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Steven Cliff, Ph.D.
Chief - Climate Change Market Branch
California Air Resources Board
1001 I Street
Sacramento, CA 95812-2828

Sent Via Email

Dear Dr. Cliff:

Praxair, Inc., (Praxair)[1] provides the following comments on the *January 31, 2014 Discussion Draft of Potential Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms* ("January 31st Discussion Draft"). As discussed below, Praxair requests that the Air Resources Board ("ARB") update the emissions benchmark specified in Table 9-1 for liquefied hydrogen to reflect the best in class liquefied hydrogen facility in California. The liquefied hydrogen benchmark should not account for gaseous hydrogen facilities. Liquefied hydrogen is a unique and distinct product from gaseous hydrogen. Liquefied and gaseous hydrogen facilities are structurally different, and the ARB's regulations should explicitly recognize that differentiation. Praxair has also separately provided the ARB with certain emissions and product data per the ARB's request on page 157 of the January 31st Discussion Draft.

DISCUSSION

In the current iteration of the Cap-and-Trade Rulemaking process, the ARB has endeavored to recognize the diversity of California's economy. For example, the revised regulation would recognize the different types of food processing. The ARB would also distinguish between different types of refineries. Specifically, the ARB would provide two different emissions intensity benchmarks for "typical" and "atypical" petroleum refining.[2] Even though typical and atypical refineries produce similar products, the processes are structurally different, and hence merit different benchmarks. Like the food processing sector, liquefied and gaseous hydrogen have different demands and uses for their products, and similar to the refining sector, liquefied and gaseous hydrogen production are structurally distinct. Failure to recognize

[1] Praxair was founded in 1907 and became an independent publicly traded company in 1992. Praxair is a supplier of atmospheric gases and coating services business, and is globally recognized for its sustainability efforts (Dow Jones Sustainability World Index in each of the last 11 years, and World CDP Leadership Index for six consecutive years). In California, Praxair has 1000 employees at 80 locations and five production facilities: two atmospheric, two carbon dioxide, and one hydrogen.

[2] See proposed revisions to 17 Cal. Code Reg. Sec. 95891, Table 9-1 at p. 154.

the distinctions between gaseous and liquefied hydrogen would result in differing treatment for liquefied hydrogen as compared to other products that have unique, product-specific benchmarks under Table 9-1. This result would create a fundamental and arbitrary inconsistency in how the ARB is applying its policies for calculating emission benchmarks.

To avoid this result, the ARB should address the fact that liquefied and gaseous hydrogen are different products, have different demands and are produced by different types of facilities. As discussed below, there are three general structural differences between liquefied and gaseous hydrogen plants that justify developing a benchmark specific to California's liquefied hydrogen facilities.

1. *Liquefied and Gaseous Hydrogen Have Different Demands.*

Liquefied Hydrogen plants are smaller than plants producing gaseous hydrogen for use by refineries. This is because liquefied hydrogen plants are sized to meet the regional and fluctuating market demands for liquefied hydrogen. As such, liquefied hydrogen plants are typically 5 - 10% of the size of gaseous hydrogen plants serving refineries. Moreover, due to the predictable demand of refineries, gaseous hydrogen plants typically operate closer to their nameplate capacities, resulting in higher operating efficiencies. Liquefied hydrogen plants have less consistent demand, meaning they cannot consistently achieve the same operating efficiencies as gaseous hydrogen plants serving refineries. Thus, due to the completely different customers and demands for their products, liquefied and gaseous hydrogen plants have different GHG emissions intensities.

Liquefied hydrogen is also a separate and distinct product from gaseous hydrogen due to the handling of liquefied hydrogen after liquefaction, the scope of potential customers, and the manner in which distribution occurs. These distinctions are important because the new Mandatory Reporting Requirements direct liquefied hydrogen producers to report the quantity sold to customers. Since this information will be the basis for allocations, the development of a liquefied hydrogen benchmark must account for the quantity of product sold to customers.

Gaseous hydrogen is typically consumed close to the gaseous hydrogen production facility (such as in a refinery setting) and there are minimal commodity losses between what is produced and what is delivered to customers. On the other hand, there are commodity losses associated with the handling and delivery of liquefied hydrogen. Liquefied hydrogen is transported by truck and there can be losses due to the distance traveled, elevation, temperature and other factors. Since liquefied hydrogen producers must report the volumes sold to their customers under the Mandatory Reporting Regulation (and this information will be the basis for the allowance allocation), the liquefied hydrogen benchmarks must account for the delivered product. Developing a benchmark that is consistent with the reporting requirements is necessary to ensure that liquefied hydrogen is treated consistently with other Emissions Intensive Trade Exposed industries (e.g., glass manufacturing).

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2. *Liquefied Hydrogen Plants Do Not Achieve The Same Operational Efficiencies As Gaseous Hydrogen Plants.*

Second, there are differences in energy intensities of liquefied and gaseous hydrogen plants serving refineries. Liquefied hydrogen plants do not incorporate the same heat recovery technologies that are typically used by the large gaseous hydrogen plants designed to meet the more predictable and steady demands of refineries. Gaseous hydrogen plants are able to market waste steam for various applications in the refinery, whereas liquefied hydrogen plants do not have customers for their waste steam. Liquefied hydrogen plants also have a higher "heat leak unit value" (i.e., how much heat is lost per MT of hydrogen produced). This is because less hydrogen is produced compared to large refineries and liquefied hydrogen plants do not achieve the same operating efficiencies as gaseous hydrogen plants.

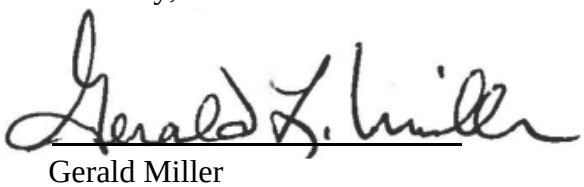
3. *Liquefied Hydrogen Has Greater Purity Requirements Than Gaseous Hydrogen.*

Liquefied hydrogen plants are structurally different due to the purity requirements for creating liquefied hydrogen. To produce liquefied hydrogen, the hydrogen feedstock from a Steam Methane Reformer ("SMR") must be purified to 10 ppm. By comparison, SMR's that serve refineries only have to have a purity of 1,000 ppm. To achieve the higher purity for liquefaction, the filtering process disposes of both hydrogen and impurities together. The impact of purifying the hydrogen is the loss of approximately 5.6% of the molecules created in the reforming process. This reduced volume of hydrogen increases the CO2 emissions per unit of hydrogen produced.

CONCLUSION

Praxair requests that the ARB recognize the distinctions between gaseous and liquefied hydrogen and develop an appropriate benchmark for liquefied hydrogen that is consistent with the ARB's analysis for other products. The ARB should base the liquefied hydrogen benchmark on the best-in-class facility in California, or average the emissions intensities of the California facilities and then multiply the average by a 90% efficiency factor. We appreciate your continued attention to this important issue and look forward to discussing these issues in the next iteration of this rulemaking.

Sincerely,



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