Environmental Defense Fund

February 20, 2024

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

Submitted Electronically

Re: Comments regarding proposed amendments to the Low Carbon Fuel Standard

Dear Chair Randolph,

Thank you for the opportunity to provide comments on the proposed amendments to California's Low Carbon Fuel Standard. 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 during the informal workshop process, 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.

We are pleased to see that this proposal strengthens the CI reduction benchmarks both pre- and post-2030. Alongside this increased rigor, EDF hopes to see amendments that will 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 regarding four aspects of the proposed LCFS amendments: 1) crediting for manure biogas, 2) hydrogen crediting and usage, 3) crediting for medium- and heavy-duty vehicle charging, and 4) sustainable decarbonization of the aviation sector.

1. Crediting for Manure Biogas

Agriculture, particularly the dairy industry, is a major source of California's methane emissions. Almost 25% of California's total methane emissions are estimated to come from dairy manure. Addressing dairy manure methane emissions is a key action needed to meet California's climate goals. We applaud the state for establishing a specific methane reduction for the dairy and livestock sectors in SB 1383 (Lara, 2016). California dairy farmers, as price takers, have little

market power to pass costs associated with methane reduction solutions on to the consumer, we therefore also recognize the important role that programs such as the LCFS continue to play in incentivizing and supporting reductions in livestock methane sources.

We appreciate CARB's stance that capturing methane from landfills, dairies, and wastewater is critical to achieving climate targets, and we are aligned with CARB's preference for biomethane to be used to produce low-carbon intensity hydrogen and electricity. We agree that attention is needed to ensure methane capture projects are not abandoned as LCFS transitions away from combustion vehicles towards hard-to-decarbonize sectors.[1]

Manure biogas systems, when operated and installed in a responsibly maintained farm system, are a proven technology that can address existing sources of agriculture methane (from dairy manure storage systems) while replacing fossil fuel-derived methane. Given the large number of liquid manure systems that exist on California (and US) dairies, continuing to include manure biogas systems—as part of an environmentally comprehensive farm nutrient management system—in the LCFS is a powerful tool to drive agriculture methane reductions from existing sources. Continued eligibility is important to meet California's climate goals and drive further agriculture methane reductions across the US.

Today, the LCFS is the most impactful market-based tool to incentivize livestock farmers to adopt methane capture technologies. However, as with any program, it is not perfect. We cannot focus on solving methane, a global climate pollutant, without also ensuring meaningful improvement in the local environment and community.

Addressing Local Pollution

Sources of on-farm methane leakage need to be properly managed.

While they are an important tool for capturing methane, the leakage of methane and the resulting net methane emissions relative to the counterfactual must be considered. EPA acknowledges in its RNG Operations Guide that "fugitive emissions of methane, depending upon their magnitude, can negate the climate and environmental benefits of RNG projects." While methane's negative impact on climate is commonly discussed, methane can also be dangerous to human health at the local level, as a precursor to ozone.[2] Ozone, even at relatively low levels, can cause health effects including inflammation and damage of the airways and further aggravating lung diseases such as asthma, emphysema, and chronic bronchitis.[3]

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[1] https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf
[2] https://unece.org/2010/presentations/Importance%20of%20Methane%20for%20Ozone.pdf
[3] https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution

One of the largest sources of methane leakage in digester biomethane production comes from improper digestate management.[4] Digestate is the effluent that comes out of the digester, which contains nutrients that can fertilize crops. It is common in the United States for digestate to be held in open storage pits or lagoons. Although the manure has been digested, and most of the biogas has been captured in the digester, digestate still produces some methane which is emitted if the digestate is stored in an open lagoon or storage tank. Residual methane emissions from the digestate are estimated to be between 0.2-5.9% of that captured in the digester.

Covering digester effluent storage captures this residual methane, which can be flared or added to the digester biogas, enhancing the carbon market value when it is used for energy. An impermeable cover on the digestate can reduce residual methane emissions by 90%.[4] There are also developing technologies that can capture the ammonia and concentrate it, making it easier to land apply or potentially be sold to generate additional revenue.[5,6]

Another large source of methane leakage is from the processing of biogas – to produce renewable natural gas sufficient to meet natural gas pipeline standards. Methane leakage from the processing of biogas is estimated to be in the 2 – 4% range up to as much as 15%.[7] Methane leakage in the transmission and distribution of natural gas has been estimated to be in the range of 0.4 - 0.9%.[8]

Local air quality impacts that result either directly or indirectly from anaerobic digestion must be addressed.

One of the most significant local air pollutants of concern surrounding biogas systems is ammonia. Approximately 80% of ammonia emissions in the United States, encompassing emissions from both natural sources and human activities, are from agricultural sources. Notably, around 60% of these national emissions stem from livestock manure.[9] Ammonia is a health concern, as it has the potential to form fine particulate matter (PM2.5), which can lead to respiratory and pulmonary issues in nearby communities.[10] Ammonia emissions also present an environmental risk contributing to soil acidification and/or eutrophication in downwind ecosystems.[11]

During anaerobic treatment or storage, manure organics decompose in an oxygen-free environment and produce methane, ammonia, and other gases. In open-system manure storage

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[4] https://ecommons.cornell.edu/server/api/core/bitstreams/a725208d-82ba-4b17-aab4-b1305191c377/content
[5] https://www.sciencedirect.com/science/article/abs/pii/S0048969721021689?via%3Dihub
[6] https://www.mdpi.com/1996-1073/16/4/1643
[7] https://iopscience.iop.org/article/10.1088/1748-9326/ab9335
[8] https://www.wri.org/research/production-and-use-waste-derived-renewable-natural-gas-climate-strategy-united-states
[9] https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data#doc
[10] https://pubmed.ncbi.nlm.nih.gov/20458016/
[11] https://www.sciencedirect.com/science/article/pii/S0301479722018588?via%3Dihub

or treatment lagoons, as the manure undergoes anaerobic decomposition, most of these compounds are lost to the atmosphere. If the anaerobic decomposition takes place in an enclosed environment (such as a covered lagoon or anaerobic digester), the methane degases from the liquid phase and is captured under the cover where it can be collected and flared or used as a fuel. However, the ammonia stays in the solution and hence the dissolved ammonia becomes concentrated inside the anaerobic digester, particularly relative to that remaining dissolved in an open lagoon.

Once the digestate from the anaerobic digester or covered lagoon is discharged from beneath the cover into an open lagoon or storage tank, the ammonia is lost to the atmosphere in the same quantity or perhaps somewhat higher quantities, relative to that lost in an open lagoon, presenting a serious health risk to downwind communities.

Any tax credit generated from biogas created from manure in covered lagoons or anaerobic digesters for hydrogen production should be predicated upon the management of the digestate to reduce ammonia losses. Keeping the digestate in an enclosed system would greatly reduce the loss of ammonia from the digestate as well as allow for the capture of the residual methane in the digestate. The residual methane could be added to the digester biogas and used as fuel. An impermeable cover on the digestate reduces ammonia losses by 55-100% and residual methane emissions by 90%[4] while a permeable cover is estimated to reduce ammonia by 40-80%.[12]

Crediting should be contingent upon meeting specific standards to further reduce local environmental impacts.

As discussed, farm systems can have a negative impact on local communities, specifically around air pollutants, odors, and other downwind ecosystem and water concerns. Producers of biomethane from digesters should have a robust system in place to participate in LCFS to ensure the digester and its nutrients are managed properly. Third-party vetted Nutrient Management Plans (NMP) and Comprehensive Nutrient Management Plans (CNMP) are utilized in many states to reduce the environmental footprint of livestock operations. In New York State for instance, certified nutrient management planners help farmers create farm plans and verify they are followed throughout the year.[13] This standard goes beyond what EPA requires and adds assurance to communities that best management practices are followed, even in emergencies.

For farmers using digesters, compliance with relevant USDA NRCS standards, including both USDA NRCS Nutrient Management (Code 590)[14] to ensure digestate nutrients are well-managed and USDA NRCS Anaerobic Digester Conservation Practice Standard (CPS) for Anaerobic Digesters (Code 366) is paramount. This guidance outlines standard practices to improve air

[12] https://extension.colostate.edu/topic-areas/agriculture/best-management-practices-for-reducing-ammonia-emissions-lagoon-covers
[13] http://nmsp.cals.cornell.edu/publications/extension/CAFOCNMPNY2023.pdf
[14] https://datcp.wi.gov/Documents/NM590Standard2015.pdf

quality by reducing greenhouse gas emissions and objectionable odors from manure or agricultural waste, and/or to reduce transport of pathogens to surface water.[15] These practices apply where biogas production and capture are components of a waste management system plan or a comprehensive nutrient management plan, and sufficient and suitable organic feedstocks are readily available. This practice outlines standards for system design, cover, etc., as well as gas collection, transfer, control, utilization, and monitoring/safety requirements, including criteria for maintenance of air quality, but does notably leave out the control of ammonia emissions, which should be addressed per earlier information.

Without these guardrails, programs like LCFS could encourage the build-out of additional digesters with no oversight into how they are managed – potentially leading to harmful methane leaks and other air pollutants, including ammonia, which can negatively affect local air, soil, and water quality and in turn, harm local communities.

Deliverability

Beyond accelerating the capture of manure methane emissions on California livestock farms, the LCFS, in its current form, has also helped address methane emissions from manure across the US. Under the current regulation, the LCFS allows for indirect accounting of biomethane injected into the North American natural gas pipeline without a deliverability requirement. This enables farm systems across the country to participate in supplying biomethane for the LCFS. However, CARB's proposed changes include new deliverability requirements for natural gas pipeline injection.

Indirect accounting without a deliverability requirement should continue, provided that out-of-state biogas systems contribute to the overall improvement of the local environment and community.

Continuing to allow indirect accounting of biomethane without a deliverability requirement, serves to lift the conversation on manure methane emissions across the country and push other states to engage in how to address agriculture methane emissions. Since methane emissions are a global pollutant, the current LCFS regulation helps reduce methane emissions in a broader context than just California.

As the supply of RNG from manure digestion represents less than 1.5% of current natural gas production, limiting deliverability will decrease the number of offset credits available for the LCFS.[16] Another implication of limiting delivery is the quenching effect it would have on

[15] https://www.nrcs.usda.gov/sites/default/files/2023-04/366-NHCP-CPS-Anaerobic-Digester-2023.pdf
[16] https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

livestock methane capture across large sections of the US as well as the amount of low CI hydrogen produced.[17]

As the market regulator, CARB has the ability and responsibility to ensure that out-of-state manure biogas systems are being implemented in a manner that protects local water quality and air quality, and meaningfully reduces the impact of livestock on local communities. It's imperative that CARB utilize its authority to ensure full compliance with LCFS regulations to not only ensure fraud is prevented in indirect accounting, but that biogas producers contributing to local pollution are held accountable. Biogas systems are complex operations and if farm systems are not currently meeting equivalent environmental regulations and expectations to those followed by California biogas systems, out-of-state biogas systems should not be eligible for participation in the LCFS.

There are numerous examples across the US of manure biogas systems that, upon reaching the current technology end-of-life, are no longer being used and manure methane emissions are again being released into the atmosphere. Without ongoing appropriate economic incentives, farms will not continue to operate manure biogas systems and will not reinvest in the technology. CARB needs to consider how best to address manure biogas systems when they reach the end of the ten-year avoided methane crediting period.

2. Hydrogen Crediting and Usage

Hydrogen is a short-lived, indirect greenhouse gas (GHG) that causes warming by increasing the concentrations of GHGs in the atmosphere.[18] At least 15 scientific publications over the past two decades, including two IPCC assessment reports, have cautioned about the climate impacts of hydrogen emissions in the context of a potential hydrogen economy.[19]

Around 30% of molecular hydrogen (H_2) emitted into the atmosphere chemically reacts with the naturally occurring hydroxyl radical after a few years. This reaction ultimately increases the amounts of short-lived greenhouse gases including methane, tropospheric ozone, and stratospheric water vapor. Recent advancements in chemistry-climate modeling have led to the quantification of hydrogen's full atmospheric warming effects using multiple models—leading to a doubling of earlier warming potency estimates. The latest science suggests 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.[18]

Hydrogen is notoriously hard to hold onto given its small molecular size and is emitted throughout the value chain from both operational releases and leakage. Currently, sensors with

[17] https://gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf
[18] https://acp.copernicus.org/articles/23/13451/2023/acp-23-13451-2023.html
[19] https://www.nature.com/articles/s41467-022-35419-7

the speed and sensitivity necessary to quantify emissions are not widely available; and in the absence of direct measurement data, several studies have estimated emissions from venting, purging, and leakage at various stages of the value chain and in total,[20] finding a wide range in emissions anywhere from <1% to 20%. Thanks to DOE funding, advanced sensor equipment is currently under development, with early models just entering the market this year. These sensors will enable empirical measurements of hydrogen emissions from existing infrastructure in the near future.

Operational and fugitive hydrogen emissions should be excluded from receiving LCFS credits.

Due to hydrogen's warming impacts, it is critical to exclude "wasted" gas from operational practices (i.e., vented or purged hydrogen) from being able to claim the LCFS credit. Similarly, detectable levels of unintentional emissions (i.e. leaks) should also be immediately excluded. These lost volumes can easily be determined by comparing the known inputs with their calculated outputs of hydrogen energy to be sold, and these loss rates should be reported alongside the claimed volumes to improve the data collection around hydrogen emissions. In the near future, as high-precision sensors become more readily available, hydrogen producers will be able to measure small leaks along with their calculated lost volumes. CARB can thus stipulate that all levels of fugitive emissions will eventually be excluded from receiving LCFS credits.

Hydrogen emissions should be factored into CA-GREET.

Because of its well-documented role as an indirect greenhouse gas, hydrogen must be factored into life cycle assessments through the CA-GREET model. Argonne has already been exploring the inclusion of hydrogen emissions into the GREET model. This can be done by using GWP values of 37 for GWP20 and 12 for GWP100.[21]

While the GREET model currently does not include hydrogen's warming effects, it does include estimated loss rates throughout the value chain. We recommend that hydrogen's GWPs be applied to the current loss rates, and then as empirical measurements become available, the loss rates should be updated regularly. Hydrogen producers can also account for hydrogen emissions via a mass balance calculation of what they expect to produce versus what they actually produce.

Producers should be required to submit and comply with hydrogen emission management plans.

To both verify the amount of wasted hydrogen gas and as an incentive to control hydrogen emissions, producers should be required to submit hydrogen emission management plans. These will likely include a commitment to using the best available sensor technology to detect

[20] https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full
[21] https://acp.copernicus.org/articles/23/13451/2023/

leaks, and operational best practices to mitigate leakage such as tightening valves and seals, establishing a leak detection and repair program, and incorporating technology to recombine vented, purged, and residual hydrogen with oxygen back into water. Management plans should also disclose whether you are using venting, flaring, and purging practices and state how a facility is verifying final volumes to ensure tax credit compliance.

Hydrogen should be deployed responsibly by targeting the hard-to-abate sectors.

Due to hydrogen's leakage risks combined with the relative energy intensity involved in its production, processing, and distribution, hydrogen use should be limited to hard-to-abate applications. The U.S. National Clean Hydrogen Strategy and Roadmap[22] states the importance of targeting "strategic, high-impact uses for clean hydrogen," including "the industrial sector (e.g., chemicals, steel, and refining), heavy-duty transportation, and long-duration energy storage."

Based on data from available scientific literature and hydrogen supply chain models, we know that light-duty vehicles can be more effectively decarbonized, with greater climate benefits, via EV batteries.[23] On average, powering a hydrogen fuel cell vehicle requires three to four times (and up to nine times) more energy than an electric battery.[24] In addition to the energy needed to convert renewable electricity into hydrogen fuel — and then back again through a hydrogen fuel cell — hydrogen also requires additional energy-intensive processes, such as compressing or liquefying hydrogen for transport and storage. In contrast, renewable electricity does not require conversions into a different state and is significantly less energy-intensive for transmission, distribution, and end use.

On the other hand, using hydrogen to produce fuels for aviation and maritime shipping – both hard-to-abate end uses with limited opportunities for electrification – are clearly "no regrets" opportunities that should be prioritized through the LCFS.

3. Crediting for Medium- and Heavy-Duty Vehicle Charging

Medium- and heavy-duty vehicles are responsible for a disproportionate amount of greenhouse gas (GHG) emissions and local pollution relative to the size of their population. In California, despite the fact that trucks are just seven percent of all vehicles in the state, they emit nearly 33% percent of particulate matter, 25% percent of nitrogen oxides (NOx), and nearly 9% percent of greenhouse gas emissions[25] from the transportation sector; electrifying these vehicles will therefore produce outsized climate and local air pollution benefits. This is particularly important in the state's disadvantaged communities, because while the health impacts, which can

[22] https://ww2.arb.ca.gov/ghg-inventory-graphs
[23] https://blogs.edf.org/energyexchange/wp-content/blogs.dir/38/files//2023/01/Methodology-for-H2-Energy-Intensity-Blog.pdf
[24] https://blogs.edf.org/energyexchange/2023/01/30/rule-1-of-deploying-hydrogen-electrify-first/
[25] https://ww2.arb.ca.gov/ghg-inventory-graphs

negatively affect "every organ in the body, are experienced to some extent all across the state, "low-income and communities of color…are often disproportionately affected by emissions from freight movement due to their proximity to transportation infrastructure,"[27] such as ports, railyards, and freight corridors. Because of this disproportionate impact, there is an urgent need to electrify medium- and heavy-duty vehicles in these neighborhoods.

"[26]

The proposed expansion of the Clean Fuel Reward program will further incentivize and streamline the adoption of medium- and heavy-duty electric vehicles.

EDF supports the proposal to change the scope of the statewide Clean Fuel Reward program from a light-duty rebate to a medium and heavy-duty rebate. The focus on new and used rebates for medium- and heavy-duty trucks that are exempted from the Advanced Clean Fleets regulation will chart a path towards electrification for the segments of the trucking sector that are most challenging to transition. This program will be particularly important for small fleets and independent owners/operators, for whom up-front purchase price can be a major barrier to electrification.

LCFS crediting for medium- and heavy-duty vehicle charging will support the deployment of necessary infrastructure to help California realize the full benefits of the Advanced Clean Trucks and Advanced Clean Fleets rules.

While the goals embedded in the Advanced Clean Trucks and Advanced Clean Fleet regulations – setting sales and purchase targets for zero-emission vehicles – are crucial components for a sustainable, equitable transportation future, the benefits will not be realized without adequate charging that is sufficient in number and well-designed to support the medium- and heavy-duty vehicles in the state. As such, EDF views the introduction of a new medium- and heavy-duty vehicle Fast Charging Infrastructure (MHD FCI) credit as critical for this effort. The operational variation of medium- and heavy-duty vehicles necessitates a wide diversity of charging equipment and capabilities. Given the diversity of charging needs, the 10 years of crediting will be one of many state-supported funding solutions necessary to transition fleets effectively and affordably throughout the state.

CARB should remove the minimum nameplate power rating requirement for the MHD FCI program.

EDF recommends that CARB modify the proposed eligibility requirements for participating in the MHD FCI program to remove the requirement that each charger (also referred to as Fueling Supply Equipment or FSE) "must have a minimum nameplate power rating of 250 kW." While some electric trucks and buses will rely on direct current fast chargers (DCFCs) with nameplate capacities of 250 kW or greater, many will not need this level of charging. This is particularly

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[26] https://www.ucsusa.org/resources/cars-trucks-buses-and-air-pollution#toc-effects
[27] https://ww2.arb.ca.gov/sites/default/files/2021-09/Proposed_2020_Mobile_Source_Strategy.pdf

true for fleets operating out of and charging at private depots which may have shorter duty cycles and can spread their charging overnight and/or several daytime blocks with lower-power DCFC or level-2 charging. Removing the 250 kW requirement would allow these fleets to optimize their charging based on their own operational needs, resulting in grid-beneficial charging behavior, while still remaining eligible for the program. Consistent with this recommendation, CARB should also remove or modify the limitation that no more than ten chargers per applicant per site would be eligible for credits. The proposed 10 MW cap per customer per site is a sufficient constraint on individual customers accumulating credits while retaining the flexibility for applicants to deploy chargers in number and capacity consistent with their needs. Otherwise, applicants would potentially be incentivized to oversize chargers' nameplate capacity to maximize credit eligibility.

4. Sustainable Decarbonization of the Aviation Sector

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).

The proposed LCFS reforms include changes that will significantly impact California's efforts to decarbonize the aviation sector and warrant thorough consideration. Expanding the scope of the Low Carbon Fuel Standard (LCFS) program to include aviation fuels beyond the existing voluntary opt-ins for alternative jet fuels[28] is a necessary step towards achieving carbon neutrality in California by 2045 and will likewise support collective climate ambition. The structured deployment of sustainable aviation fuels (SAF) in California is crucial for the civil aviation sector to reach the International Civil Aviation Organization (ICAO)'s global goal of net-zero climate impact by 2050.

The following recommendations are relevant in evaluating how to sustainably transition from the uptake of conventional fossil jet fuel to the uptake of alternative jet fuel in the State.

All fossil jet fuel provided in California should generate deficits under the LCFS, not only intrastate flight fuel burn.

We respectfully encourage CARB to extend a reformed LCFS beyond the proposed amendment of CCR §95482(c)(1)(2), and instead, cover all fossil jet fuel uplifted in California to ensure the

[28] Important to note, 'alternative jet fuels' denotes a broader category than does 'SAF.' Per definitions established at the federal and international levels, 'SAF' refers solely to fuels produced using renewable energy sources, wastes and residues and meet sustainability criteria.

greatest degree of climate benefits. Whereas the modified text makes conventional fossil jet fuel subject to LCFS regulation only for intrastate flights, we recommend instead that CARB delete altogether the exemption §95482(c)(1)(2), "Conventional jet fuel or aviation gasoline."

The broader coverage of all flights – whether intrastate, interstate, or international -- is consistent with the generally applicable language of Gov. Schwarzenegger's Executive Order S-01-07 establishing the LCFS applicable to all transportation fuel providers in California. It is also consistent with the authority CARB exercised in the 2018 LCFS reform when it included alternative jet fuel as an opt-in fuel entitled to generate credits, providing the necessary steppingstone towards more comprehensive action now.

Furthermore, an amended LCFS covering only intrastate flights could pose a serious risk of invalidation under federal law. CARB could easily sidestep this risk by removing the exemption language and thus treating fossil jet fuel as part of the general suite of transport fuels subject to LCFS regulation.

On this front, CARB needs to act now – and act prudently. Postponing the effective start date until 2028 would be a missed opportunity we cannot afford. Planning for intrastate-only aviation coverage – and with such a long delay - would be neither legally viable in the face of federal preemption nor commensurate with the climate emergency.

In terms of emissions quantities, intrastate flights represent a mere 10% of emissions from jet fuel uplifted in California, or around 6% of the total aviation emissions from flights to and from California.[29] In a scenario of LCFS coverage limited to intrastate flights, Governor Newsom's requested "aggressive 20% clean fuels target for the aviation sector" in 2030 translates to emissions reductions on the order of 1% of California's aviation emissions.[30] This is far too small a quantity to achieve meaningful benefits for climate action or for human health.

CARB must protect workers' and airport-adjacent communities' health by regulating jet fuels' aromatic content and thus mitigating particulate matter pollution.

Fuel-related emissions from landing and take-off operations disproportionately affect local communities as well as workers within the airport envelope. Communities living in proximity to

[29] Based on 2020 inventory data available at: https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/ghg_inventory_scopingplan_sum_2000-20.pdf

[30] https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf?emrc=1054d6

airports are exposed to elevated levels of ultrafine particles (UFP) and are at risk of adverse health effects, a critical issue upon which CARB needs to act without further delay.[31]

While alternative aviation fuel blends have the potential to reduce harmful aviation emissions by reducing aromatic content, such an outcome will not happen unless additional regulations are enforced. Furthermore, the gradual scale-up of alternative aviation fuels means that a fuel swap will help only marginally in the near term - if at all - which is insufficient to protect overburdened communities already suffering decades' worth of accumulated adverse health effects.

To deliver tangible near-term public health benefits, CARB should not only extend the scope of LCFS-covered jet fuel but, California should also undertake complementary action to regulate jet fuel composition. Jet fuel aromatic content could be reduced by hydrotreating conventional jet fuel while tapping on IRA's generous clean hydrogen subsidies to cushion price impacts and GHG emissions penalties.[32] This is a near-term measure that could slash PM2.5 emissions without adversely affecting safety, i.e., in a manner that would be fully compatible with existing federal airworthiness certifications.

The prohibition on converting forested land into agricultural production should extend to also protect wetlands and grasslands.

As noted in Appendix E: Rationale, section W(5), "It is vital that the LCFS program limit deforestation and land use change as a result of feedstock production as much as possible." The proposed new §95488.9(g), Sustainability Requirements for Crop-Based and Forestry-Based Feedstocks, takes a step toward installing the needed guardrails. Notably, the requirement that all domestic and imported feedstocks be traced to their point of origin has a more comprehensive coverage than any other domestic tracing requirement to date. However, the text is incomplete in fulfilling its purpose outlined in the ISOR(II)(F), "reduce the risk that rapid expansion of biofuel production and biofuel feedstock demand could result in deforestation or adverse land use change."

Direct land use change (DLUC) can occur on land cover types other than only forest. High-carbon-stock and high-biodiversity land types include grasslands and wetlands as well; bringing these lands into bioenergy feedstock cultivation is every bit as dangerous as bringing forests into

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[31] For a more detailed description, a literature review, and an overview of options on how to tackle $PM_{2.5}$ emissions from aviation see EDF's letter to the U.S. Environmental Protection Agency from April 4, 2022:
https://downloads.regulations.gov/EPA-HQ-OAR-2019-0660-0207/attachment_1.pdf

[32] In recent filings, EDF has underscored the vital importance of reducing climate and health harming pollution from hydrogen production. See: https://www.edf.org/sites/default/files/2023-09/Petition%20for%20Rulemaking%20-%20Hydrogen%20Production%20Facilities%20-%20CAA%20111%20and%20112%20-%20EDF%20et%20al.pdf

cultivation. These natural land conversion emissions are non-negligible: the soil carbon released from plowing alone can be greater than the entire lifecycle carbon intensity of fossil jet.[33]

Therefore, the first sentence of §95488.9(g), "Crop-based and forestry-based feedstocks must not be sourced from land that was forested after January 1, 2008," should be modified to protect grasslands, wetlands, and peatlands in addition to forested land.

By removing the deficit-generating exemption for all fossil jet fuel provided in California, regulating jet fuels' aromatic content, and protecting a broad range of natural lands from agricultural conversion, CARB can deliver on deep decarbonization and public health goals now.

CARB's upcoming decision on LCFS reform offers a golden opportunity to lay down the foundation for the high-integrity SAF needed to make real progress in transforming the aviation sector's outlook for climate action in California. Including the aviation sector under the LCFS is urgent, and we can't afford to miss this opportunity to deliver on deep decarbonization and public health goals.

Regulating fossil aviation fuels under the LCFS will ensure that the environmental attributes associated with the use of alternative jet fuels are claimed on California's emissions ledger, rather than under other jurisdictions through indirect accounting systems. The emissions reduction benefits from the use of alternative aviation fuels take place upstream of fuel combustion, i.e., within sectors counted toward California's GHG inventory (or equivalent inventory for imports).

Covering aviation fuels under the LCFS will also ensure that the aviation sector shares responsibility for a portion of the cost of deploying SAF in California, rather than leaving road transportation end-users to subsidize the aviation sector (a dynamic driven also by the federal Renewable Fuel Standard). Even so, the impact on airfare prices of expanding the scope of the LCFS to aviation should be modest because (1) generous federal subsidies are available to offset increased manufacturing expenses, and (2) air carriers have the ability to shield themselves against marginal price signal pass-throughs from jet fuel providers.

In parallel to striking out §95482(c)(1)(2), CARB would also need to recalibrate the increase in stringency of the LCFS carbon intensity targets to account for the uptick in aviation's sectoral demand. This task is already under deliberation and should be relatively straightforward, though it is no less time-sensitive than the other components of LCFS analysis.

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[33] Estimates from Spawn et al, 2019, Environ. Res. Lett. 14 045009. There is a wide geographic variation in both the size and sensitivity of affected carbon stocks that would need to be evaluated on a case-by-case basis. Still, the primary source of land conversion in the United States is grassland to cropland, in which disruption of soil organic carbon stocks makes it a larger emissions source than conversion of the Brazilian Cerrado.
https://iopscience.iop.org/article/10.1088/1748-9326/ab0399/pdf

Thank you for 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,

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