September 15, 2025

Submitted Electronically to
https://ww2.arb.ca.gov/lispub/comm/bclist.php

California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Proposed Amendments to the Advanced Clean Fleets and Low Carbon Fuel Standard Regulations

The Center for Biological Diversity ("the Center") submits these comments in response to the California Air Resources Board's (CARB) proposed amendments to the Advanced Clean Fleets and Low Carbon Fuel Standard regulations. Specifically, the Center wishes to address the CARB staff proposal to modify the derating factors for light- and medium-duty hydrogen refueling infrastructure (LMD-HRI) crediting within the Low Carbon Fuel Standard (LCFS) regulation. The purpose of this proposed change is to "provide stronger crediting support for hydrogen stations and more adequately support[ ] development of stations that can accommodate the refueling demand of larger medium-duty hydrogen FCEV." However, as discussed in the following comments, incentivizing the development of hydrogen fueling stations is unnecessary given the existence of and continuing improvements to battery-electric technology. Given the fledgling status of hydrogen fuel cell vehicle adoption in comparison to battery-electric vehicles (despite the incentives presently available for both), battery-electric technology has clearly won the competition between the two and should be prioritized for further development, especially in the light- and medium-duty transportation sector.

Electric batteries outcompete hydrogen fuel in the light- and medium-duty transport sector.

Hydrogen simply is not necessary in the light- and medium-duty transport sector given the prevalence of battery-electric alternatives. At most, the use of hydrogen should be limited to those sectors without a viable present-day alternative, such as replacing existing dirty gray fossil-based hydrogen, crude oil refineries, or steel manufacturing.[1] Whenever direct electrification can be used instead of hydrogen, as with vehicles, it is the demonstrably better choice. Electricity made from solar and wind to power electric vehicles is more efficient, lower cost, lower in CO_2 emissions, and a mature energy resource, compared to producing hydrogen to power fuel cell electric vehicles.[2] In line with this, the IPCC forecasts the role of hydrogen to be quite narrow,

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[1] See, for example, Michael Liebreich, *The Clean Hydrogen Ladder (v.4.1)* (2021), available at https://www.linkedin.com/pulse/clean-hydrogen-ladder-v40-michael-liebreich/; see also, Michael Liebreich, *The Unbearable Lightness of Hydrogen,* BloombergNEF (2022), available at https://about.bnef.com/blog/liebreich-the-unbearable-lightness-of-hydrogen/, and Michael Barnard, *Chemical Engineer Paul Martin Reflects on Liebreich's Hydrogen Ladder & #Hopium—Part 1,* Clean Technica (2021*)(hydrogen is actually a decarbonization problem, not a decarbonization solution),* available at https://cleantechnica.com/2021/09/01/cleantech-talk-chemical-engineer-paul-martin-reflects-on-liebreichs-hydrogen-ladder-hopium-part-1/.
[2] Hydrogen Science Coalition, https://h2sciencecoalition.com (last accessed: October 5, 2023).

even in 2050, only about 2.1% of total energy consumption, due to its inefficiencies and economic challenges, among other issues.[3] "As a general rule, and across all sectors, it is more efficient to use electricity directly and avoid the progressively larger conversion losses."[4] Further, "[a]s a source of work, fuel cells, turbines, and engines are only 60% efficient – far worse than electric motors – and far more complex…. [H]ydrogen's role in the final energy mix of future net-zero emissions world will be to do things that cannot be done more simply, cheaply and efficiently by the direct use of clean electricity and batteries."[5] Since powering light- and medium-duty road transportation with batteries is currently simpler, cheaper, and more efficient that using hydrogen, there is no reason to push hydrogen as a transportation fuel source.

Further, using batteries comes with fewer risks than relying on hydrogen. First, hydrogen is a potent, indirect greenhouse gas with 100 times the warming power of CO_2 over a 10-year period and 33 times over 20 years.[6] As a small molecule, hydrogen is more leakage-prone than methane, posing climate risks across the production and supply chains. Also, transporting hydrogen through pipelines is more dangerous than transporting methane: it is more likely to explode, burns hotter, and is more corrosive to pipelines.[7] And all forms of hydrogen production use massive amounts of water—much more than solar and wind per unit of energy produced—which will put extra stress on water supplies in areas that may be suffering from climate crisis-charged drought.[8] Thus, not only is hydrogen fuel more complicated, expensive, and inefficient to use than batteries, it also comes with risks not seen with batteries. For these reasons, we should focus on rolling out existing efficiency and decarbonized electrification solutions in the transportation sector before making bets on a hydrogen economy.[9]

Battery-electric vehicles are already in use and being increasingly deployed in California.

Battery-electric vehicles (BEVs) are being readily purchased in California at a rate far outpacing hydrogen fuel cell electric vehicles (FCEVs). As of this writing, BEVs are 19%

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[3] IPCC, *Technical Summary Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), available at https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_TechnicalSummary.pdf; see also David Cebon and Johanne Whitmore, *Hydrogen's role in the energy transition to 2050—Three evidence-based recommendations,* The OECD Forum Network (2023), available at https://www.oecd-forum.org/posts/hydrogen-s-role-in-the-energy-transition-to-2050-three-evidenced-based-recommendations, and Michael Liebreich, *The Unbearable Lightness of Hydrogen,* BloombergNEF (2022), available at https://about.bnef.com/blog/liebreich-the-unbearable-lightness-of-hydrogen/.

[4] IPPC, *Technical Summary Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), available at https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_TechnicalSummary.pdf.

[5] Michael Liebreich, *Separating Hype from Hydrogen — Part Two: The Demand Side,* BloombergNEF (2020), available at https://about.bnef.com/blog/liebreich-separating-hype-from-hydrogen-part-two-the-demand-side/.

[6] Ocko, I.B. and Hamburg, S. P., Climate consequences of hydrogen emissions, 22 Atmos. Chem. Phys. 9349 (2022).

[7] Pipeline Safety Trust, Hydrogen Pipeline Safety, Summary for Policymakers (2023), https://pstrust.org/wp-content/uploads/2023/01/hydrogen_pipeline_safety_summary_1_18_23.pdf.

[8] DiFelice, M. and Murray, B., Exposing a New Threat to Our Water: Hydrogen Power, Food & Water Watch (2023), https://www.foodandwaterwatch.org/2023/02/07/hydrogen-water-use/.

[9] David Cebon and Johanne Whitmore, *Hydrogen's role in the energy transition to 2050—Three evidence-based recommendations,* The OECD Forum Network (2023), available at https://www.oecd-forum.org/posts/hydrogen-s-role-in-the-energy-transition-to-2050-three-evidenced-based-recommendations.

(168,751 vehicles) of total light-duty vehicles sales in 2025 (901,739 vehicles), while FCEVs are essentially negligible (130 vehicles).[10] If PHEVs (32,121 vehicles) are considered, BEVs and PHEVs are 22% of total vehicle sales. Cumulatively, of the over 2 million ZEVs (zero-emission vehicles: BEVs + PHEVs + FCEVs) that have been sold in California, over 76% have been BEVs, 23% have been PHEVs, while only 2% have been FCEVs.[11] It is thus clear that BEVs are desirable and thus far outcompeting FCEVs in adoption. It seems an unnecessary task to try to lift FCEV adoption to the level of BEVs when BEVs are shown to be technologically sound, well-established, and associated with fewer risks.

This extends to the medium- and heavy-duty ZEV sectors. Though a much smaller proportion of total vehicles, BEVs still are the proven choice. Of total medium- and heavy-duty ZEVs at the end of 2024 in California (5,857 vehicles), nearly 96% were BEVs compared to 4% FCEVs.[12] And BEVs encompass a greater assortment of vehicle types, including transit buses, delivery vans, tractor trucks, school buses, tractors, delivery vans, coach buses, and garbage trucks, with dozens of manufacturers represented. Meanwhile, FCEVs in California only consist of tractor trucks and transit buses with only a few manufacturers represented.[13]

Momentum with battery electric vehicle adoption is present nationwide. A total of 607,089 electric cars were sold in the United States between January and June this year, which is an increase of 1.5% compared to the same period last year and constituting a record high.[14] And regarding medium- and heavy-duty vehicles, before 2021, there were only a few hundred electric vehicles sold per year, but in 2024 alone there were over 120,000 sold. And California is leading the charge: California makes up the largest share of U.S. electric medium- and heavy-duty vehicle sales, with 24% of nationwide Class 2B-8 electric vehicles in 2024.[15] Rather than investing resources in a technology (i.e. FCEV technology) that has fallen behind, California should continue its leadership in seeing the widespread adoption of battery electric vehicles.

Investing in battery-electric charging infrastructure will better help California achieve decarbonization goals.

As already well-established, BEVs are much further along in development than FCEVs, and the momentum with BEVs should be pushed to the maximum. Partly, this means addressing a key limitation to wider BEV adoption: charging. As acknowledged in recent recommendations from California agencies to Gov. Newsom, continuing progress in ZEV adoption means accelerating zero-emission infrastructure build-out and increasing electric vehicle charger

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[10] California Energy Commission, Light-Duty Vehicle Population in California (Accessed September 10, 2025), https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/light

[11] *Id.*

[12] California Energy Commission, Medium- and Heavy-Duty Zero-Emission Vehicles in California (Accessed September 10, 2025), https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/medium

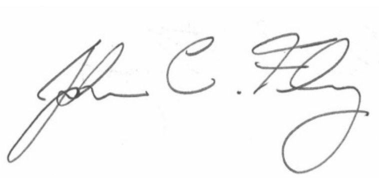
[13] *Id.*

[14] Westerheide, Carla, BEV sales in the US reach record high, Electrive (July 16, 2025), https://www.electrive.com/2025/07/16/bev-sales-in-the-us-reach-record-high/

[15] Reolfi, Rachel, U.S. Market & Policy Update: Medium- and Heavy-Duty Electric Vehicles, Atlas EV Hub (July 7, 2025), https://www.atlasevhub.com/data-stories/u-s-market-policy-update-medium-and-heavy-duty-electric-vehicles/

reliability and access.[16] A robust charging network is not only possible for light-duty vehicles, but for medium-duty and heavy-duty vehicles as well.[17] In a time of a federal administration hostile to ZEV adoption efforts, it is necessary to capitalize on progress that has already been made to keep California on track with its climate goals. We should not be distracted by the purported promise of hydrogen fuel that may never be realized. The promise of battery electric technology has already been realized and just needs a large push to cross the finish line. If any LCFS amendments are to be made, they should be for a fully battery-electric transportation future.

Sincerely,



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[16] CARB, CEC, CPUC, CalSTA, GO-Biz, and CA DCA, Report to the Governor in Response to Executive Order N-27-25 on Zero-Emission Vehicle Deployment (August 2025), https://ww2.arb.ca.gov/sites/default/files/2025-08/August%202025%20Report%20to%20the%20Governor%20in%20Response%20to%20Executive%20Order%20on%20ZEV%20Deployment%20FINAL_0.pdf

[17] Squires, Anna, The Dawn of Electric Trucking Calls for High-Power Charging, National Renewable Energy Laboratory (January 15, 2025), https://www.nrel.gov/news/feature/2025/the-dawn-of-electric-trucking-calls-for-high-power-charging