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Earthjustice Comments on Hydrogen's Role in California's Clean Energy Future

Additional submitted attachment is included below.

July 12, 2022

California Energy Commission
1516 Ninth Street
Sacramento, California 95814-5512
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Re: Docket No. 21-IEPR-05, Role of Hydrogen in California's Clean Energy Future

Dear California Energy Commission Staff:

Earthjustice appreciates the opportunity to provide comments on the June 21, 2022, Integrated Energy Policy Report Commissioner workshop on the role of hydrogen in California's clean energy future. With the cost of renewable electricity plummeting and the promising progress of both electrolyzer and fuel cell technology, green hydrogen now presents an important opportunity to displace fossil fuels from some of the toughest reaches of the energy system. The CEC can help position California as a leader in eliminating reliance on fossil fuels through technologies that are demonstrably compatible with urgent climate goals and the commitment to redress environmental injustice.

At the same time, the CEC cannot ignore the enormous risks to both planetary and public health posed by the stark reality of the status quo hydrogen economy. Nor can state policy ignore or perpetuate practices by which industries use hydrogen to launder fossil fuel subsidies and investments as "green." Many proposals for hydrogen production and use would further reinforce decades of path-dependence in polluting infrastructure that our climate and overburdened communities cannot afford.[1] Even proposals that focus exclusively on zero-emission green hydrogen risk wasting precious time and public resources on end-uses that could decarbonize more quickly and efficiently through solutions that are already available and more easily scaled.

[1] *See, e.g.*, Scott DiSavino, "Hydrogen Will Give U.S. NatGas Pipes New Life in Carbon-Free World" (June 14, 2022) https://wtvbam.com/2022/06/14/hydrogen-will-give-u-s-natgas-pipes-new-life-in-carbon-free-world/.

Summary of Recommendations:

1. **California's first priority should be displacing its current use of fossil-derived hydrogen.**
2. **California should focus on internationally-recognized definitions of green hydrogen and reject flawed accounting scores that ignore environmental justice.**
    a. **Carbon-intensity based definitions of "clean" hydrogen send muddled market messages and fail to direct the outcomes needed for the energy transition.**
    b. **Carbon-intensity scoring is fraught, and subject to flawed assumptions that can perversely reward polluting forms of hydrogen production.**
    c. **Carbon-intensity scoring ignores environmental justice considerations.**
3. **The CEC should ensure hydrogen investments are limited to projects that comply with regulations called for by SB 1505.**
4. **The CEC should transition investments for hydrogen away from the on-road transportation sector.**
    a. **California should end unproductive investments in light duty hydrogen refueling infrastructure.**
    b. **The CEC's transportation funding should direct support for the use of green hydrogen toward heavy, long-haul, off-road applications.**
    c. **The CEC should pursue opportunities to reduce reliance on diesel back-up generators with green hydrogen fuel cells.**

1. California's first priority should be displacing its current use of fossil-derived hydrogen.

Today, the vast majority (over 95%) of all hydrogen is produced from fossil fuels. In the United States, almost all industrial facilities dedicated to hydrogen production use steam methane reformation ("SMR") of fossil gas.[2] About 60% of the hydrogen consumed in U.S. oil refineries comes from SMR and the remainder is the byproduct of other chemical processes in the industry.[3] California consumes an estimated 800,000 metric tons per year of hydrogen in its oil refining sector, where the hydrogen is used to lower the sulfur content of diesel.[4] Assuming the California refineries are consistent with national trends, about SMR is responsible for producing about 480,000 metric tons of hydrogen for these refineries each year. SMR spews health-harming pollutants including nitrogen oxides, fine particulate matter, carbon monoxide, and volatile organic compounds into the air of neighboring communities.[5] In California, this includes communities such as Richmond, Carson, Wilmington, Martinez, Bakersfield, and other predominantly low-income communities of color that host oil refineries.[6]

While there are multiple technologies and solutions that can reduce diesel demand (direct electrification through battery-electric trucks and buses, reduced vehicle-miles-traveled, etc), there is no other decarbonized feedstock that can substitute for hydrogen in the refining process. Before listening to the pleas of large oil industry trade associations calling for new funding into hydrogen-powered transportation, California should focus on using green hydrogen to displace the large volumes of fossil-derived hydrogen already embedded in the diesel transportation supply chain. Similar prioritization has been shown in Germany, where policies have helped direct a third of German oil refiners to move toward substituting gray for green hydrogen. One of their refinery complexes in the Rhineland will be the first to operate a 10 MW advanced PEM electrolyzer.[7]

While California works toward phasing-out oil refining, hydrogen demand in this sector will remain high for the intervening decades. **Advancing new, large-scale categories of**

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[2] Energy Futures Initiative, The Future of Clean Hydrogen in the United States: Views from Industry, Market Innovators, and Investors (Sept. 2021) at 15, Figure 1.
[3] *Id.* (of the 6.5 Mt of hydrogen used in the U.S. oil refining sector, 2.62 Mt is by-product hydrogen and the rest is from SMR).
[4] Matthew Bravante, BloombergNEF Remarks - CEC 2022 Hydrogen Consultation (June 21, 2022) at slide 7, available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=243616.
[5] *See* Pinping Sun et al., *Criteria Air Pollutants and Greenhouse Gas Emissions from Hydrogen Production in U.S. Steam Methane Reforming Facilities*, Env't Sci. & Tech., Vol. 53 Issue 12, (Apr. 30, 2019), https://www.osti.gov/pages/servlets/purl/1546962.
[6] California Energy Commission, California's Oil Refineries (Accessed July 8, 2022) https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/californias-oil-refineries.
[7] IHS Markit, "German Refineries Kick Off Complex Green Hydrogen Switch" (June 16, 2021) https://cleanenergynews.ihsmarkit.com/research-analysis/german-refineries-kick-off-complex-green-hydrogen-switch-.html.

hydrogen use while green hydrogen remains so scarce is irresponsible, given the enormous renewable energy requirement needed just to displace this fossil-derived hydrogen and the lack of other suitable alternatives for doing so. Today, substituting green for fossil hydrogen in California's refineries would require roughly 8.4 gigawatts of renewable electricity.[8] As panelist Matthew Bravante described, hydrogen is "unavoidable" for decarbonization of the oil refining process, whereas it has either "low potential" or is "uncompetitive" for the new pots of demand California is currently creating in the on-road transportation sector.[9] This application has the added benefit of not requiring any new technologies for the hydrogen's use, nor the buildout of large new pipeline and storage capacity given the existing hydrogen infrastructure.

2. **California should focus on internationally-recognized definitions of green hydrogen and reject flawed accounting scores that ignore environmental justice.**

Over the course of the workshop, several industry panelists expressed support for a shift away from the "color"-based typology that distinguishes hydrogen by production method and towards a carbon-intensity score to define "clean" hydrogen. A carbon-intensity approach is agnostic to non-carbon factors in the feedstocks or methods used to produce hydrogen. For several reasons, Earthjustice strongly disagrees with this approach.

a. **Carbon-intensity based definitions of "clean" hydrogen send muddled market messages and fail to direct the outcomes needed for the energy transition.**

To send a clear, transformational signal to the market, we urge the CEC to keep any public hydrogen support targeted to green hydrogen—a product internationally-recognized to be defined as hydrogen produced from electrolysis powered by 100% renewable energy.[10] This is the only established form of hydrogen production that has a realistic path to consistency with California's carbon neutrality goals. Moreover, green hydrogen has unique benefits that make it especially useful as a decarbonization tool: its deployment has the attendant benefit of scaling renewable electricity generation, and it alone has the potential to harness surplus variable solar and wind energy. Green hydrogen has the potential to be produced relatively close to where it is needed without costly buildout of transportation infrastructure, given that it can be produced

[8] Matthew Bravante, BloombergNEF Remarks - CEC 2022 Hydrogen Consultation (June 21, 2022) available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=243616.
[9] *Id.*
[10] The IEA defines green hydrogen as hydrogen produced "using electricity generated from renewable energy sources," as does the International Renewable Energy Agency, the European Bank for Reconstruction and Development ("made by using clean electricity from renewable energy technologies to electrolyse water"), international energy companies like Iberdrola ("electrolysis from renewable sources") hydrogen industry giant PlugPower (produced through the electrolysis of water with electricity generated from zero-carbon sources") and energy consultancies like Wood Mackenzie ("produced from water by renewables-powered electrolysis").

wherever there is water and electricity.[11] This is not a quality of technologies like biomass gasification or biomethane reformation, which requires the transportation of small, scattered supplies of biomass to large, centralized production facilities, either by truck or by pipeline.[12] And while other production pathways may someday have a chance of being "low-carbon," studies show that even under the very strictest conditions, they would only approach the very worst-performing (*i.e.*, most carbon-intensive) forms of green hydrogen production that exist today, and will never achieve close to zero greenhouse gas emissions.[13] Directing funding to hydrogen production pathways that cannot be scaled or achieve the zero emission-profile needed to achieve carbon neutrality will waste limited public support and risk locking in pollution.

Earthjustice is dismayed that California's current carbon-intensity based policy framework for the transportation sector—the Low-Carbon Fuel Standard ("LCFS")—counterproductively incentivizes status quo, polluting forms of hydrogen production that book and claim attributes from remote biogas projects. As panelist and Earthjustice Senior Attorney Sara Gersen demonstrated during the workshop comparing two LCFS certification pathways for hydrogen, green hydrogen produced from electrolysis powered by solar photovoltaics in Alameda County receive a carbon-intensity score of zero, while hydrogen produced from SMR of fossil gas in Wilmington coupled with the purchase of environmental attributes from dairy methane in Indiana receives a carbon intensity score of negative 287 gCO_{2e}/MJ.[14] Setting aside the flawed assumptions that allow for carbon-negative scoring (which we discuss below) it is clear that the LCFS does nothing to promote the production of green hydrogen over the production of business-as-usual, fossil-derived hydrogen.

The international community is far ahead of California and the United States in drawing up national hydrogen strategies that focus exclusively on green hydrogen,[15] and have already set

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[11] Renee Cho "Why We Need Green Hydrogen" Columbia University - State of the Planet (Jan. 7, 2021) https://blogs.ei.columbia.edu/2021/01/07/need-green-hydrogen/#:~:text=So%2C%20what%20is%20green%20hydrogen,its%20only%20byproduct%20is%20water.

[12] Iain Staffel et al., The Role of Hydrogen and Fuel Cells in the Global Energy System, (Jan. 2019) at 477 https://pubs.rsc.org/en/content/articlepdf/2019/ee/c8ee01157eat.

[13] *See, e.g.*, Christian Bauer et al., On the Climate Impacts of Blue Hydrogen Production (Nov. 9, 2021) https://doi.org/10.33774/CHEMRXIV-2021-HZ0QP; Robert Howarth & Mark Jacobson, How green is blue hydrogen?, Energy Science & Engineering (Aug. 12, 2021), https://onlinelibrary.wiley.com/doi/full/10.1002/ese3.956; IRENA, Green Hydrogen: A Guide to Policy Making, at 9 (2020), https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Nov/IRENAGreenhydrogenpolicy2020.pdf.

[14] Sara Gersen, Reclaiming Hydrogen for a Renewable Future: Distinguishing Oil& Gas Industry Spin from Zero Emissions Solutions (at slide 5) https://efiling.energy.ca.gov/GetDocument.aspx?tn=243619.

[15] For example, both Germany and Uruguay's National Hydrogen roadmaps focus exclusively on green hydrogen and scaling renewable energy deployment alongside electrolyzers. See, e.g. Soren Amelang, "Germany's National Hydrogen Strategy" (June 17, 2020) https://www.cleanenergywire.org/factsheets/germanys-national-hydrogen-strategy and IEEFA, Uruguay launches green hydrogen plan for 20 gigawatts of renewables (June 21, 2022) https://ieefa.org/articles/uruguay-launches-green-hydrogen-plan-20-gigawatts-renewables#:~:text=Uruguay%20launches%20green%20hydrogen%20plan%20for%2020%20gigawatts%20of%20renewables,-June%2021%2C%202022&text=PV%20Tech%3A,10GW%20of%20electrolysers%20by%202040.

out scaling electrolyzer deployment based around large, new renewable energy generation projects dedicated to serving hard-to-abate emissions from sectors like fertilizer and steel. Spain, for example, is beginning work on a 1.7 GW wind and solar plant with a 500 MW electrolyzer to substitute green for fossil-derived ammonia in fertilizer production.[16] Sweden is deploying record-levels of electrolyzers to help decarbonize its steel industry and produce "green steel" that will be used in Volvo's battery-electric trucks.[17] California should likewise sharpen its focus on scaling renewable energy and electrolyzer deployment to enable similar projects that are critical for tackling the climate crisis.

b. Carbon intensity scoring is fraught, and subject to flawed assumptions that can perversely reward polluting forms of hydrogen production.

Even if book and claim were not allowed, and hydrogen production relied on actual biomethane, it is unlikely that this hydrogen would be beneficial for the climate. Several structural barriers stand between achieving acceptably low lifecycle emissions using methane feedstocks, and each requires complex regimes of monitoring and verification to assess, let alone enforce. The upstream leakage of methane during production, treatment, transport, and storage alone can be enough to offset the benefits of using methane to displace petroleum or coal.[18] Importantly, this remains true whether the methane is fracked fossil gas or biogenic gas. **New research indicates that the leakage risks associated with biogas and biomethane supply chains are far greater than previously assumed—likely twice as high.[19]** For any methane that is intentionally produced, wherever total system leakage is greater than 0, the resulting biomethane is greenhouse gas positive.

The CI scoring for dairy manure methane in the LCFS misses these concerns by assuming that any of the methane captured is a net benefit because—if not for the LCFS—it must otherwise be vented to the atmosphere. More fundamentally, the methane from manure lagoons is neither inevitable nor unavoidable, as it does not occur under more sustainable livestock management practices. Instead, it is the result of profit-maximizing management practices that consolidate and confine many thousands of cows to single farms where they produce waste in excess of the land's ability to naturally reincorporate it. The recent trends towards confinement and consolidation, according to the U.S. EPA, translates "into an increasing

[16] Anmar Frangoul, "Danish Energy Fund to Lead Massive Green Hydrogen Project in Spain, Powered by Wind and Solar (Feb. 2, 2022) https://www.cnbc.com/2022/02/02/danish-energy-fund-to-lead-massive-green-hydrogen-project-in-spain.html.
[17] Volvo, "Volvo Trucks: First in the World to Use Fossil-Free Steel in its Trucks" (May 24, 2022) https://www.volvotrucks.com/en-en/news-stories/press-releases/2022/may/volvo-trucks-first-in-the-world-to-use-fossil-free-steel-in-its-trucks.html.
[18] Emily Grubert, "At Scale, Renewable Natural Gas Systems Could be Climate Intensive: The Influence of Methane Feedstock and Leakage Rates," Environ Research Letters, at 6; available at https://iopscience.iop.org/article/10.1088/1748-9326/ab9335.
[19] Semra Bakkaloglu et al., Methane Emissions Along Biomethane and Biogas Supply Chains are Underestimated (June 17, 2022) https://spiral.imperial.ac.uk/bitstream/10044/1/97815/2/Bakkaloglu%20et%20al.2022.pdf.

use of liquid manure management systems, which have higher potential CH_4 [methane] emissions…"[20]

Incentives for methane capture reward industrial agriculture operations for adopting these harmful practices. As environmental justice communities have repeatedly pointed out, and as new research finds, the LCFS favors large dairies over small or pasture-based farms that handle their manure more sustainably.[21] The findings of the Union of Concerned Scientist and Humboldt State University indicate that the LCFS is causing market distortions that encourage industry consolidation and that penalize farms that allow their herd to range free and deposit manure in a way that does not generate methane in the first instance.[22]

Regardless of whether livestock operations would produce methane without incentives to capture it, the CEC should not use a carbon-intensity framework that rests on the false assumption that the methane would enter the atmosphere but-for the incentive to use the biomethane for hydrogen production. That is, the CEC's hydrogen policies must avoid the flaws in the LCFS' carbon accounting, which has allowed industry to claim the biomethane they capture is a carbon negative resource—even when the methane was captured using equipment that had already been funded through other public subsidies and private settlements which claimed credit for the methane capture.[23] Environmental justice groups have alerted CARB to these flaws in the LCFS framework by filing a petition for reform of the LCFS rules, but CARB has not acted to fix the problems that the petition exposes. Consequently, it would be unreasonable to assume that CARB or any other agency can craft a carbon-accounting methodology that accurately assesses the lifecycle emissions of fuels that rely on livestock biomethane.

Moreover, as experts point out, "…if the methane can be captured for [biomethane] production, it can be captured for diversion to a flare, and it is unrealistic to assume that capturable methane would be vented under a GHG conscious policy regime… Flaring destroys the methane with the same destructive benefit as combusting the methane productively."[24] The study warns that scaling the intentional production of methane could have perverse and

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[20] U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017 – Agriculture, at 5-9, https://www.epa.gov/sites/production/files/2019-04/documents/us-ghg-inventory-2019-chapter-5- agriculture.pdf.
[21] Comments of Leadership Counsel et al., Re: Low Carbon Fuel Standard Public Workshop (Nov. 5, 2020); https://www.arb.ca.gov/lists/com-attach/98-lcfs-wkshp-oct20-ws-UDIGaVM9V2kCYVUh.pdf.
[22] Amin Younes and Kevin Fingerman, "Quantification of Dairy Farm Subsidies Under California's Low Carbon Fuel Standard" (Sept. 2021), https://www.arb.ca.gov/lists/com-attach/24-lcfs-wkshp-dec21-wsAHVSN1MhVlpXNQRl.pdf, pp. 18-19.
[23] Public Justice *et al.*, *Petition for Rulemaking to Exclude All Fuels Derived from Biomethane from Dairy and Swine Manure from the Low Carbon Fuel Standard Program*, at 20–24 (Oct. 27, 2021), https://food.publicjusticenet/wp-content/uploads/sites/3/2021/10/Factory-Farm-Gas-Petition-FINAL.pdf.
[24] Emily Grubert, "At Scale, Renewable Natural Gas Systems Could be Climate Intensive: The Influence of Methane Feedstock and Leakage Rates," Environ Research Letters, at 6; available at https://iopscience.iop.org/article/10.1088/1748-9326/ab9335.

climatically significant effects:"[b]ecause biogas and biomethane can generate revenue, it is not only possible but expected to intervene in biological systems to increase methane production beyond what would have happened anyway when there is an incentive to do so."[25] We are concerned that the market for industrial dairy pollution created by the LCFS has become an impediment to more just, effective policies that would reform polluting practices by appropriately holding polluters responsible for their own pollution.

c. **Carbon-intensity scoring ignores environmental justice considerations.**

The flawed negative carbon intensity assumptions in California's LCFS Program greenwashes pollution-intensive practices in frontline communities that live in the nation's pollution capital. Appeals to the vague value of "technology neutrality" that accompany a myopic focus on carbon intensity cannot substitute for ignoring environmental justice concerns. Carbon-intensity based hydrogen incentive regimes like the LCFS generously reward fossil-derived hydrogen paired with industrial dairy methane credits as "cleaner" than solar-powered electrolytic hydrogen. Neither the communities breathing the air pollution from the SMR plant in Wilmington generating gray hydrogen, nor the communities living with the water pollution from the dairies generating the "environmental attributes," would agree that this hydrogen is "clean."

Incremental reforms to carbon-intensity methodologies cannot make incentives for livestock methane capture consistent with environmental justice principles. Large, unsustainable industrial dairies are the only facilities that can link to the LCFS supply chain.[26] The predominantly rural, disadvantaged communities of color in California's Central Valley–living in one of the most environmentally stressed parts of the country–would likely be surprised to hear the industrial dairies in their zip codes are considered source of "clean" energy. In an air basin that is in extreme non-attainment with federal 8-hour ozone standards, these dairies are the region's largest source of ozone-forming pollution.[27] In a region with the highest rate of drinking water contamination in the State, they are the largest source of groundwater nitrate pollution.[28] As discussed above, the distortionary effects of the LCFS are rewarding dairies to produce more methane by consolidating and increasing herd sizes, and with it, increasing severe air, water, and odor impacts for adjacent communities.[29] Rather than rely on incentive schemes that risk these unintended consequences, California's leaders must address the agriculture industry's methane

[25] *Id.*
[26] *See, e.g.*, U.S. EPA, "Is Anaerobic Digestion Right for your Farm?" (Accessed Jan. 4, 2021) https://www.epa.gov/agstar/anaerobic-digestion-right-your-farm.
[27] Sheraz Gill et al., "Air Pollution Control Officer's Revision of the Dairy VOC Emission Factors," SJVAPCD, at 9 (Feb. 2012), https://www.valleyair.org/busind/pto/emission_factors/2012-Final-DairyEE-Report/FinalDairyEFReport(2-23-12).pdf.
[28] Eli Moore et al., "The Human Costs of Nitrate-contaminated Drinking Water in the San Joaquin Valley," Pacific Institute, at 7 (Mar. 2011), https://pacinst.org/wpcontent/uploads/2011/03/nitrate_contamination3.pdf.
[29] Comments of Leadership Counsel et al., Re: Low Carbon Fuel Standard Public Workshop (Nov. 5, 2020), https://www.arb.ca.gov/lists/com-attach/24-lcfs-wkshp-dec21-wsAHVSN1MhVlpXNQRl.pdf.

pollution head-on with stringent regulation on livestock facilities, which can first take effect on January 1, 2024.

3. CEC should ensure hydrogen investments are limited to projects that comply with regulations called for by SB 1505.

To stop misleading Californians and subsidizing fossil fueled-hydrogen, the CEC's investments in hydrogen refueling stations must be limited to projects that—at a minimum—comply with regulations that must be adopted under SB 1505. CARB and the hydrogen industry have contributed to a disingenuous narrative that more than 33 percent of the hydrogen dispensed at California fueling stations is renewable. For example, CARB states that "California's [hydrogen fueling] network has recently been dispensing up to 90 percent renewable hydrogen."[30] The California Hydrogen Business Council has repeated that claim and also falsely stated that "[i]n 2018, between 37% and 44% of hydrogen used for transportation in California was renewable."[31] In reality, most of the hydrogen that CARB and industry are labeling as "renewable" is produced from fossil fuels through SMR. The industry calls this hydrogen "renewable" when it is matched with credits for the "environmental attributes" of biomethane from out-of-state sources.[32]

Mislabeling hydrogen produced from fossil fuels as "renewable" is not just misleading the public and perpetuating an industrial process that harms public health—it obscures CARB's longstanding failure to require state-funded hydrogen fueling stations to dispense at least 33.3 percent renewable hydrogen, as state law requires. In 2006, California enacted Senate Bill ("SB")1505 (Lowenthal), which ordered CARB to adopt regulations no later than July 1, 2008, that: "Require that, on a statewide basis, no less than 33.3 percent of the hydrogen produced for, or dispensed by, fueling stations that receive state funds be made from eligible renewable energy resources as defined in subdivision (a) of Section 399.12 of the Public Utilities Code."[33] Today—nearly fifteen years after the enactment of Senate Bill 1505 and more than thirteen years past the deadline for CARB to adopt implementing regulations—the agency has not adopted a rule that requires hydrogen fueling stations to dispense a minimum amount of hydrogen made from renewable energy resources.

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[30] CARB, 2020 Annual Evaluation of Fuel Cell Electric Vehicle Deployment& Hydrogen Fuel Station Network Development (Sept. 2020), at xxiv, https://ww2.arb.ca.gov/sites/default/files/2020-09/ab8_report_2020.pdf.

[31] California Hydrogen Business Council, Hydrogen FAQs, https://www.californiahydrogen.org/resources/hydrogen-faq/.

[32] John Eichman & Francisco-Flores Espino, *California Power-to-Gas and Power-to-Hydrogen Near-Term Business Case Evaluation*, NREL (Dec. 2016) ("NREL 2016, Business Case Evaluation"), at 59 ("Senate Bill 1505 in California requires that 33.3% of hydrogen produced for or dispensed by state-funded fueling stations must be made from eligible renewable resources. At present, the majority of the required renewable hydrogen is produced from SMR and coupled with the purchase of biogas credits."), https://www.nrel.gov/docs/fy17osti/67384.pdf.

[33] Senate Bill No. 1505, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200520060SB1505.

As a result of failing to implement SB 1505, CARB is hydrogen made from fossil fuels as "renewable" even though it does not meet the statutory standard for renewable hydrogen. CARB's practice of counting hydrogen made from fossil fuels as "renewable" is inconsistent with the statute for at least two reasons. First, SB 1505 demands that at least a third of hydrogen dispensed at state-funded fueling stations be "made from" renewable energy resources. Under the plain meaning of the statute, hydrogen made from fossil fuels does not qualify. The statute does not authorize CARB to accept credits for "renewable attributes" in lieu of requiring hydrogen to actually be made from renewable energy resources.

Second, SB 1505 specified that state-funded hydrogen fueling stations must dispense hydrogen made from renewable *electricity* resources. This requirement necessarily excludes hydrogen produced through SMR—regardless of whether the facility uses a fossil fuel feedstock, a biomethane feedstock, or buys "environmental attributes" to supposedly mitigate the impacts of its fossil fuel use—because SMR facilities do not make hydrogen from renewable electricity resources, as SB 1505 demands. That is, SB 1505 requires that hydrogen be made from "eligible renewable resources as defined in subdivision (a) of Section 399.12 of the Public Utilities Code." In turn, Public Utilities Code Section 399.12 defines "[e]ligible renewable energy resource" as "an electrical generating facility that meets the definition of 'renewable electrical generation facility'" in the Public Resources Code, subject to certain provisos.[34] Thus, SB 1505 orders CARB to require state-funded fueling stations to dispense hydrogen made from renewable *electrical generating facilities.* The statute's legislative history puts this requirement succinctly: "At least 33 percent of the hydrogen produced or dispensed must be made from renewable sources of electricity."[35] Thus, under SB 1505, the only permissible way to use biomethane to produce renewable hydrogen pursuant is to use Renewable Portfolio Standard-eligible biomethane to power an electric generating unit and use the resulting electricity to produce hydrogen.

Consistent with SB 1505, the CEC should limit funding to fueling stations that dispense at least 33.3 percent *green* hydrogen and not allow hydrogen produced through SMR coupled with credits for "environmental attributes." Compliance with SB 1505 will ensure that the state's hydrogen industry is investing in green hydrogen and will deliver health benefits to California communities because green hydrogen production that relies on wind and solar resources does not emit health-harming air pollution—unlike SMR.

4. The CEC should transition investments for hydrogen away from the on-road

[34] Today, the Public Utilities Code definition of eligible renewable energy resource is codified at Section 399.12(e). However, subsequent amendments to Public Utilities Code Section 399.12 do not change the analysis because the statute has always defined "Eligible renewable energy resource" to mean "an electric generating facility" that meets certain criteria.

[35] *See, e.g.*, Assembly Committee on Transportation Bill Analysis, SB 1505 (Lowenthal) – as Amended August 7, 2006, at 7 (Aug. 8, 2006).

transportation sector.

a. California should end unproductive investments in light duty hydrogen refueling infrastructure.

Of all the possible applications for green hydrogen—a scarce, and extremely costly resource—there is virtually unanimous consensus that light-duty passenger transport is one of the worst.[36] As CEC Chair David Hochschild explained in a presentation to a Joint Legislative Committee in March, hydrogen's low efficiency leads to "significant wasted energy compared to electrification. A FCEV would require 2 times the clean electricity as a BEV."[37] The significant energy efficiency advantage of BEVs—even relative to conventional gasoline vehicles, means they are already the cheapest vehicle to own in almost any part of the United States. By 2024 or earlier, they are expected to be cheaper than conventional vehicles even on an upfront price basis. There is no reason for California to continue investing in costly refueling infrastructure that less efficiently, more expensively duplicates the decarbonization role of a vastly more advanced technology—direct electrification with BEVs.

Moreover, California's light-duty hydrogen refueling infrastructure is already vastly over-built. Today, California has 177 light-duty hydrogen refueling stations opened or planned, just 23 stations short of the goal of having 200 stations up by 2025. CEC estimates that this is enough to support 230,000 fuel cell vehicles. This is enough refueling capacity to support 25 times the number of FCEVs registered in California today (around 9,000). **There is no reason to expect this system will require expansion.** Most carmakers have completely abandoned any projects they had pursuing passenger FCEVs. For example, Volkswagen's CEO declared that "you won't see any hydrogen usage in cars…not even in 10 years because the physics behind it are so unreasonable." Toyota, the longest holdout on the transition to battery electric vehicles, has just announced a full line up of electric models. California should join the chorus of experts, analysts, and industry officials and end public support for light-duty fuel cell vehicles.

b. The CEC's transportation funding should direct support for the use of green hydrogen toward heavy, long-haul, off-road applications.

[36] *See, e.g.*, Volkswagen, Battery or fuel cell, that is the question, (Mar. 12, 2020) https://www.volkswagenag.com/en/news/stories/2020/03/battery-or-fuel-cell--that-is-the-question.html ("The conclusion is clear: in the case of the passenger car, everything speaks in favor of the battery and practically nothing speaks in favor of hydrogen. 'No sustainable economy can afford to use twice the amount of renewable energy to drive with fuel cell passenger cars rather than battery-powered vehicles,' says study leader Dietmar Voggenreiter."); *see also* Norman Gerhardt et al., Fraunhofer Institute for Energy Economics, "Hydrogen in the Energy System of the Future: Focus on Heat in Buildings," at 5 (May 2020); Michael Liebreich, "Separating Hype from Hydrogen – Part Two: The Demand Side" (Oct. 16, 2020) https://about.bnef.com/blog/liebreich-separating-hype-from-hydrogen-part-two-thedemand-side/.

[37] David Hochschild, California Energy Commission – Hydrogen Presentation (Mar. 14, 2022) at 4 https://atrn.assembly.ca.gov/sites/atrn.assembly.ca.gov/files/CEC%20Hydrogen%20Presentation-%20Chair%20David%20Hochschild.pdf.

While passenger vehicles are the worst-ranked application for hydrogen ("uncompetitive"), trucks and buses are marginally better—ranked second-to-last, or "low potential."[38] Earthjustice is concerned that investments in refueling infrastructure for medium- and heavy-duty vehicles could replicate the problem of wasting public funds on overbuilding underutilized or unnecessary infrastructure. The need for hydrogen even in much of the medium- and heavy-duty sector is not well-supported enough to justify widespread investment. Academics,[39] truck manufacturers,[40] and multiple independent analysts have concluded that battery electric technology is best positioned to decarbonize the vast majority of road-transport (even long-haul trucking).[41] Today, the only commercially available HCFV medium- and heavy-duty vehicles are transit buses.[42] Despite HFCV buses being a well-established technology, and despite being eligible for a +100% voucher enhancement (i.e. a doubling of the subsidy), only 6 of more than 11,300 zero emission trucks and buses purchased through California's HVIP program have been FCEVs.[43] The answer is in large part that there are several, cheaper and more efficient battery-electric buses. AC Transit, which has long pioneered fuel-cell technology, found in a study of their own fleet that the HFCV buses were the least reliable and had the highest cost-per-mile of any vehicle in operation.[44]

This advantage for BEV trucks is likely to hold across most of the medium- and heavy-duty market. As BNEF highlighted in their slides, there is already a large and rapidly expanding market for BEV trucks, covering ranges up to 80% of the maximum range achieved by HFCVs.

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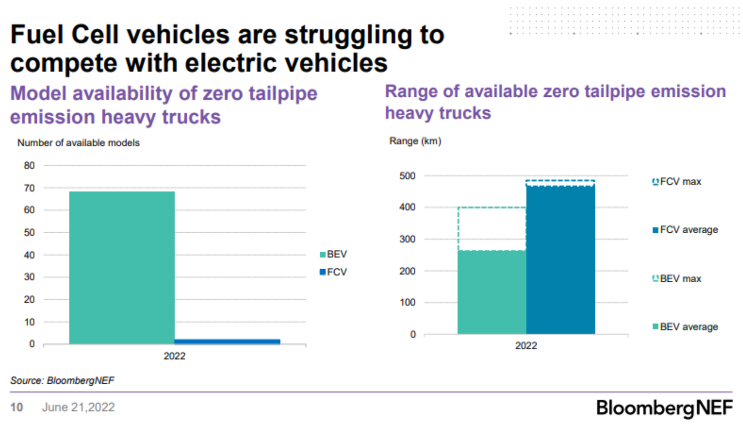
[38] Michael Bravante, BloombergNEF Remarks - CEC 2022 Hydrogen Consultation (June 21, 2022) available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=243616.
[39] Patrick Plotz, Hydrogen Technology is Unlikely to Play a Major Role in Sustainable Road Transport *Nature Electronics* (Jan 31, 2022) https://www.nature.com/articles/s41928-021-00706-6.
[40] TRATON, "Why the future of trucks is electric," (Apr. 13, 2021) https://traton.com/en/newsroom/current-topics/furture-transport-electric-truck.html.
[41] *See, e.g.*, Amol Phadke et al., Why Regional and Long-Haul Trucks are Primed for Electrification Now (Mar. 2021) https://eta-publications.lbl.gov/sites/default/files/updated_5_final_ehdv_report_033121.pdf; Transport & Environment, Why the Future of Long-Haul Trucking is Battery Electric (Feb. 2022).
[42] California HVIP, HVIP Eligible Vehicles (Accessed July 10, 2022) https://californiahvip.org/vehicles/?t_type=379
[43] California HVIP, HVIP Impact (Accessed July 10, 2022) https://californiahvip.org/impact/
[44] AC Transit, AC Transit ZEBTA Study (July 19, 2021) https://www.actransit.org/press-release/ac-transit-groundbreaking-zero-emission-bus-side-by-side-technologies-study.



As battery technology continues to outpace expert predictions, and more long-range BEV trucks are commercialized, there will be increased opportunity costs associated with overbuilding medium- and heavy-duty hydrogen refueling infrastructure. We urge the CEC to proceed with caution with investments in this sector and aim to target investments in fleets or applications that are uniquely challenging for BEVs. In the on-road sector, these are likely to be niche long-haul applications where the need for sub-20 minute refueling times outweighs the higher maintenance and refueling costs that come with HFCVs.[45]

Instead, the CEC should focus on expanding the range of applications that can achieve zero-emissions by targeting green hydrogen fuel cell deployment to the heaviest, long haul operations—mostly in the shipping and aviation sectors. Notably, even here, batteries and direct electrification will continue to play an important role. Battery-electric ferries and inland vessels are already in operation across parts of the world. Last year, a short-haul all-electric cargo ship began commercial operation in Norway.[46] Another startup, Fleet Zero, aims to decarbonize long-haul ocean-going vessels using a battery-swap model with container-sized batteries while stringing together shorter trips.[47] While the range of applications that can be directly electrified using batteries continually expands, a least-regrets strategy to scaling green hydrogen and fuel cell technology will be to focus on long-haul voyages. For long-haul voyages, liquid or gaseous fuels are likely to be necessary for the foreseeable future.

The CEC's policies on hydrogen-fueled transportation should exclusively support options that rely on fuel cells—as opposed to combustion engine technologies. Unlike fuel cells, engines that combust hydrogen or a hydrogen derivative do not eliminate NOx emissions. Due to its

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[45] Transport & Environment, Comparison of Hydrogen and Battery Electric Trucks (June 2020) https://www.transportenvironment.org/wp-content/uploads/2021/07/2020_06_TE_comparison_hydrogen_battery_electric_trucks_methodology.pdf.
[46] Rapid Transition Alliance, Making Waves: Electric Ships are Sailing Ahead (July 8, 2022) https://www.rapidtransition.org/stories/making-waves-electric-ships-are-sailing-ahead/.
[47] Devin Coldewey, "Fleetzero Looks to Capsize the Shipping World with Electric Vessels Serving Forgotten Ports (Mar. 15, 2022) https://techcrunch.com/2022/03/15/fleetzero-looks-to-capsize-the-shipping-world-with-electric-vessels-serving-forgotten-ports/.

high flame temperature, any equipment that burns hydrogen creates significant NOx pollution risks. A focus on fuel cells will align decarbonization with the urgent need to address freight pollution in frontline communities

c. The CEC should pursue opportunities to reduce reliance on diesel back-up generators with green hydrogen fuel cells.

For the same reason, the CEC should also emphasize fuel cells over combustion in stationary and back up power generation applications. The CEC's EPIC and Gas Research and Development Programs name "power generation and emission control" as a planned end use investment. Earthjustice urges the CEC to avoid investments that rely on continued or worsening air pollution—including the burning of hydrogen or hydrogen-methane blends. Because hydrogen burns at a higher flame temperature than methane, it can produce even more NOx pollution than methane combustion alone. It is imperative that reliance on hydrogen does not increase NOx emissions—even on an hourly basis—in Los Angeles or elsewhere in the South Coast Air Basin, which is in extreme nonattainment of the federal health-based 1-hour ozone standard.[48] Further hourly reductions are needed to meet California's even more stringent 1-hour ozone standard.[49] Significant hydrogen combustion is likely incompatible with meeting health-based air quality standards. As the South Coast Air Quality Management District explains in its most recent draft air quality management plan, "there is no viable pathway to achieve the needed reductions without widespread adoption of zero emission (ZE) technologies across all mobile sectors and stationary sources large and small."[50]

Given the need for a widespread transition to zero-emission technologies, it is doubtful that investments in emission controls will make it feasible to burn hydrogen in California's most polluted air basins without contributing to exceedances of air quality standards. Pollution controls for turbines that can operate on pure hydrogen is so challenging that turbine manufacturers' trade associations have found "flexibility might be needed on NOx limits" to accommodate a transition to hydrogen.[51] NOx emissions can spike while a facility is starting up because it takes some pollution control systems hours to warm up, but facilities burning

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[48] U.S. Environmental Protection Agency, 1-Hour Ozone (1979) Nonattainment Areas, https://www3.epa.gov/airquality/greenbook/onc.html. Increases in NOx emissions over short periods can also impact the region's ability to meet the federal 8-hour ozone standard, for which it is also in extreme nonattainment. U.S. Environmental Protection Agency, 8-Hour Ozone (2015) Nonattainment Areas, https://www3.epa.gov/airquality/greenbook/jnc.html.

[49] California Ambient Air Quality Standards set a 1-hour limit for ozone of 0.09 parts per million. California Air Resources Board, Ambient Air Quality Standards, https://ww2.arb.ca.gov/sites/default/files/2020-07/aaqs2.pdf.

[50] South Coast Air Quality Management District, 2022 Draft Air Quality Management Plan (May 2022) at ES-5, http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/draft2022aqmp.pdf?sfvrsn=12.

[51] Mirko Bothien et al., *Hydrogen Gas Turbines: The Path Towards a Zero-Carbon Gas Turbine*, European Turbine Network, at 77 (Jan. 2020), https://etn.global/wp-content/uploads/2020/01/ETN-Hydrogen-Gas-Turbines-report.pdf.

hydrogen would likely operate for short, infrequent periods because of their high operational costs.

By contrast, investments in green hydrogen fuel cells paired with renewable energy, battery storage, and microgrids is a valuable opportunity to supply zero-emission back-up power and displace reliance on diesel generators.[52] While fuel cells have historically been used for smaller capacity power generation than turbines, they have several significant advantages (besides the obvious one that they help rather than hurt our chances of meeting federal health-based air quality standards). Fuel cells can operate at higher efficiencies than combustion power plants, and be cited in urban settings near load centers because they are quiet and zero-emitting, reducing the need for transmission investments.[53] And because fuel cells rely on the same principal process as electrolyzers, they benefit from the expected cost declines and efficiency improvements that come from increased investment in green hydrogen.

Conclusion

We look forward to working with CEC Staff to develop an investment program that leverages green hydrogen to advance a rapid and equitable zero emission California.

Sincerely,

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Earthjustice

[52] *See, e.g.*, Tami Hood, Hydrogen Fuel Cells to Replace Diesel Backup for Data Center in the Netherlands (Mar. 1, 2022) https://www.hydrogenfuelnews.com/hydrogen-fuel-cells-backup-power/8551533/.

[53] Sasan Saadat and Sara Gersen, Reclaiming Hydrogen for a Renewable Future (Aug. 2021) at 24 https://earthjustice.org/sites/default/files/files/hydrogen_earthjustice_2021.pdf.