelines to various industrial end-users. In the future, we envision growing hydrogen hub infrastructure as being critical to supporting California and global climate objectives by connecting new, global, hydrogen supplies with local and growing demand

centers in a market framework. Private companies will play a critical role in growing both low-carbon hydrogen supply and demand with the interconnected infrastructure that is needed to facilitate the hydrogen energy transition at scale.

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.

Respectfully,



Miles Heller
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