



July 3, 2023

Submitted via email to: [LCFSWorkshop@arb.ca.gov](mailto:LCFSWorkshop@arb.ca.gov)

Dr. Cheryl Laskowski, Branch Chief  
Transportation Fuels Branch  
California Air Resources Board  
1001 I St.  
Sacramento, CA 95814

Re: Twelve Benefit Corporation Feedback on Potential Changes to the Low Carbon Fuel Standard

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Dear Dr. Laskowski:

Although there is no longer an open feedback period for any of the informal public meetings and workshops that the California Air Resources Board (CARB) has held over the last several months on potential changes to the Low Carbon Fuel Standard (LCFS) Program, Twelve Benefit Corporation (Twelve) is taking this opportunity to submit these comments inasmuch as the formal rulemaking stage for the “Proposed LCFS Amendments” has yet to be reached.<sup>1</sup> To the extent specificity is needed pursuant to the introductory paragraph on CARB’s “LCFS Meetings and Workshops” webpage, please consider this comment letter and the accompanying proposed regulatory language as referring to the virtual community meetings held on June 1 and June 2, for which the timeframe for feedback ended on June 14, 2023.<sup>2</sup>

As detailed below, our comments pertain to section 95488.8(i) of the current LCFS regulation. In particular, this letter proposes and discusses the basis for the attached revisions to the regulatory text. The revisions would enable indirect accounting mechanisms for renewable or low-carbon intensity (low-CI) electricity when it is used as a feedstock for the production of power-to-liquid (PtL) transportation fuels, sometimes referred to as electrofuels or e-fuels. We believe these revisions are warranted, as they would significantly incentivize the scale-up of these ultra-low carbon fuels, which are regarded as one of the most promising pathways, if not the most promising pathway to decarbonization of the aviation (and broader heavy-duty transportation) sector. Twelve respectfully requests that CARB include these proposed revisions in its forthcoming LCFS rulemaking package.

Before setting out our comments in Part II below, we first provide background information on Twelve and our groundbreaking carbon transformation™ technology, as well as a brief general overview of PtL fuels.

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<sup>1</sup> See <https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-11-1%20LCFS%20Amendments%20Admin%20Record%20Commencement%20Memo.pdf>.

<sup>2</sup> See <https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/lcfs-meetings-and-workshops>.

## I. Background

### A. *Twelve and Carbon Transformation*

Founded in 2015 and based in northern California, Twelve currently employs a staff of almost three hundred chemists, engineers, techno-economic experts, product developers, and other specialists, with the vast majority of our personnel working in one of our locations in Berkeley and Alameda. We are on a mission to eliminate global carbon dioxide (CO<sub>2</sub>) emissions and build a fossil-free future.

Our patented carbon transformation technology takes captured CO<sub>2</sub> and, using only water and renewable electricity, transforms it into syngas, a combination of carbon monoxide and hydrogen. Once formed, the syngas is routed through an integrated Fischer-Tropsch reactor and then upgraded, ultimately resulting in our E-Jet<sup>®</sup> fuel – PtL sustainable aviation fuel (SAF, or as CARB refers to it under the LCFS Program, alternative jet fuel) that meets the specifications in Annex A1 of ASTM International’s D7566 Standard (*Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons*). We expect our E-Jet, which has been tested and validated under a grant from the U.S. Air Force,<sup>3</sup> to reduce lifecycle greenhouse gas (GHG) emissions up to 90% in comparison to conventional, petroleum-based jet fuel.<sup>4</sup>

At the Paris Air Show last month, we publicly announced plans to begin construction of our first E-Jet plant in Moses Lake, Washington.<sup>5</sup> We selected Moses Lake in part because of the availability and abundance of low-carbon electricity in the state of Washington, including existing and new renewable sources. Over the next few years, we intend to develop additional fuel production plants in various other locations around the country. As a California-based company, we hope to be able to arrange for the uplift of a sizable portion of the PtL SAF we produce by aircraft in California.

### B. *PtL Fuels in General*

While technological approaches to the production of PtL fuels vary, the common thread among all such fuels is the utilization of the same feedstocks: CO<sub>2</sub> that is either captured from an industrial source (e.g., an ethanol facility) or obtained through direct air capture; water, which is electrolyzed to produce hydrogen; and a renewable source of electricity (e.g., solar, wind, hydropower). The national blueprint for transportation decarbonization, a multi-agency effort released by the federal government earlier this year, points out that PtL fuels represent “a viable

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<sup>3</sup> See <https://www.af.mil/News/Article-Display/Article/2819999/the-air-force-partners-with-twelve-proves-its-possible-to-make-jet-fuel-out-of/>.

<sup>4</sup> For more on Twelve and our revolutionary CO<sub>2</sub> electrolysis technology, please visit our website at [twelve.co](https://www.twelve.co).

<sup>5</sup> See <https://www.commerce.wa.gov/news/twelve-announces-plans-to-scale-production-of-sustainable-aviation-fuel-made-from-co2-in-washington-state/>. The Moses Lake plant will use biogenic CO<sub>2</sub> captured from an industrial point source, but our carbon transformation technology also converts CO<sub>2</sub> extracted from the air via direct air capture.

pathway” to sustainable, low-carbon transportation fuels.<sup>6</sup> According to the U.S. Department of Energy (DOE), one of the federal agencies involved in that effort, PtL fuels “have dramatically lower land, water, and [GHG] footprints compared to fossil fuels.”<sup>7</sup> Specifically in the context of the hard-to-abate aviation sector,<sup>8</sup> PtL SAF poses fewer land-related issues than most biomass-based SAF, is also advantageous from a water demand standpoint, and has been cited as “the only SAF technology that has the potential for unbounded production,”<sup>9</sup> an apt description given the ever-increasing concentration of CO<sub>2</sub> in the Earth’s atmosphere. For its part, Airbus, the commercial aircraft manufacturer, has referred to PtL SAF as an “exciting option” for fueling airplanes.<sup>10</sup>

With the above background in mind, our LCFS comments follow.

## II. Indirect Accounting for Renewable or Low-CI Electricity is Warranted for PtL Fuels

Section 95488.8(i), which was added to the LCFS regulation as part of the 2018 rulemaking, makes clear that indirect accounting mechanisms for renewable or low-CI electricity can only be used under the Program in two instances: (1) when the electricity is used as a transportation fuel (i.e., in an electric vehicle); and (2) when the electricity is used to make hydrogen via electrolysis, where that hydrogen is then used either as a transportation fuel (i.e., in a fuel cell electric vehicle) or in the production of another transportation fuel.<sup>11</sup>

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<sup>6</sup> *The U.S. National Blueprint for Transportation Decarbonization: A Joint Strategy to Transform Transportation*, at 55 (Jan. 2023), available at <https://www.energy.gov/sites/default/files/2023-01/the-us-national-blueprint-for-transportation-decarbonization.pdf>.

<sup>7</sup> DOE Bioenergy Technologies Office, “CO<sub>2</sub> Reduction and Upgrading for e-Fuels Consortium,” available at <https://www.energy.gov/eere/bioenergy/co2-reduction-and-upgrading-e-fuels-consortium>.

<sup>8</sup> As the Federal Aviation Administration (FAA) puts it, “decarbonization of the aviation sector is extremely challenging.” See FAA, *United States 2021 Aviation Climate Action Plan*, at 3 (Nov. 2021), available at [https://www.faa.gov/sites/faa.gov/files/2021-11/Aviation Climate Action Plan.pdf](https://www.faa.gov/sites/faa.gov/files/2021-11/Aviation%20Climate%20Action%20Plan.pdf).

<sup>9</sup> Rhodium Group, “Sustainable Aviation Fuels: The Key to Decarbonizing Aviation” (Dec. 7, 2022), available at <https://rhg.com/research/sustainable-aviation-fuels/>; see also World Economic Forum, *Clean Skies for Tomorrow: Delivering on the Global Power-to-Liquid Ambition*, at 10 (May 2022) (referring to PtL SAF’s “high GHG reduction potential” compared to other types of SAF and indicating that the feedstocks “are theoretically unlimited”), available at [https://www3.weforum.org/docs/WEF\\_Clean\\_Skies\\_for\\_Tomorrow\\_Power\\_to\\_Liquid\\_Deep\\_Dive\\_2022.pdf](https://www3.weforum.org/docs/WEF_Clean_Skies_for_Tomorrow_Power_to_Liquid_Deep_Dive_2022.pdf).

<sup>10</sup> Airbus, “Power-to-Liquids, explained” (July 15, 2021), available at <https://www.airbus.com/en/newsroom/news/2021-07-power-to-liquids-explained>.

<sup>11</sup> 17 CCR § 95488.8(i)(1); see also CARB, “Low Carbon Fuel Standard (LCFS) Guidance 19-01: Book-and-Claim Accounting for Low-CI Electricity,” at 1-2 (Dec. 2022), available at [https://ww2.arb.ca.gov/sites/default/files/2022-12/19-01\\_updated%20for%20WREGIS%20changes\\_ADA.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-12/19-01_updated%20for%20WREGIS%20changes_ADA.pdf); CARB, “LCFS Electricity and Hydrogen Provisions,” available at <https://ww2.arb.ca.gov/resources/documents/lcfs-electricity-and-hydrogen-provisions>.

In its November 2018 Final Statement of Reasons (2018 FSOR), CARB reiterated what it had indicated at the outset of the 2018 rulemaking, that “[t]he CI of pathways for electricity supplied to vehicles, and hydrogen produced by electrolysis rely almost entirely on the source of the electricity, but no options exist under the current regulation for matching low-CI electricity to an EV or electrolysis load.”<sup>12</sup> CARB then explained in the 2018 FSOR as follows:

Pathways . . . for hydrogen produced by electrolysis use electricity as a feedstock. Staff views the flexibility for indirect accounting of low-CI electricity for these pathways as analogous to the flexibility that the LCFS has always offered to other biofuels in using a mass balance approach to allocation of finished fuel to various feedstocks. In this regard, electricity has historically been disadvantaged in the program by being limited to the regional grid CI. Additionally, these changes create consistency between the treatment of biomethane that is indirectly supplied through the common carrier pipeline, and renewable electricity that is supplied through the electrical grid.<sup>13</sup>

CARB went on to emphasize that it was not recognizing indirect accounting under the LCFS Program in any other instances (i.e., in instances other than the two specified in section 95488.8(i)(1)) in part because “[t]he GHG benefits of allowing indirect accounting for renewable or low-CI process energy are expected to be relatively small as most alternative fuel production does not rely extensively on electricity consumption.”<sup>14</sup>

As indicated in the attached document, which shows the textual regulatory revisions we are proposing, Twelve maintains that indirect accounting for renewable or low-CI electricity should likewise be allowed in a third, specific and limited instance: when the electricity is used in the production of a PtL transportation fuel like Twelve’s E-Jet. The language changes laid out in the attachment are simple, straightforward, and narrowly tailored. In addition to minor add-ons in section 95488.8(i), all of which are shown in redline, we are putting forward a proposed definition of the term “power-to-liquid fuel” to ensure the intended scope of the proposal is not exceeded.<sup>15</sup> Importantly, the conditions in subparagraphs (1)(A) and (B) would have to be met for indirect accounting to be allowed.

As with the existing authorized uses now contained in section 95488.8(i)(1), the CI value of any fuel producer’s PtL fuel depends, as CARB put it in the 2018 FSOR, “almost entirely on the

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<sup>12</sup> 2018 FSOR at 172, quoting from the Initial Statement of Reasons (2018 ISOR) at III-95. In the 2018 ISOR, CARB proffered as the rationale for indirect accounting that “[s]upport for electricity decarbonization for electric vehicles allows for ultra-low carbon fuel pathways, which will help California better meet GHG emission reduction goals.” 2018 ISOR at III-96.

<sup>13</sup> 2018 FSOR at 172. Elsewhere in the document, CARB stated that “[i]ndirect, or book-and-claim, accounting for renewable or low-CI energy is recognized under the LCFS only for feedstocks or when the input is used directly as a fuel, not process energy.” *Id.* at 483.

<sup>14</sup> *Id.* at 173.

<sup>15</sup> We acknowledge that the term “low-CI electricity” is a defined term in the LCFS regulation (17 CCR 95481(a)(94)) and expressly includes “an eligible renewable resource” as defined under the California Renewables Portfolio Standard Program. Nevertheless, insofar as the subtitles of subsection (i) and paragraph (1) each include the term “renewable,” we recommend from a pure drafting standpoint that this term also be inserted elsewhere in section 95488.8(i)(1), as shown in the attachment.

source of the electricity.” In a presentation at a recent Commercial Aviation Alternative Fuels Initiative event, Dr. Ian Rowe, who co-leads the DOE CO<sub>2</sub> Reduction and Upgrading for e-Fuels Consortium, confirmed this, pointing out that PtL fuels “can have a very low carbon intensity IF they are made with renewable electricity.”<sup>16</sup> Moreover, as with electrolytic hydrogen production, electricity serves as a feedstock for PtL fuel production, not as process energy. Finally, indirect accounting in this additional instance is further justified by the fact that, separate and apart from the electricity being a feedstock rather than process energy, the GHG emission reductions that would result from the allowance of indirect accounting would be quite significant inasmuch as the fuel production process, once again as CARB put it in the 2018 FSOR, “rel[ies] extensively on electricity consumption.” That, of course, is the whole premise behind the burgeoning PtL fuel industry – using electricity (from a renewable source) to ultimately transform CO<sub>2</sub> into an ultra-low carbon liquid fuel.<sup>17</sup>

From a public policy perspective, allowing indirect accounting for renewable or low-CI electricity used in the production of a PtL transportation fuel makes good sense in that it would significantly incentivize not only the scale-up of these promising liquid fuels, but also the much-needed development and utilization of renewable energy resources like solar, wind, and hydroelectric. It is undeniable that the LCFS Program is designed to reduce GHG emissions from the transportation sector, and Twelve’s proposal would squarely further that purpose. That the proposal would also yield ancillary benefits for the electricity grid by supporting lower-CI stationary electricity generation should not be ignored or disregarded, particularly given that for a host of reasons, PtL fuel producers cannot always co-locate their facilities at a renewable electricity source or build a solar or wind farm as part of their fuel production facility.

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Thank you for your consideration of our comments and proposed regulatory revisions. Please do not hesitate to contact me or my colleague, Ira Dassa ([ira.dassa@twelve.co](mailto:ira.dassa@twelve.co)), if you have any questions. As a California-based company, and with the manufacture of the all-important CO<sub>2</sub> electrolyzer stacks that will be deployed at our first fuel production plant now taking place at our facility in Alameda, I want to stress in closing that we would be pleased to meet or otherwise engage with you or your staff on any aspect of our proposal.

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<sup>16</sup> See Ian Rowe (DOE Bioenergy Technologies Office), “Emerging Technologies to Support the SAF Grand Challenge 2050 Goal: Routes to Achieving Net-Zero Fuels and E-Fuels,” at slide 11 (June 16, 2023) (emphasis in original), available at [https://caafi.org/resources/pdf/SAF\\_Virtual\\_Conf\\_June2023\\_Session\\_13\\_Ian\\_Rowe.pdf](https://caafi.org/resources/pdf/SAF_Virtual_Conf_June2023_Session_13_Ian_Rowe.pdf).

<sup>17</sup> Twelve’s proprietary process is unique in that we use electricity not only to create electrolytic hydrogen for the syngas but, equally important, to electrolyze CO<sub>2</sub> via our revolutionary CO<sub>2</sub> electrolyzer technology. Under the current LCFS regulation, our understanding is that indirect accounting can be used for the water electrolysis step. (Note that in the future, we may opt to obtain green hydrogen from a supplier.) However, we are submitting this proposal because the novel CO<sub>2</sub> electrolysis step in our process does not appear to be encompassed within section 95488.8(i)(1), which we assume triggers the applicability of the section 95488.8(h) preclusion against indirect accounting mechanisms “[u]nless expressly provided elsewhere in [the LCFS regulation].” This, in turn, would affect the CI score of our E-Jet fuel.

Sincerely yours,

*Andrew Stevenson*

Andy Stevenson  
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Attachment

cc: Liane M. Randolph, Chair  
Dr. Steven C. Cliff, Executive Officer  
Rajinder Sahota, Deputy Executive Officer  
Anil Prabhu, Manager, Fuels Evaluation Section

§ 95481. Definitions and Acronyms.

(New (a)(120))

(120) “Power to Liquid Fuel” means a synthetic fuel that is produced from captured carbon dioxide, water, and renewable or low-CI electricity.

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§ 95488.8. Fuel Pathway Application Requirements Applying to All Classifications.

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(i) *Indirect Accounting for Renewable or Low-CI Electricity and Biomethane.*

(1) *Book-and-Claim Accounting for Renewable or Low-CI Electricity Supplied as a Transportation Fuel* ~~*or Used to Produce Hydrogen, or Used to Produce a Power-to-Liquid Fuel.*~~ Reporting entities may use indirect accounting mechanisms for renewable or low-CI electricity supplied as a transportation fuel ~~or~~ for hydrogen production through electrolysis for transportation purposes (including hydrogen that is used in the production of a transportation fuel), or for the production of a power-to-liquid fuel for transportation purposes, provided the conditions set forth below are met:

- (A) Reporting entities may report renewable or low-CI electricity used as a transportation fuel or as an input to hydrogen or power-to-liquid fuel production delivered through the grid without regard to physical traceability if it meets all requirements of this subarticle.
- The renewable or low-CI electricity must be supplied to the grid within a California Balancing Authority (or local balancing authority for hydrogen or power-to-liquid fuel produced outside of California) or alternatively, meet the requirements of California Public Utilities Code section 399.16, subdivision (b)(1). Such book-and-claim accounting for renewable or low-CI electricity may span only three quarters. If a renewable or low-CI electricity quantity (and all associated environmental attributes, including a beneficial CI) is supplied to the grid in the first calendar quarter, the quantity claimed for LCFS reporting must be matched to grid electricity used as a transportation fuel or for hydrogen or power-to-liquid fuel production no later than the end of the third calendar quarter. After that period is over, any unmatched renewable or low-CI electricity quantities expire for the purpose of LCFS reporting.
- (B) Renewable or low-CI electricity can be indirectly supplied through a green tariff program (including the Green Tariff Shared Renewables program described in California Public Utilities Code Section 2831-2833) or other contractual electricity supply relationship that meets the following requirements:
1. Electricity is generated by, or supplied under contract to, the pathway applicant for all environmental attributes of the claimed electricity. In order to substantiate renewable or low-CI electricity claims, the applicant must make contracts available to the Executive Officer, upon request, to demonstrate that the electricity meets the requirements of this subarticle. Generation invoices or metering records are required to substantiate the quantity of renewable or low-CI electricity produced from the renewable assets. Monthly invoices must be unredacted copies of originals showing electricity sourced (in kWh) and contracted price;
  2. All electricity procured by any LSE for the purpose of claiming a lower CI must be in addition to that required for compliance with the California Renewables Portfolio Standard (described in California Public Utilities Code sections 399.11-399.32) or, for hydrogen or power-to-liquid fuel produced outside of California, in addition to local renewable portfolio requirements;
  3. Renewable energy certificates or other environmental attributes associated with the electricity, if any, are retired and not claimed under any other program with the exception



of the federal RFS, and the market-based compliance mechanism set forth in title 17, California Code of Regulations Chapter 1, Subchapter 10, article 5 (commencing with section 95800). Retirement of renewable energy credits for the purpose of demonstrating Green Tariff Shared Renewables procurement to the California Public Utilities Commission does not constitute a double claim.

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