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January 5, 2021

Cheryl Laskowski, Chief, Transportation Fuels Branch
California Air Resources Board 1001 I Street
Sacramento, CA 95814

Comments submitted electronically

RE: Comments Related to the December 7th Low Carbon Fuel Standard Workshop

Dear Ms. Laskowski,

Air Products is pleased to provide comments in support of CARB's planned rulemaking for the Low Carbon Fuel Standard (LCFS). The LCFS is a very successful, performance-based program in helping to transition California's transportation fuels to cleaner, low-carbon alternatives and we strongly support its continued strengthening through this rulemaking. Low-carbon hydrogen will play a key role in the energy transition and continuing to decarbonize transportation fuels in California, and it is important that the LCFS provide the necessary and appropriate, technology-neutral framework to advance this opportunity. 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, the only U.S.-based global industrial gas company, has been in operation for over 80 years and has 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 nine 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 and zero emission vehicles, in line with California's goals. 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, and Air Products recently

signed a contract with thyssenkrupp Uhde Chlorine Engineers to supply a more than two-gigawatt (2 GW) electrolysis plant for the project. 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. This facility will provide approximately 650 metric tons per day, or enough hydrogen to fuel roughly 26,000 buses or 13,000 Class 8 trucks every day.

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, which will produce approximately 1,800 metric tonnes per day of blue hydrogen in Louisiana or enough hydrogen to fuel roughly 72,000 buses or 36,000 Class 8 trucks every day. This U.S. project also includes the capture and permanent sequestration of over five million metric tons per year of carbon dioxide. 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.

Feedback on Concepts Shared

Amendment Timing

While we understand staff's desire to coordinate this rulemaking with the important feedback and outputs from the 2022 Scoping Plan modeling work and board direction, we ask that the LCFS regulatory development occur at the earliest possible point in the process and in parallel with the scoping plan development to the extent feasible. Many of the potential concepts CARB discussed and that we support, as discussed below, could progress substantially with language drafted for review well ahead of the finalization of the Scoping Plan. A parallel process would enable release of the 45-day package at the earliest possible date in 2023 or even upon finalization of the Scoping Plan in late 2022. And while some implementation aspects, like revised annual carbon intensity targets, need to be implemented coincident with a new calendar year (i.e., 2024), we urge CARB to implement as many amendments as possible upon adoption in 2023 so that associated emissions benefits from the program and of deploying lower carbon alternative fuels can be realized as soon as possible.

Program Stringency

CARB indicated a willingness to review the stringency of the annual targets ahead of 2030. While the 2022 Scoping Plan Update will provide important inputs to these targets both before and after 2030 consistent with the statewide reduction targets and carbon neutrality goal recently sustained, lower LCFS credit prices indicate that the targets should be strengthened in the near-term. The credit prices have been falling throughout 2021 and have been averaging around the $150/mt level in the last two months of 2021 – well below historic levels, while project developers have been expecting to develop new projects at the price ceiling contemplated in the regulation. We believe this is an indication of the success of the program in driving alternative

fuel growth and fossil-based transportation fuel displacement. However, to send a strong market signal to incentivize the lowest carbon fuels and more conventional fuel displacement, we urge CARB to propose near-term reductions in the carbon intensity levels and longer-term reductions consistent with the state's carbon neutrality targets.

Opportunities for Lower Carbon Hydrogen

We applaud CARB's willingness to expand opportunities for low-carbon hydrogen to be used both as a fuel and feedstock in ways that maximize the environmental reductions attributed to the low-carbon hydrogen. Providing a 'book and claim' accounting approach is essential for hydrogen that is transported in multi-source/multi-use distribution systems where lower carbon hydrogen is comingled with conventionally produced hydrogen. This approach will support near-term development of low-carbon hydrogen projects and ensure that the low-carbon attributes of the hydrogen are retained and applied to end-uses where the most environmental benefit can be derived and sends the necessary long-term signal that low-carbon hydrogen plays an important role in decarbonizing transportation. Robust accounting protocols, similar to those used to track biogas, renewable power, and EV charging, can be easily applied to hydrogen to ensure that these attributes are appropriately tracked and the integrity of the LCFS is maintained with no double counting of credits.

It will be important that the provisions allow the environmental attributes of hydrogen at varying carbon intensities to be tracked and credited consistent with a variety of end uses including, but not limited to:

- Hydrogen dispensed to fuel cell vehicles.
- Feedstock to produce renewable fuels like renewable diesel, gasoline, or alternative jet fuel, including co-processed renewable fuels.
- Feedstock to conventional fuel production via the refinery investment credit provisions.

In addition, we ask that CARB consider applying this same 'book & claim' approach to hydrogen that is transported in the form of ammonia (NH3) – essentially enabling the environmental attributes to be retained by the low-carbon hydrogen in the form of NH3 and comingled with other forms of NH3 in transportation systems (i.e., pipelines, vessels). NH3 is an established, globally traded commodity and is an efficient transport method for hydrogen over long distances. In their Net Zero by 2050 roadmap, IEA[1] and others have documented these advantages and have even identified low-carbon NH3 as a promising way to decarbonize the global shipping industry when used as a fuel. By enabling low-carbon attribute tracking for both hydrogen and NH3, the LCFS will be well positioned to advance hydrogen for decarbonization of all transportation end uses in the energy transition.

CARB's proposal to clarify that hydrogen production facilities not co-located with a refinery can generate credits under the refinery investment credit provision is an important clarification and provides equitable treatment between third-party hydrogen production and production embedded in refinery operations. Air Products is supportive of this clarification and believes this

[1] Net Zero by 2050 - A Roadmap for the Global Energy Sector (windows.net)

should apply to all provisions under the refinery investment credit provisions – including use of low-carbon electricity in third-party hydrogen plants.

On slide 17, CARB indicated consideration of preferential allocation of low-carbon hydrogen to specific fuel pathways used for reporting. Air Products views this as complementary to the expanded 'book and claim' provisions and believes that environmental attribute tracking and apportionment is important both within and without the hydrogen plant production process. The use of low-carbon electricity or feedstock, like renewable natural gas, should be apportioned to produce low-carbon hydrogen that can then be apportioned by volume to the most beneficial downstream uses – whether as a fuel or a feedstock. This apportionment should then continue, in the case when hydrogen is used as a feedstock, to the renewable or conventional fuel use and assigned to fuel that is consumed in the state of California. The environmental attributes should not be 'diluted' through averaging if some portion of the produced fuel is exported from the state.

Tier 1 Simplified Calculator

Air Products appreciates CARB's consideration of a Tier 1 Simplified Calculator for hydrogen and encourages CARB to pursue robust engagement with the hydrogen production sector so the full range of hydrogen production pathways can be considered, and the most accurate and consistent information can be incorporated into the calculator. We also ask that CARB include optionality in this calculator for the use of NH3 as a long-distance hydrogen carrier. We stand ready to contribute to this effort in cooperation with CARB staff.

Expansion of Hydrogen Refueling Infrastructure Credits to Medium and Heavy-Duty Vehicles

One of the most important concepts mentioned by CARB at the workshop was the expansion of hydrogen refueling infrastructure (HRI) credits to stations serving medium and heavy-duty vehicles. Air Products strongly supports this expansion. The current HRI program, in combination with other California incentives, has been very effective in promoting the infrastructure build-out in support of zero emission fuels and vehicles. It is important that CARB build on this success by expanding the program to truck and bus markets. This expansion will complement CARB's ambitious goals under the Advanced Clean Truck (ACT) regulation, the proposed Advanced Clean Fleet (ACF) regulation and help advance the state's goals for zero-emission vehicles in line with Executive Order N-79-20. During ACF regulatory workshops, one of the consistent concerns expressed is the availability of refueling infrastructure and the LCFS, with its proven record of success in this area, can play a very important role. This is especially true given CARB's proposal to enable both private and public medium- and heavy-duty infrastructure access to these important HRI credits in the regulation. Many of the fleets covered by the ACF will be privately operated with private fuel stations that can benefit from the incentive the LCFS offers, and we strongly support allowing HRI credits for both public and private medium- and heavy-duty hydrogen refueling stations.

Model and Emission Factor Updates

Air Products supports CARB updating the CA-GREET model to the latest version (GREET 2021) from Argonne National Labs. There have been important changes to emission factors related to hydrogen production supply chains and the production of ammonia produced using renewable electricity as a couple of key examples. Equally important is the need to update the grid carbon intensities consistent with the current grid mixes across the country as the mixes have generally improved as lower carbon generation sources have replaced coal-fired generation. In many cases, the carbon intensity estimates for electrical energy are overstated, which burdens the fuel or feedstock with higher resulting carbon intensity pathway values. Moreover, an accurate and current accounting of electricity carbon intensity should be applied not only to electrolytically produced hydrogen and balance of plant operations, but also extended to all aspects of hydrogen production and processing (i.e., liquefaction). Providing for annual updates as the CA-grid mix improves for all parts of the hydrogen supply chain will ensure that lower carbon hydrogen will be incented and promoted for use in California.

CARB also mentioned updating references to the latest Energy Economy Ratios (EERs) for fuel cell vehicles. Air Products supports these updates to enable the most accurate accounting of the greenhouse gas reductions associated with the use of hydrogen as a transportation fuel.

Future Workshop Topics

Co-Product Allocation

Air Products recommends CARB clarify the basis for allocating the carbon footprint to co-products when one will be used as a low-CI feedstock in a fuel pathway or used as a fuel directly. Air Products is aware of a generally accepted concept of allocating emissions between products according to their respective energy content. There are examples, however, where this may not represent the most appropriate basis when the co-products are not both “energy” streams. In these cases, an economic allocation may be more appropriate. We request that CARB include this as a topic at a future workshop to explore option further.

Biopropane and Low-Carbon Hydrogen Synergy

While commonly utilizing fossil methane, other hydrocarbons can be reformed to produce hydrogen. In the same way that biomethane and renewable natural gas can be a low-CI substitute for fossil natural gas, biopropane/renewable propane can serve the same purpose, reducing the carbon-intensity of hydrogen produced from that feedstock. The opportunity to utilize biopropane is particularly attractive where renewable diesel production generates a co-product propane stream that is a suitable feedstock for low-carbon hydrogen production. In a virtuous cycle, this low-carbon hydrogen can then be used as a feedstock for the production of the renewable diesel fuel. Similar to the ‘book and claim’ approaches discussed above, it will be important that the portion of hydrogen produced from this biopropane feedstock retain its low-carbon attributes and be apportioned by volume to the renewable diesel plant if transported through a comingled hydrogen pipeline system.

Carbon Capture and Sequestration (CCS)

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. The LCFS provides an important signal for reducing carbon emissions from projects that deploy CCS for both conventional and low-carbon alternative fuels.

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.

In prior comments submitted to CARB in November 2020, Air Products highlighted several ways that the certainty and emission reductions for CCS projects can be improved. These are listed in bullet form for brevity, but we recommend a future workshop dedicated to this topic to explore these and other improvement concepts more fully.

- Additionality criteria for legacy CCS projects
- Clarify opportunities for the CCS project operator to be sole holder of the permanence certificate
- Clarify transferability of permanence certificate
- Improved clarity for CCS buffer account contributions when CCS protocol is employed for low-CI fuel production (i.e., renewable diesel production)
- Allow administrative controls to prevent future drilling in storage complex
- Expand the applicability of the CCS protocol to offshore storage reservoirs

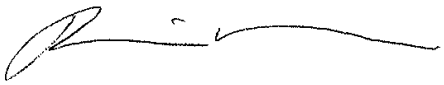
SB-1505

We suggest that provisions or guidance related to ensuring compliance with the renewable hydrogen requirements envisioned by SB-1505 be discussed at a future workshop. These provisions will be particular important as hydrogen use expands via heavy-duty HRI credits.

Closing

In the workshop, CARB proposed many concepts that will improve the LCFS and promote lower carbon hydrogen applications in California. Air Products strongly supports these important concepts and appreciates the opportunity to provide this feedback. We would be happy to meet with CARB to work through draft language to realize these concepts. Please feel free to contact me by phone (916-860-9378) or email hellermt@airproducts.com.

Respectfully,



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