December 7, 2021

Dr. Cheryl Laskowski
California Air Resources Board
1001 I Street
Sacramento, CA 95812

Dear Dr Laskowski;

We are pleased to submit for consideration by the California Air Resources Board (ARB) a proposal for extending the Hydrogen Refueling Infrastructure (HRI) Pathway under the Low Carbon Fuel Standard (LCFS) to heavy-duty hydrogen refueling stations (HD HRS). We are proposing this to accelerate the build out of HD HRS and reducing the carbon intensity of hydrogen supply, by providing LCFS credits based on installed fuel dispensing capacity.

The existing HRI Pathway for light-duty hydrogen refueling stations (LD HRS) has proved to be a very effective policy tool in the construction of HRS capacity and decarbonization of hydrogen fuel. The success since its adoption in 2018 is now visible, and we believe this rulemaking is the appropriate time to extend the HRI Pathway to HD HRS while sending a strong signal to station developers and fleets that LCFS policy will support Medium and Heavy-duty Fuel Cell Electric Vehicles (HD FCEV) in compliance with the Advanced Clean Trucks, Advanced Clean Fleets and Innovative Clean Transit rules.

We believe expanding the HRI Pathway to include HD HRS can provide an effective incentive for expanding zero-emission vehicle infrastructure while remaining consistent with the LCFS policy intent by accomplishing the following during the early years of HD FCEV deployment:

- partially offset the initial lower utilization of hydrogen refueling stations, thereby supporting refueling network development to increase the availability of hydrogen and ensure vehicles are supported;
- enable efficient development of hydrogen refueling stations at a sustained pace and scale to achieve significant cost reduction, for efficient use of public and private funds and reducing the cost of low-carbon fuels for Californians;

- enable the incentive structure already in place in the LCFS to reduce the carbon intensity of hydrogen through increasing renewable content;
- become self-balancing and sun-setting, with credit generation through the Hydrogen Infrastructure Pathway decreasing over time as hydrogen sales and station utilization increase;
- ensure best-in-class carbon intensity and infrastructure quality through eligibility conditions;
- ensure no material or unintended impacts to the overall LCFS policy and stakeholders through fixed limits on duration, infrastructure capacity, and credit generation.

The HRI proposal for HD HRS is attached and for any questions or additional information on this proposal, please contact Teresa Cooke, Executive Director of the California Hydrogen Coalition at tcooke@bhfs.com.

Thank you for your consideration,

David P. Edwards, PhD
Director, Hydrogen Energy
Air Liquide

Shane Stephens, PhD
Founder and Chief Development Officer
FirstElement Fuel

Lauren Skiver
CEO/General Manager
Sunline Transit

Amy Adams
Vice President, Fuel Cell & Hydrogen Technologies
Cummins Inc.

Brian Goldstein
Executive Director
Energy Independence Now

Tim Carmichael
State Agency Relations Manager
SoCalGas

Kevin Harris
Director – Sales & Business Development, Americas
Hexagon Purus

Wayne Leighty, MBA, PhD
Hydrogen Commercial Head, North America
Shell Renewables & Energy Solutions

Michael Lord
Executive Engineer
Toyota Motor North America

Marcos Cuevas
Vice President West Region
Linde Inc.

Denny Zane
Executive Director
MoveLA

Ryan Erickson
Vice President
Trillium

Eddy Nupoort
Director of Sales and Business Development
Nel Hydrogen

Danielle Lincoln
General Manager – Renewables
Chevron

Attachment: HRI Credits for HD Stations Proposal

cc: Richard Corey
Rajinder Sahota
Matt Botill

Hydrogen Refueling Infrastructure Pathway (HRI)

Replicate the successful HRI Pathway for stations serving Light-Duty (LD) vehicles to a parallel pathway for stations serving Heavy-Duty (HD) vehicles

LCFS INFRASTRUCTURE PATHWAYS:
EFFECTIVE IN OFFSETTING LOW INITIAL UTILIZATION & ACTIVATING LCFS SIGNAL TO DECARBONIZE NEW FUELS

HRI and FCI pathways create durable and scalable mechanisms in the Low Carbon Fuel Standard

Concept: generate LCFS credits for the retail capacity for low carbon fuel sales that require new infrastructure (e.g., hydrogen)

Impact: activates network coverage by offsetting low initial utilization of refueling capacity for new vehicle-fuel combinations

Enables: efficient development of hydrogen stations to reduce cost → efficient use of public funds, progress to commerciality

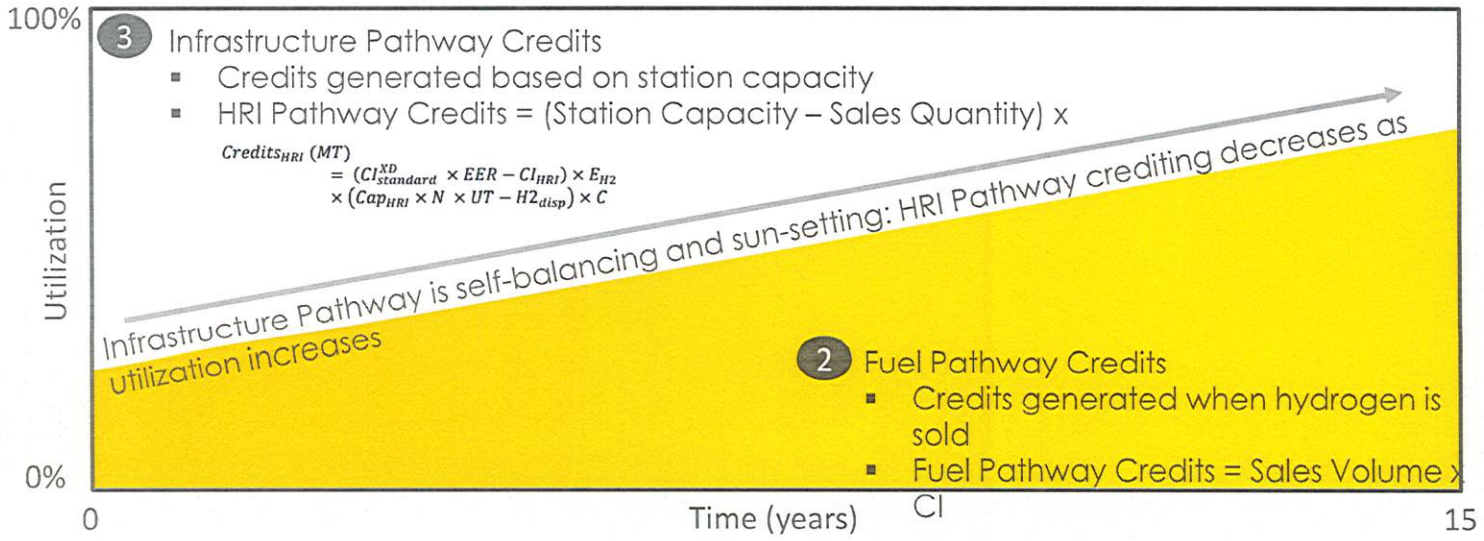
Result: incentivizes acceleration & expansion of hydrogen refueling capacity and renewable decarbonized production pathways

1 Station developer

(a) selects station capacity and fuel pathway*

(b) reports quarterly the sales volume and pathway

* Determines area of rectangle



Problem: HRI eligibility is limited to stations serving Light Duty (LD) vehicles (confirmed CARB interpretation of regulation)

Recommend: replicate HRI Pathway with separate eligibility for light-duty retail stations and heavy-duty commercial stations

PROVEN POLICY MAGIC OF THE HRI PATHWAY

HRI HAS BEEN WORKING AS INTENDED

The Policy Magic of HRI Pathway Has:

1.) H2 from 33% to 90% Renewable in 2020, zero CI in 2021
2.) Increased Average New Station Capacity 2.5 times
3.) Unlocked Station Development Programs 5x bigger than all prior grant funding, enabling 50% cost reduction

HRI Adopted in 2018 LCFS Amendments — 4 Jan 2019

90% Renewable Hydrogen Supply — 2020

Zero CI Hydrogen Announcements — 2020

Approximately 24 Stations Open

- 385 kg/d Avg. Capacity
- 450 kg/d New Capacity

5x Increase →

2.5x Increase →

GFO-19-602 announced in July 2020

- 123 Stations into Development (opening 2021+)
- 1,100 kg/d Avg. New Station Capacity

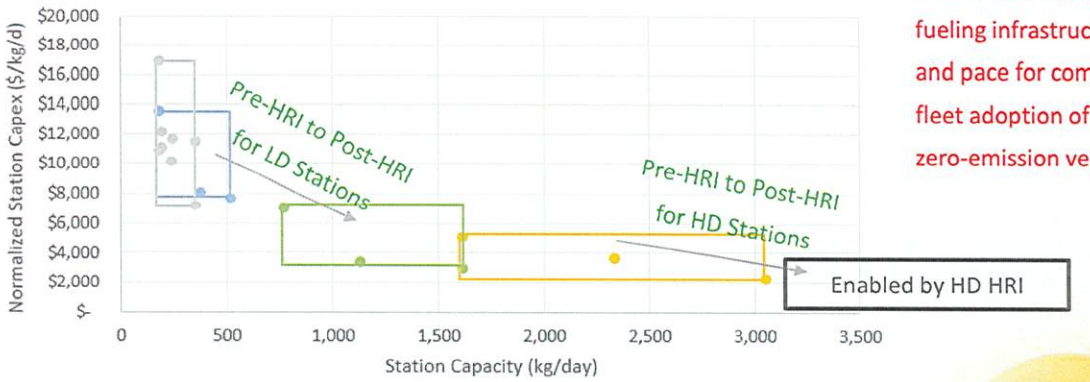
1.5 years to respond

+ 1.5+ years to build

= 3+ years lag time

Act Now for HD HRI...

Hydrogen Refueling Stations in California
Trends in Total Capital Cost and Station Capacity



Key

Phase 1 LD: PON 09-608, 12-606, 13-607	(45 total stations awarded)
Phase 2 LD: GFO-15-605	(20 total stations awarded)
Phase 3 LD: GFO-19-602	(123 total stations awarded)
Phase 1 HD: GFO-20-604 & GFO-20-606	(2 total stations awarded)

... to launch viable hydrogen fueling infrastructure at scale and pace for commercial fleet adoption of heavy-duty zero-emission vehicles

PROPOSAL: HRI PATHWAY FOR HEAVY-DUTY (HD) STATION CAPACITY

A separate HRI pathway for hydrogen stations serving HD vehicles is needed

		LD HRI	"HD HRI"	Potential Unintended Consequence	Mitigation / Motivation
Station Capacity	Station Capacity Cap (kg/d)	1,200	4,800 De-Rated at 50%	Does the Market Cap provide support to a sufficient number of stations? - This will depend on many factors, including ramp-up of utilization Does the HRI crediting keep the hydrogen business in the "right shape" for incentives to serve customers & sell hydrogen - Yes, and this is ensured with appropriate sideboards (reference: Availability Multiplier) Sense-check: is the HD Station Capacity Cap proportioned to trucks similarly as the LD Station Capacity Cap is for cars? - LD per HyScape is about 400 kg/d/dispenser maximum, thus a 3-dispenser station could certify to the cap of 1,200 kg/d - HD at 4 trucks/hr./dispenser (ca. 15 minutes each) x 10 hr (proxy) = 40 trucks per day x 35 kg per truck = 1,050 kg/d/dispenser, thus a 3x dispenser HD station could certify to the station cap of [3,000] kg/d.	
	HyScape Model Input	Chevron Friday Profile	Chevron Friday Profile	HRI crediting should be based on realistic nameplate capacity to serve a normal demand profile, not theoretical maximum for 24-hour constant demand.	The "Chevron Friday" demand profile approximates normal demand for both light-duty and heavy-duty vehicles (i.e., the normal demand profiles are quite similar).
	Required SOC	SOC > 95%	SOC > 95%	Ensure the certified capacity can serve customers well	Capacity certified for HyScape Modeled capacity at 95% SOC
	Application for Expansion	• Throughput in Qtr. > 50% original capacity • Same deadline YE 2025 for application • Does not extend the period of crediting	• Throughput in Qtr. > 50% original capacity • Same deadline (adoption +6 yr) for application • Does not extend the period of crediting	If hydrogen refueling stations are built too large for initial demand and/or expanded in capacity too early, the crediting to individual stations could be excessive and thereby limit the number of stations that can be supported by the HRI pathway, and the natural offramp from HRI crediting as station utilization increases could be slowed.	The requirement to achieve at least 50% utilization of the original capacity and within the certification period before expanding capacity helps to ensure stations are build to serve anticipated demand and that HRI crediting helps to support the early build-out of as many stations as possible.
	Allocation of Capacity for Multi-Modal HRS	Unclear, to be determined case-by-case, intent to allocate capacity according to fueling positions	Allocate based on combined/iterative HyScape modeling (1) Model LD capacity (2) Given LD dispensing at capacity, then model remaining capacity for HD	A method for allocation of capacity between LD and HD pathways will enable stations serving both where practical, for the efficient build-out of early hydrogen refueling infrastructure in support of state goals. HyScape Version 2.0 will be needed for several reasons. To enable allocation, model iteration will be needed (i.e., HyScape 1.0 does not have a mechanism set a certain demand as fixed, then model remaining capacity).	
HyScape	HyScape	HyScape Version 2.0	HyScape Version 2.0	HyScape Version 2.0 will be needed, with improvements that should be applied to both LD HRI and HD HRI pathways - The CARB perhaps through CEC will need to contract with NREL, and Station Developers need to provide input to NREL	

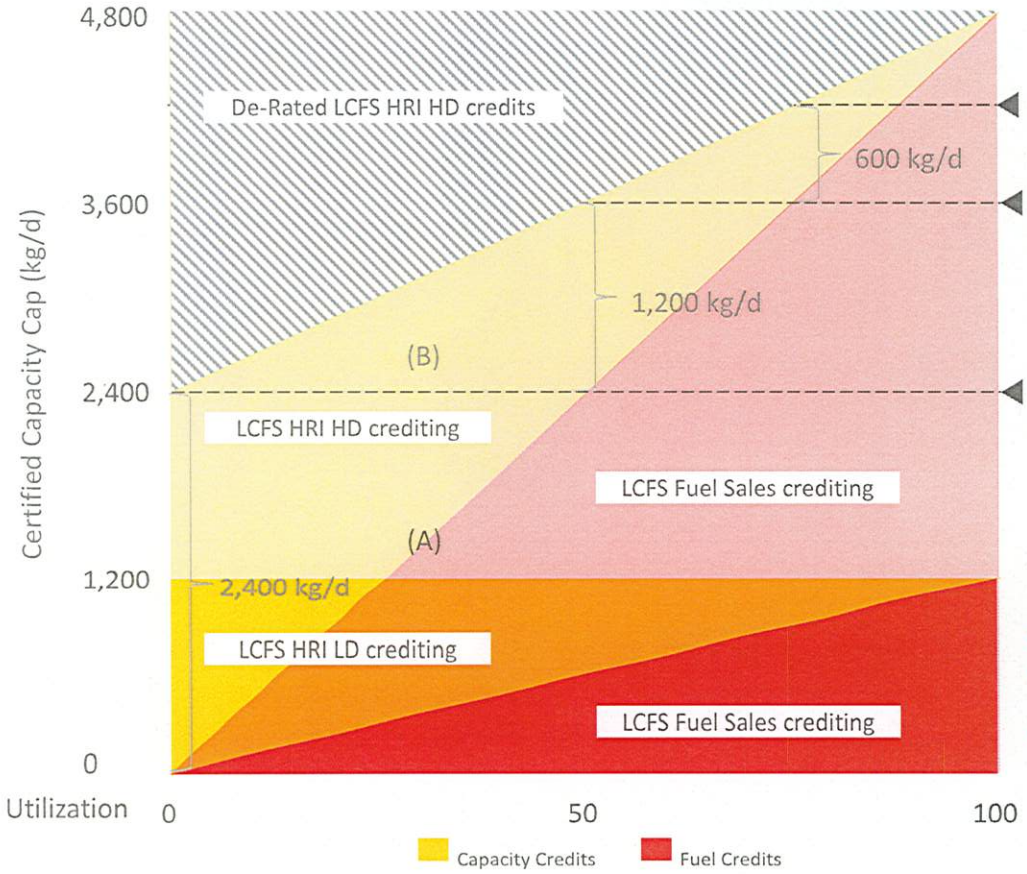
Sense Check: Economies of scale must be realized for HD HRI crediting to create similar "help" to station economics as in LD stations

- A station with up to 4x more capacity getting only 2x more HRI crediting help will need to achieve closer to 2x cost (i.e., next 50% cost reduction per capacity)

HRI PATHWAYS FOR STATIONS SERVING LD/MD & HD

THE ROLE OF DE-RATING HRI HD CREDITS

De-Rate HD HRI Credits by 50% for Certified Capacity Cap of 4,800 kg per day to encourage HD-scale stations without excessive crediting



LCFS HRI HD credits de-rated to 50% of full crediting

(at 75% Utilization of 4,800 kg/d Certified Capacity Cap, HD crediting is for 600 kg/d)

LCFS HRI HD credits de-rated to 50% of full crediting

(at 50% Utilization of 4,800 kg/d Certified Capacity Cap, HD crediting is for 1,200 kg/d)

LCFS HRI HD credits de-rated to 50% of full crediting

(at 0% Utilization of 4,800 kg/d Certified Capacity Cap, HD crediting is for 2,400 kg/d)

The area of potential HD HRI crediting is 2x greater than the existing policy for LD HRI crediting, for stations with 4x greater fueling capacity:

- HD stations with up to 4x more capacity get up to 2x more help
- With each HRI pathway capped at 2.5% of Market, the HD HRI pathway may support fewer stations than the LD HRI pathway…
- … but higher starting and/or faster increase in utilization could result in more stations supported by the HD HRI pathway than LD HRI pathway

PROPOSAL: HRI PATHWAY FOR HEAVY-DUTY (HD)

SIDEBOARDS

The HD HRI pathway needs *additional* Market Cap of at least 2.5% of prior quarter deficits

		LD HRI	"HD HRI"	Potential Unintended Consequence	Mitigation / Motivation
Sideboards	Market Cap	2.5% of deficits from prior quarter (for LD)	**2.5%** of deficits from prior quarter (for HD)	Ensure "dilution" of LCFS policy does not exceed the cap (i.e., certainty on expected size of policy impact, expected increase in utilization to offramp from HRI crediting)	• HRI pathway approvals will stop unti HRI < 2.5% deficits • Acceptance of new applications will stop until HRI < 2.5% deficits
	Availability • Multi-HRS Site • Multi-Modal HRS	Multiplier	Multiplier	"Paper Tiger" Station with poor Operations (capacity is not available to serve customers)	• Station Availability: any period of time that SOSS reports that a portion of the station capacity is not available will count as a pro-rated amount of station availability, proportional to the percentage of the station capacity that remains available for fueling for this period of time. - Example: two independent stations at a single location
	CI Cap	150 gCO2e/MJ	150 gCO2e/MJ	Could HRI crediting occur without decarbonizing hydrogen	
	CI Floor (applies only to HRI Crediting)	0 gCO2e/MJ	0 gCO2e/MJ	• Concern with excessive HRI crediting based on negative CI underminning the number of HRS and/or amount of capacity built out. • But hard to match specific supply to specific station (and may vary over time)	Company Wide Weighted Average CI of all company's stations applies to each station HRI
	Renewable Content Floor	40%	40%	Could HRI crediting occur with non-renewable feedstocks	

Sense Checks:

- Station Cap at 4,800 kg/d that is de-rated at 50% yields maximum crediting potential of 2,400 kg/d
  - Double maximum crediting potential for 4-times station capacity requires 50% cost reduction for same "help" to station economics
- Station Cap for HD at 4x larger than LD, for station vision that is 1/5th (200 HD Stations vs. 1,000 LD Stations)
- Ca FCP Vision for 70,000 Class 8 FCETs on-road by 2035, supported by 200 Stations, implies 350 trucks per station
  - Thus each station would need to provide 10,000 to 20,000 kg/d capacity (if average fill is 30 – 50 kg)
  - This would achieve about 20% of the ~350,000 HD Trucks in California (CA Trucking Association)
- A station with 4,800 kg/d capacity would likely have 2 – 3 fueling positions (a reasonable starting point)

PROPOSAL: HRI PATHWAY FOR HEAVY-DUTY (HD) ELIGIBILITY (1 OF 2)

The HD HRI pathway needs small differences in eligibility appropriate to HD vehicles and commercial fleets

		LD HRI	"HD HRI"	Potential Unintended Consequence	Mitigation / Motivation
Eligibility	Grant Funding	Eligible (Grants + HRI can be additive)	Eligible (Grants + HRI can be additive)	Excessive support for hydrogen refueling stations?	• HRI Pathway is essential within LCFS policy for new fuels (suffer low initial utilization) to "activate" the signal to decarbonize from the start (the "Policy Magic") • Grant funding remains competitive solicitation • Solicitations ask to explain funding need / intent for HRI
	Eligibility for Existing Stations	Eligible	Eligible	Do stations already built need support?	• Important signal to decarbonize supply • Level playing field with newly-built stations • Small impact (few existing, with small capacity) • Some limited opportunity to accelerate / scale
	Eligibility Period for Applications	Q4 2019 - YE 2025	Enactment +6 years	• Period of Eligibility may be too short if industry reaction is delayed (e.g., station development, fueling protocol, etc.) • Pace of Development during the Period of Eligibility may be insufficient to achieve goals (e.g., 200 stations in 4 years after 2 year lag for response = 50 per year)	• Natural Sunset (Decrease) in HRI crediting as FCET adoption progresses (ACT, ICT, ACF) • CARB prerogative to amend via LCFS Rulemaking to extend the Period of Eligibility
	Period to Open (from Certification)	24 months	24 months	Packing applications prematurely Reasonable time from Application to Open	24 months is in line with demonstrated development time
	Crediting Period	15 years	15 years	Concern re sustained operation of stations But stations kept open beyond useful life?	15 years is reasonable balance Availability as multiplier in crediting to ensure customer service

PROPOSAL: HRI PATHWAY FOR HEAVY-DUTY (HD) ELIGIBILITY (2 OF 2)

A separate HRI pathway for hydrogen stations serving HD vehicles is needed

		LD HRI	HD HRI	Potential Unintended Consequence	Mitigation / Motivation
	Station Eligibility	Located in California Justification for Location	Located in California Justification for Location	Paper Tiger Stations in Middle of Nowhere	Sufficient location justification for eligibility
		Open to the Public - no obstructions or obstacles - no access cards or codes - no registration or training - public point of sale system - accepts credit & debit cards - connected to SOSS & shown as open retail - permit to operate from AHJ - fully commissioned - meets an appropriate SAE fueling protocol - at least 3 OEM confirm their customers can fuel - all dispensers have Temporary Use Permit or are Type Approval Certificate by CDFA/DMS - 24 hours unless restricted by AHJ	Open to the Public - no obstructions or obstacles - no access cards or codes - subject to approval of vehicle safety & protocol - no registration or training - public point of sale system - accepts credit & debit cards - connect to SOSS & shown Open Retail - permit to operate from AHJ - fully commissioned - meets an appropriate SAE fueling protocol - at least 1 OEM confirm their customers can fuel - all dispensers have Temporary Use Permit or are Type Approved Certificate by CDFA/DMS - 24 hours unless restricted by AHJ	Public crediting program should not be used for the exclusive benefit of a private interest.	LD Vehicles have set standards for fueling (H70T40, J2601) so restricting access is unnecessary, but HD Vehicles do not yet have set standards and may ultimately include several approaches. Reasonable allowances are needed: 1. Station will not be required to dispense hydrogen at pressures or using fueling protocols for which the installed hardware is not suitable. 2. Access can be restricted for new vehicle types and/or fueling requirements until such time as the station operator can reasonably confirm the suitability and safety for fueling the vehicle (i.e., do need to allow for vetting process)
		On-road vehicles only (by virtue of Open to the Public)	On-road vehicles only (by virtue of Open to the Public)	What about off-road (e.g., marine port, airport, construction, agriculture)?	• Encourage efficient infrastructure with public access • Allowance for Private stations would likely require special treatment, thus better handled separately
		Inelligible if (a) funds pursuant to settlement, regulation, enforcement; (b) required mitigation measure for CEQA	Inelligible if (a) funds pursuant to settlement, regulation, enforcement; (b) required mitigation measure for CEQA		