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February 20, 2024

The Honorable Liane Randolph
Chair
California Air Resources Board
1001 I Street
Sacramento, CA 95814
(Comments submitted electronically)

Dear Chair Randolph,

We appreciate the opportunity to comment on the Proposed Low Carbon Fuel Standard (LCFS) Amendments.

Raízen is a company created from an independent Joint Venture with shared control between Shell and Cosan, which operates in the production and sale of sugar, bioenergy and bioeletricity. We have a fully integrated process that involves everything from the cultivation of the sugarcane to the production of sugar and ethanol and the logistics of distribution and marketing of these products. We are currently the largest sugarcane-ethanol producer globally, and a unique holder of second-generation ethanol technology operating in a commercial scale.

We would like to start our comments by recognizing CARB's technical staff's diligent work and willingness to engage with stakeholders in the process of updating the LCFS regulations through this rulemaking.

We continuously seek to manage and improve the carbon footprint of our products by diversifying our renewable energy portfolio, with the objective of delivering decarbonization solutions to the market. We increasingly invest to support the mitigation of climate change and the global energy transition. Markets that aim to decarbonize the transportation sector and have a premium policy related to biofuels, such as LCFS / CARB (Low Carbon Fuel Standard / California Air Resources Board), are naturally of interest to Raízen for the commercialization of our biofuels. We pride ourselves for being a committed stakeholder to CARB's LCFS program for a long time and for always offering reliable and trustworthy data on the ethanol sector in Brazil. Raízen has also supplied a significant amount of ethanol to California in recent years.

While acknowledging the advancements that the draft proposal brings, we would like to highlight some points we believe may improve the proposed amendments to the LCFS program.

1. **Comments on Sustainability Requirements for Crop-Based Feedstocks (Section 95488.9 (g), Appendix A-1.1)**

We understand the pivotal role sustainability certifications play in assuring a fair-trade system combined with sustainable development. Raízen, for instance, has its plants certified by certification schemes, such as Bonsucro and ISCC. Recently, we were the first ethanol producer in the world to be certified with the ISCC CORSIA Plus certification.

In addition to certifications, geographic traceability is maintained for the sugarcane we process, whether sourced from our own operations or from third-party suppliers. This entails the possession of shapefiles delineating the locations of the farms and plots from which we procure or cultivate sugarcane. Our differentiated management of the supply chain enables us to ensure the geographic traceability of our raw materials under the highest sustainability standards in production.

Based on our experience complying with and promoting sustainable practices, we regard such certifications (RSB, ISCC and Bonsucro) as internationally recognized in this field. Not to mention Renovabio, in Brazil. We would therefore encourage CARB to carefully consider these established certification schemes and taking steps to recognize and align with these respected approaches thus avoiding duplication of efforts and placing additional burdens on companies that intend to have trade flows with the state of California and would need to abide by LCFS' sustainability criteria.

Finally, for tracking crop-based feedstock in the supply chain, Raízen strongly recommends the mass-balance approach, a system widely recognized by sustainability certification schemes. The mass balance approach is widely utilized due to its simplicity, particularly within value chains that involve multiple suppliers. In the mass balance tracking model, materials, or products with a set of specified characteristics are mixed according to defined criteria with materials or products without that set of characteristics. Acknowledging the relevance of international reliable certification schemes, the mass balance approach would require fewer resources for biofuel producers, CARB staff and certification bodies. It also ensures transparency through clear documentation. This approach provides feedstock buyers with greater certainty about the sustainability criteria.

2. **Comments on Tier 1 for Second-Generation Ethanol (E2G)**

Raízen is the unique holder of second-generation ethanol technology operating at a commercial scale. We have one E2G plant operating since 2018 (Costa Pinto) producing at full capacity (~7,925.161,6 gallons/year), as well one recently delivered new plant under construction and 8 more to be constructed soon. It is important to highlight that the E2G production is entirely bagasse-based, tackling climate change with a less carbon intense fuel compared to conventional biofuels, and bringing disruptive technology, as well providing good local jobs and economic growth.

Looking at this expansion plan and benefits of the second-generation ethanol, Raízen's E2G production will significantly increase during the coming years. **Therefore, we strongly advocate for CARB staff to incorporate the second-generation ethanol pathway into Tier 1.** Recognizing the hurdles in integrating new pathways, we stand ready to support CARB staff by providing valuable operational data.

3. Comments on Backhaul Energy Intensity (Section II-C, Appendix B)

Raízen echoes Shell's assertion that **the addition of backhaul energy intensity to ocean tankers for Brazilian sugarcane is not a universally applicable condition**. This situation does not apply to ethanol transported from Brazil to the US. Raízen can provide evidence of its trading logistics, as it has done in the past, and is pleased to collaborate with CARB staff again to offer further information.

4. Comments on Tier 1 CI Calculator

Firstly, we want to acknowledge CARB's technical staff for their continued efforts and willingness to collaborate with us in the ongoing process of updating the calculator for sugarcane ethanol. However, CARB is faced with a significant responsibility, one that will influence transportation policy for years to come, not only in the US but also in other jurisdictions across the United States and internationally. We are eager to continue contributing to this endeavor.
As we discussed last year during the amendment process of the Draft Tier 1 Calculator, we would like to reiterate some of our comments regarding the assumptions incorporated in the Tier 1 CI Calculator. **Recognizing the potential challenges faced by CARB staff in reviewing Tier 2 applications, we respectfully propose the integration of the following requests into the Tier 1 calculator**. This strategic enhancement aims to optimize efficiency and mitigate administrative burdens associated with Tier 2 evaluations, aligning with our commitment to facilitating smoother processes within regulatory frameworks.

a. N_2O emissions from applied N

The emission factor for direct N_2O emissions from nitrogen inputs, as previously outlined in CA-GREET 3.0, stood at 0.01 kg-N_2O-N/kg N-fert applied to soils, as sourced from the IPCC (2006). In the current version of the CA-GREET 4.0, this figure has been revised to 0.00895 kg-N_2O-N/kg N-fert based on Wang et. al (2012). But no updated was included in the Tier 1 CI Calculator. Raízen acknowledges the efforts of CARB staff in updating this value in CA-GREET 4.0.

Despite this updated science evidence, it is worth noting that this adjustment may still not accurately reflect the Brazilian reality, and **the IPCC generally recommends prioritizing regional data whenever available.**

Carvalho et al. (2021)[1], in a recent publication, conducted a comprehensive study based on 14 relevant publications reflecting current nitrogen fertilization practices in South-Central Brazil's sugarcane industry. Their research is grounded in data gathered from field studies conducted across 17 experimental sites. Importantly, they meticulously accounted for background emissions of N_2O EF, incorporating over 86 reported values. Notably, the study encompasses N_2O EFs derived from sugarcane cultivated under green mechanized harvesting, which dominates over 95% of the sugarcane cultivation area in the South-Central region of Brazil.

Carvalho et al. (2021) found the average N_2O–N EF of 0.006 kg N2O-N/kg N applied, considering all N fertilizer sources, for the sugarcane ratoon, which receives most of the N application of the sugarcane areas, and represents 80% of the sugarcane cycle and 89% of the total amount of N fertilizer consumed considering the entire sugarcane mill. **The EF value recommended by Carvalho is 33% lower than the value proposed by Wang et at. (2012).** The value identified by Carvalho is justified by good drainage properties of the deep Oxisols soils, where sugarcane is commonly cultivated in Brazil.

Hence, the review of in situ N_2O–N EF measurements from sugarcane in Brazil indicates values below the default currently proposed in the CA-GREET 4.0, and notably lower than those observed in many sugarcane areas in other regions worldwide. IPCC (2019) values, used in the current Tier 1 CI Calculator, were primarily derived from studies in Europe (34%), North America (28%), and Asia (19%), with Central-South America contributing with only 6−7% to the dataset. Therefore, does not represent the sugarcane reality in the region.

Raízen strongly recommends that CARB staff consider using the value of 0.006 kg-N_2O-N/kg N-fert for both CA-GREET 4.0 and Tier 1 CI Calculator, reflecting the specific conditions in South-Central Brazil's sugarcane production areas.

b. Unburned Mechanized Harvesting

Mechanized harvesting, which involves unburned methods, dominates the sugarcane harvesting landscape in Brazil's Center-South region, representing more than 95% of the total yield. This assertion is substantiated by both official governmental data[2] and primary data meticulously collected and

[1] *Carvalho, J. L. N.; Oliveira, B. G.; Cantarella, H.; Chagas, M. F.; Gonzaga, L. C.; Lourenço, K. S.; Bordonal, R. O.; Bonomi, A. Implications of regional N2O–N emission factors on sugarcane ethanol emissions and granted decarbonization certificates. Renewable and Sustainable Energy Reviews, 149 (2021), 111423. https://doi.org/10.1016/j.rser.2021.111423*

[2] Safra cana-de-açúcar, Center-South region: https://unicadata.com.br/listagem.php?idMn=4

audited by Renovabio in 2018 and 2019. Renovabio's findings further affirm the correlation between mechanized harvesting practices and the adoption of unburned methods. However, despite this evidence, the default values in the Tier 1 CI Calculator for sugarcane ethanol indicate a mechanization rate of just 80% in São Paulo state and 65% in other states, including the Center-South region.

As per CARB's request, an analysis utilizing remote sensing data was conducted employing the Mapbiomas-Fire[3] and UNICA's sugarcane area vectors. Data were processed in the Qgis software. For each sugarcane polygon, the percentage of intersection with the polygon of burned area from Mapbiomas-Fire was estimated. After the geospatial statistics calculations, the results were added to the attribute table of the vector, and state-level statistics were computed. Consequently, the total sugarcane area for 2020 was assessed at 10,280,528.7 hectares, of which 82,847.10 hectares were subjected to burning practices, accounting for less than 1% of the sugarcane area (**Figure 1**).

Considering the significant influence of this input on the calculator and the industry's substantial efforts to reduce emissions through modern harvesting techniques**, Raízen asks CARB staff to carefully review this information**. The implications of CARB's policies extend beyond California, impacting the wider country and the world. It's crucial that CARB's assumptions regarding mechanized harvesting accurately reflect Brazil's sugarcane production patterns, translating into improved carbon intensity for Brazilian ethanol.

We respectfully urge CARB to consider implementing an option for individual mechanization percentage, supported by evidence, within the Tier 1 CI calculator. If, for any reason, this is not feasible, we kindly request that the staff adjust the default mechanization values for Center-South Brazil to a value no lower than 95%. By doing so, CARB will align input more closely with actual practices.

[3] MapBiomas. MapBiomas Project - Mapbiomas-Fire Collection 1. 2022. Available at: https://mapbiomas.org/en/colecoes- mapbiomas-1?cama_set_language=en. *The Mapbiomas-Fire product was elaborated from mosaics of Landsat Satellite images, with 30 meters of spatial resolution, covering the years from 1985 to 2020, providing monthly and annual data of the burned areas in Brazil. The burned area estimation was carried out using artificial intelligence from machine learning algorithms in the Google Earth Engine platform. The algorithm was trained with samples of burned and non-burned areas, in addition with the burned area product of MODIS sensors (MCD64A1) and hot spots data from INPE.*

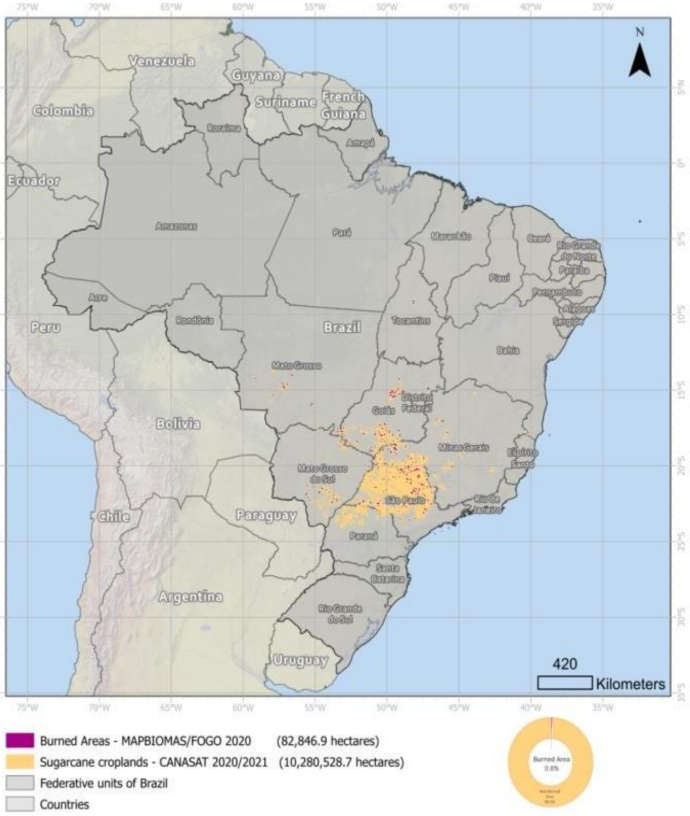


Figure 1. Intersection from the sugarcane area with the burned areas polygons from the MapBiomas-Fire for the center-south region of Brazil. Sources: Mapbiomas-Fire, Canasat.

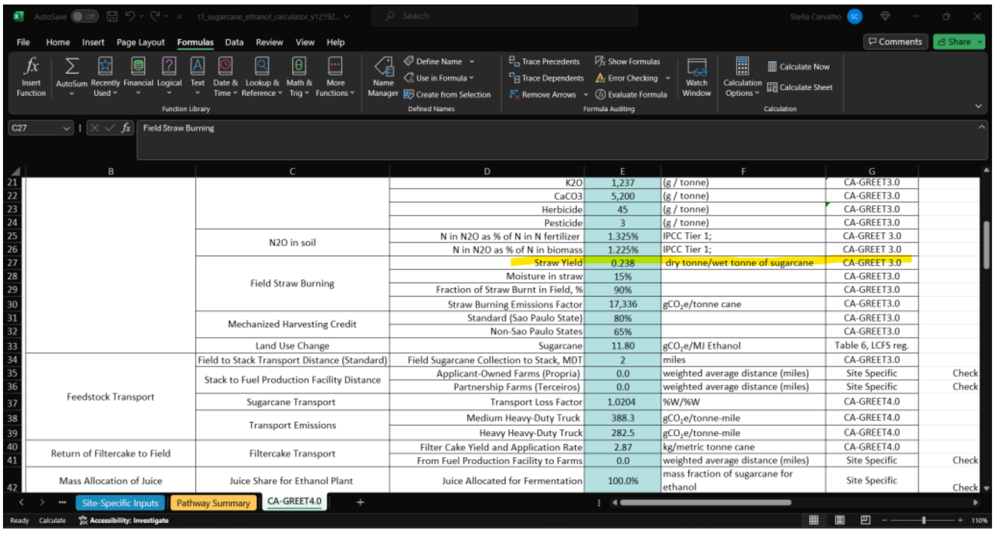
c. Electricity Exported Credits

Sugarcane-based electricity in Brazil serves as a valuable supplement to hydroelectric generation, particularly during the dry season when water resources may be limited. Its contribution helps mitigate the need for natural gas- and coal-based electricity generation, thus promoting a more sustainable energy mix. **Raízen strongly recommends that CARB staff consider electricity export credits by acknowledging the displacement of the margin of the Brazilian electricity grid.** This should be based on sugarcane electricity's contribution to total thermoelectric generation during the dry season in Brazil. This approach allows for the reallocation of energy dispatching primarily during this period, reducing the risk of deficit without worsening water reservoir conditions. Raízen disagrees with CARB's approach, which excludes energy exported in the off-season and fails to consider energy produced by cogeneration from third-party biomass. This can create a "double standard" where the rainy season is used to calculate the national electricity grid average but ignored when CARB excludes export electricity credits generated in the off-season months. Both approaches significantly impact the carbon intensity (CI) value of ethanol mills in Brazil.

For a more detailed exploration of electricity production and dispatch in Brazil, please refer to **Annex A.**

d. Straw Yield

Raízen greatly appreciates CARB staff's consideration in updating the sugarcane straw yield in the CA-GREET 4.0, reducing it from 0.24 t/t cane (dry basis) to 0.14 t/t cane (dry basis). However, **Raízen identified the need to CARB staff also implement this change in the Tier 1 CI Calculator.** As previously explained, this revised value is widely accepted by the academic community and is being utilized in numerous studies, including the latest versions of the Argonne GREET Model. **We therefore strongly ask CARB to reconsider this value in the Tier 1 CI Calculator.**



	B	C	D	E	F	G	
21			K2O	1,237	(g / tonne)	CA-GREET3.0	
22			CaCO3	5,200	(g / tonne)	CA-GREET3.0	
23			Herbicide	45	(g / tonne)	CA-GREET3.0	
24			Pesticide	3	(g / tonne)	CA-GREET3.0	
25		N2O in soil	N in N2O as % of N in N fertilizer	1.325%	IPCC Tier 1;	CA-GREET 3.0	
26			N in N2O as % of N in biomass	1.225%	IPCC Tier 1;	CA-GREET 3.0	
27		Field Straw Burning	Straw Yield	0.238	dry tonne/wet tonne of sugarcane	CA-GREET 3.0	
28			Moisture in straw	15%		CA-GREET3.0	
29			Fraction of Straw Burnt in Field, %	90%		CA-GREET3.0	
30			Straw Burning Emissions Factor	17,336	gCO_2e/tonne cane	CA-GREET3.0	
31		Mechanized Harvesting Credit	Standard (Sao Paulo State)	80%		CA-GREET3.0	
32			Non-Sao Paulo States	65%		CA-GREET3.0	
33		Land Use Change	Sugarcane	11.80	gCO_2e/MJ Ethanol	Table 6, LCFS reg.	
34	Feedstock Transport	Field to Stack Transport Distance (Standard)	Field Sugarcane Collection to Stack, MDT	2	miles	CA-GREET3.0	
35		Stack to Fuel Production Facility Distance	Applicant-Owned Farms (Propria)	0.0	weighted average distance (miles)	Site Specific	Check
36			Partnership Farms (Terceiros)	0.0	weighted average distance (miles)	Site Specific	Check
37		Sugarcane Transport	Transport Loss Factor	1.0204	%W/%W	CA-GREET4.0	
38		Transport Emissions	Medium Heavy-Duty Truck	388.3	gCO_2e/tonne-mile	CA-GREET4.0	
39			Heavy Heavy-Duty Truck	282.5	gCO_2e/tonne-mile	CA-GREET4.0	
40	Return of Filtercake to Field	Filtercake Transport	Filter Cake Yield and Application Rate	2.87	kg/metric tonne cane	CA-GREET4.0	
41			From Fuel Production Facility to Farms	0.0	weighted average distance (miles)	Site Specific	Check
42	Mass Allocation of Juice	Juice Share for Ethanol Plant	Juice Allocated for Fermentation	100.0%	mass fraction of sugarcane for ethanol	Site Specific	Check

Figure 2. Current assumption for straw yield in the Tier 1 CI Calculator for sugarcane ethanol.

In conclusion, Raízen appreciates the opportunity to contribute with the LCFS rulemaking process and with CARB staff. Once again, we would like to put ourselves available for technical discussions with the high qualified CARB staff. We look forward to continuing the ongoing dialogue and collaboration staff to move forward with these discussions that we are certain will contribute to lowering emissions in the California transport sector.

Sincerely,

Raízen

Annex A. The Brazilian Electrical System

The Brazilian Electrical System (National Interconnected System - SIN) is 99% interlinked[4], so virtually all the production and transmission of electricity in Brazil happens in one main grid closely monitored by the National Electric System Operator (ONS), a federal agency responsible for coordinating and controlling operation of the electricity generation and transmission facilities in the SIN under the supervision and regulation of the National Electric Energy Agency (ANEEL). This unique system adopted by the country creates certainty as to what sources contribute to the marginal generation of power. Sugarcane biomass-based electricity in Brazil receives a fixed income to deliver a "package" of energy per year to the grid. Sugarcane biomass receives this fixed income for the energy it produces and declares its Unit Variable Cost (UVC) equal to zero, since cogeneration of sugarcane biomass electricity occurs in order to meet the demand of the sugar and ethanol industry. Wind and solar sources also have a UVC equal to zero. In this way, all the electrical energy these sources produce is made available to the national grid (since the government already paid a fixed income for it).

The procedure varies for thermo-gas sources. In addition to the fixed income they receive for standby readiness, their UVC exceeds zero. This implies that whenever the ONS deploys them, they are compensated for both their fuel expenses and operational costs. In fact, since sugarcane biomass is classified with a unit variable cost equal to zero, the ONS adopts the so-called merit order,where thermal plants from lower to higher operating costs are dispatched in order to meet demand. The ones with lower UVC are the first to be called to meet domestic demand. Since biomass plants have unit variable cost equal to zero, when available (during the sugarcane harvest season), they are the first to be dispatched to the system, without the need for an order from the ONS. Differently from sources like coal, diesel, and natural gas, the generation of energy from sugarcane biomass sources is controlled and dictated by the industrial process itself instead of by order of the national operator.

[4] https://www.ons.org.br/paginas/sobre-o-sin/sistemas-isolados