

February 20, 2024

California Air Resources Board  
1001 I Street  
Sacramento, CA 95814

**Submitted Electronically via <https://ww2.arb.ca.gov/lispub/comm/bclist.php>**

**Re: Proposed Low Carbon Fuel Standard Amendments**

Dear Board Members,

LanzaJet thanks CARB for the opportunity to comment on the proposed changes to the California Low Carbon Fuel Standard (LCFS). As longtime supporters of the CA LCFS program, LanzaJet is encouraged by CARB's proposal to better align the program with the ambitious path laid out in the 2022 Scoping Plan. We echo parallel comments submitted by a broad coalition of sustainable aviation fuel (SAF) producers, including LanzaJet, in strongly supporting CARB's proposal to eliminate the exemption for intrastate fossil jet fuel under the LCFS.<sup>1</sup> We comment separately to stress the importance of that key next step in enhancing the market signal for SAF and also to provide insights on other key provisions in the proposal.

LanzaJet is an industry-leading SAF producer using a proprietary alcohol-to-jet (ATJ) process to convert any source of low-carbon, sustainable ethanol into ASTM-compliant SAF and renewable diesel. Following a decade of technology development and demonstration, LanzaJet was launched in 2020 with a clear mission—to scale the SAF market and enable meaningful decarbonization of the aviation sector. LanzaJet recently completed construction of a first-of-a-kind commercial scale SAF facility in Soperton, Georgia, U.S., and we are pursuing a pipeline of SAF projects to meet our goal of 1 billion gallons of domestic production by 2030. LanzaJet's equity investors include LanzaTech, Suncor, Mitsui, British Airways, and Shell, and financial support has been provided by ANA and Microsoft.

LanzaJet recognizes and appreciates California's continued leadership in the adoption of clean fuels in the aviation sector—one of the most difficult to decarbonize. In the 2018 LCFS rulemaking, CARB initiated inclusion of SAF in the program on an opt-in, credit-generating basis, which has since been replicated in other LCFS jurisdictions.<sup>2</sup> Unfortunately, while a helpful first step in providing some value for SAF under the LCFS, a stronger market signal is needed. The slow uptake of SAF in California can be traced, in part, to state regulatory rules, including the lack of an obligation on fossil jet fuel under the LCFS.<sup>3</sup>

California has rightfully set ambitious targets for aviation and for SAF specifically: Governor Newsom recently called for 20% clean fuels adoption in the aviation sector,<sup>4</sup> the state legislature has estimated a need for at least 1.5 billion gallons of SAF blending by 2030,<sup>5</sup> and the 2022 CARB Scoping Plan states that

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<sup>1</sup> See SAF group comments on LCFS Rulemaking 2024.docx submitted February 20, 2024

<sup>2</sup> Both [Oregon Clean Fuels Program](#) and [Washington Clean Fuels Standard](#) currently exempt fossil jet fuel from generating deficits and allow SAF to generate credits on an opt-in basis.

<sup>3</sup> See Bay Area Air Quality Management District, Sustainable Aviation Fuel: Greenhouse Gas Reductions from Bay Area Commercial Aircraft (October 2020) available at <https://www.baaqmd.gov/news-and-events/page-resources/2020-news/121120-saf-report>. See also <https://stillwaterassociates.com/saf-in-the-ira-era-how-do-the-incentives-stack-up/>.

<sup>4</sup> See California Office of the Governor, Governor's Letter to Chair Randolph. July 22, 2022. <https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf?emrc=1054d6>

<sup>5</sup> See AB1322 (Rivas) available at [https://leginfo.ca.gov/faces/billNavClient.xhtml?bill\\_id=202120220AB1322](https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1322). AB 1322 was passed by the California assembly in 2022 and later vetoed by Governor Newsom, who, in his veto letter, supported the legislature's intent with the bill and ordered CARB to develop a "plan to reduce greenhouse gas emissions through the production and use of sustainable aviation fuels by July 1, 2024". Governor Newsom's veto letter available at <https://www.gov.ca.gov/wp-content/uploads/2022/09/AB-1322-VETO.pdf?emrc=7598b6>

80% of all aviation fuel demand will need to come from SAF by 2045.<sup>6</sup> Given California’s aggressive goals in the aviation sector and its recognition in the proposal that the LCFS should actively encourage transitioning the use of renewable fuels to hard-to-decarbonize sectors in the coming decades, we urge CARB to better align the aviation provisions with the ambition that will be needed to achieve the state’s goals.

Accordingly, we urge CARB to significantly strengthen the signal for SAF in the proposal provisions that would impact the aviation sector. Specifically, we suggest that CARB consider the following revisions to the proposal:

1. Include all fossil jet fuel as a deficit generator under the LCFS.
2. Accelerate the obligation to begin in 2025, rather than 2028.
3. Allow indirect accounting of low-CI electricity and RNG for SAF production, a regulatory approach that is already in place for electric vehicle charging.
4. Allow book-and-claim use of SAF as proposed for hydrogen used as a transportation fuel.
5. Further strengthen proposed increases to the stringency of the program.
6. Align the definition of renewable diesel with the definition used by the EPA Renewable Fuel Standard Program (RFS).
7. Adopt the proposed rules for feedstock traceability with provisions to avoid increasing administrative burdens.
8. Utilize the LCFS to encourage long term transition of biofuels into hard-to-decarbonize sectors like aviation.

Please see our detailed comments and rationale for each below.

### **1. Include all jet fuel as a deficit generator under the LCFS.**

The current proposal to remove the exemption only for intrastate jet fuel is an important step in the right direction, but far from sufficient to meet state goals for the aviation sector. Currently, the LCFS provides a “rack fee” benefit that accrues to replacements for obligated fuels, like renewable diesel, but not to SAF.<sup>7</sup> This benefit, in conjunction with other state and federal regulatory rules, systematically disincentivizes SAF production, leading SAF credit generation under the LCFS to be consistently less than 1% of credit generation for very similar renewable diesel.<sup>8</sup> While removing the exemption for intrastate jet fuel SAF will help by partially eliminating the LCFS rack fee benefit, an obligation on roughly 10% of the jet fuel pool cannot be expected to fully close the gap nor to substantially increase the market signal for SAF production. Indeed, CARB’s own modeling suggests that SAF blending could reach about 100 million gallons in 2030 and about 200 million in 2045 as a result of the current proposal.<sup>9</sup> While these volumes represent encouraging growth from today’s volumes, they still fall far short of state goals, which would require roughly

<sup>6</sup> See CARB, 2022 Scoping Plan for Achieving Carbon Neutrality. December 2022. [https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp\\_1.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp_1.pdf). Page 73. The Scoping Plan scenario envisions 20% of aviation fuel demand met by electricity (batteries) or hydrogen (fuel cells) in 2045, with sustainable aviation fuel meeting the remaining 80%.

<sup>7</sup> Under the LCFS, suppliers of obligated fuels like diesel face a compliance cost, part of which they pass through to purchasers of fuel “at the rack”. This rack fee narrows the gap between the cost of fossil and renewable fuels, increasing the willingness to pay for the latter.

<sup>8</sup> Besides the LCFS rack fee, additional regulatory disincentives to SAF include the state Cap-at-the-Rack cost under the Cap-and-Trade program, which similarly narrows the price gap between fossil and renewable diesel, and the federal Renewable Fuel Standard (RFS) program which awards 1.7 RINs per gallon of renewable diesel compared to just 1.6 per gallon of SAF. While the total size of the incentive gap varies, the BAAQMD analysis estimated it in 2020 at about \$0.42 per gallon advantage for producing renewable diesel versus SAF, of which the LCFS represented about \$0.14. An obligation only on intrastate jet fuel—a small fraction of the total pool—would reduce the LCFS disparity only marginally. New federal incentives under the Inflation Reduction Act, such as the SAF Blender’s Tax Credit (40B) and the Clean Fuels Production Credit (45Z) can in theory make up much of that difference, but given that those expire in 2025 and 2027, respectively, they do not send a robust investment signal for needed SAF production. See CA LCFS Data Dashboard, Figure 2 at <https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard>; See also Bay Area Air Quality Management District (BAAQMD), Sustainable Aviation Fuel: Greenhouse Gas Reductions from Bay Area Commercial Aircraft. October 2020. available at <https://www.baaqmd.gov/news-and-events/page-resources/2020-news/121120-saf-report>.

<sup>9</sup> CARB, Appendix C-1 Standardized Regulatory Impact Assessment, September 2023. <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/appc-1.pdf>. Figure 4, page 18.

800 million gallons of SAF to meet Gov. Newsom’s 20% clean fuels adoption target, 1.5 billion gallons in 2030 to meet the AB 1322 goal, and 3.2 billion gallons by 2045 to meet the 2022 Scoping Plan target. As noted by the International Council on Clean Transportation (ICCT), obligating only intrastate jet fuel would have “a minimal impact on the program due to the small size of this fuel pool and would fail to meaningfully promote aviation decarbonization”.<sup>10</sup>

To boost the impact of the aviation provisions and put California on a path to achieving its aviation decarbonization goals, we encourage CARB to remove the exemption for all jet fuel uplifted in California. While anything that closes the LCFS incentive gap between jet and diesel substitutes (including obligating only a portion of jet fuel as proposed) will be directionally helpful in increasing SAF supply, obligating all jet fuel uplifted in CA will have a much more significant impact in sending an investment signal for SAF and driving SAF use in the state.

If CARB maintains a focus on obligating only intrastate jet fuel use, we suggest that CARB obligate all jet fuel combusted in California, as outlined in the September 20, 2023 Board meeting, when CARB staff stated that intrastate jet fuel would include not only flights within California, but also the portion of jet fuel combusted in California from other flights that start or end in California. Such a provision need not be overly precise or require direct regulation of or reporting from aircraft operators. Rather, existing data and tools could be used to develop a rough estimation of intrastate fuel use.<sup>11</sup>

## **2. Accelerate the obligation to begin in 2025, rather than 2028.**

CARB states that the proposal to delay the obligation for fossil fuel jet fuel until 2028 is meant to provide “sufficient time for potential producers of alternative jet fuel to add capacity for the anticipated increased demand of alternative jet fuel”<sup>12</sup> However, such a delay is unnecessary, and we urge CARB to consider an earlier implementation date. We note that British Columbia has already added an obligation for all fossil jet fuel beginning in 2026, coupled with a volumetric SAF mandate beginning in 2028.<sup>13</sup> Given that CARB is only proposing an obligation for jet fuel and not an actual SAF requirement, consistent with the LCFS, there is technically no need for lead time to increase SAF production capacity because the structure of the LCFS program allows for compliance via credits generated outside of aviation—credits which are readily available today. In addition, CARB has already provided a five-year window for growth since making SAF an opt-in credit generator in 2019, during which time SAF volumes recorded under the LCFS have increased five-fold, despite a global pandemic and the continued regulatory disadvantages for SAF producers under both the LCFS and the Cap and Trade program.<sup>14</sup> Nevertheless, SAF continues to lag far behind similar ground transportation fuels under the LCFS. This gap should not be misinterpreted as a signal that the SAF market or SAF technologies are insufficiently mature to support an obligation for aviation, but rather should serve as evidence that the lack of an LCFS obligation for aviation has steered producers toward more lucrative opportunities serving road transportation.<sup>15</sup>

In any event, LanzaJet is confident that there will be enough production capacity to meet demand beginning in 2025. In the last year alone, global SAF capacity has increased by over 300 million gallons from a single producer and the International Air Transport Association estimates 2024 SAF production to triple to over

<sup>10</sup> Stephanie Searle, International Council on Clean Transportation Comments on the November 2022 LCFS Workshop. December 21, 2022. <https://www.arb.ca.gov/lists/com-attach/84-lcfs-wkshp-nov22-ws-B2lQOVAnVVkEMAc3.pdf>.

<sup>11</sup> See Graver, Rutherford, and Zheng, CO<sub>2</sub> Emissions from Commercial Aviation. ICCT, 2020. <https://theicct.org/wp-content/uploads/2021/06/CO2-commercial-aviation-oct2020.pdf>. The methods used by Graver et al. could be extended with a simple additional calculation to attribute fuel burn from either take-off or landing (whichever occurs in California) plus a fraction of the cruising fuel burn equal to the fraction of the route’s distance that lies within the state.

<sup>12</sup> See CARB, Appendix E: Purpose and Rationale for Low Carbon Fuel Standards Amendments. January 2, 2024. [https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/lcfs\\_appx.pdf](https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/lcfs_appx.pdf). Page 12.

<sup>13</sup> See [https://www.bclaws.gov.bc.ca/civix/document/id/oic/oic\\_cur/0699\\_2023](https://www.bclaws.gov.bc.ca/civix/document/id/oic/oic_cur/0699_2023)

<sup>14</sup> See CA LCFS Data Dashboard, Figure 2 at <https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard>

<sup>15</sup> On regulatory disincentives, see footnote 8. On technology and market maturity, several SAF pathways have already been commercialized. A total of 8 pathways for SAF production have been approved under ASTM 7566, and 3 additional coprocessing pathways have been approved under ASTM D1655. See [https://www.caafi.org/focus\\_areas/fuel\\_qualification.html](https://www.caafi.org/focus_areas/fuel_qualification.html).

500 million gallons, or 1.5 million metric tonnes.<sup>16</sup> In the U.S., SAF production capacity has expanded by at least 70 million gallons, with new facilities including LanzaJet’s Freedom Pines Fuels<sup>17</sup> and Montana Renewables Great Falls plant<sup>18</sup> coming online. Additional expansions are in the pipeline, including concrete, near-term plans for expansions from Diamond Green Diesel,<sup>19</sup> Montana Renewables,<sup>20</sup> and California’s own World Energy.<sup>21</sup> Most importantly, there are roughly 3 billion gallons of renewable diesel consumed in the U.S. each year, 80% of which is produced domestically,<sup>22</sup> and half of which could easily be transitioned to SAF production—where it would produce additional benefits to both climate and local air quality— if additional policy incentives were put in place under the LCFS to level the playing field for SAF. In sum, there is sufficient SAF production capacity and CARB need only send an appropriate market signal. We urge CARB to maintain its role as a leader in LCFS policy by accelerating its fossil jet fuel obligation to 2025.

### **3. Allow indirect accounting of low-CI electricity and RNG for SAF production, a regulatory approach that is already in place for electric vehicle charging.**

LanzaJet supports existing policy to allow indirect accounting for low-CI electricity and RNG inputs to the production of low-CI hydrogen, and we applaud CARB’s proposal to expand access through the use of power purchase agreements (PPAs) for low-CI electricity.<sup>23</sup> However, we strongly believe that the same access should be expanded to SAF. At minimum, we urge CARB not to eliminate the existing allowance for indirect accounting for low-CI electricity to produce hydrogen that is used in the production of fuels, including SAF.

CARB’s arguments for providing additional flexibility to low-CI hydrogen when directly used as a transportation fuel apply equally to SAF. Both low-CI hydrogen and SAF are young technologies with nascent markets that displace hard-to-electrify end uses like powering aircraft. The 2022 CARB Scoping Plan calls for significant growth in the use of both and, in the aviation sector, envisions even greater growth for SAF—from less than 1% of jet fuel consumption today to 80% in 2045.<sup>24</sup>

Despite these parallels, current and proposed LCFS rules for indirect accounting of low-CI energy systematically disadvantage SAF relative to hydrogen. Hydrogen producers have access to emissions reductions from process energy—low-CI electricity and RNG—that SAF cannot access. This is counter to state goals for SAF uptake and aviation decarbonization. We urge CARB to promote equity between future fuels like SAF and hydrogen and allow indirect accounting of RNG and low-CI electricity—both as a direct input to SAF and as an input to hydrogen for use in SAF.

### **4. Allow book-and-claim use of SAF, as proposed for hydrogen used as a transportation fuel**

<sup>16</sup> See <https://www.neste.com/products-and-innovation/sustainable-aviation/questions-and-answers-about-saf> ; <https://www.iata.org/en/pressroom/2023-releases/2023-12-06-02/>

<sup>17</sup> See <https://www.prnewswire.com/news-releases/lanzajet-celebrates-grand-opening-of-the-worlds-first-ethanol-to-sustainable-aviation-fuel-production-facility-302052431.html>.

<sup>18</sup> See <https://www.prnewswire.com/news-releases/montana-renewables-begins-sustainable-aviation-fuel-deliveries-to-shell-301820679.html>.

<sup>19</sup> See <https://worldbiomarketinsights.com/valero-energy-and-darling-ingredients-on-time-with-saf-plant-in-texas/#:~:text=Valero%20Energy%20and%20Darling%20Ingredients%20on%20time%20with%20SAF%20plant%20in%20Texas,-by%20Daniela%20Castim&text=Valero%20Energy%20and%20Darling%20Ingredients%20have%20announced%20that%20their%20joint,the%20first%20quarter%20of%202025>.

<sup>20</sup> See <https://www.ogj.com/energy-transition/article/14296189/calumet-provides-operational-update-on-montana-renewables-great-falls-plant>.

<sup>21</sup> See <https://www.prnewswire.com/news-releases/world-energy-secures-permits-will-completely-convert-its-southern-calif-refinery-to-create-north-americas-largest-worlds-most-advanced-sustainable-aviation-fuel-hub-301531135.html>.

<sup>22</sup> See <https://ethanolproducer.com/articles/epa-2375-billion-rins-generated-in-2023>. RIN data, which measure consumption of renewable diesel, underestimate domestic production capacity because a fraction of domestically produced fuels are exported.

<sup>23</sup> See CARB, Staff Report: Initial Statement of Reasons (ISOR). December 19, 2023. <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf>. Page 34.

<sup>24</sup> See CARB, 2022 Scoping Plan for Achieving Carbon Neutrality. December 2022. [https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp\\_1.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp_1.pdf). Page 73.

LanzaJet also supports the proposal to allow book-and-claim accounting for low-carbon intensity hydrogen used as a transportation fuel. We agree with CARB’s rationale for allowing hydrogen book and claim: that physical delivery is impractical for large scale production that is sent to several off-takers through shared pipelines.<sup>25</sup> However, the same rationale also applies to SAF, and we strongly recommend that the offtake opportunities provided by book and claim should be available to all pipeline-fungible liquid and gaseous fuels.

All of the arguments given by CARB in the Initial statement of Reasons for extending book and claim to low-CI hydrogen also apply to SAF.<sup>26</sup> Like hydrogen, the SAF market is nascent, and relies on large scale production, pipeline deliveries, and multiple off-takers for economies of scale. In the aviation sector, both hydrogen and SAF serve the same end use—transportation fuel for aircraft.

The 2022 Scoping Plan sees SAF as the essential key to meaningful decarbonization of aviation through 2045—displacing 80% of the fossil fuels used by the sector. Despite that, current and proposed LCFS rules for book and claim that exclude SAF make it much more logistically difficult and carbon intensive for jet fuel suppliers to provide their customers with emissions reductions from SAF than it would be from hydrogen.

## **5. Further strengthen proposed increases to the stringency of the program.**

LanzaJet supports the proposed measures to increase the stringency of the LCFS program and encourages CARB to boost stringency even more. We believe that near-term efforts to quickly boost LCFS prices back to meaningful levels are essential, and we therefore urge CARB to 1) aim for a 6 or 7% stepdown in the CI reduction target in 2025, rather than the proposed 5%, and 2) move implementation of the auto adjustment mechanism forward from 2028 to 2027. Additionally, we suggest that CARB increase the 2030 CI reduction target—currently at 20%-- even beyond the proposed 30%. A recent study by ICF found that a 42% CI reduction by 2030 is both feasible and necessary to support progress toward the 2022 Scoping Plan goals.<sup>27</sup>

## **6. Align the definition of renewable diesel with the definition used by the EPA RFS program.**

LanzaJet believes that the proposed definition of “renewable diesel” is unintentionally limited to certain production processes (hydrotreating or Fisher-Tropsch) and feedstocks (lipids, biocrudes, or gasified biomass).<sup>28</sup> The proposed definition would arbitrarily exclude renewable diesels produced via alcohol-to-fuels pathways as well as via other non-enumerated feedstocks. We urge CARB to let lifecycle analysis, guided by the latest science, determine eligibility for credit generation under the LCFS and broaden the definition to include objective criteria, as was the case with the former definition.

Specifically, we suggest that CARB expand the definition of renewable diesel to align with the EPA definition of a non-ester renewable diesel under the federal RFS program:

“A fuel or fuel additive that meets the Grade No. 1–D or No. 2–D specification in ASTM D975 (incorporated by reference, see [§ 80.12](#)) and can be used in an engine designed to operate on conventional diesel fuel;”<sup>29</sup>

<sup>25</sup> See CARB, Staff Report: Initial Statement of Reasons (ISOR). December 19, 2023.

<https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf>. Page 34.

<sup>26</sup> See CARB, Staff Report: Initial Statement of Reasons (ISOR). December 19, 2023.

<https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf>. Page 30.

<sup>27</sup> See ICF, Analyzing Future Low Carbon Fuel Targets in California. June 2023. Submitted to CARB June 30, 2023.

<sup>28</sup> See CARB, Appendix A-1 Proposed Regulation Order (Proposed Sections for Amendments). January 2, 2024.

[https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/lcfs\\_appa1.pdf](https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/lcfs_appa1.pdf). Page 22.

<sup>29</sup> See 40 C.F.R. § 80.2

**7. Adopt the proposed rules for feedstock traceability with provisions to avoid duplicative administrative burdens.**

In principle, LanzaJet supports the additional proposed guardrails on crop-based feedstocks—the sustainability of our SAF is paramount to us. However, we urge CARB to ensure that these requirements do not add additional undue administrative burden to reporting entities. SAF producers participate in a variety of regulatory programs and incentives beyond the CA LCFS, including the federal Renewable Fuel Standard (RFS) program, incentives under the Inflation Reduction Act, the International Civil Aviation Organization’s Carbon Offsetting Reduction Scheme for International Aviation (CORSA), and others. As such, SAF producers, like other low carbon fuel producers, are already subject to multiple, separate sets of detailed regulations for tracking, verifying, and independently certifying the details of feedstock production and procurement. Given that we do not believe any producer would produce a biomass-based transportation fuel only for the LCFS market, we urge CARB to avoid adding a new, bespoke, and duplicative administrative burden under the LCFS. We strongly request that CARB explicitly allow for the new feedstock tracking and certification requirements to be met by existing certification schemes, such as EPA Quality Assurance Plans under the RFS program, International Sustainability and Carbon Certification (ISCC) or the Roundtable on Sustainable Biofuels (RSB).

**6. Utilize the LCFS to encourage long term transition of biofuels into hard-to-decarbonize sectors like aviation.**

We applaud CARB for thinking dynamically about existing biofuel resources, and considering ways to encourage diversions into sectors where they will be most needed to meet 2022 Scoping Plan goals. A key example of this type of thinking is CARB’s proposals aimed at pivoting biomethane from its current end-use as a road transportation fuel into hard-to-decarbonize applications like industry and flexible power generation.<sup>30</sup> We strongly urge CARB to apply the same thinking to the aviation sector and use the LCFS to encourage the diversion of biofuels from road transport—including both renewable diesel and ethanol—to aviation.

We believe there is ample justification for CARB to prioritize a long-term transition of biofuel resources to SAF:

First, while both light and medium/heavy-duty transportation are expected to electrify over the coming decades (although on different timetables), aviation will take much longer to transition to decarbonize, and SAF is expected to be the chief decarbonization lever for the foreseeable futures. The 2022 Scoping Plan scenario envisions 100% sales of zero emissions vehicles for light duty transport by 2035 and for medium/heavy duty transport by 2040, but for aviation sees only 20% alternative propulsion (hydrogen or electric) possible by 2045.<sup>31</sup> In short, SAF is California—and the world’s—only viable option for meaningful decarbonization in the aviation sector before mid-century.

Second, SAF provides additional air quality benefits that have not been fully considered by CARB. CARB notes that the current proposal would result in reductions in oxides of nitrogen (NO<sub>x</sub>) and fine particulate matter (PM 2.5).<sup>32</sup> In addition, a recent synthesis of emissions measurement campaigns by the Airport Cooperative Research Program (ACRP), administered by the Transport Research Board of the U.S. National Academies of Sciences, found that a 50% SAF blend could reduce by nearly 40% oxides of sulfur,<sup>33</sup> which are known to have significant negative effects on exposed populations, and which are present in greater

<sup>30</sup> See CARB, Staff Report: Initial Statement of Reasons (ISOR). December 19, 2023.

<https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf>. Page 33.

<sup>31</sup> See CARB, 2022 Scoping Plan for Achieving Carbon Neutrality. December 2022. [https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp\\_1.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp_1.pdf). Page 72-73.

<sup>32</sup> See CARB, Staff Report: Initial Statement of Reasons (ISOR). December 19, 2023.

<https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf>. Page 57.

<sup>33</sup> Airport Cooperative Research Program, Alternative Jet Fuels Emissions Quantification Methods Creation and Validation Report. August 2019. Page 10. Available at <http://www.trb.org/Publications/Blurbs/179509.aspx>

proportions in fossil jet fuel than other transportation fuels like diesel. Additionally, other studies have found greater reductions in PM than the 55% cited in the SRIA. The ACRP study found PM reductions of up to 65%, and a more recent measurement campaign found that SAF produced via the alcohol-to-jet pathway could reduce non-volatile particulate matter by up to 97%.<sup>34</sup>

Third, California’s environmental justice communities have explicitly asked CARB to support displacement of fossil jet fuel with SAF, both in the formal recommendations to CARB of the Environmental Justice Advisory Committee<sup>35</sup> and in person, at the September 28<sup>th</sup>, 2023, Board meeting. Communities that live near and work at airports are some of the most vulnerable in California: of the ten busiest airports in the state, four are located within SB 535 designated disadvantaged communities, and another four are immediately adjacent.<sup>36</sup> These communities have long borne the disproportionate health impacts of unmitigated fossil jet fuel combustion.

Fourth, jet fuel causes unique contributions to global climate change that are unrecognized by the LCFS—harms that SAF can mitigate. Emerging research indicates that particulate matter reductions from SAF reduce aviation’s non-CO<sub>2</sub> climate impact, specifically the climate forcing from “contrail cirrus” impacts (the combined warming from contrails and contrail-induced cirrus). The current best estimate from the most recent comprehensive study is that the climate impact from contrail cirrus is nearly twice the impact from CO<sub>2</sub>.<sup>37</sup> Even the low end of current estimates—which show that contrail cirrus causes roughly half the total warming of CO<sub>2</sub>—warrants consideration of potential mitigation opportunities from SAF.<sup>38</sup> One recent study cited found that a 50% SAF blend could reduce contrail cirrus climate impacts by over 20%. An eventual shift to 100% SAF could reduce the climate impact of contrail cirrus by 50%.<sup>39</sup> While continued scientific uncertainty around the size of the non-CO<sub>2</sub> climate impacts makes them difficult to precisely quantify, the direction of those impacts—less warming when SAF is used—is known.

We strongly believe that these additional benefits—which align closely with state goals and priorities and accrue only to SAF—justify action by CARB to prioritize the production and use of SAF. As CARB has noted, transitioning fuels to other sectors in the long term requires that market signals transition first.<sup>40</sup> Under the current proposal, the market signal for SAF would improve marginally, but not nearly enough to overcome existing disincentives and pivot biofuel production toward SAF. Therefore, we encourage CARB to consider additional measures to credit the additional climate and air quality benefits. For example, CARB should consider applying a credit multiplier for SAF based on the most conservative estimates of non-CO<sub>2</sub> climate benefits of SAF. (The European RED II program, currently provides a multiplier of 1.2x for SAF.) Alternatively, CARB might develop a “CO<sub>2</sub> equivalent” metric to account for these benefits in terms of carbon intensity and incorporate them into the CA-GREET model, as has been suggested by the European Commission in its recent study on how to address the non-CO<sub>2</sub> climate impacts of aviation.<sup>41</sup>

<sup>34</sup> Tran, Brown and Olfert. Comparison of Particle Number Emissions from In-Flight Aircraft Fueled with Jet A1, JP-5 and an Alcohol-to-Jet Fuel Blend. *Energy Fuels* 34, 6, 7218–7222 (2020). <https://doi.org/10.1021/acs.energyfuels.0c00260>.

<sup>35</sup> See AB 32 EJAC DRAFT Recommendations to the CARB on the Low Carbon Fuel Standard Regulation Updates. August 24, 2023. <https://www2.arb.ca.gov/sites/default/files/2023-08/EJAC%20Low%20Carbon%20Fuel%20Standard%20Recommendations%20Version%201%20082423.pdf> and EJAC, Environmental Justice Advisory Committee 2022 Scoping Plan Recommendations: NF54. Page 16. September 30, 2022. <https://www2.arb.ca.gov/sites/default/files/barcu/board/books/2022/090122/finalejacrecs.pdf>.

<sup>36</sup> See <https://oehha.ca.gov/calenviroscreen/sb535>. LAX, OAK, BUR, and ONT are within disadvantaged communities. SFO, SMF, SNA, and LGB are adjacent.

<sup>37</sup> D.S. Lee, et al. The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018. *Atmospheric Environment* 244, 117834 (2021). <https://doi.org/10.1016/j.atmosenv.2020.117834>.

<sup>38</sup> *Id.*

<sup>39</sup> See European Union Aviation Safety Agency, Updated Analysis of the non-CO<sub>2</sub> Climate Impacts of Aviation and the Potential Policy Measures Pursuant to EU Emissions Trading System Directive Article 30(4) (synthesizing research on SAF non-CO<sub>2</sub> climate benefits and suggesting further consideration of SAF policy measures to mitigate aviation climate impacts); available at [https://www.easa.europa.eu/sites/default/files/dfu/201119\\_report\\_com\\_ep\\_council\\_updated\\_analysis\\_non\\_co2\\_climate\\_impact\\_s\\_aviation.pdf](https://www.easa.europa.eu/sites/default/files/dfu/201119_report_com_ep_council_updated_analysis_non_co2_climate_impact_s_aviation.pdf).

<sup>40</sup> See CARB, Staff Report: Initial Statement of Reasons (ISOR). December 19, 2023.

<https://www2.arb.ca.gov/sites/default/files/barcu/regact/2024/lcfs2024/isor.pdf>. Page 30.

<sup>41</sup> See European Union Aviation Safety Agency, Updated Analysis of the non-CO<sub>2</sub> Climate Impacts of Aviation and the Potential Policy Measures Pursuant to EU Emissions Trading System Directive Article 30(4) (synthesizing research on SAF non-CO<sub>2</sub> climate

We also urge CARB to consider carefully how to account for the lifecycle emissions involved in a pivot—rather than an expansion—of biofuels toward the aviation sector. As light and medium/heavy duty road transportation electrify, the 2022 Scoping Plan envisions a 94% reduction in demand for ethanol in California’s transportation sector by 2045—an absolute decline of 1.6 billion gallons per year of biofuel.<sup>42</sup> This presents a key opportunity to expand SAF production; at the national level, the 17B of ethanol currently blended into gasoline each year could become 10 billion gallons per year of SAF—more than triple the amount envisioned in the 2022 Scoping plan and the SAF Grand Challenge—with no net new ethanol demand.<sup>43</sup> The emissions factors for land use change (LUC) under the LCFS are based largely on a shock in emissions from the initial land conversion, annualized over a project horizon of 30 years.<sup>44</sup> However, if there is no net new ethanol demand, there can be no new land use change. As long as ethanol production does not substantially increase, LanzaJet recommends CARB maintain consistency with the assumptions that underlie the current LUC carbon intensity values by phasing out LUC emissions once emissions are amortized over the full 30-year project horizon land use change emissions have been fully accounted for. With nearly half of that amortization period over and the current rulemaking extending to 2045, LanzaJet believes it would be appropriate for CARB to include provisions for phasing out ILUC emissions in 2040, 30 years after the 2010 rulemaking, particularly for feedstocks like ethanol where significant demand destruction is forecasted and the “demand shock” rationale for ILUC cannot be reasonably maintained.

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Thank you for the opportunity to comment on this LCFS Rulemaking. Please don’t hesitate to reach out if you have any questions.

Sincerely,



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benefits and suggesting further consideration of SAF policy measures to mitigate aviation climate impacts); *available at* [https://www.easa.europa.eu/sites/default/files/dfu/201119\\_report\\_com\\_ep\\_council\\_updated\\_analysis\\_non\\_co2\\_climate\\_impacts\\_aviation.pdf](https://www.easa.europa.eu/sites/default/files/dfu/201119_report_com_ep_council_updated_analysis_non_co2_climate_impacts_aviation.pdf).

<sup>42</sup> See <https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-PATHWAYS-data-E3.xlsx>.

<sup>43</sup> See <https://ethanol.org/ethanol-today/ethanols-flight-plan-to-sustainable-aviation-fuel>

<sup>44</sup> See CARB, Staff Report: Initial Statement of Reasons (ISOR). March 5, 2009. <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2009/lcfs09/lcfsisor1.pdf>. Page IV-21-26.