February 20, 2024

The Honorable Liane M. Randolph
Chair
California Air Resources Board

(Comment submitted electronically)

RE: Infinium Operations, LLC's Recommendations that would Enable California to Harness the Profound Decarbonization Potential of eFuels

Dear Chair Randolph,

Infinium Operations, LLC ("Infinium") is pleased to submit comments recommending specific modifications to the California Air Resources Board's ("CARB") proposed amendments to the Low Carbon Fuel Standard ("LCFS"). We strongly support CARB's LCFS program as it sends a strong market signal to decarbonize the transportation sector, is performance based, and provides long-term policy stability that supports investment. However, we respectfully request that CARB revisit its proposed power sourcing structure (the "Proposed Structure" or "Proposed Regulations") as applied to power-to-liquid fuels ("PtL Fuels") which are also known as eFuels. In the same way that electric vehicles must utilize zero carbon power to be carbon neutral, eFuels must be produced from zero carbon power to be carbon neutral. We respectfully recommend that CARB follow its own precedent by allowing eFuels to source low carbon intensity ("Low-CI") power in the future in the same manner as electric vehicles do today.

As further examined in this comment, the Proposed Structure precludes the recognition of greenhouse gas ("GHG") emission reductions that are achieved by sourcing Low-CI power that is delivered over the grid to produce eFuels. By effectively mandating that eFuel production facilities source only grid power that includes fossil-based power except in rare circumstances, the Proposed Structure prevents both the growth of the eFuel industry and the expansion of new sources of renewable power. These policy outcomes undercut the tremendous potential of eFuels to decarbonize internal combustion vehicles ("ICVs") and jet engines; run counter to the goals of CARB's 2022 Scoping Plan to dramatically decarbonize transport and power; and reduce the likelihood that California will achieve carbon neutrality by 2045.

<u>Recommended Changes</u>

Infinium respectfully requests the following modifications to the Proposed Structure:

1. Allow eFuel production facilities to utilize the book-and-claim power sourcing system that is currently authorized for battery electric vehicles and electrolytic hydrogen to source Low-CI power via book-and-claim to produce electrolytic hydrogen and to produce drop-in fuels from hydrogen and carbon dioxide.
2. Establish a book-and-claim accounting system for hydrogen pipelines that is applicable outside California.

3. Establish a book-and-claim accounting system for carbon dioxide pipelines that is applicable outside California.
4. Revise the proposed Alternative Fuel definition to account for drop-in eFuel alternatives for gasoline and diesel fuel.

About Infinium

Infinium's mission is to decarbonize the transportation sector through the production of eFuels, an ultra-low carbon fuel alternative to petroleum derived transportation fuels. Infinium eFuels are drop-in replacements for use in planes, ships and motor vehicles without the need for costly infrastructure changes. Infinium's proprietary technology utilizes carbon dioxide (CO_2) that would otherwise be emitted, renewable power, and water as feedstocks to produce transportation fuels (e.g. eSAF, eDiesel and eNaphtha), with substantial reductions in lifecycle GHG emissions as compared to fossil-based alternatives.

Infinium's strategic and financial investors, include affiliates of Amazon, NextEra Energy, Mitsubishi Heavy Industries, SK Ventures, and AP Ventures- leading companies that are interested in both reducing their carbon footprints and innovating solutions to current environmental issues.

Infinium operates the first commercial drop-in eFuel facility in the world from its plant in Corpus Christi, Texas which will provide eFuels to Amazon's middle mile trucking fleet. Infinium announced a second commercial eFuel facility in West Texas called Project Roadrunner, which will be the largest in the world when it begins production in 2026. Project Roadrunner will produce primarily Infinium eSAF and smaller volumes of eDiesel and eNaphtha. Anchor partners include American Airlines as a sustainable aviation fuel ("SAF") off-taker and Breakthrough Energy Catalyst providing project equity investment.

How Can eFuels Help California Achieve Carbon Neutrality?

eFuels are renewable transportation fuels that are unique in that none of the energy content of the fuel comes from the input raw materials such as crude oil or biological sources (i.e., fuel feedstocks). The raw materials to produce eFuels are water and carbon dioxide that have no accessible energy value. Instead, the energy content in eFuels originates from renewable electricity applied during production to create hydrogen via electrolysis and subsequently reacted with CO_2 to yield eFuels such as eSAF, eDiesel and eNaphtha. In this respect, eFuels provide a method to convert renewable energy into a drop-in replacement fuel for ICVs and long-haul jets without the need to extract energy or release additional carbon from fossil crude oil or biomass-derived feedstocks.

eFuels have been recognized as a foundational fuel pathway in the policy framework of many jurisdictions and have also been recognized as a vital solution by non-governmental organizations ("NGOs") and think tanks. eFuels (with lifecycle GHG emission reductions exceeding 90% if produced using zero CI energy) provide the most effective means to substantially decarbonize internal combustion vehicles ("ICVs") and long-haul jets, and the drop-in nature of

eFuels allows harnessing the massive value and capabilities of existing vehicles and liquid fuel infrastructure (e.g. storage and distribution systems).

The underlying logic of utilizing eFuels has been demonstrated by analysis completed by the University of California Institute of Transportation Studies ("ITS") in a report that charted California's likely course to carbon neutrality in the transportation sector. As stated in the Executive Summary, "The purpose of this study is to provide a research-driven analysis of possible policy options that could, if combined, put the state on the pathway to a carbon-neutral transportation system by 2045." [1]

The ITS report's authors deployed an aggressive suite of policies to accelerate and maximize the speed and scale of the transportation electrification to create the scenario for their analysis. Nonetheless, the Driving California's Transportation Emissions to Zero report concluded that a significant number of ICVs will remain on the road beyond 2035 and even beyond 2045 and these vehicles will require a substantial continued supply of liquid fuels. The ITS report recognized the resiliency of ICVs in terms of vehicle life and reached the conclusion that while total energy demand for transportation would drop substantially due to the efficiency of electric vehicles, ***almost half of all transportation energy demand in California would still be met by liquid fuels in 2045 as is reflected by the following figure from the ITS report***.[2] Importantly, the methodology of the ITS report limited the demand for SAF to fuel uplifted for intrastate flights in California only,[3] thus the report's fuel demand forecast did not account for approximately 90% of aviation fuel demand in California.

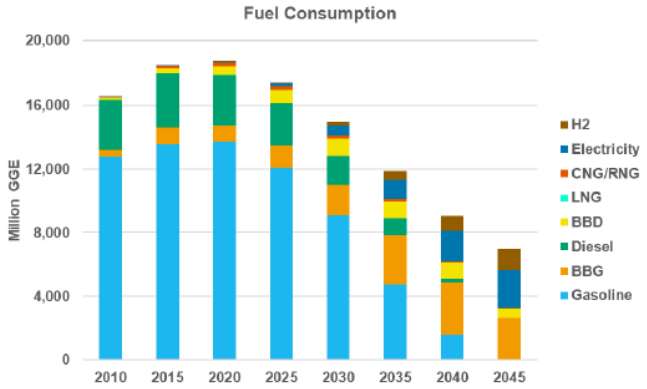


Figure EX-2. CO_2 emissions and fuel consumption projections in the LC1 scenario. The near-zero CO_2 emissions target is reached by 2045, with nearly all fossil fuels replaced by electricity, hydrogen, and biofuels at that date. (MMT, million metric tonnes; SAF, sustainable aviation fuel; H2, hydrogen; CNG/RNG, compressed natural gas/renewable natural gas; LNG, liquefied natural gas; BBD, bio-based diesel, including biodiesel and renewable diesel; BBG, bio-based gasoline, including ethanol blends and drop-in gasoline replacement fuels)

Driving California's Transportation Emissions to Zero

[1] See Institute of Transportation Studies, "Driving California's Transportation Emissions to Zero," (April 2021), available at https://escholarship.org/uc/item/3np3p2t0 , Executive Summary at p. 1, and Figure EX-2.
[2] Id.
[3] Id. at p. 395.

A close review of the ITS fuel forecasts for 2045 highlights the critical importance of low carbon liquid fuels to California's goal of achieving carbon neutrality:

- With reference to BBG (Bio-based Gasoline), ITS projected that the demand for this type of fuel would approximately double between 2025 and 2045 from 1.2 BGY to 2.4 BGY (in GGE, Gasoline Gallon Equivalent).
    - It is important to note that in the current market, ethanol is the only commercialized Bio-based gasoline and is restricted to a maximum blend level of 10%. Flex fuel vehicles can utilize blends of up to 85% but represent a small portion of the ICV fleet.
    - Thus, unless a drop-in Bio-gasoline is commercialized or eFuel is utilized, fossil-based gasoline would be the only fuel option and preclude achievement of California's carbon neutrality goal.
- With reference to BBD (Bio-based Diesel), the ITS report projects demand for this type of fuel will decline from approximately 930 MGY to 625 MGY (GGE).
    - However, as previously noted, the ITS report only evaluated demand for intrastate jet fuel in its analysis. If aviation fuel for interstate and international fuel is included, the demand for BBD in 2045 would increase to approximately 4.6 BGY or continued fossil jet fuel usage would be necessary to enable air travel.
    - Thus, if California considered all jet fuel uplifted in the State, it would be necessary to expand bio-based diesel usage by a factor of over 7x, a strategy that the ITS report deemed infeasible due to biomass feedstock supply constraints. eFuels will have a significant role in filling this void, given concerns regarding feedstock supply.

The European Union has Integrated eFuels into their Climate Policies

Consistent with the ITS analysis, the European Union ("EU") has determined eFuels to be an essential solution in the transport sector toward achieving the Union's carbon neutrality goals.

The EU RefuelEU Aviation program mandates steadily increasing blends of SAF for flights originating and departing in the EU with a sub-mandate for eFuels of 35% by 2045, as depicted in this chart.[4] In the road sector, under the Renewable Energy Directive ("RED"), eFuels must be blended to a minimum of 1% by 2030, with member countries planning to adopt higher quotas of up to 5.5%. In the marine sector, under the FuelEU Maritime program, eFuels are expected to play an outsized role in meeting the sector decarbonization mandate of 80% reduction in GHG emissions by 2050.

[4] See TOPSOE, "The Outlook for SAF," Timeline 3: The Course of Legislation, available at "https://www.topsoe.com/sustainable-aviation-fuel/saf-outlook".

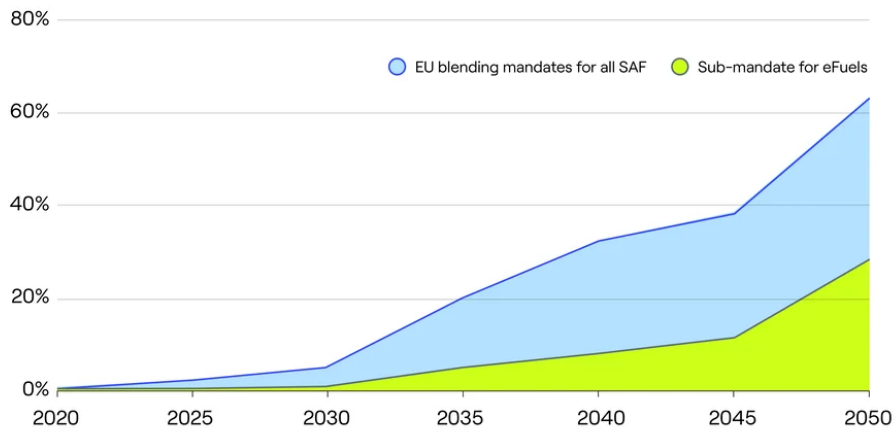


Chart: EU blending mandates for all SAF and sub-mandate for eFuels

The International Council on Clean Transportation has Recognized the Importance of eFuels

This past November, The International Council on Clean Transportation ("ICCT") published a white paper assessing the feasibility of meeting the targets in the Biden Administration's SAF Grand Challenge based on "resource availability, production costs, technology readiness level, and policy support."[5] ICCT's white paper emphasized the importance of eSAF in meeting the 2050 SAF Grand Challenge goal of 35 billion gallons, as follows:

> *We find that the near-term 2030 production target can be met with sustainable resources, but the 2050 target will be far more challenging to reach. In the longer-term, biomass volumes will need to be supplemented with a combination of other fuel sources or fuel burn reduction to meet the energy needs of the entire U.S. aviation sector. . . .*
>
> *E-fuels, or synthetic aviation fuels produced from renewable electricity, could help to bridge the supply gap in later years. . . .Though the technology remains in the demonstration phase, e-fuels have gained significant interest in Europe and other markets due to their 'drop-in' advantages and theoretically unlimited supply. For example, the EU has adopted an e-fuel mandate of 1.2% of aviation fuel, averaged over 2030 and 2031, and 5% of aviation fuel volumes by 2035 (European Commission, 2023). These e-fuels are estimated to be costlier than most biomass-derived SAFs in the near-future, but their costs could rapidly come down as electrolyzer technology*

[5] O'Malley, J., Pavlenko, N., & Kim, Y.H. (2023). Meeting the SAF Grand Challenge: Current and Future Measures to Increase U.S. Sustainable Aviation Fuel Production Capacity. International Council on Clean Transportation. Available at https://theicct.org/wp-content/uploads/2023/11/ID-37-%E2%80%93-SAF-Grand-Challenge-white-paper-letter-40036-v3.pdf.

> *matures and the cost of renewable electricity declines (Zhou et al., 2022). . . . With the use of policy incentives, including the IRA's 10-year production tax credits for hydrogen and carbon capture, utilization, and storage (CCUS), e-fuels will likely become cost-competitive within a much shorter timeframe.*[6]

Low-CI Power Sourcing is Essential to the Success of eFuels

As noted by ICCT, eFuels are costlier than most biomass-derived SAF currently and in the near future. However, there is an opportunity to reduce the cost of eFuels as electrolyzer technology matures and the cost of renewable electricity further declines. Success in driving down the cost of both wind and solar power has been an enormous success story that has been led in the US by California policy. Similarly, California's 2022 Scoping Plan contained ambitious goals to expand supply and demand for hydrogen while driving down prices.

eFuels are uniquely well-situated to benefit from further reductions in the cost of renewable power and electrolyzers but the tremendous potential of this industry's growth will be stunted by the policy change in the Proposed Structure. Under §95488.8(i)(1)(A)-(B) of the existing LCFS Regulation, book-and-claim accounting is authorized for Low-CI Electricity supplied as a transportation fuel or to produce hydrogen through electrolysis if that hydrogen is used either as a transportation fuel or in the production of another transportation fuel (e.g., SAF). Through these provisions, eFuel production facilities are explicitly authorized to source Low-CI Electricity from the grid to produce hydrogen that is used in the production of eFuels. Under these existing LCFS provisions, Low-CI electricity can be sourced flexibly through the use of Renewable Energy Certificates ("RECs") or via a qualifying Green Tariff program.

The proposed LCFS regulatory revisions that CARB released on December 22, 2023, would dramatically narrow the power-sourcing landscape for eFuel producers. The proposed amendments would revoke the current authorization to source Low-CI Electricity for electrolysis through the REC mechanism. To source Low-CI Electricity, the proposed regulations would instead require an eFuel facility to construct a wind, solar or other renewable generation project and directly connect that power generation source behind the utility meter to the eFuel facility, which is typically impractical and infeasible. CARB's regulatory proposal will severely inhibit the growth of a liquid fuel technology that holds great promise for scaling and, as noted above, is not dependent upon biomass feedstocks. By changing its policy this significantly with no notice to the industry or delayed phase-in, CARB will also undermine investor confidence in the continuity of its policy structure and thereby deter investment in ***all clean fuel facilities and technologies***, including game-changing fuels like eFuels.

Book-and-Claim Power Sourcing Recommendation

Due to the importance of Low-CI Electricity to the production of eFuels, and the importance of eFuels to meeting both California's 2045 carbon neutrality goal and California's specific goals to displace fossil jet fuel with SAF, we respectfully recommend that CARB modify

[6] *Id.* at 21.

the proposed LCFS amendments such that eFuel production facilities are authorized to procure Low-CI Electricity for electrolytic hydrogen production and their other energy needs via book-and-claim accounting.

Under existing LCFS provision §95488.8(i)(1)(A)-(B), Low-CI electricity supplied as a transportation fuel, e.g., used to power BEVs, can be sourced flexibly through the use of RECs or via a qualifying Green Tariff program. Under these provisions, it is also required that the electricity be supplied to the grid within the same balancing authority as where the EVs are charged or in compliance with CPUC §399.16, that all environmental attributes be retired with limited exceptions, and that the RECs be used within three quarters of when the RECs were generated.

As is currently the case for electrolytic hydrogen that can utilize RECs to obtain Low-CI power, CARB should restore and authorize this same power sourcing structure for eFuels that meets the requirements established by §95488.8(i)(1)(A)-(B). See Exhibit A for illustrative regulatory language that is aligned with this comment's recommendations.

Infinium also requests that the proposed definition for Alternative Fuel be revised to include the range of eFuel types including eDiesel, and eNaphtha / eGasoline. As drafted, the definition for Alternative Fuel includes fuels that are not CaRFG and 'diesel fuel'. However, for example, diesel fuel, as defined under California Code of Regulations, title 13, section 2281(b), includes any fuel that is commonly or commercially know, sold or represented as diesel fuel. As a result, any drop-in non-petroleum alternative such as eDiesel could be classified as 'diesel fuel' under this broad definition. See Exhibit A for illustrative regulatory language that is aligned with this comment's recommendations.

Infinium's Pipeline Recommendations

Hydrogen: Infinium supports CARB's proposal to provide a 'book-and-claim' accounting approach for low-CI hydrogen. To meet California's GHG reduction targets and support the eFuel industry, it is essential to utilize book-and-claim to preserve the CI attribute of hydrogen that is transported in multi-source/multi-use distribution systems, where Low-CI hydrogen is comingled with conventionally produced hydrogen. A robust book-and-claim system for hydrogen will ensure that the low-carbon attributes of the hydrogen are retained and applied to end-uses where the most environmental benefit can be derived. This sends the necessary long-term signal for low-CI hydrogen to play a meaningful role in decarbonizing transportation.

One key improvement to the LCFS proposal that Infinium supports is to eliminate the requirement that eligible hydrogen must be supplied to California in a dedicated pipeline as proposed in §95488.8(i)(3)(A). This requirement places an unnecessary constraint on a nascent market and will stifle investments at a time when massive capital outlays are needed to bring low-carbon hydrogen to scale. There are no dedicated interstate hydrogen pipelines to California. This requirement therefore favors only in-state hydrogen pipelines and fails to recognize the value of using hydrogen as a feedstock to produce eFuels out of state and imported for use in California. Section 95488.8(i)(3) specifically indicates the intention that the low-CI hydrogen book-and-claim approach should be applied to hydrogen used in "Alternative Fuel Production", but this proposed

eligibility requirement precludes alternative fuel facilities out of state from realizing these benefits. We anticipate that eFuel production facilities will be located in fuel producing regions across North America, be connected to regional hydrogen pipelines, and must necessarily lower their CI by utilizing low-CI hydrogen. We urge CARB to adopt a wider worldview that acknowledges the need for a multi-jurisdictional supply chain for low-CI hydrogen.

We specifically request that CARB modify §95488.8(i)(3)(A) as follows:

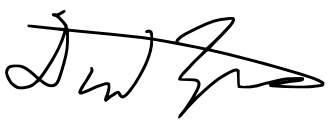
> Low-CI hydrogen is injected into a dedicated hydrogen pipeline physically connected to ~~California~~ a distribution system or a production facility that provides transportation fuel to California.

Carbon Dioxide: Infinium recommends that book-and-claim be similarly established for carbon dioxide transported by pipeline with the following proposed regulation:

> *Book-and-Claim Accounting for Pipeline-Injected carbon dioxide Used in Alternative Fuel Production.* Indirect accounting may be used for carbon dioxide used to produce alternative fuel for transportation purposes provided the conditions set forth below are met:
>
> (i) Carbon dioxide is injected into a dedicated carbon dioxide pipeline physically connected to a production facility that provides alternative fuel to California
>
> (ii) To substantiate carbon dioxide quantities injected into the pipeline as an input to alternative fuel production, the pathway application and subsequent Annual Fuel Pathway Reports must include the following documents linking the environmental attributes of carbon dioxide in kg with corresponding quantities of carbon dioxide in kg withdrawn from the pipeline: monthly invoices showing the quantities of carbon dioxide (in kg) sourced and the unredacted contract by which the fuel pathway holder obtained the environmental attributes.

Thank you for the opportunity to provide comments. Should you have any questions or would like additional information, please feel free to contact me at dzaziski@InfiniumCo.com.

With kind regards,



David Zaziski, Ph.D.
Vice President, Policy & Government Affairs

The following proposed regulatory text is provided for illustrative purposes with deleted text as compared to the Proposed Regulations indicated by ~~strike-outs~~ and inserted text indicated by underlining.

§ 95481. Definitions and Acronyms.

(…)

"Alternative Fuel" means any transportation fuel that is not fossil CaRFG, fossil diesel fuel, or fossil jet fuel including those fuels specified in section 95482(a)(3) through (a)(13).

(…)

"PtL Fuel" means a synthetic hydrocarbon fuel that is produced from water, captured CO_2 and electricity, and that can replace or be blended into CARBOB, CaRFG, diesel fuel or jet fuel.

(…)

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

(…)

(i) Indirect Accounting for Low-CI Electricity, Biomethane, PtL Fuel and Low-CI Hydrogen.

(1) *Book-and-Claim Accounting for Low-CI Electricity Supplied as a Transportation Fuel, Direct Air Capture projects, or Used to Produce PtL Fuel or Hydrogen.* Reporting entities may use indirect accounting mechanisms for low-CI electricity supplied as a transportation fuel, for PtL Fuel supplied as a transportation fuel, for hydrogen production and processing for transportation purposes (including hydrogen that is used in the production of a transportation fuel), or for direct air capture projects, provided the conditions set forth below are met:

(A) For electricity used as a transportation fuel, for PtL Fuel production, or as an input to hydrogen production delivered through the grid without regard to physical traceability if it meets all requirements of this subarticle. The low-CI electricity must be supplied to the grid within a California Balancing Authority (or local balancing authority for PtL Fuel or hydrogen 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 low-CI electricity may span only three quarters. If a 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 PtL Fuel production no later than the end of the third calendar quarter. After that period is over, any unmatched low-CI electricity quantities expire for the purpose of LCFS reporting.

(B) Low-CI electricity used as a transportation fuel or used for hydrogen or PtL Fuel production for transportation purposes 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 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 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 PtL Fuel production for transportation purposes 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 not issued credits or claimed under any other voluntary or mandatory 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.

(C) For direct air capture projects ~~or for hydrogen used as a transportation fuel~~, low-CI electricity must meet the following criteria:

1. The low-CI electricity must be supplied to the grid within the local balancing authority where the electricity is consumed or delivered to that local balancing authority without substitution consistent with the requirements of California Public Utilities Code section 399.16, subdivision (b)(1).

2. The pathway holder or the project operator must be the first contracted entity for procuring the low-CI electricity.

3. Low-CI electricity must be supplied by new or expanded low-CI electricity that begins new or expanded production on or after January 1, 2022, or within three years of the start of the hydrogen production facility or direct air capture project, whichever is later.

4. Such book-and-claim accounting for low-CI electricity may span only one quarter. If a 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 in the same calendar quarter. After that period is over, any unmatched low-CI electricity quantities expire for the purposes of LCFS reporting.

5. Any renewable energy certificates or other environmental attributes associated with the energy are not issued credits or claimed produced, or are retired and not claimed under any other voluntary or mandatory program with the exception of the federal RFS, incentives under the Infrastructure Investments and Jobs Act or the Inflation Reduction Act, 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).

(…)