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Attn.: **California Environmental Protection Agency - Air Resources Board (ARB)**
Topic: **Feedback to "Hydrogen in the LCFS" – Public Working Meeting for Stakeholder Groups**

January 5, 2017

Nel Hydrogen appreciates this opportunity to provide input to the proposed updates and changes to "Hydrogen in the LCFS," as proposed by ARB in the Public Working Meeting for Stakeholder Groups on December 5, 2016.

Nel Hydrogen is a leading manufacturer of hydrogen production and fueling equipment, and is an active member of various organizations supporting the expansion of hydrogen for transport across California and the US, including the CaFCP, CHBC, FCHEA and H2USA.

We appreciate ARB's thorough, initial considerations and guiding questions to garner hydrogen stakeholder feedback, in addition to their continued administration and re-adoption of the LCFS in advancing renewable hydrogen in California.

Below and on the following pages, we have provided our input on selected topics.

Nel Hydrogen thanks the ARB for the opportunity to provide feedback to the LCFS. Should the ARB have any questions or need for further information on our feedback, we would be happy to assist.

Best regards
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1. Low participation of hydrogen in LCFS

Low participation in LCFS amongst hydrogen providers may be directly attributed to past and present low hydrogen sales volume in California, and thus low credit volumes available for purchase from most single providers. Attracting interested buyers of these low-volume credits may be the obstacle. Stakeholders required to offset carbon emissions under the LCFS may choose to focus on a few purchases of large credit volumes from stakeholders with conventional fuel production technologies who--due to higher market volumes--generate higher credit volumes.

This obstacle may be overcome by introducing a multiplier for hydrogen LCFS credits that would help increase the credit volume that can be offered. E.g., one (1) credit calculated

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and generated via a certain hydrogen pathway is multiplied by multiplier "X." The multiplier may vary according to the CI value of the hydrogen pathway – e.g., a lower CI uses a higher multiplier, thus incentivizing a transition to larger-volume renewable-hydrogen production. Increasing the volume of credits generated via hydrogen would also improve the business case for investments into hydrogen production and fueling, helping to evolve the industry as a whole.

This multiplier incentive could be reduced gradually as the volume of hydrogen fuel produced and dispensed increases – in order to address the potential issue that the incentive would make too substantial an impact on the credit generation in the overall LCFS market.

2. Removal of opt-in status for hydrogen in the LCFS

Both pros and cons of the proposed removal of the LCFS "opt-in" status should be considered by ARB.

"Opt-in" removal may help advance LCFS credit generation and advance the use of renewable hydrogen for transportation in California. Also, it would provide more straightforward and transparent documentation of renewable hydrogen content in California and compliance with SB 1505 – which is beneficial to the industry as a whole in advocating for the environmental benefits of hydrogen.

However, in the event that LCFS credit values and trading markets are reduced (or collapses, as with CO2 credits in Europe, for example), the administrative costs of reporting hydrogen LCFS credits may outweigh the financial gains. Instead, a mandatory LCFS reporting requirement for hydrogen would become an additional burden to hydrogen credit generators, as compared to other zero or near-zero emission transport technologies.

This issue could be addressed by both ensuring a lean reporting process (less costly) and increasing the value of hydrogen credits (by addition of a credit multiplier), as it would provide cushion or buffer in the event of low market prices of LCFS credits. See specific proposals in other sections in this document.

3. Station operators as first-in-line to generate credits

It is understandable and relevant that ARB wants to avoid potential double-reporting of hydrogen LCFS credits. Linking credit generation to both the quantity of hydrogen fuel dispensed and to the Station Operator appears to be a straight forward approach – should both ARB proposed changes regarding the *"first right of refusal to generate the credits"* for the Station Operator and the opportunity to *"contractually pass the opportunity to generate credits to the upstream producer"* be implemented.

It may also be relevant to explicitly define "Station Operator" as the entity who conducts the actual commercial sale of the dispensed hydrogen to consumers. This clear definition would prevent any confusion on the ownership of LCFS credits -- e.g., stakeholders providing the land lease (landlord) and/or lease of equipment (financial lease provider or equipment provider) would not be the "first-in-line" owner of the credits.

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4. New hydrogen lookup tables

Several aspects of the proposed ARB updates and additional Lookup Tables for electrolyser pathways should be considered.

The addition of additional electrolyser pathways is highly welcomed, in particular the pathway for offsite electrolyser production as this would enable connection to large scale renewables at lower costs.

The unique descriptions of the various pathways should not only be more explicit, but apply the same methodology across every pathway, particularly for process steps that are shared. For example, offsite hydrogen production via SMR or electrolysers should share the same distribution pathways and associated distribution CI values if the ARB suggestion of aggregating liquid and gaseous distribution pathways is implemented.

It is also unclear if the phrases *"includes liquefaction and re-gasification steps"* or *"No liquefaction and re-gasification steps"* outline whether production is offsite or onsite, and thus if distribution is included. If this is the case, the Hydrogen Lookup Table could be simplified by stating *"offsite (including distribution),"* or *"onsite (excluding distribution)"* instead (see examples in table below).

The suggestion to aggregate the pathways for liquid and gaseous hydrogen would help reduce the number of pathways. Additionally: the Lookup Table should not state the form/state of hydrogen in terms of "Compressed" as this would be irrelevant. Also a new, combined distribution related CI value would have to be calculated for the two distribution methods (gaseous and liquid), so only one value is used and added to the pathways for SMR or electrolyser offsite production.

These various changes are exemplified in the updated Look-up table below.

Pathways for Steam Methane Reformation	Pathways for Electrolysis
~~Compressed~~ H2 from reforming of NG ~~(includes liquefaction and re-gasification steps)~~ – Offsite (including distribution)	~~Compressed~~ H2 from electrolysis with average California grid electricity ~~(includes liquefaction and re-gasification steps)~~ – Offsite (including distribution)
~~Compressed~~ H2 from reforming of NG ~~(No liquefaction and re-gasification steps)~~ – Onsite (excluding distribution)	~~Compressed~~ H2 from electrolysis with average California grid electricity ~~(No liquefaction and re-gasification steps)~~ – Onsite (excluding distribution)
~~Compressed~~ H2 from reforming with NG process energy and 100% biomethane feedstock ~~(includes liquefaction and re-gasification steps)~~ – Offsite (including distribution)	~~Compressed~~ H2 from electrolysis with 100% renewable solar/wind electricity ~~(includes liquefaction and re-gasification steps)~~ – Offsite (including distribution)
~~Compressed~~ H2 from reforming with NG process energy and 100% biomethane feedstock ~~(No liquefaction and re-gasification steps)~~ – Onsite (excluding distribution)	~~Compressed~~ H2 from electrolysis with 100% renewable solar/wind electricity ~~(No liquefaction and re-gasification steps)~~ – Onsite (excluding distribution)

As a general note, it should also be possible for Station Operators to use and apply a mix of hydrogen supply pathways in their LCFS reporting – e.g., hydrogen dispensed at a station may be delivered from a variety of pathways.

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5. Addition of EER values for new vehicle types

The widespread use of fuel cells in buses and trucks (i.e., Medium- and Heavy-Duty Vehicles) is advancing rapidly, and the determination of appropriate, vehicle class-specific EER values is therefore highly relevant. Whereas one EER value may be sufficient for Light-Duty Vehicles (given that these vehicles are comparably-sized), it may be appropriate to have specific EER values for different classes of Medium- and Heavy-Duty Vehicles (both buses and trucks) given their variety of vehicle sizes.

6. Removal of REC generation for renewable electricity used for hydrogen production

The ARB proposal to avoid counting both RECs and LCFS credits toward renewable electricity-based hydrogen supply is understandable and relevant for public credibility.

However, removing the application of RECs for renewable electricity consumed for hydrogen production and fueling may limit the financial incentive to use renewable electricity. For many renewable electricity generators, the REC is an integral component of the financing and business case, as the REC generates additional revenue. A stakeholder procuring renewable electricity for electrolysis hydrogen production and fueling would therefore have to compensate the electricity generator for the lost REC revenue.

At a REC value of $0.015/kWh, for example, this would translate into an additional cost for fully renewable, electrolysis-based hydrogen of approximately $1/kg (at 65 kWh/kg electricity consumption for both production and fueling).

This additional cost to produce and dispense renewable, electrolysis hydrogen would reduce the competitiveness of the potential additional market price for the renewable LCFS credit at its current value for the “100% renewable electrolysis” Pathway of $2.9/kg, as compared to the fossil based “Natural Gas SMR” Pathway with an LCFS credit value of $1.62/kg hydrogen[1]. Thus, removing the potential application of a REC value to a LCFS pathway would make it difficult for fully-renewable hydrogen to compete with fossil-generated hydrogen from SMR.

However, this issue may be resolved by applying a multiplier for hydrogen LCFS credits generated from pathways based on renewable electricity, and where the ability to apply REC credits has been removed. E.g., one (1) credit generated is multiplied by a multiplier “X”. The multiplier should be sufficient to offset the lost REC value, and thus offset the additional electricity cost for the hydrogen that arise from compensating the renewable generator for the lost REC revenue. The lost REC value (and thus the relevant multiplier) could be calculated using the electricity consumption assumed for the specific pathway and the REC value at the given time in the marketplace.

The application of this multiplier would be analogous to the performance credit multiplier in the “California Zero Emission Vehicle Regulation,” that allocates ZEV credits according to market-relevant metrics, such as performance criteria on driving range and fueling time. For the LCFS, such a credit multiplier would not be related to performance (as for the ZEV),

[1] ARB presentation slide 8 "Hydrogen in the LCFS" https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/12052016presentation_h2.pdf

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but be related instead to the direct, environmental benefit achieved from renewable hydrogen compared to fossil SMR-based hydrogen. Thus the higher environmental benefit the higher credit generation by addition of a multiplier.

Another topic to consider when removing the application of RECs to electricity for hydrogen relates to hydrogen production and fueling that is not collocated with the renewable generation plant. E.g., this is relevant when the solar/wind plant is placed in a remote area and the hydrogen production occurs onsite at the fueling station in an urban area.

Today, applying RECs is a practical way for the hydrogen operator to document that the procured electricity corresponds to renewable electricity. The REC inherently verifies the renewable origin, which the hydrogen operator then can use as documentation or proof when generating LCFS credits.

Should the application of RECs to electricity consumed for hydrogen be removed, then an alternative method for documenting the renewable origin may be needed.

It is also relevant to consider that the procurement of renewable electricity for hydrogen operators would involve a different process than for other electricity consumers, if RECs are removed for hydrogen consumption specifically. When procuring renewable electricity, the hydrogen operator would have to ensure that the renewable generator does not apply and sell the associated RECs. For other electricity consumers, the REC aspect is not of their concern, as the renewable generator "just" sells its electricity and auctioning the RECs is a separate process.

Apart from creating a unfavorable situation for hydrogen operators compared to other electricity consumers, it is also unclear how this issue could be resolved in practice.

7. Requirements for ownership of renewable power generation

There are several issues to consider in relation to the ARB proposals for requirements on "non-co-located" renewable power:

- *"generated on land owned by the charging station operator and located within the same EDU territory as the charging station"*;
- *"the renewable generation system is developed expressly for supplying the station's power demand (meaning the project is developed concurrently or after the station is installed"*

These changes would require the hydrogen producer to acquire land and invest capital in new renewable power generation. This implies that use of existing renewable energy sources to produce and dispense hydrogen would not achieve a lower CI value.

Currently, the deployment of hydrogen production and fueling requires substantial investments and financial commitments from stakeholders. Additionally, required investments in land and renewables generation would substantially increase the scope of investments and risk, and to a level that is likely not attractive to stakeholders.

The global perspective of renewable hydrogen production is to connect with and take advantage of existing renewable energy sources to help balance the grid and reduce the need for curtailments as the share of renewables in the grid increases. If these ARB proposed changes are adopted, this would no longer be feasible in California.

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8. Hydrogen Fueling Facility IDs

If the approach of "Station Operators as first-in-line to generate hydrogen LCFS credits" is implemented, then a structured identification of hydrogen fueling facilities is necessary.

For fueling at publicly-available stations, a straightforward approach may be to use the unique DMS sticker identification for each fueling dispenser, which can then be aggregated by each operator for all of their dispensers at each of their sites. The DMS stickers directly represent the metered hydrogen that is legally dispensed in California.

For non-public stations -- e.g., for private vehicle fleets such as FCEVs, HDVs, and forklifts, where a DMS sticker may not be required -- the station address combined with relevant documentation of the dispensed quantity either via metering or sales invoices should suffice.

Alternatively, the unique manufacturer code on fueling equipment could also be used as identification, ensuring a standard methodology for both public and private stations.

9. Third-party aggregators

The opportunity for third parties to aggregate hydrogen LCFS credits may address potential issues arising from removal of the "opt-in" status, as the LCFS reporting requirement can be transferred from the Station Operator to other qualified stakeholders. Potential volume synergies on hydrogen LCFS credits by third-party aggregation could also help reduce administrative burdens.

However, this may also cause issues in the marketplace. E.g., if a few, major stakeholders who specialize in the LCFS market seek to rapidly close compelling deals (due to volume) with Station Operators at both a large scale and share of the hydrogen station market. Such concentration of hydrogen LCFS credits to few stakeholders could create a market grid-lock with regard to agreements on hydrogen delivery prices and the valuation of hydrogen LCFS credits.

The above issue may already be present in other segments of the LCFS, and may be addressed by existing oversight or other proactive countermeasures that potentially also could be applied to hydrogen.

Therefore, the use of third-party aggregators is both a positive and relevant option to credit generators, but may also need to be regulated sufficiently to avoid market issues.

10. Verification of hydrogen

The proposed ARB exemption for hydrogen from third-party verification seems relevant, given the low credit volumes generated for the foreseeable future. As such, the approach of using "Lookup Table Pathways" and reporting on dispensed hydrogen, procured renewable energy, and feedstocks seems sufficient at this time.

With regard to setting a threshold for exemption from third-party verification, the utilization level of a hydrogen fueling station could be used as a parameter (i.e., kg dispensed per day as a % of the station maximum daily capacity).

A hydrogen station is likely to achieve a more commercial and profitable operation when utilization is in excess of 50%. Whereas a lower utilization indirectly requires higher capital investments into the operation during the early years of operation. Thus, the costs and resources required for third-party verification should preferably only be applied once the station is profitable – where the example of a 50% utilization level could be an indicative threshold.

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