CENTER for BIOLOGICAL DIVERSITY Because life is good.

August 27, 2024

Chair Liane Randolph and
Members of the Board
California Air Resources Board
1001 I St.
Sacramento, CA 95814

RE: Proposed Low Carbon Fuel Standard Amendments (August 12, 2024 release)

Dear Chair Randolph and Members of the Board:

The Center for Biological Diversity submits the following comments on the California Air Resources Board's (CARB) proposed August 12, 2024 amendments to the Low Carbon Fuel Standard (LCFS). Please note that we are submitting the references cited herein for CARB's convenience. Those references are available here: https://diversity.box.com/s/8jcli9f2vwyof9cbq1qx5sna1m0d0hsb.

I. CARB must end LCFS credits to out-of-state projects conducting EOR associated with CCS.

As we called for in our February 2024 comments, and as urged by the Environmental Justice Advisory Committee (EJAC), CARB must end credits to projects outside of California that produce oil using captured carbon dioxide (CO_2).

The EJAC specifically directed CARB staff to "Prohibit enhanced oil recovery as an eligible sequestration method."[1] Crediting CO_2-based enhanced oil recovery (EOR) is also at odds with California law. SB 905 (2022) prohibits operators in California from utilizing CO_2 from carbon capture and storage (CCS) in EOR.[2] Yet while the State decidedly took a stand against CCS-associated EOR within California, the LCFS door remains open to incentivizing this same harmful practice *outside* the State's borders.

Under the LCFS CCS Protocol, applicable CCS projects are those "that capture carbon dioxide (CO_2) and sequester it onshore, in either saline or depleted oil and gas reservoirs, *or oil and gas reservoirs used for CO_2-enhanced oil recovery (CO_2- EOR)*.[3] Thus, non-California regulated entities conducting EOR will be compensated by CARB for causing

[1] EJAC, Recommendations to the California Air Resources Board (CARB) on the Low Carbon Fuel Standard Regulation Updates (version August 28, 2023), https://www.arb.ca.gov/lists/com-attach/1-lcfs2024-VjMFaQNjUGABWFA0.pdf.
[2] SB 905 at Section 4(b) (Caballero, 2022),), to be codified in Cal. Pub. Res. § 3132(b); *see also* Senate Bill 1314 (Limón, 2022) (also signed into law and prohibiting EOR using CO_2 derived from CCS operations).
[3] CARB LCFS CCS Protocol at 7 (Aug. 13, 2018) (emphasis added). CCS projects are eligible for LCFS participation under the Tier 2 pathway. *See* 17 Cal. Code Regs. § 95488.1(d)(7)(B).

environmental and community health damage elsewhere. This asymmetry is simply wrong and must be corrected by removal of CCS-related EOR from the LCFS.

It is not too late to close the out-of-state LCFS EOR loophole. Below are possible changes to accomplish this:

A. Remove the underlined language below from the LCFS CCS Protocol:
   - The CCS Protocol applies to projects "that capture carbon dioxide (CO_2) and sequester it onshore, in either saline or depleted oil and gas reservoirs, or oil and gas reservoirs used for CO_2-enhanced oil recovery (CO_2- EOR)."

B. Update the following regulations:
   - In 17 Cal. Code Regs. section 95490(a)(1) (stating that eligible entities include "Alternative fuel producers, refineries, and oil and gas producers that capture CO_2 on-site and geologically sequester CO_2 either on-site or off-site"), make clear that, to be eligible, capture and sequestration of CO_2 does not include EOR.
   - In 17 Cal. Code Regs. section 95490(a)(2) (stating that "If CO_2 derived from direct air capture is converted to fuels, it is not eligible for project-based CCS credits. However, applicants may apply for fuel pathway certification using the Tier 2 pathway application process as described in section 95488.7"), make clear that CO_2 derived from direct air capture may not be used for EOR.

II. CARB must not encourage continued and/or prolonged use of fossil fuels through its petroleum-plus-CCS phase-out loophole.

In the amendments proposed earlier this year, CARB explained it is seeking to "encourage existing petroleum facilities to deploy"[4] CCS and to allow these fossil fuel projects to continue to generate credits beyond the phase-out date of December 31, 2040.[5] CARB kept this loophole open in its August 2024 proposal, in its "Innovative Crude" section.[6] Specifically, for all other "Innovative Crude" crediting methods *other than* CCS, credits will end "no later than December 31, 2040."[7] Credits for crude using CCS, however, continue indefinitely.

This loophole evidences a fundamental misunderstanding of how CCS works. CCS does not wholly eliminate GHG emissions from any industrial process. Simply putting CCS onto a refinery does not mean the climate intensity of that production is acceptable. No CCS project has, or is, promising 100% CO_2 capture. While modeling often relies on an

[4] LCFS Proposed Amendments, Appendix E at page 88, Y.8, rationale for proposed §§ 95489(c)(1)(A)2 and 95489(e)(1)(D)1.
[5] LCFS Proposed Amendments, Appendix E at page 93, X.19, proposed for §§ 95489(c)(5), 95489(d)(5)(C), 95489(e)(5)(B), and 95489(f)(5)(B).
[6] LCFS Proposed Amendments, § 95489(c)(1)(A)2 (defining general requirements for "innovative crude").
[7] LCFS Proposed Amendments, § 95489(c)(5).

assumed 90% capture rate, this is far from what is achieved in reality.[8] One recent real-world California example is the Aera CarbonFrontier project proposed in Kern County. That Project's CEQA review shows that for at least the first seven years, the project will be *net positive* in GHG emissions, even while running CCS on its natural gas-fired power plants.[9]

Providing a phase-out exemption for fossil fuel projects in California invites failed and under-delivering polluting facilities to continue to pollute communities and the climate, all without any end in sight. The Board must not set California's climate goals back by allowing crude operations using CCS to receive credits far beyond the 2040 phase-out date.

III. CARB Should Limit Incentives for Hydrogen and Restrict Crediting to Renewable-Fueled Hydrogen

We appreciate that the latest proposed amendments remove hydrogen produced from fossil gas from credit generation eligibility. However, given the climate imperative to phase out fossil fuels expeditiously, waiting until the end of 2030 to remove credit eligibility for fossil hydrogen is a mistake. Instead, credit eligibility should be removed from fossil hydrogen immediately upon completion of the current LCFS amendment process. Further, as we discussed at length in our comments from February 2024, limitations on hydrogen should extend beyond fossil hydrogen to that produced from biomass and biogas as well. Instead, with the proposed amendments, hydrogen produced through steam methane formation of biogas and biomass gasification would still be credited under the LCFS.

Steam methane reformation of biogas, including that paired with CCS, and gasification or pyrolysis of biogenic resources (e.g. woody biomass and biogas), should be explicitly excluded because of their associated harms. Woody biomass, as a feedstock (e.g. in gasification or pyrolysis) or energy source to make hydrogen, harms the climate,[10] communities, and ecosystems with significant emissions of CO_2[11] and criteria and other health-harming pollutants.[12] As the IPCC, the federal Environmental Protection Agency's

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[8] *See generally* IEEFA, The Carbon Capture Crux (Sept. 1, 2022), https://ieefa.org/resources/carbon-capture-crux-lessons-learned.

[9] *See* Draft EIR CarbonFrontier CCS Project by Aera Energy, LLC, SCH 2023060293, https://ceqanet.opr.ca.gov/2023060293/2 at pages 4.8-32, 33. Moreover, the construction emissions to build the CCS infrastructure will release 27,975 MT CO_2/e. *Id.* at 4.8-24.

[10] Sterman, John et al., Does wood bioenergy help or harm the climate?, 78 Bulletin of the Atomic Scientists 128 (2022), DOI: 10.1080/00963402.2022.2062933, available at https://www.tandfonline.com/doi/full/10.1080/00963402.2022.2062933; Partnership for Pol'y Integrity, *Air pollution from biomass energy* (updated April 2011), available at https://www.pfpi.net/wp-content/uploads/2011/04/PFPI-air-pollution-and-biomass-April-2011.pdf.

[11] Sterman, John et al., Does replacing coal with wood lower CO2 emissions? Dynamic lifecycle analysis of wood bioenergy, 13 Env't Rsch. Letters 015007 (2018), DOI: 10.1088/1748-9326/aaa512, available at https://www.tandfonline.com/doi/full/10.1080/00963402.2022.2062933.

[12] Liu, Wu-Jun et al., Fates of chemical elements in biomass during its pyrolysis, 117 Chemical Reviews 6367 (2017), https://pubs.acs.org/doi/10.1021/acs.chemrev.6b00647; Yao, Zhiyi et al., Particulate emissions from the gasification and pyrolysis of biomass: Concentration, size distributions, respiratory deposition-based control measure evaluation,

Science Advisory Board, and other scientists have established, wood bioenergy should not be assumed to be carbon neutral;[13] Using methane to produce hydrogen increases methane leakage risk, with one biogas plant study finding that leaked methane can be as high as 14.9% of total methane production.[14] There is also a significant pollution burden from biogas facilities near communities.[15] The LCFS should not incentivize and subsidize feedstocks that harm the climate and pollute the same communities that have historically borne the pollution burden of our status quo energy portfolio.

At most, the LCFS should only allow hydrogen production where hydrogen generators are powered by *new* sources of zero-emissions electricity (additionality or incrementality) that directly supply the grid electrolyzers are connected to (deliverability), within the same hour that generators are running (hourly matching). [16] This is reaffirmed by the IRS's proposed rulemaking in which hydrogen producers could only receive the Section 45V clean hydrogen production tax credit by adhering to the 3 pillars.[17] However, CARB staff's proposed amendments would allow the continued use of problematic feedstocks like dairy biogas and biomass, despite the emissions and environmental burdens they carry.

Even if produced via electrolysis in adherence to the three pillars, the use of hydrogen should be limited to those sectors without a viable present-day alternative, such as replacing existing dirty gray fossil-based hydrogen, crude oil refineries, or steel

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242 Environmental Pollution 1108 (2018), https://doi.org/10.1016/j.envpol.2018.07.126; Saxe, Jennie Perey et al., Just or bust? Energy justice and the impacts of siting solar pyrolysis biochar production facilities, 58 Energy Research & Social Science 101259 (2019) https://doi.org/10.1016/j.erss.2019.101259; Pang, Yoong Xin et al., Analysis of environmental impacts and energy derivation potential of biomass pyrolysis via piper diagram, 154 Journal of Analytical and Applied Pyrolysis 104995 (2021), available at https://doi.org/10.1016/j.jaap.2020.104995.

[13] IPCC Task Force on National Greenhouse Gas Inventories, Frequently Asked Questions, available at https://www.ipcc-nggip.iges.or.jp/faq/faq.html, at Q2-10 (IPCC Guidelines do not automatically consider biomass used for energy as 'carbon neutral,' even if the biomass is thought to be produced sustainably); EPA Science Advisory Board, SAB Review of Framework for Assessing Biogenic CO2 Emissions from Stationary Sources (2019), at 2 (not all biogenic emissions are carbon neutral nor net additional to the atmosphere, and assuming so is inconsistent with the underlying science); Beddington, J. et al., Letter from scientists to the EU parliament regarding forest biomass (2018), available at https://empowerplants.files.wordpress.com/2018/01/scientist-letter-on-eu-forest-biomass-796-signatories-as-of-january-16-2018.pdf.

[14] Scheutz, Charlotte & Anders M. Fredenslund, Total methane emission rates and losses from 23 gas plants, 97 Waste Mgmt. 38-46 (2019), https://doi.org/10.1016/j.wasman.2019.07.029.

[15] Nicole, W., CAFOs and Environmental Justice: The Case of North Carolina, 121 Environmental Health Perspectives a182 (2013); Montford, K. and Wotherspoon, T., The Contagion of Slow Violence: The Slaughterhouse and COVID-19, 10 Animal Studies Journal 80 (2021); Domingo, N.G.G. et al., Air quality-related health damages of food, 118 PNAS e2013637118 (2021).

[16] Ricks, Jenkins, *The Cost of Clean Hydrogen with Robust Emission Standards: A Comparison Across Studies,* Princeton University Zero-carbon Energy Systems Research and Optimization Laboratory (2023), available at https://subscriber.politicopro.com/f/?id=00000187-9bb4-daaa-a5e7-bfbfff120000; Dan Esposito et al., *Smart Design of 45V Hydrogen Production Tax Credit Will Reduce Emissions and Grow the Industry,* Energy Innovation Policy & Technology (2023); and Ben Haley, Jeremy Hargreaves, *Three-Pillars Accounting Impact Analysis,* Evolved Energy Research (2023), available at https://www.evolved.energy/post/45v-three-pillars-impact-analysis.

[17] Section 45V Credit for Production of Clean Hydrogen: Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property, Proposed Rules, 88 Fed. Reg. 246, 89220-255 (Dec. 26, 2023)(to be codified at 26 C.F.R. Part 1)

manufacturing.[18] Whenever direct electrification can be used instead of hydrogen, as with vehicles, it's the demonstrably better choice. Electricity made from solar and wind is more efficient, lower cost, lower in CO_2 emissions, and a mature energy resource.[19] The LCFS should be incentivizing full electrification rather than hydrogen which is projected to have only a limited role in a carbon-free future.[20]

IV. CARB Should Strictly Limit the Use of Crop-based Biofuels.

The latest amendments do little to address the concerns we raised in our February 2024 comments about the continued sanctioning of crop-based biofuels. The most recent amendment put forth by CARB is to "provide credits for biomass-based diesel produced from virgin soybean oil and canola oil for up to 20 percent of annual biomass-based diesel reported on a company-wide basis." While this is a limitation on crediting for two problematic feedstocks, the measure is too limited in scope. It still allows crediting for the use of some soybean oil and canola oil, and it does not preclude expanded use of crop-based feedstocks outside of soybean oil and canola oil such as corn and other grains. Thus, crop-based biofuels are still, in effect, incentivized, despite the known risks.

Relying on crop-based biofuels results in both direct and indirect land use change emissions that worsen the climate crisis, counter to their intended purpose. For example, in an analysis of 17 potential alternative-fuel pathways looking at different feedstocks, technologies, and world regions, researchers found that using virgin vegetable oil had the highest indirect land-use change emissions because of links to high deforestation and peat oxidation in southeast Asia, driven by palm expansion.[21] In the same study, it was found that producing biofuels from any vegetable oil in any region, including corn and soy in the U.S. context, would encourage palm oil expansion and associated peat oxidation in southeast Asia due to substitutions among vegetable oils and international trade.[22] Thus,

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

[19] Hydrogen Science Coalition, https://h2sciencecoalition.com (last accessed: February 8, 2024).

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

[21] Zhao, X. et al., Estimating induced land use change emissions for sustainable aviation biofuel pathways, 779 Science and the Total Environment (2021).

[22] Zhao, X. et al., Estimating induced land use change emissions for sustainable aviation biofuel pathways, 779 Science and the Total Environment (2021).

high indirect land-use change emissions from virgin vegetable oil biofuel pathways undermine some, if not all, of the greenhouse gas savings from these fuels.[23]

There could also be unforeseen harms to communities and the environment. For instance, a 2017 study found that increased production of crop-based biofuels heavily contributes to global water scarcity and is not the best option for bioenergy.[24] Meanwhile, a 2016 study found that, just in the United States, about 140 million people could be fed with the resources for bioethanol, and about 10 million people could be fed with the resources for biodiesel, indicating the threat of crop-based biofuels to global food security.[25] Also, with increased production of crop-based biofuels, there is the potential for increased nutrient and pesticide runoff to surface waters and contamination of groundwater due to crop cultivation.[26]

Another harm from crop-based biofuels is the impact to communities from biofuel refining and resulting criteria pollutant emissions. Crop-based biofuels are most often produced using the Hydroprocessed Esters and Fatty Acids (HEFA) pathway, which reacts crop feedstock with hydrogen at high temperatures and pressures to form fuel.[27] Because of the high temperatures and extremely high pressures, runaway increases in temperature are common, which result in operators flaring refinery gases to bring conditions back under control. However, in doing so, toxic and smog-forming air contaminants are emitted such as particulate matter, sulfur dioxide, and hydrocarbons that worsen air quality. Because HEFA processes require more hydrogen than petroleum refining, it is expected that hydro-conversion-related flaring would be worse with HEFA refining, along with explosion and fire risk.[28] With refineries most often sited in low-income communities and communities of color,[29] environmental justice harms are exacerbated by the presence of HEFA refining and would worsen with crop-based biofuel expansion.

Many of the risks associated with crop-based biofuels would have been mitigated if CARB had accepted the amendments in the Comprehensive Environmental Justice Scenario proposed by CARB's Environmental Justice Advisory Committee (EJAC). The proposal was to "[c]ap the use of lipid biofuels (commonly known as crop-based biofuels) at 2020 levels, about 855 million gallons, pending an updated risk assessment to determine phase out

[23] Pavlenko, N. and Searle, S., Fueling flight: Assessing the sustainability implications of alternative aviation fuels, International Council on Clean Transportation (2021); Zhao, X. et al., Estimating induced land use change emissions for sustainable aviation biofuel pathways, 779 Science and the Total Environment (2021).
[24] Gerbens-Leenes, P.W., Bioenergy water footprints, comparing first, second and third generation feedstocks for bioenergy supply in 2040, 59 European Water 373 (2017).
[25] Rulli, M.C. et al., The water-land-food nexus of first-generation biofuels, 6 Nature Scientific Reports (2016).
[26] National Research Council 2011. Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy. Washington, DC: The National Academies Press. https://doi.org/10.17226/13105.
[27] Van Dyk, S. et al., Potential synergies of drop-in biofuel production with further co-processing at oil refineries, 13 Biofuels Bioproducts & Biorefining 760 (2019).
[28] Karras, G., Changing Hydrocarbons Midstream: Fuel chain carbon lock-in potential of crude-to-biofuel petroleum refinery repurposing, Prepared for: National Resources Defense Council (2021).
[29] Donaghy, T. et al., Fossil fuel racism in the United States: How phasing out coal, oil, and gas can protect communities, 100 Energy Research & Total Science 103104 (2023).

timelines for high-risk, crop-based feedstocks."[30] Capping the use of lipid biofuels could spur the development of less deleterious alternatives such as the use of true waste products in biofuel production such as municipal solid waste and push the needed transition to battery-electric in shipping and trucking,[31] all while preventing the expansion of crop-based biofuel harms. Instead, crop-based biofuels are treated as the unavoidable alternative to fossil fuels, locking in the threat to communities and the environment. CARB should revisit the amendments originally proposed by EJAC.

V. CARB Should Add Conventional Jet Fuel as a Deficit-Generator But Add Strong Guardrails on Crop-Based Biofuels.

The latest amendments completely remove conventional jet fuel ("CJF") from consideration for inclusion under the LCFS. We supported the inclusion of CJF for intrastate flights, as put forth in the previously proposed amendments, and beyond that supported the inclusion of all CJF combusted in and over California, including by interstate and international flights. The latest amendments constitute a failure in holding the aviation industry accountable for its emissions.

It is beyond time to end the unfair advantages given to CJF that perpetuate the industry's use of fossil fuels. Many state policies heavily subsidize the industry's use of carbon-based jet fuels, which works against the state's efforts at decarbonizing the sector and allows this fuel to be under-regulated. For example, fuel used in international flights are exempt from sales and use taxes in California, a practice that was estimated to cost state and local governments nearly $300 million in revenue in 2021-2022.[32] Commercial airlines are also exempt from the excise tax for jet fuel, a tax break that costs the state about $23 million each year.[33] The carveout in the Low Carbon Fuel Standard for conventional jet fuel saves the airlines an estimated $110 to $360 million each year[34] on the cost of that fuel.

With the latest amendments, CARB is allowing CJF its status as an opt-in fuel to remain. This means that refiners will not be required to reduce the carbon intensity of CJF. Further, the current opt-in model is problematic because it allows alternative aviation fuel producers to generate and sell LCFS credits for revenue, despite the quality of alternative fuel feedstock used. Such alternative aviation fuels ("AJFs"), or so-called Sustainable Aviation Fuels ("SAFs"), are often not truly sustainable, being derived from problematic sources like crop-based feedstocks and other forms of biomass, with which we have already expressed our concerns.

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[30] ISOR, p. 116.
[31] Minjares, R. and Basma, H., Battery-electric trucks: The most affordable path to decarbonizing tractor-trailers, International Council on Clean Transportation (April 27, 2023), https://theicct.org/event/battery-electric-trucks-the-most-affordable-path-to-decarbonizing-tractor-trailers/.
[32] CA Dept. of Tax and Fee Administration, Aircraft Jet Fuel - Frequently Asked Questions, *available at* https://www.cdtfa.ca.gov/taxes-and-fees/aircraft-jet-fuel-faq.htm .
[33] CA Dept. of Finance, Tax Expenditure Reports 2021-22, at p. 11, *available at* https://dof.ca.gov/wp-content/uploads/sites/352/Forecasting/Economics/Documents/2021-22-Tax-Expenditure-Report.pdf.
[34] State fuel use estimated using DoT T-100 data on available seat miles originating in state & DoT data on national airline fuel consumption for 2019.

Relying on such biofuels results in both direct and indirect land use change emissions that worsen the climate crisis, counter to their intended purpose. Rather than accept the true and full climate costs of aviation and invest more seriously in research for zero-emission technologies like electric aircraft, the industry has set its sights on SAFs, equating to delays in true climate progress in the aviation sector. To minimize harms from the aviation sector, CJF should be fully incorporated in the LCFS—including that for intrastate, interstate, and international flights—while eliminating from crediting crop-based and other problematic biomass biofuels, and only allowing other biofuels that meet strict and transparent sustainability criteria.

The purported reason for not including CJF in the LCFS is that "[a]viation fuel suppliers who would generate deficits under the initial proposal could simply acquire credits to meet that compliance obligation."[35] This is not a valid reason for inaction. Instead, the LCFS program needs a full overhaul where fuels meet stringent criteria for sustainability, and bad actors are unable to buy their way out of true emissions reductions with surplus credits. Amendments should reflect this level of improvement to the LCFS.

VI. CARB Should Remove Woody Biomass Feedstocks from the LCFS Program.

In the latest amendments, the following definition of "forest biomass waste" is put forth, in place of "forestry residues": "small-diameter, non-merchantable residues, limited to forestry understory vegetation, ladder fuels, limbs, branches, and logs that do not meet regional minimum marketable standards for processing into wood products."[36] With this definition, CARB staff propose to include forest waste biomass feedstocks as a specified source feedstock. As noted in our previous comments, the allowance of any forest-derived material, whether designated as "waste" or "residues," is ultimately problematic, polluting, and not climate beneficial.

First, the use of forest biomass to produce biofuels is likely to employ gasification and pyrolysis, two highly polluting techniques. The gasification of biomass at high temperatures (800-1200°C) produces a "syngas" containing large amounts of CO_2, as well as methane (CH_4), carbon monoxide (CO), and hydrogen (H_2), in addition to liquid hydrocarbons and tar, solid char and ash residues, and a wide array of air pollutants. The pyrolysis of biomass additionally produces pyrolytic oil and larger quantities of char.[37] Further, biomass gasification and pyrolysis produce a wide range of health-harming pollutants including fine particulate matter, NOx, SOx, benzene, toluene and xylenes (BTEX), tars and soot, and persistent organic pollutants such as polycyclic aromatic hydrocarbons (PAHs) (e.g., naphthalene), polychlorinated dibenzo-*p*-dioxins and

[35] Proposed LCFS Amendments (August 12, 2024), p. 3.
[36] Proposed LCFS Amendments, § 95481.
[37] Shayan, E. et al., Hydrogen production from biomass gasification; a theoretical comparison of using different gasification agents, 159 Energy Conversion and Management 30 (2018), https://doi.org/10.1016/j.enconman.2017.12.096.

dibenzofurans (PCDD/Fs).[38] Importantly, gasification and pyrolysis of biomass are significant sources of fine particulate matter (PM 2.5) that can penetrate deeply into the lungs, even enter the bloodstream, and cause serious health problems.[39] Fine particulate matter pollution is linked to a higher risk of premature death, heart disease, stroke, and aggravated asthma.[40] With biomass gasification and pyrolysis project proposals slated for Central Valley communities already overburdened with pollution, [41] to sanction forest biomass under the LCFS would contribute to environmental injustice as well, given the overarching threats of air pollution, water pollution, noise pollution, CO_2 leakage, and ecosystem damage.

Similar to biomass combustion, gasification and pyrolysis of biomass produce large quantities of CO_2 as well as methane emissions that worsen the climate emergency. The claim that woody biomass is a carbon neutral feedstock has been thoroughly debunked,[42] given the lost carbon storage and sequestration from extracting biomass, and the significant CO_2 emissions during biomass processing and gasification, pyrolysis, or combustion.[43] The combustion, gasification, and pyrolysis of trees and other forest material—including residues considered to be "waste"— leads to a net increase of carbon emissions in the atmosphere for decades to centuries.[44]

CARB's proposed specifications for forest biomass waste, however well-intentioned, are too vague to limit forest degradation, nor will they meaningfully reduce the significant

[38] Partnership for Policy Integrity, Air pollution from biomass energy, https://www.pfpi.net/air-pollution-2/; Liu, Wu-Jun et al., Fates of chemical elements in biomass during its pyrolysis, 117 Chemical Reviews 6367 (2017), https://pubs.acs.org/doi/10.1021/acs.chemrev.6b00647; Yao, Zhiyi et al., Particulate emissions from the gasification and pyrolysis of biomass: Concentration, size distributions, respiratory deposition-based control measure evaluation, 242 Environmental Pollution 1108 (2018), https://doi.org/10.1016/j.envpol.2018.07.126; Saxe, Jennie Perey et al., Just or bust? Energy justice and the impacts of siting solar pyrolysis biochar production facilities, 58 Energy Research & Social Science 101259 (2019) https://doi.org/10.1016/j.erss.2019.101259; Pang, Yoong Xin et al., Analysis of environmental impacts and energy derivation potential of biomass pyrolysis via piper diagram, 154 Journal of Analytical and Applied Pyrolysis 104995 (2021), https://doi.org/10.1016/j.jaap.2020.104995.

[39] Yao, Zhiyi et al., Particulate emissions from the gasification and pyrolysis of biomass: Concentration, size distributions, respiratory deposition-based control measure evaluation, 242 Environmental Pollution 1108 (2018), https://doi.org/10.1016/j.envpol.2018.07.126.

[40] U.S. Environmental Protection Agency, Health and Environmental Effects of Particulate Matter, https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm.

[41] Clean Energy Systems, Clean Energy Systems Enters Into An Agreement to Acquire the Madera Biomass Power Plant (Jul. 12, 2022), *available at* https://www.cleanenergysystems.com/clean-energy-systems-enters-into-an-agreement-to-acquire-the-madera-biomass-power-plant; LLNL and DOE, Getting to Neutral: Options for Negative Carbon Emissions in California (2019), *available at* https://livermorelabfoundation.org/2019/12/19/getting-to-neutral/.

[42] Booth, Mary S, Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy, 13 Env't Rsch. Letters 035001 (2018), https://doi.org/10.1088/1748-9326/aaac88; Sterman, John et al., Does wood bioenergy help or harm the climate?, 78 Bulletin of the Atomic Scientists 128 (2022), https://doi.org/10.1080/00963402.2022.2062933.

[43] Climate Action Network International, Position: Carbon Capture, Storage, and Utilisation (January 2021), https://climatenetwork.org/resource/can-position-carbon-capture-storage-and-utilisation/; Fern, 2022, Six problems with BECCS, https://www.fern.org/fileadmin/uploads/fern/Documents/2022/Six_problems_with_BECCS_-_2022.pdf.

[44] Booth, Mary S., Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy, 13 Env't Rsch. Letters 035001 (2018), https://doi.org/10.1088/1748-9326/aaac88; Laganiere, Jerome et al., Range and uncertainties in estimating delays in greenhouse gas mitigation potential of forest bioenergy sourced from Canadian forests, 9 GCB Bioenergy 358 (2017), https://doi.org/10.1111/gcbb.12327; Sterman, John et al., Does wood bioenergy help or harm the climate?, 78 Bulletin of the Atomic Scientists 128 (2022).

harms to the climate, communities and forests detailed above. Almost all forest logging and thinning projects are done under the justification that they will promote forest health and resilience and/or are needed for fuels reduction. Trees and other forest vegetation of any size can be lopped and masticated into "small-diameter" residues and called "non-merchantable." Incentivizing the commodification of forest materials under the LCFS will lead to the removal of more biomass from the forest than would happen if these materials were not commodified, threatening forest ecosystems and forest carbon storage. Management practices should instead prioritize leaving residues or wastes in the forest to maintain soil organic carbon, retain vital nutrients in the ecosystem, and support wildlife habitat.

CONCLUSION

Thank you for consideration of these comments. The references cited herein are available here: https://diversity.box.com/s/8jcli9f2vwyof9cbq1qx5sna1m0d0hsb

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