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February 20, 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

Dear Chair Randolph and Members of the Board:

The Center for Biological Diversity appreciates the opportunity to comment on CARB's proposed amendments to the Low Carbon Fuel Standard ("LCFS"). There are serious issues with the current iteration of the LCFS: it is misaligned with the California's electrification goals, worsens environmental injustices, and permits a credit excess from biofuels and other "false solutions" that undercuts the credit price. We offer several concerns and suggestions to improve the program in order to better address the state's climate goals and avoid reliance on false solutions that accelerate the climate crisis.

I. CARB Should Use the Time Until the Final Vote to Incorporate Feedback from the Board and the Public.

We appreciate that the Board recently delayed a final vote on the LCFS, given the volume of comments the Board has received. While we are generally skeptical of industry-led attempts to delay implementation of life-saving rules that the Board has adopted in recent years, there were good reasons to delay a vote on this particular proposal. The Board now has time to analyze and incorporate the changes requested in this comment letter, as well as the changes recommended by the Environmental Justice Advisory Committee ("EJAC"), many of which are not reflected in the current proposal.

The LCFS has been trending in the wrong direction in recent months. The current proposal backtracks in important ways from what staff had outlined in September. For example, the new proposal backslides on the previously announced avoided methane policy, allows retroactive crediting for pathways that favor non-zero-emission fuels, and adds (inadequate) safeguards on crop-based feedstocks. The Board now has time to consider the changes proposed here before the LCFS is finalized. It should use the coming months to revisit some of the fundamental assumptions currently baked into the program, which could have a tremendous impact on whether the program will help meet the state's climate goals.

II. Carbon Capture and Storage Threatens to Derail Climate Goals and CARB Must Respond Accordingly.

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

CARB must remove its provision allowing credits to projects outside of California that produce oil using captured carbon dioxide (“CO_2”). This provision is at odds with California law. Closing this loophole would not only align with California law, but also reduce opportunities for fossil fuel production, and align with an EJAC recommendation.

In September 2022, Governor Newsom signed Senate Bill 905 (SB 905) into law.[1] Among other provisions, SB 905 prohibits operators in California from utilizing CO_2 from CCS operations in enhanced oil recovery (“EOR”).[2]

It’s easy to see why the legislature listened to communities in California and banned EOR associated with CCS. EOR involves the injection of fluids and/or gases (such as CO_2) underground to extract fossil fuels.[3] EOR threatens drinking water integrity, yet regulations on EOR activities are decades old and fall short of providing sufficient safeguards for groundwater.[4] In addition, all forms of EOR have some risk of blowouts that can result in leakage and/or surfacing of fossil fuels or injection fluids.[5] And throughout the EOR lifecycle—from construction to injection, production, and waste disposal—there are risks to the environment and communities from air, water, and noise pollution.[6] Adding to this is the contribution to climate change caused by extracting and using more fossil fuels via EOR. One study found that for each ton of CO_2 injected for EOR, 2.7 tons of CO_2 are eventually emitted from burning recovered oil.[7]

Yet while California decidedly took a stand against CCS-associated EOR within the State, CARB’s 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*

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[1] SB 905 (Caballero, 2022), https://leginfo.legislature.ca.gov/faces/billStatusClient.xhtml?bill_id=202120220SB905.
[2] *Id.* at Section 4(b), 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] Clean Water Action, The Environmental Risks and Oversight of Enhanced Oil Recovery in the United States at 5 (Aug. 2017), https://www.cleanwater.org/sites/default/files/docs/publications/The%20Environmental%20Risks%20and%20Oversight%20of%20Enhanced%20Oil%20Recovery%20in%20the%20United%20States.pdf.
[4] *Id.*
[5] *Id.* at 13.
[6] *Id.* at 12.
[7] *Id.* at 23, *citing* Banks, Brian et al., *SaskPower’s Carbon Capture Project – What Risks? What Rewards?*, Canadian Center for Policy Alternatives at 16-17 (2015) (noting that this calculation “does not even account for carbon dioxide losses in the course of the injection process: a substantial proportion returns to the surface with the oil.”).

and gas reservoirs used for CO_2-enhanced oil recovery (CO_2- EOR).[8] Thus, non-California regulated entities conducting EOR will be compensated by CARB for causing environmental and community health damage elsewhere. This asymmetry is simply wrong and must be corrected by removal of CCS-related EOR from the LCFS.

Closing the out-of-state EOR loophole aligns with the EJAC's recommendation that CARB has yet to address in the LCFS revisions. The EJAC specifically directed CARB staff to "Prohibit enhanced oil recovery as an eligible sequestration method."[9]

The following are possible changes to remove CCS-related EOR:

A. Remove the bolded 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.

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

CARB is seeking to "encourage existing petroleum facilities to deploy"[10] technologies like CCS and in doing so, to allow these fossil fuel projects to continue to generate credits beyond the phase-out date of December 31, 2040.[11] This amendment creates a dangerous loophole that relies on a so-called climate solution that is anything but; the result will be California incentivizing and perpetuating the climate catastrophe and the health and environmental harms that come with it.

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[8] 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).
[9] 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.
[10] LCFS Proposed Amendments, Appendix E at page 88, Y.8, rationale for proposed §§ 95489(c)(1)(A)2 and 95489(e)(1)(D)1.
[11] 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).

Encouraging fossil fuels and exempting their use from phase-out is reckless and derails California's efforts at climate leadership. The Intergovernmental Panel on Climate Change (IPCC) modeled pathway to the best chance of limiting warming to 1.5°C makes no use of fossil fuels with CCS or bioenergy with CCS and limited to no use of engineered CO_2 removal technologies.[12] CCS projects around the world have failed drastically—and repeatedly—to meet their GHG emission reduction promises.[13] For example, in July 2021, Chevron admitted that its self-described "world's biggest CCS project" failed to meet its five-year capture target and was seeking a deal to make up for millions of tons of CO_2 emitted.[14] In another example, the Petra Nova[15] CCS facility which was promised to capture 90 percent of the power plant's total CO_2 emissions only captured 7 percent.[16] 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.

There is also a substantial energy penalty for the use of CCS that reduces any potential climate benefits—especially when that extra energy is sourced from fossil fuels.[17] An energy penalty is defined as the extra energy required to run a capture process or the amount of energy spent when compared to the energy generated.[18] The energy penalty of CCS increases the fuel requirement for electricity generation by 11-40%.[19] Thus, the installation of CCS and its concomitant energy penalty drives even more pollution, which is currently unaccounted for in CARB's Scoping Plan and, seemingly, in the proposed phase-out exemption.

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[12] The IPCC-modeled pathway with the best chance of keeping warming at or below the target of 1.5°C makes no use of fossil fuels with CCS. IPCC, Summary for Policymakers in Global Warming of 1.5°C (2018) at 14, Section C.1.1., Figure SPM 3b (Pathway 1); *see also* IPCC SR1.5, at Ch. 2.3.3 and Table 2.SM.12.

[13] Institute for Energy Economics and Financial Analysis (IEEFA), *The Carbon Capture Crux: Lessons Learned* (Sept. 2022), https://ieefa.org/resources/carbon-capture-crux-lessons-learned.

[14] Bruce Robertson & Milad Mousavian, *If Chevron, Exxon and Shell Can't Get Gorgon's Carbon Capture and Storage to Work, Who Can?* IEEFA (April 26, 2022), https://ieefa.org/articles/if-chevron-exxon-and-shell-cant-get-gorgons-carbon-capture-and-storage-work-who-can.

[15] Petra Nova was shut down in 2020 due to plunging oil prices but will soon restore operations. Kevin Crowley, *The World's Largest Carbon Capture Plant Gets a Second Chance in Texas*, Bloomberg (Feb. 8, 2023), https://www.bloomberg.com/news/articles/2023-02-08/the-world-s-largest-carbon-capture-plant-gets-a-second-chance-in-texas#xj4y7vzkg.

[16] Ctr. for Int'l Envtl. L., *Confronting the Myth of Carbon-Free Fossil Fuels: Why Carbon Capture Is Not a Climate Solution*, 8 (2021), https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf at 2.

[17] *See* Mark Z. Jacobson, *The Health and Climate Impacts of Carbon Capture and Direct Air Capture*, 12 Energy & Environmental Science (2019), https://pubs.rsc.org/en/content/articlelanding/2019/ee/c9ee02709b#!divAbstract.

[18] *Id*.

[19] *See* Kurt House, et. al., *The Energy Penalty of Post-Combustion CO_2 Capture & Storage and its Implications for Retrofitting the U.S. Installed Base*, Energy & Envtl. Sci. (Jan. 22, 2009), https://dash.harvard.edu/bitstream/handle/1/12374812/1239214136-mja188.pdf.

c. Hydrogen using fossil fuels plus CCS must not be eligible for reducing the CI score or LCFS credits generally.

As explained later in this comment, the only form of hydrogen that should be considered under any provision in the LCFS is "green hydrogen," or hydrogen made by splitting water into hydrogen and oxygen using 100% solar or wind energy, while adhering to the three pillars. Instead, CARB staff are proposing to allow "hydrogen as an intermediate input to alternative or petroleum fuel production is eligible for reducing the GHG emissions associated with fuel production if hydrogen production is equipped with" CCS.[20]

As reiterated throughout this comment letter, CARB should not be incentivizing and prolonging the use of fossil fuels *in any manner*. This includes fossil fuels plus CCS. Facilities using CCS do *not* capture 100% of their climate-harming emissions, they incur a high energy penalty (meaning more energy use and emissions), and fossil fuel production is rife with environmental and health harms. Phasing out fossil fuels should be a fundamental tenant of any climate-focused policy, but CARB insists on carving out ways for fossil fuels to continue, such as this hydrogen allowance. These carve outs must end.

d. CARB must ensure capture-to-injection tracking of CO_2.

While we do not support the false climate fix that is CCS, we do support CARB's proposal that "additional entities, such as CO_2 transporters, along the supply chain of a CCS project" register as joint applicants and include "how the captured CO_2 passes through the supply chain among various entities."[21] We agree that "it is crucial for CCS projects to track the CO_2 throughout the supply chain."[22] It is important to avoid double-counting and double credits, both at the LCFS level and to the extent this information can be used to avoid double-counting at the federal level with IRS 45Q tax credits, which is rife with this kind of fraud.[23]

We recommend that CARB staff prohibit applicants from claiming confidential business information (CBI) in their applications so that members of the public have insight into the joint applicants involved in the entirety of a CCS project.

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

a. The proposed sustainability criteria for crop-based biofuels are woefully inadequate.

The proposed LCFS amendments allow for the continued use and expansion of crop-based (lipid) biofuels despite evidence that they are unsustainable and a danger to environmental and

[20] LCFS Proposed Amendments, Appendix E at page 104, Z.2, proposed for § 95490(a)(2).
[21] LCFS Proposed Amendments, Appendix E at page 107, Z.6, proposed for § 95490(c)(1).
[22] *Id.*
[23] Taxpayers for Common Sense, "45Q Issue Brief – Nearly 90 Percent of Carbon Sequestration Tax Credits Based on Insufficient Reporting and Fraudulent Claims" (Feb. 2023), https://www.taxpayer.net/climate/45q-issue-brief-nearly-90-percent-of-carbon-sequestration-tax-credits-based-on-insufficient-reporting-and-fraudulent-claims/.

public health. The only effort CARB staff propose to address these concerns is to identify and implement a sustainability certification for crop-based biofuels, without defining the criteria that would make a crop-based biofuel viable for use under such a certification. A sustainability requirement that equates to satisfying a certification standard that has yet to be defined is meaningless, and it should not have been proposed without a certification standard already chosen for consideration.

In the absence of CARB-established sustainability criteria, we looked to general definitions of energy sustainability to establish governing principles for biofuels. The result was the following biofuels sustainability criteria: (1) the fuel must be produced using feedstock that is readily available and can be replenished; (2) collecting and processing the feedstock must not cause environmental and social harms; (3) procuring the feedstock must not result in significant land-use change or otherwise hinder land's natural ability to store and sequester carbon; and (4) the lifecycle greenhouse gas emissions from the fuel must be near zero relative to conventional jet fuel.[24] In applying these sustainability criteria, it becomes clear that no crop-based biofuel is sustainable.

b. In permitting crop-based biofuels, CARB is allowing climate-damaging emissions.

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.[25] Though CARB staff are proposing to remove palm-derived fuels from eligibility under the LCFS, it must be noted that this does not eliminate the threat of CARB's sanctioning of crop-based biofuels leading to palm oil expansion. 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.[26] Thus, 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.[27]

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[24] Fleming, J., The Biofuels Myth: Why 'Sustainable Aviation Fuels' Won't Power Climate-Safe Air Travel (August 2022), Center for Biological Diversity, *available at:* https://biologicaldiversity.org/programs/climate_law_institute/pdfs/2022_The_Biofuels_Myth_Center_for_Biological_Diversity.pdf.

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

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

[27] 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).

CARB staff state that, "[w]ith continued increased demands on biofuel crops the Proposed Amendments could contribute to increased direct and indirect land use change to accommodate new croplands," but go on to minimize this statement by stating that "the likelihood of this is at least partially (and potentially fully) accounted for by the LUC scores added to crop-derived pathways."[28] However, the reality is that the Proposed Amendments likely will yield additional direct and indirect land use change emissions without any guarantee that these emissions will be fully accounted for. So CARB staff are proposing guidance on crop-based biofuels that could lead to unforeseen climate-harming emissions.

c. Crop-based biofuels pose a threat to communities and the environment.

There could also be unforeseen harms to communities and the environment. One such harm is worsening water scarcity. 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.[29] Meanwhile, a 2016 study found that biofuels rely on about 2-3% of the global water and land used for agriculture. Based on the food calories used for biofuel production, that amount could feed about 30% of the malnourished global population.[30] 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.[31] 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.[32]

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.[33] 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

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[28] Appendix D, p. 32.
[29] Gerbens-Leenes, P.W., Bioenergy water footprints, comparing first, second and third generation feedstocks for bioenergy supply in 2040, 59 European Water 373 (2017).
[30] Rulli, M.C. et al., The water-land-food nexus of first-generation biofuels, 6 Nature Scientific Reports (2016).
[31] Rulli, M.C. et al., The water-land-food nexus of first-generation biofuels, 6 Nature Scientific Reports (2016).
[32] 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.
[33] 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).

HEFA refining, along with explosion and fire risk.[34] With refineries most often sited in low-income communities and communities of color,[35] environmental justice harms are exacerbated by the presence of HEFA refining and would worsen with crop-based biofuel expansion.

Biofuel refinery expansion is alluded to by CARB staff: "Potential compliance responses to the Proposed Amendments…include construction and operation of new facilities to produce renewable diesel, biodiesel, and AJF and collection and distribution of feedstock to supply these facilities, or replace existing petroleum refineries."[36] Indeed, attempts are already being made in the Bay Area, for example, to convert existing oil and gas refineries to HEFA refineries, [37] and where low-income communities and communities of color would bear the brunt of air-pollution exposure.

d. CARB should adopt the EJAC recommendation of a cap on crop-based biofuels.

Given the risks associated with crop-based biofuels, it is disappointing that CARB staff rejected 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 timelines for high-risk, crop-based feedstocks."[38] The EJ Scenario was rejected because it would purportedly result in higher volumes of fossil diesel being used than any of the other scenarios evaluated. However, capping the use of lipid biofuels could instead spur the development of less deleterious alternatives such as the use of true waste products in biofuel production such as municipal solid waste (mentioned in the amendments),[39] and push the needed transition to battery-electric in shipping and trucking,[40] 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.

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[34] 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).
[35] 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).
[36] Appendix D, p. 25.
[37] *See e.g.*, Rodeo Renewed Project Draft Revised Environmental Impact Report, County File No. CDLP20-02040, State Clearinghouse No. 2020120330, October 2023.
[38] ISOR, p. 116.
[39] Appendix E, p. 66.
[40] 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/.

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

CARB is proposing to add conventional jet fuel ("CJF") for intrastate flights as a deficit-generator, as opposed to its current status as an opt-in fuel.[41] In including aviation emissions in the LCFS, the Board must walk a fine line between eliminating the exemption for dirty jet fuel while not incentivizing the use of crop-based biofuels, which damage ecosystems and communities.[42]

First, we note that the current language on this issue is weaker than staff had previously suggested, which will delay the potential benefits achieved through this change. The current proposal includes only fuel from intrastate flights, rather than all fuel that is combusted in and over California by all flights, including interstate and international. And it delays implementation until 2028.[43] These limiting factors will needlessly slow the benefits that may come from a transition to a more sustainable aviation industry. CARB should explore whether it can accelerate the implementation of this change and include fuel combusted from international and interstate flights for the portion of their trips that occur within the state's boundaries. If the Board chooses not to explore these avenues in this rulemaking, it should revisit these options at its next opportunity.

Second, 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.[44] Commercial airlines are also exempt from the excise tax for jet fuel, a tax break that costs the state about $23 million each year.[45] The carveout in the Low Carbon Fuel Standard for conventional jet fuel saves the airlines an estimated $110 to $360 million each year[46] on the cost of that fuel.

Relatedly, the industry continues to push the false solution of so-called Sustainable Aviation Fuels. 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 become enamored with false solutions like carbon offsets or flawed, short-term answers like SAFs. Many sources of SAF feedstock are likely unable to scale up to the industry-wide demand, and particularly

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[41] CARB, Staff Report: Initial Statement of Reasons (Dec. 19, 2023), p. 26, *available at*: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf
[42] These are referred to as Alternative Jet Fuel in the program.
[43] ISOR at p. 26.
[44] 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 .
[45] 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.
[46] 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.

problematic sources of biofuel feedstock like palm oil may create even more problems than they solve. Therefore, CARB should carefully regulate the feedstocks that receive credit for contributing to SAFs.

Third, while ending the exemption for CJF is a welcome first step, it needs to be paired with complementary policies that strictly limit the use of crop-based biofuels, as described above in Part III. The inclusion of CJF in the program at this juncture provides the Board an opportunity to ensure that included fuels meet true sustainability criteria going forward. 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. The Board should therefore choose to allow only feedstocks that have little to no land use effects or indirect emissions, such as municipal solid waste.

In short, the promotion and subsidization of SAFs, without adequate regard for the lifecycle impact and other ecological consequences of different feedstocks, threatens to substitute one problem for a host of others. California should not be in the business of subsidizing an industry's transition to fuels that promote deforestation in other parts of the country and world. Because crop-based biofuels are simply not sustainable, CARB should only incentivize fuels that meet strict and transparent sustainability criteria—a goal the Board has not reached in its current proposal.[47]

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

a. The LCFS should only allow hydrogen production that adheres to the three pillars.

According to CARB staff, "[p]otential compliance responses to the Proposed Amendments could include the construction of new or expanded hydrogen production facilities, using steam methane reformation, electrolysis, or gasification technologies."[48] This highlights a grave issue with the proposed amendments since, according to current best science, the cleanest way to produce hydrogen, without drawing much needed renewables from other uses, is to employ the three pillars—hourly matching, deliverability, and additionality—in the process of renewable-fueled electrolysis.[49]

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[47] *See infra*, Part III.
[48] Appendix D, p. 29.
[49] 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.

Specifically, hydrogen production should proceed 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). 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.[50] Yet, CARB staff's proposed amendments would allow the continued use of fossil gas, and the use of problematic feedstocks like dairy biogas and biomass, despite the emissions and environmental burdens these all carry. The only form of hydrogen that should be considered under any provision in the LCFS is "green hydrogen," or hydrogen made by splitting water into hydrogen and oxygen using 100% solar or wind energy, while adhering to the 3 pillars.

b. The LCFS should only allow electrolytic hydrogen produced using renewable solar and wind energy.

"Blue hydrogen" production, or steam methane reformation 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: CCS, on which blue hydrogen production relies, has proven to be ineffective, dangerous, and expensive,[51] with research showing that blue hydrogen can be worse for the climate than burning fossil fuels.[52] Woody biomass, as a feedstock (e.g. in gasification or pyrolysis) or energy source to make hydrogen, harms the climate,[53] communities, and ecosystems with significant emissions of CO_2[54] and criteria pollutants.[55] As the IPCC, the

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[50] 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)

[51] Taylor Kubota, *Stanford Study casts Doubt on Carbon Capture,* Stanford News (Oct. 25, 2019), https://news.stanford.edu/2019/10/25/study-casts-doubt-carbon-capture/, citing Mark Z. Jacobson, *The health and climate impacts of carbon capture and direct air capture*, 12 Energy Envt. Sci. 3567 (2019), https://pubs.rsc.org/en/content/articlelanding/2019/ee/c9ee02709b/unauth#!divAbstract; Clark Butler, IEEFA, *Carbon Capture and Storage Is About Reputation, Not Economics* at 4 (2020), https://ieefa.org/wp-content/uploads/2020/07/CCS-Is-About-Reputation-Not-Economics_July-2020.pdf; *CAN Position: Carbon Capture, Storage, and Utilization*, Climate Action Network Int'l at 9 (2021), https://climatenetwork.org/resource/can-position-carbon-capture-storage-and-utilisation/.

[52] Howarth, R.W. and Jacobson, M.Z., How green is blue hydrogen? 9 Energy Sci. Eng. 1676 (2021).

[53] 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.

[54] 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.

[55] 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

federal Environmental Protection Agency's Science Advisory Board, and other scientists have established, wood bioenergy should not be assumed to be carbon neutral;[56] 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.[57] There is also a significant pollution burden from biogas facilities near communities.[58] The LCFS should no longer 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.

c. Hydrogen will only have a limited role in a carbon-free future.

Ultimately, even hydrogen produced using clean, renewable energy should play only a limited role in a carbon-free future, given the risks it carries. First, hydrogen is a potent, indirect greenhouse gas with 100 times the warming power of CO_2 over a 10-year period and 33 times over 20 years.[59] As a small molecule, hydrogen is more leakage-prone than methane, posing climate risks across the production and supply chains. Also, transporting hydrogen through pipelines is more dangerous than transporting methane: it is more likely to explode, burns hotter, and is more corrosive to pipelines.[60] Further, hydrogen production from fossil gas and coal emits dangerous health-harming pollution.[61] And all forms of hydrogen production use massive amounts of water—much more than solar and wind per unit of energy produced—which will put

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), available at https://doi.org/10.1016/j.jaap.2020.104995.

[56] 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.

[57] 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.

[58] 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).

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

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

[61] Sun, P. et al., Criteria Air Pollutants and Greenhouse Gas Emissions from Hydrogen Production in U.S. Steam Methane Reforming Facilities, 53 Environ. Sci. Technol. 7103 (2019).

extra stress on water supplies in areas already suffering from climate crisis-charged drought.[62] At present, about one million Californians lack access to safe, clean, and affordable water adequate for human consumption,[63] begging the question of whether water should be diverted to hydrogen production.

Thus, the use of hydrogen should be limited to those sectors without a viable present-day alternative, such as replacing existing dirty gray fossil-based hydrogen, crude oil refineries, or steel manufacturing.[64] This would effectively exclude the sectors for which the proposed amendments are most incentivizing hydrogen adoption: light-duty, medium-duty, and heavy-duty transport. Through the Hydrogen Refueling Infrastructure (HRI) provision, for instance, CARB is incentivizing the rapid buildout of hydrogen refueling infrastructure.[65] However, resources would be better directed to other pursuits given that for light-duty vehicles, battery-electric is readily available, energy efficient, and lower cost than the hydrogen fuel cell alternative.[66] Likewise, for heavy-duty vehicles such as those in long-haul trucking, it has now been shown that battery-electric is competitive and economically advantageous.[67] 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.[68] The LCFS should be incentivizing full electrification rather than hydrogen which is projected to have only a limited role in a carbon-free future.[69]

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

[63] Pineda, Dorany et al., *'A ticking time bomb': Why California Can't provide safe drinking water to all its residents*, LA Times, Sept. 27, 2023, https://www.latimes.com/environment/story/2023-09-27/californias-struggle-for-clean-water-is-getting-harder (last visited February 8, 2024).

[64] *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/.

[65] *See e.g.*, Appendix E, p. 30.

[66] Plötz, P., Hydrogen technology is unlikely to play a major role in sustainable road transport, 5 Nature Electronics 8 (2022).

[67] Phadke, A. et al., Why Regional and Long-Haul Trucks are Primed for Electrification Now, Lawrence Berkeley National Laboratory (2021), https://eta-publications.lbl.gov/sites/default/files/updated_5_final_ehdv_report_033121.pdf. 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/.

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

[69] IPCC, Technical Summary Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (2022), available at

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

CARB's proposed amendments to section 95488.8(g)(1)(A)1 on Specified Source Feedstocks adds "forestry residues" to the list of feedstocks, with some specifications: "Small-diameter, non-merchantable forestry residues removed for the purpose of forest fire fuel reduction or forest stand improvement and from a treatment where no-clear cutting occurred."[70]

We oppose the inclusion of woody biomass feedstocks, including forest and agricultural residues, in the LCFS program due to the significant greenhouse gas pollution, air pollution, degradation of forest ecosystems, and loss of forest carbon storage that come from producing biofuels and hydrogen from woody biomass. CARB's proposed specifications for forest residues are vague and will not meaningfully reduce harms.

a. CARB should not include woody biomass, including forest and agricultural residues, as feedstocks in the LCFS program due to the harms to the climate, public health, and forest ecosystems.

As detailed below, the production of biofuels and hydrogen from woody biomass releases large amounts of planet-heating CO_2 and toxic air pollutants, worsening the climate emergency and harming public health. While the GREET model incorrectly treats forest feedstocks as carbon neutral, scientific research clearly shows that combustion or gasification 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. Biomass facilities often concentrate pollution in communities of color and low-income communities in California, worsening environmental injustice.[71] Adding CCS to biomass gasification, pyrolysis, or combustion would still result in significant climate and air pollution and threaten public and safety, given CCS has proven to be ineffective, unsafe, and energy-intensive. Incentivizing hydrogen and biofuels production from forest biomass risks increasing logging and thinning, which degrade wildlife habitat and result in a net loss of forest carbon storage and sequestration, at a time when we must be protecting forest carbon stores. Biofuel and hydrogen production from woody biomass are not part of a clean, just energy future and should not be included in the LCFS program.

i. Gasification and pyrolysis of biomass to produce hydrogen and biofuels produce large amounts of CO_2 and health-harming pollutants.

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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/.

[70] Appendix A-1 at 145.

[71] Center for Biological Diversity, Forest Biomass Energy is a False Solution (2021), https://www.biologicaldiversity.org/campaigns/debunking_the_biomass_myth/pdfs/Forest-Bioenergy-Briefing-Book-March-2021.pdf.

Gasification and pyrolysis are the primary processes being promoted to produce hydrogen and biofuels from woody biomass such as trees and agricultural materials. The gasification of biomass at high temperatures (800-1200°C) produces a "syngas" containing large amounts of CO_2, as well as methane (CH4), 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. The biomass fuel, gasifier type, temperature, and gasifying agent (e.g., steam, air, oxygen, oxygen-enriched air) influence the composition of the syngas.[72] Biomass gasification and pyrolysis processes to produce hydrogen are still in the initial development phase, have not been demonstrated at any meaningful scale, are technically difficult, and expensive.

ii. Health-harming pollutants.

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 dibenzofurans (PCDD/Fs).[73] 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.[74] Fine particulate matter pollution is linked to a higher risk of premature death, heart disease, stroke, and aggravated asthma.[75]

The formation of NOx precursors, including NH_3, HCN and HNCO, during biomass pyrolysis has been widely reported, where NOx damages the respiratory system and contributes to acid

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[72] 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.
[73] 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.
[74] 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.
[75] 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.

rain, harming ecosystems.[76] Of the BTEX compounds produced during gasification and pyrolysis, benzene is a known human carcinogen, and toluene and xylenes damage the brain and nervous system, respiratory system, kidneys, and liver.

The formation of liquid tar is an inherent problem in biomass gasification. Tar contains toxic substances such as benzene, toluene, and naphthalene, while tar build-up also lowers energy efficiency, interrupts continuous operation, and increases maintenance costs of gasification processes.[77] Methods to clean tar from equipment would create large amounts of toxic wastewater, with resulting environmental and community harms.[78]

iii. Climate-heating CO_2.

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. Biomass-derived hydrogen and biofuels are often falsely promoted as being carbon neutral or carbon negative (i.e., meaning that they will lead to a net removal of CO_2 from the atmosphere) based on the inaccurate claims that woody biomass is a carbon neutral feedstock and/or that CCS can be used to capture the CO_2 emitted from the process. The claim that woody biomass is a carbon neutral feedstock has been thoroughly debunked,[79] given the lost carbon storage and sequestration from extracting biomass, and the significant CO_2 emissions during biomass processing and gasification, pyrolysis, or combustion.[80] For example, substantial upstream emissions are released from cutting and extracting trees and other vegetation which immediately ends their carbon storage and sequestration; the use of fertilizers and pesticides after cutting; transporting biomass often long distances in diesel trucks; and processing biomass through chipping and drying.[81] The combustion, gasification, and pyrolysis of trees and other forest material—

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[76] Chen, Hongyuan et al., A review on the NOx precursors release during biomass pyrolysis, 451 Chemical Engineering Journal 138979 (2022), https://doi.org/10.1016/j.cej.2022.138979.
[77] He, Quing et al., Soot formation during biomass gasification: A critical review, 139 Renewable and Sustainable Energy Reviews 110710 (2021), https://doi.org/10.1016/j.rser.2021.110710.
[78] Luo, Xiang et al., Biomass gasification: an overview of technological barriers and socio-environmental impact. In *Gasification for Low-Grade Feedstock* (2018): 1-15, https://www.intechopen.com/chapters/59423.
[79] 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.
[80] 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.
[81] *See*, *e.g.*, Roder, Mirjam et al., How certain are greenhouse gas reductions from bioenergy? Life cycle assessment and uncertainty analysis of wood pellet-to-electricity supply chains from forest residues, 79 Biomass and Bioenergy 50 (2015), DOI: 10.1016/j.biombioe.2015.03.030.

including residues considered to be "waste"— leads to a net increase of carbon emissions in the atmosphere for decades to centuries.[82]

Furthermore, CCS has consistently proven to be exceptionally ineffective, unsafe, expensive, and targets environmental justice communities.[83] CCS operations are very energy-intensive given the high energy requirements needed to separate, compress, transport, and inject CO_2, typically requiring at least 15-25% more energy, which results in increased greenhouse gas and air pollution emissions.[84] CCS projects around the world have consistently failed to meet their carbon-capture promises, often by large margins.[85] Moreover, 95% of CO_2 captured in the U.S. by CCS is used to pump oil and gas out of the ground in process called enhanced oil recovery,[86] worsening the climate emergency. CCS poses significant new health, safety, and environmental risks from toxic air pollution emitted from CCS facilities, earthquake risks from underground CO_2 injection, and the inevitable ruptures of CO_2 pipelines and leaks from underground CO_2 storage that can sicken and even kill people.[87] In short, putting CCS equipment on biomass gasification and pyrolysis facilities (BECCS) would still lead to significant CO_2 and co-pollutants emissions, endangering communities and the climate.

iv. Environmental injustice.

Biomass gasification and pyrolysis project proposals are targeting communities in the Central Valley already overburdened with pollution. For example, idled Central Valley bioenergy facilities in or near communities, such as the Madera biomass facility, are being proposed for

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[82] 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).
[83] Center for Biological Diversity, Carbon Capture and Storage is a False Solution for the Climate and Our Communities (2022), https://biologicaldiversity.org/campaigns/carbon-capture-and-storage/pdfs/CCS-explainer.pdf.
[84] Climate Action Network International, Position: Carbon Capture, Storage, and Utilisation (January 2021), https://climatenetwork.org/resource/can-position-carbon-capture-storage-and-utilisation/; IEEFA, The carbon capture crux: Lessons learned (Sept. 2022), https://ieefa.org/resources/carbon-capture-crux-lessons-learned.
[85] IEEFA, The carbon capture crux: Lessons learned (Sept. 2022), https://ieefa.org/resources/carbon-capture-crux-lessons-learned.
[86] Global CCS Institute, https://status22.globalccsinstitute.com/2022-status-report/appendices/.
[87] Pipeline Safety Trust, Regulatory and Knowledge Gaps in the Safe Transportation of Carbon Dioxide by Pipeline (2022), https://pstrust.org/wp-content/uploads/2022/10/CO2-Regulatory-and-Knowledge-Gaps-1.pdf; Dan Zegert, Huffington Post, "The Gassing of Satartia" (Aug. 2021), https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f; Fowler, Sarah, 'Foaming at the mouth': First responders describe scene after pipeline rupture, gas leak, The Clarion-Ledger (February 27, 2020), https://www.clarionledger.com/story/news/local/2020/02/27/yazoo-county-pipe-rupture-co-2-gas-leak-first-responders-rescues/4871726002/.

conversion to biomass gasification or pyrolysis facilities to produce hydrogen, threatening to worsen environmental injustice for these communities.[88] Another recent proposal envisions a massive build-out of 50 to 100 biomass processing facilities—many of them biomass gasification and pyrolysis facilities—that would be concentrated in the Central Valley, paired with a polluting network of CO_2 pipelines, railcars, and trucking, and the injection of 100 million tons of CO_2 underground each year,[89] with inevitable harms from air pollution, water pollution, noise pollution, CO_2 leakage, earthquake risks, and ecosystem damage.

v. High water usage.

Biomass gasification to produce hydrogen has extremely high water usage. One recent study estimated that biomass gasification uses 306 kg water per kg of H_2 produced, which is orders of magnitude more than electrolysis production pathways estimated at 9 to 18 kg water per kg H_2.[90] This would put extra stress on water supplies in areas already suffering from climate crisis-charged drought.

vi. Forest ecosystem harms and lost forest carbon storage and sequestration.

Incentivizing the production and commodification of hydrogen and biofuels from woody biomass is likely to increase forest logging and thinning which degrade wildlife habitat and result in a net loss of carbon storage and sequestration from forests, at a time when we must be reducing deforestation and protecting forest carbon stores.[91] Logging and thinning trees releases their stored carbon to the atmosphere in a triple whammy for the climate: it increases overall carbon emissions, reduces the forest carbon sink, and requires massive public subsidies, taking resources away from truly low-carbon solar and wind energy.

b. CARB's proposed specifications for forest residues are vague and will not meaningfully reduce harms.

CARB's proposed specifications for forest residues are that they are "[s]mall-diameter, non-merchantable forestry residues removed for the purpose of forest fire fuel reduction or forest stand improvement and from a treatment where no-clear cutting occurred."[92] However well-intentioned, these specifications are too vague to limit forest degradation nor will they

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[88] 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.
[89] 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/.
[90] Mehmeti, Andi et al., Life cycle assessment and water footprint of hydrogen production methods: from conventional to emerging technologies, 5 Environments 24 (2018).
[91] Moomaw, William R. et al., Intact Forests in the United States: Proforestation mitigates climate change and serves the greatest good, Frontiers in Forests and Global Change (2019).
[92] Appendix A-1 at 145.

meaningfully reduce the significant 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 in the forest to maintain soil organic carbon, retain vital nutrients in the ecosystem, and support wildlife habitat.[93]

Thank you for consideration of these comments.

Sincerely,

John Fleming, PhD, Senior Scientist
Scott Hochberg, Staff Attorney
Victoria Bogdan Tejeda, Staff Attorney
Shaye Wolf, PhD, Climate Science Director

Center for Biological Diversity
Climate Law Institute
1212 Broadway, Suite 800
Oakland, CA 94612
(510) 844-7100
jfleming@biologicaldiversity.org
shochberg@biologicaldiversity.org
vbogdantejeda@biologicaldiversity.org
swolf@biologicaldiversity.org

References available at: https://diversity.box.com/s/8jcli9f2vwyof9cbq1qx5sna1m0d0hsb

[93] Walmsley, J.D. et al., Whole tree harvesting can reduce second rotation forest productivity, 257 Forest Ecology and Management 1104 (2009); Buccholz, Thomas et al., Mineral soil carbon fluxes in forests and implications for carbon balance assessments, 6 GCB Bioenergy 305 (2014); Achat, David et al., Forest soil carbon is threatened by intensive biomass harvesting, 5 Scientific Reports 15991 (2015), https://www.nature.com/articles/srep15991; Achat, David et al., Quantifying consequences of removing harvesting residues on forest soils and tree growth – A meta-analysis, 348 Forest Ecology Management 124 (2015).