October 16, 2024

Ms. Liane Randolph
Chair, California Air Resources Board
1001 I Street Sacramento, CA 95814

Submitted Electronically

Re: Comments regarding the second 15-day public notice for the proposed amendments to California's Low Carbon Fuel Standard

Dear Chair Randolph,

Thank you for the opportunity to provide comments on the second 15-day public notice for the proposed amendments to California's Low Carbon Fuel Standard (LCFS). Environmental Defense Fund (EDF) appreciates the work CARB staff has dedicated to amending the Low Carbon Fuel Standard. EDF looks forward to continuing to engage in this rulemaking and supporting the successful decarbonization of California's transportation sector.

As we have stated in previous comments, updating LCFS to increase the program's ambition and efficacy will be integral to ensuring California can deliver the outcomes and emissions reductions envisioned in the final Climate Change Scoping Plan, as well as achieve carbon neutrality by 2045.

EDF hopes to see amendments that sustain the LCFS's role in promoting the use of lower carbon alternatives to petroleum fuels, thus bringing substantial health, economic, and environmental benefits. To that end, we offer the following comments on the proposed LCFS amendments concerning hydrogen, feedstock sustainability, and sustainable aviation fuel (SAF).

Hydrogen

EDF's hydrogen team consists of experts across many geographies working together to ensure that zero- and low-carbon H_2 deployment delivers on its promise to generate maximum climate benefits while protecting public health, environmental integrity, and community well-being — locally and globally. EDF has been a longstanding advocate within the U.S. hydrogen sector, actively participating at both state and federal levels to push for strong hydrogen outcomes, most recently around the 45V Hydrogen Production Tax Credit and DOE's Hydrogen Hubs program. Our in-house science team has

also spearheaded cutting-edge research initiatives dedicated to advancing hydrogen and methane leakage detection and mitigation.

EDF appreciates CARB's thoughtful approach to leveraging LCFS to effectively scale up hydrogen production and advance California's decarbonization efforts. We offer the following recommendations to ensure implementation includes proper protections and maximizes climate benefits.

CARB should tighten the carbon emissions threshold for "low-carbon hydrogen" to ensure more rigorous standards

The current carbon emissions threshold for 'low-carbon hydrogen' should be lowered. The proposed removal of the electrolytic requirement makes it more likely that high-emissions hydrogen is produced and sold into the system. The proposed energy density threshold for what is defined as 'low-carbon hydrogen' (i.e., less than or equal to 55g/MJ for gaseous hydrogen and 95 g/MJ for liquid hydrogen) equates to 6.6 kgCO2e/kgH2 for gaseous and 11.4 kgCO2e/kgH2 for liquid hydrogen respectively. Despite including end use in the system boundary, these thresholds need to be more rigorous to ensure that LCFS credits do not support the production of pollutive hydrogen.[1] For example, the EU well-to-wheel threshold number is significantly lower at 3.38kg CO2e/kgH2 as part of the Renewable Energy Directive (RED III).[2]

If the electrolytic requirement for hydrogen is removed, other climate protections need to be put in place

Removing the electrolytic requirement and allowing hydrogen produced via fossil fuel pathways to be eligible does stand to significantly increase the GHG emissions associated with hydrogen production. For example, a recent analysis conducted by EDF found that for every fossil hydrogen facility built instead of a renewable hydrogen one, GHG emissions would be expected to increase at least 7-fold – equaling the long-term climate impact of 2-3 natural gas-fired power plants each year.[3]

CARB proposed extending the credit eligibility of hydrogen produced from fossil fuel pathways until 2035 – adding five years to the original phaseout date of 2030. Hydrogen produced via fossil fuel pathways must include important provisions to address the full climate impact of hydrogen, as outlined below.

1. **Upstream methane emissions accounting must be accurate within LCFS:** Upstream methane emissions accounting must be accurate within LCFS to capture the full impact of fossil-based hydrogen. Methane is the main component of natural gas and is vented and leaked into the atmosphere throughout the natural gas supply chain. Upstream methane emissions can greatly reduce the climate benefits of fossil-based hydrogen. For example, when combined with the warming impact of hydrogen emissions (from leaking, venting, and

[1] https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard; Calculations assume a 120 MJ/kg energy density for hydrogen.
[2] https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/747085/EPRS_BRI(2023)747085_EN.pdf
[3] a6nmb6p6646ftfboj4l7oa1y0j662jfc.pdf (edf.org)

purging), high rates of methane leakage (i.e., 2.1%) can make some forms of blue hydrogen worse for the climate in the near term than the fossil fuel alternatives it is replacing.[4]

In the same way that emissions from electricity generation vary by grid region, methane emissions from oil and gas production vary substantially by basin. For example, recent measurement data from EDF's MethaneAIR program has found that methane leak rates from individual oil and gas basins can vary widely, ranging from 1% of gross gas production to nearly 8%.[5] Any estimates around upstream methane emissions should be basin-specific and not reliant on a single nationwide default methane leak rate as it obscures these large differences between basins and prevents full and accurate accounting of greenhouse gas emissions.

Some hydrogen producers have proposed the ability to enter user-specific methane rates as part of emissions assessments. However, this data is not yet verifiable, and peer-reviewed studies using direct methane measurements continue to demonstrate that actual emissions are significantly higher than self-reported estimates contained in official inventories.[6] Natural gas certification schemes vary widely in coverage, participation, integrity, and verification and monitoring requirements, and currently, none of the existing certification regimes are sufficiently robust to be included in a regulatory framework.[7]

As more robust verification systems become developed,[8] it will be important that this process includes regularly updating the residual national average that others claim and/or otherwise avoiding the risk that producers would cherry-pick the lowest number (i.e., their user-specific rate or the national average, whichever was lowest). Overall, until user-specific values can be reliably verified, CARB should require basin-specific methane rates to be utilized.

2. **Include actual carbon capture rates**: CARB must require actual, verified carbon capture rates. "Nameplate" capacities can be erroneous as CCS technology often captures carbon dioxide at lower rates, facilities may not run CCS continuously or fully control their emissions from all processes, and infrastructure for carbon transport and storage can have unplanned outages. Producers must also verify claims by demonstrating permanent sequestration, detailing each ton of carbon stored while following best practices. This data also must be reported, verified, and publicly available.

3. **Low-carbon RNG should not be allowed to offset the hydrogen carbon intensity score**: While EDF supports the use of low-carbon RNG in book-and-claim accounting to offset fossil

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[4] https://pubs.acs.org/doi/10.1021/acs.est.3c09030
[5] https://www.edf.org/media/new-data-show-us-oil-gas-methane-emissions-over-four-times-higher-epa-estimates-eight-times
[6] https://www.nature.com/articles/s41467-021-25017-4
[7] Efforts are ongoing to update methane emissions reporting under subpart W of EPA's Greenhouse Gas Reporting Program (GHGRP), but existing reporting requirements have been shown to significantly underestimate actual emissions. The GHGRP is also limited in coverage, applying only to larger facilities, and lacks monitoring and verification requirements. It would therefore be inappropriate at this point to allow the use of bespoke inputs based on emissions reported to subpart W.
[8] https://www.catf.us/2024/07/joint-catf-edf-principles-methane-reporting-45v/

natural gas transportation fuel, extending this accounting method to hydrogen's carbon intensity value within the LCFS would be problematic. Allowing low-CI RNG scores to affect hydrogen's CI eligibility would further undermine the hydrogen's climate benefit by effectively offsetting a different, cleaner production method of hydrogen. If this offset were allowed, unabated dirty hydrogen production could be eligible for the LCFS by claiming a very small portion of RNG inputs.

4. **Consider the warming impact of hydrogen emissions**: Hydrogen itself is an indirect greenhouse gas, with the latest science finding that hydrogen emissions are 30-40 times more powerful at trapping heat over the following 20 years than carbon dioxide for equal mass, and 8-12 times more powerful over a 100-year period.[9, 10, 11, 12] Hydrogen is also a very small, slippery, leak-prone molecule. Both of these factors combined mean that hydrogen emissions can significantly undermine the climate benefits of hydrogen use. For example, a recent study published by EDF considers the climate impacts of eight well-to-use hydrogen pathways in the industry, transport, and power sectors compared to the fossil fuel alternatives they intend to replace. The authors found that for blue hydrogen pathways, high hydrogen (i.e., 10% leakage) and methane emissions (i.e., 2.1% leakage) can yield an increase in warming in the near term by up to 50%, whereas low emissions decrease warming impacts by at least 70%. Even for green hydrogen pathways, upper-end hydrogen emissions (10% leakage) can reduce the climate benefits in the near term by up to 25%, emphasizing the importance of accounting for hydrogen emissions within CARB's LCA equation and requiring hydrogen leakage prevention plans be put in place.[13]

5. **Incorporate the latest science on GWP values and time horizons**: Both methane and hydrogen are potent greenhouse gases in the near term, as indicated above, and their emissions need to be accurately accounted for across dual time scales of global warming potential. The GWP20 value of methane is already reflected in the latest IPCC report, but there is now also scientific consensus around the warming potential of hydrogen. Four IPCC assessment reports (TAR, AR4, AR5, AR6) mention hydrogen's warming effects. The IPCC Third Assessment Report (TAR) cautions that "in a possible fuel-cell economy, future emissions may need to be considered as a potential climate perturbation."[210] Hydrogen's GWP100 values (based on its tropospheric effects only) are reported in the Fourth Assessment Report[14] and Fifth Assessment Report.[15] The Sixth Assessment Report identifies hydrogen leakage as a challenge that the industry must overcome.[16] A recent multi-model assessment asserted high confidence in the quantification of hydrogen's warming effects and explicitly stated that the science is robust enough to be included in policy decisions and

[9] https://acp.copernicus.org/articles/23/13451/2023/
[10] https://www.nature.com/articles/s43247-023-00857-8
[11] https://www.sciencedirect.com/science/article/abs/pii/S0360319922055380?via%3Dihub
[12] https://www.nature.com/articles/s43247-022-00626-z
[13] https://pubs.acs.org/doi/10.1021/acs.est.3c09030
[14] IPCC Fourth Assessment Report (AR4), Working Group I, Chapter 2, 2.10.3.6 Hydrogen (2007)
[15] IPCC Fifth Assessment Report (AR5), Working Group I, Chapter 8 Supplemental Material, 8.SM.14 Metric Values for Other Near-Term Climate Forcers to Support Section 8.7.2, pg. 23 (2013)
[16] IPCC AR6 Working Group III, Chapter 6, 6.4.5.1 Hydrogen: Low-carbon Energy Fuel, pg. 657 (2022)

tools.[17] Based on these sources, a GWP100 value of 11.6 and GWP20 value of 37.3 can reliably be used for hydrogen, and a GWP100 value of 28 and GWP20 value of 84 can be used for methane.

A robust LCFS program is important for promoting the use of lower-carbon alternatives, including hydrogen. Therefore, it is crucial that LCFS incorporate rigorous standards and climate protections to ensure California can reap the greatest health, economic, and environmental benefits.

Feedstock Sustainability and Sustainable Aviation Fuel

For almost a decade, EDF has been working to reduce harmful pollution from aviation to mitigate climate change and deliver public health benefits utilizing alternative fuels. This includes engagement in climate policy at the International Civil Aviation Organization (ICAO), leading and participating in expert working groups developing ICAO's Sustainability Framework for Sustainable Aviation Fuel (SAF) – an effort that builds heavily on California's Low Carbon Fuel Standard (LCFS). We were also deeply involved in the inclusion of SAF tax credits in the federal Inflation Reduction Act (IRA).

Sustainable feedstocks are vital to the production of sustainable aviation fuel and play a significant role in California's efforts to effectively decarbonize the aviation sector. The following comments concern strengthening CARB's proposal to ensure the sustainability of feedstocks.

CARB should strengthen its proposal for sustainability certification of feedstocks

We appreciate the addition to section 95488.8(g)(1)(D) in January requiring attestation letters for specified source feedstocks, at each entity spanning the chain of custody from the point of origin to the fuel production facility. We also applaud the January addition of section 95488.9(g) requiring continuous third-party sustainability certification. However, the most recent iterations of proposed amendments to section 95488.9(g), in the current 15-day package and the August package, carve out an exemption from third-party sustainability certification for all specified source feedstocks.

Where pathway applications concern true wastes, residues, and byproducts, we agree that in theory, the risk of overlooking adverse features is lower than for purpose-grown and -harvested energy feedstocks. That said, the question remains of ascertaining whether a feedstock truly is a waste, residue, or byproduct. The documentation elements listed in section 95488.8(g)(1)(B)-(C) of existing regulation would cover the essentials if all applicants and signatories always wrote the truth. Per the indicated process, however, chain-of-custody records, feedstock transfer documents, and the proposed attestation letters are to be maintained but not submitted until CARB Executive Officer or other verifier requests the information. As such, the existing documentation protocol relies largely on an honor system.

The reduced CI favors specified source feedstocks, and suppliers and/or fuel pathway applicants now have even more incentive than before to designate their inputs as specified source feedstocks with inaccurate sustainability features. If CARB is to successfully preempt fraud in the LCFS program, then

[17] https://www.nature.com/articles/s43247-023-00857-8

such a broad category of materials should not receive an automatic waiver from third-party verification.

Standardizing sustainability certification would help relieve the administrative burden

We understand the desire to reduce administrative burden throughout the LCFS program where practicable. While claims made in pathway applications would be subject to audits under penalty of perjury, these fraud deterrence measures would come into effect only if a claim raises enough suspicion for CARB staff to actively investigate. In other words, most of the administrative burden for auditing specified source feedstock letters of attestation falls on CARB staff per the proposal. Even with the option to request that a 3rd party verifier handle the audit, such instances require that CARB staff first identify the case and then make a special request to the third-party verifier – all after applications have been filed and reviewed. In contrast, we recommend that the handling of specified source feedstock be included in section 95488.9(g) requiring third-party sustainability certification and attestation documents like for any other feedstock. Under such an LCFS regulation, the credentials of true wastes, residues, and byproducts would be obtained at the beginning of the process, thoroughly checked using purpose-built auditing infrastructure, and all in all, minimize the number of administrative steps on the desks of CARB staff.

Sustainability certification bodies like the Roundtable for Sustainable Biomaterials (RSB) already have standardized, consensus-built protocols and trained field specialists for auditing and verifying wastes and residues. CARB's proposed phase-in approach to sustainability requirements per section 95488.9(g)(5)-(7) allows for more than ample time to adapt to new requirements: from 2026 onward, pathway holders and applicants submit geospatial data of plot boundaries; from 2028 onwards no eligible feedstocks are sourced on lands converted after 2008; and mandatory third-party certification begins in 2028. Our recommendation would fit into this proposed phase-in timeline; section 95488.9(g) should ensure that wastes, residues, and byproduct designations are also third-party certified starting with the 2028 data year.

Updates to LCFS have nationwide implications for sustainable aviation fuel

The US Inflation Reduction Act (IRA) section 40B Sustainable Aviation Fuel (SAF) tax credit applies safe harbor to any candidate fuel demonstrating compliance with CARB LCFS verification. Each time the LCFS changes, so too does the floor for 40B stringency. In the event that the forthcoming 45Z credit guidance also relies on LCFS verification procedures, any weakening of LCFS stringency will open the door to large-scale unsustainable practices nationwide as well.

CARB has a robust list of internationally recognized certification systems

We support CARB's reference to the European Commission-recognized list of certification systems for the European Union Renewable Energy Directive (EU RED). In fact, Directive 2018/2001 has been updated with the amending Directive 2023/2413, which will be implemented by May of 2025. As such, CARB might consider a slight modification to 95488.9(g)(6)(C)(1), generalizing the wording to: "The Executive Officer will approve certification systems that ~~have been recognized by the European Commission~~ are eligible for the European Union Renewable Energy Directive (EU RED) ~~2018/2001~~ as

of December 31, 2025 per the European Commission's latest evaluation leading up to that date. Approved certification systems will be subject to the reapproval requirements of section 95488.89(g)(58)(G); or …"

Procedures for forest biomass merit further exploration

When it comes to forest waste biomass, EDF recognizes that many forests in the western U.S. are "overstocked," which increases wildfire vulnerability, particularly in a warming climate. In this context, there may be a need for clarification in the handling of biomass types derived from fuel reduction practices, including mechanical thinning and beneficial fire, which are essential for enhancing forest resilience.

We appreciate your consideration of these comments. EDF looks forward to continuing to work with CARB to update the LCFS. If you have questions or would like to discuss any of these recommendations, please contact Katelyn Roedner Sutter at kroedner@edf.org.

Sincerely,

Katelyn Roedner Sutter
California State Director