Fueling Sustainability

ENERGIA QUE ABASTECE O BEM

May 6, 2024

Liane Randolph
Chair

Steve Cliff
Executive Officer

California Air Resources Board
1001 I ST Sacramento, CA 95814

RE: LCFS California Low Carbon Fuel Standard April 10 Workshop

(Comment submitted electronically via Comment Submittal Form at https://ww2.arb.ca.gov/public-comments/low-carbon-fuel-standard-workshop-april-10-2024)

Dear Chair Randolph and Executive Officer Cliff:

FS Indústria de Biocombustíveis Ltda (FS, Fueling Sustainability) appreciates the opportunity to provide comments in response to the Public Workshop to Discuss Potential Future Changes to the Low Carbon Fuel Standard (LCFS) Program.

FS has been actively pursuing a Tier 2 pathway within the LCFS program since (2020). We appreciate the California Air Resources Board's (CARB) role in developing and implementing the vitally important LCFS program. We are submitting these comments to share our perspective with CARB that the treatment of second-crop corn grown in Brazil as fungible with first-crop corn grown in the United States is not an accurate equivalency from a carbon intensity (CI) perspective. We acknowledge that administering the program is resource-intensive and time-consuming and that requesting that CARB evaluate and potentially recognize foreign-grown corn as having a lower CI than domestic corn presents CARB with a multi-faceted challenge.

However, we think that the new concepts and regulatory provisions that CARB introduced in the April 10th workshop will enable CARB to adopt a more granular and accurate approach to assessing the CI of feedstocks grown in different regions and using different methods. In particular, we reference slide 64, entitled "Land-Use Change Values Under Staff Evaluation, to support our position that "corn is not simply corn." Instead, corn may be systematically grown in more sustainable and less carbon-intensive ways depending on the region. Notably, slide 64 states, "Staff is looking into a mechanism to assign higher LUC values than Table 6 to high-risk crop-based feedstocks entering the LCFS as part of the pathway process." We understand CARB's rationale for this approach but respectfully submit that this analysis should not be used only to disincentivize high risk feedstocks. Instead, staff should also evaluate a mechanism to assign lower land use change ("LUC") values than Table 6 to low-risk crop-based feedstocks entering the LCFS as part of the pathway process. The remainder of this comment examines the low-risk nature of second-crop Brazilian corn as well as other subjects pertaining to

opportunities to recognize CI reductions that meet the scientific defensibility standard embedded in the LCFS pathway process.

FS, Fueling Sustainability

FS is the first Brazilian company to produce ethanol, animal nutrition products, and corn oil exclusively from second-crop corn. FS uses energy cogeneration from biomass to meet its own energy needs and to generate surplus electricity sold to the Brazilian electrical grid. We have developed a new low-carbon value chain that encompasses low-carbon intensity (Low-CI) second-crop corn, incentivizes sustainable forest cultivation, enables the production and sale of high-quality animal nutrition and ethanol products, and generates bioenergy and steam.

FS has an integrated food and energy production system, a business model that uses second-crop corn as raw material. This strategy results in better use of available agricultural resources, increased yield per acre, reduced need for expansion of cultivated land, better sustainability and greater reduction of greenhouse gas (GHG) emissions.

Aligned with CARB's objectives highlighted in the LCFS Workshop held on April 10th, 2024, FS produces extremely Low-CI ethanol and is focused on developing and implementing technical innovations that can contribute to and be recognized in the LCFS program.

Summary of Issues

Brazilian corn ethanol faces a significant challenge under the LCFS program due to the absence of a regional default value grounded on regional performance. The available global default value for corn does not reflect the specific low-risk and Low-CI characteristics of Brazil's second-crop corn. We take this opportunity to request CARB's attention to the study and recognition of Brazilian farming practices, yields of double-cropped soy and corn per acre, the role of renewable biomass, the nature of second-crop corn and other factors that establish second crop Brazilian corn as a low-CI and low-ILUC feedstock and support Low-CI values for Brazilian Second Crop Ethanol**.** The main factors are highlighted below.

I. Renewable and sustainable biomass serves as a process fuel.
II. Improved agricultural practices and soybean-corn multi-cropping systems reduce the risk of LUC.
III. Brazil has soybean land available that can be used to expand the production of second-crop corn, without requiring additional land.
IV. Other jurisdictions with rigorous oversight programs have determined zero ILUC value for other multi-crops under specific conditions.
V. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) has determined zero or negative ILUC values for secondary (oilseed) crops and a zero ILUC value for sequential cropping in general (which includes 2nd crop corn).
VI. A negative ILUC for Brazilian corn ethanol is documented in scientific literature.
VII. Multi-cropping corn has a low land-use change risk and should be considered under the LCFS/CARB framework.
VIII. Brazilian corn ethanol is classified as a Low LUC risk by the ISCC/CORSIA.
IX. Recommendations RE: CARB's 2028 Sustainability Certification Program

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I. CARB should consider the use of renewable biomass as process fuel.

As an important component of this LCFS rulemaking, FS would like to advocate for the consideration of beneficially using renewable biomass as process fuel. This includes the use of renewable biomass for thermal and electric energy. Renewable biomass provides thermal and electrical energy for the industry, without any fossil fuel usage in the production process. This is highly beneficial to produce low-carbon fuel as the approach reduces processing GHG emissions due to the biogenic nature of the carbon burned in the energy-generating boilers.

While other corn ethanol producers use fossil natural gas or even coal, utilizes renewable biomass (such as planted eucalyptus and other energy crops) or wood residues for process energy. CARB's recognition of the benefits of utilizing renewable biomass to generate process energy as part of a low-CI ethanol production process is extremely important and will recognize low carbon energy inputs and motivate other market participants to move away from fossil sources.

Given that agricultural residues are treated as carbon neutral, qualifying wood residues should be treated similarly. The woody biomass that is cultivated for energy purposes is recognized by the IPCC[1] as neutral because the carbon that is released during combustion has previously been sequestered from the atmosphere in the growing process. We must emphasize that the biomass sources used by FS are fast-growing species. The global decarbonization plan recently published by IEA emphasizes that biomass necessarily plays an important role in the energy transition.[2] This IEA finding highlights the importance of CARB analyzing the various types of biomasses as process energy for LCFS pathways and determining the parameters of qualifying Low-CI renewable biomass.

II. Improved agricultural practices and soybean-corn multi-cropping systems reduce the risk of LUC.

The cultivation of second-crop corn is a technique that involves planting a second crop of corn during an additional cultivation window in the same agricultural year. In this method, soybeans and corn are planted in a direct planting system, without plowing or harrowing the soil. This contributes to a yield increase, as reported by MAGALHÃES et al. (2020). The combination of these practices significantly reduces the risk of land-use change, allowing farmers to produce more food and biofuels in the same area without needing to expand cultivated areas. In the state of Mato Grosso, where most of the corn ethanol industries are located, almost all the corn, around 99%, originates from second-crop cultivation (CONAB, 2024)[3]. This crop is planted after and in the same area as soybeans. Soybeans are grown in the summer, from September to December/January, and corn is sown directly after and on soybean residues between January and February, both in direct planting.

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[1] 2006, IPCC Guidelines for National Greenhouse Gas Inventories (Section 1.2 of Volume 1).

[2] IEA Net Zero by 2050, A Roadmap for the Global Energy Sector

[3] CONAB (2024). Companhia Nacional de Abastecimento. *Series Históricas das safras*. Available at: < https://www.conab.gov.br/info-agro/safras/serie-historica-das-safras>

Agricultural practices and technologies related to corn production have made significant progress in recent years to increase yield. The advancements in agricultural technology have enabled the implementation of production systems for multiple crops, with emphasis on the system that combines short-cycle soybeans and second-crop corn. These systems offer numerous benefits, including greater production per area, improved soil protection, and optimization of resources in the agricultural production process (EMBRAPA, 2020; MILANEZ *et al.,* 2014; MAGALHÃES *et al.,* 2020; NOVELLI *et al.,* 2023)[4].

Farmers have implemented a more strategic approach to their agriculture practices. This includes direct planting, which is a form of regenerative agriculture (NEWTON *et al.,* 2020; KHANGURA *et al.,* 2023)[5], crop rotation, the use of high-yielding corn varieties adapted to the region (EMBRAPA, 2019[6]; MAGALHÃES *et al.,* 2020) and the development of early soybean varieties adapted for the Cerrado, which was important for the development of the second crop. Precision agriculture has also played a crucial role in this approach, with the implementation of satellite monitoring systems (BOLFE *et al.,* 2020)[7], humidity sensors, and drones. This helps to optimize the use of inputs such as fertilizers and irrigation (EMBRAPA, 2022)[8]. These practices have proven to be effective in maximizing the yield of second-crop corn, promoting more sustainable and efficient production.

Second-crop corn has been a crucial factor in improving land use efficiency in modern agriculture. Studies have shown that even with long-term sequential cultivation, the soybean-corn system can maintain its benefits, particularly regarding soil quality, if good soil

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[4] EMBRAPA (2020). Empresa Brasileira de Pesquisa Agropecuária. Tecnologias de produção de soja. Londrina: Embrapa Soja, 2020. Disponível em: <https://ainfo.cnptia.embrapa.br/digital/bitstream/item/223209/1/SP-17-2020-online-1.pdf>

MAGALHÃES, P. C.; BORGHI, E.; KARAM, D.; PEREIRA FILHO, I. A. V.; RIOS, S. de A.; ABREU, S. l C.; LANDAU, E. C.; GUIMARÃES, L. J. M. PASTINA, M. M; DURÃES, F. O. M. Desenvolvimento do milho segunda safra: fatores genético-fisiológicos, Plataforma de conhecimento e práticas de manejo de cultivo e uso, visando sustentabilidade de produção e produtividade no binômio soja/milho – Sete Lagoas: Embrapa Milho e Sorgo, 2020. ISSN 1518-4277

MILANEZ et al. (2014). Produção de etanol pela integração do milho-safrinha às usinas de cana-de-açúcar: avaliação ambiental, econômica e sugestões de política. Rev. do BNDES, 41, 147-208

NOVELLI et al. (2023). *Diversified crop sequences to reduce soil nitrogen mining in agroecosystems. Agriculture, Ecosystems and Environment.*

[5] NEWTON, P.; CIVITA, N.; FRANKEL-GOLDWATER, L.; BARTEL, K.; JOHNS, C. What is regenerative agriculture? A review of scholar and practitioner definitions based on processes and outcomes. Frontiers in Sustainable Food Systems. 2020.

KHANGURA, R.; FERRIS, D.; WAGG, C.; BOWYER, J. Regenerative Agriculture – A literature review on the practices and mechanisms used to improve soil health. Sustainability. 2023, 15, 2338. https://doi.org/10.3390/su15032338

[6] EMBRAPA (2019). Empresa Brasileira de Pesquisa Agropecuária. Milho - BRS 015 Farináceo Branco - Portal Embrapa. Disponível em: <https://www.embrapa.br/en/busca-de-solucoes-tecnologicas/-/produto-servico/6048/milho---brs-015-farinaceo-branco>

[7] BOLFE, É.L.; JORGE, L.A.d.C.; SANCHES, I.D.; LUCHIARI JÚNIOR, A.; DA COSTA, C.C.; VICTORIA, D.d.C.; INAMASU, R.Y.; GREGO, C.R.; FERREIRA, V.R.; RAMIREZ, A.R. *Precision and Digital Agriculture: Adoption of Technologies and Perception of Brazilian Farmers. Agriculture 2020, 10, 653. https://doi.org/10.3390/agriculture10120653*

[8] EMBRAPA (2022). Empresa Brasileira de Pesquisa Agropecuária. AFERE - Plataforma Online de Avaliação da Fertilidade do Solo, Estado Nutricional e Recomendação da Adubação - Portal Embrapa. Disponível: <https://www.embrapa.br/en/busca-de-solucoes-tecnologicas/-/produto-servico/7362/afere---plataforma-online-de-avaliacao-da-fertilidade-do-solo-estado-nutricional-e-recomendacao-da-adubacao>

management practices are followed. The adoption of direct planting in the Cerrado region has resulted in a significant increase in soil carbon inputs, predominantly through the cultivation of a second crop corn in the same season (CORBEELS *et al.,* 2016)[9].

III. Brazil has soybean land available that can be used to expand the production of second-crop corn, without requiring additional land.

Farmers can expand their corn production without affecting the income from other crops. However, they would have to bear the higher risk of a second crop due to the end of the rainy season or uncertain demand. The corn market is highly responsive to market incentives and can occupy existing soybean areas, as observed in the last decade. In the Center-West region, there are 11.4 million hectares of second-crop corn, and Mato Grosso state has 60% of available soybean areas for second-crop corn expansion (CONAB, 2024). This is why corn ethanol production is mainly concentrated in the Brazilian center-west region, where 97% of corn production is a second crop, and 99.5% of corn ethanol is produced.

The second crop corn has significantly increased its participation in the Brazilian total corn area, accounting for approximately 77% in the 22/23 harvest. This expansion occurred mainly in already established soybean areas. Between 2000/01 and 2022/23, the area used for second crop corn in Brazil increased by about 14.7 million hectares. *However, the area used for the first crop of corn decreased by 6 million hectares during the same period*. At the same time, the area used for soybean cultivation expanded from 14 million hectares to 44 million hectares, an increase of 30 million hectares. The Center-West region, which is responsible for 73% of Brazil's second-crop corn production, had an area of 11.5 million hectares dedicated to soybean cultivation in 2011/12, which is equivalent to the area used for second-crop corn production in this region in 2022/23.

The expansion of second-crop corn production in the Center-West region occurred mainly in soybean areas that had already been consolidated for many years (CORBEELS et al., 2016; EMBRAPA, 2020). According to the latest data from CONAB (2024), the Center-West region has already allocated 60% of the soybean area for second-crop corn in the 2022/23 season. This means that 40% of the area is still available to produce a second crop.

Since 2017, the internal corn market in Mato Grosso has changed dynamics due to an increase in local corn demand by the ethanol industry. This has led to an expansion of corn production in the Center-West region to meet the additional demand. To meet the national and biofuel regulations, the ethanol mills provide a clear demand, reducing the risk to producers. Even with the expansion of corn production, it's possible to meet the additional demand by using only soybean areas, which are suitable for second-crop corn production.

IV. Other jurisdictions with rigorous oversight programs have determined zero ILUC value for other multi-crops under specific conditions.

[9] CORBEELS, M., MARCHÃO, R. L., NETO, M. S. et al. *Evidence of limited carbon sequestration in soils under no-tillage systems in the Cerrado of Brazil. Sci Rep 6, 21450 (2016). https://doi.org/10.1038/srep21450*

The Environmental Protection Agency (EPA) has investigated the potential of producing biofuels from camelina and found that it is unlikely to result in significant emissions from indirect land use change because (1) it is expected to be grown on fallow land[10] and (2) it has limited impacts in other markets (EPA, 2013)[11]. According to the EPA, camelina is not currently a popular crop and is unlikely to be grown on a large scale by farmers who could use the land for more valuable crops. However, since planting camelina in rotation can increase land value, it may be used in small areas. At present, the non-renewable fuel uses for camelina are limited, and there is no significant market for it compared to other commercial crops. Therefore, an increase in the production of camelina-based biofuels is not expected to impact other agricultural crop production or commodity markets. As a result, the EPA believes that there will be no significant greenhouse gas emissions related to indirect land use change (EPA, 2013).

Carinata, a winter crop rotation grown in the U.S. Southeast and South America, is expected to have no significant LUC emissions impact, resulting in zero LUC emissions to carinata oil. Renewable Energy Group, Inc (REG) Geismar[12] conducted an analysis that showed zero indirect emissions for carinata oil. According to REG, carinata is well-suited as a winter crop rotation in Southeast cropping systems due to its superior performance compared to other oil crops and its ability to provide soil benefits during winter months when vegetative cover is necessary. In the Southeast, carinata is typically grown during the winter months between planting and harvesting with summer crops such as soybeans, sorghum, peanuts, and cotton. The standard farming schedule involves planting in November and harvesting in early May before beginning planting for the next crop.

Multi-cropping corn ethanol in Brazil meets the conditions used by the EPA to determine low ILUC for carinata and camelina, providing an additional level of confidence for this assessment. Table 1 summarizes the requirements that the EPA has set to consider camelina or carinata as having low land use emissions. In the case of Camelina, two technical requirements had to be demonstrated in a rulemaking process. On the other hand, carinata was approved in a petition process as it demonstrated four technical requirements listed by the EPA, along with the ILUC modeling from the CORSIA regulation. Second-crop corn in Brazil meets the same technical requirements of both camelina and carinata and provides additional safety levels.

[10] Fallow land refers to cropland that is periodically not cultivated.
[11] Environmental Protection Agency (EPA). Regulation of fuels and fuel additives: Identification of additional qualifying renewable fuel pathways under the renewable fuel standard program. Vol. 78, nº 43. 2013.
[12] EPA. REG Geismar carinata oil renewable fuel pathway determination under the RFS Program. Office of Transportation and Air Quality. 2022.

Table 1. Comparison between camelina, carinata, and 2nd crop corn conditions to be considered as a low LUC

		Camelina	Carinata	2nd crop corn
1	Low impact in other (international) markets	x	x	x
2	Does not generate land displacement of the 1st crop.	x	x	x
3	Do not compete with other winter crops		x	x
4	Low risk of reducing yields of the main crops		x	x
5	ILUC under CORSIA		x	x
6	ILUC based on the FAPRI-CARD model			x
7	ILUC based on the IAM external model			x
8	ILUC based on GTAP/LCFS approach			x
9	Evidence on SOC enhancement			x
10	Rulemaking process	x		
11	Petition Process		x	x

Feedstock has minimal impact on other markets. Proponents of camelina and Carinata crops assert that the crops don´t have other markets, so their demand side doesn´t affect the market. The oil fraction of these crops could be used for cosmetics or alternative biofuel production. Camelina´s meal use is possible under current conditions, and in the future, carinata can also have uses. The important thing to note is not zero impact, but to ensure that the risk of significant impact is low. The absence of an established market does not reduce the risk of ILUC, it just creates uncertainty about how the market will develop. Second-crop corn is much better understood in this regard. Data and evidence show that the corn dynamic in Brazil is largely dominated by the second crop, and shocks in the domestic market are not transmitted to world markets in the long term. Many econometric studies have shown that internal market factors mainly affect the Brazilian corn price and that shocks in the international corn price have positively affected the local price, but the opposite was not verified (Chiodi, 2006; Caldarelli and Bacchi, 2012; Miranda et. al, 2019)[13].

[13] Chiodi, L. Integração espacial no mercado brasileiro de milho. Dissertação (Mestrado em Economia Aplicada) – Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba, 2006.
Caldarelli, C. E.; M. R. P, Bacchi. Fatores de influência no preço do milho no Brasil. Nova Economia, Belo Horizonte, 22 (1), p. 141-164, 2012. doi 10.1590/S0103-63512012000100005.
Miranda et al. 2019. Transmissão de preços no mercado internacional de milho entre Brasil e Estados Unidos. <https://periodicos.unipampa.edu.br/index.php/Agropampa/article/download/9688/21449/>

A recent econometric study by the University of Campinas confirms this finding, using monthly data from 2005 to 2022. The study applied empirical strategies such as the estimation of vector autoregressive models (VAR), cointegration tests, estimation of autoregressive vector models with error correction (VEC), Granger causality tests, and estimation of impulse response functions. The results confirm that the maize price in the Center-West region responds directly to shocks in the international price, but the reverse is not observed. Positive price response on Center-West peaks the following month after the impulse and converges to zero around the following sixth month. On the other hand, a shock of price in the MT corn market will not be transmitted to other countries, likely because of the high adaptation capacity of second-crop corn in the Brazilian market. Therefore, changes in the corn price of the local market due to ethanol demand will not affect the international market and will be limited to the second crop. Having a market and understanding how it works makes the market movements more predictable compared to crops that don´t have an established market.

Feedstock does not displace the main crop or other second crops. Proponents of both carinata and camelina have claimed that the crops do not displace primary crops due to economic competitiveness. This is also the case with multi-cropping corn, as observed data from large-scale production shows that around 100% of additional corn comes from second-crop areas, resulting in both yield and area increase. It is important to recognize that the area used for the first crop in Brazil has decreased, which has allowed other crops to expand. As for the second crop, there is no expected competition for land in the foreseeable future[14]. Brazil currently has 44 million hectares of soybeans and only 17 million hectares of doubled crop corn, which is a difference of 27 million hectares (CONAB, 2024).

Planting secondary feedstock after the main crop does not cause a reduction in the yield of the main crop. When soybeans are harvested, there are low quantities of residues left, which leaves the soil unprotected, leading to evaporation, and leaching of nutrients. This can result in soil erosion and loss of organic carbon. However, planting corn after soybeans helps retain nutrients in the soil, reduces soil erosion, and prevents plant diseases and pests. Factors such as soil cover, carbon input, straw formation on the soil surface, and soil organic matter are crucial for the stability and efficiency of the production system. It is monoculture soybean production that may interfere with the stability of production, particularly during harvests with irregular rainfall. On the other hand, annual soybean and second-crop corn can enhance the total yields per hectare and result in positive outcomes. These findings are supported by similar literature (CHADDAD, 2016; Garcia, et al. 2018; RESENDE et al. 2020)[15]. Recent technological advancements and regional climate conditions have allowed for early soybean planting, making corn an ideal sequential crop.

[14] https://farmdocdaily.illinois.edu/2024/04/potential-for-crop-expansion-in-brazil-based-on-pastureland-and-double-cropping.html

[15] Chaddad, F. The Economics and Organization of Brazilian Agriculture (Academic Press, 2016).
Garcia, Rodrigo Arroyo, et al. "Soybean-corn succession according to seeding date." *Pesquisa Agropecuária Brasileira* 53 (2018): 22-29.
Resende et al. Manejo da fertilidade do solo e adubação do milho na Região Centro Oeste, 2020. Revista Plantio Direto - Edição Especial Centro-Oeste.

As of 2022/23, the average soybean yield in Brazil is 3.5 tons/ha, a significant increase from 2.6 tons/ha in 2011/12. The Center-West region of Brazil has seen a particularly notable yield increase of 25% over a decade. Various studies have confirmed this trend, including a controlled field trial conducted by the MT Foundation in 2020. This study found that the combination of soybean and corn resulted in consistently higher soybean yields over the years (as illustrated in Figure 1).

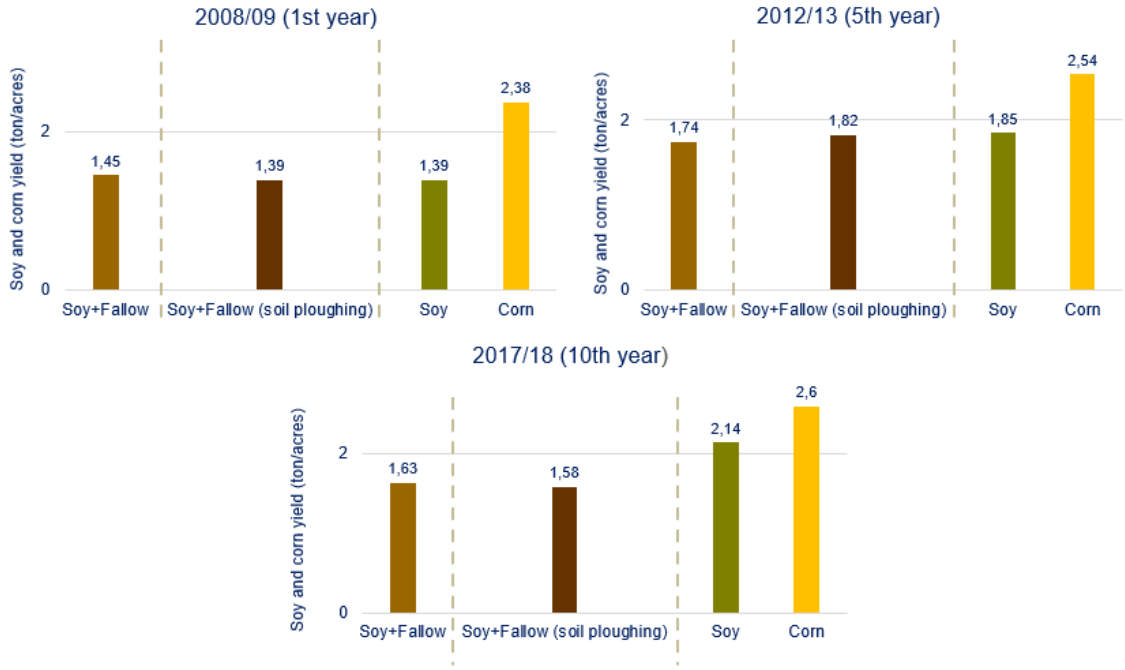

Figure 1. Controlled field trial: soybean in different production systems
Source: MT Foundation (2020).

V. CORSIA has already determined zero or negative ILUC values for secondary (oilseed) crops and a zero ILUC value for sequential cropping in general (which includes 2nd crop corn).

CORSIA has previously discussed cases of secondary crops, such as Camelina and Carinata, which have been granted negative ILUC values because they do not require additional land and do not significantly impact other markets. The negative ILUC value for these oilseeds, which produce oil and meal, is due to the replacement of existing feed sources by the feed portion of grain used to extract oil and produce SAF. There is currently no final determination from CORSIA on the correct ILUC value for second-crop corn in Brazil. The standard GTAP-Bio and GLOBIOM models used in this regulation were not prepared to analyze second crops that already exist at scale, which is a unique feature of Brazil. Meanwhile, CORSIA has determined that "sequential cropping" (in the case of 2nd crop corn) is suitable for a zero ILUC value under the Low LUC Risk approach Certification, considering the "yield increase approach".[16] This approach aims to promote practices with a low LUC risk and may be a solution for cases where

[16]To view our Low LUC Risk Certificate please visit the ISCC Website. ISCC (n.d.) All certificates. Available at: https://www.iscc-system.org/certification/certificate-database/all-certificates/.
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ILUC models face a significant challenge in accurately representing the management practice or land use dynamics.

VI. Negative ILUC for Brazilian corn ethanol is documented in scientific literature.

Moreira et al. (2020)[17] developed a consequential LCA for ethanol in Mato Grosso, using multi-cropping corn as a feedstock. This research was based on the Brazilian Land Use Model (BLUM), which is a reduced version of the FAPRI-CARD model used in the RFS2 regulation. The study published in Nature Sustainability resulted in an ILUC of -4.7 gCO_2e/MJ, for a 30-year amortization period, considering the additional production of 1 billion liters of multi-cropping maize ethanol by 2030. The negative ILUC value is mainly due to the existence of the 2nd crop in the Center-West region, the use of eucalyptus chips in the cogeneration process, and the displacement of conventional animal feed by DDG. The use of second-crop corn was not imposed as a restriction in the model, and it could select any type of corn (1st or 2nd crop) to produce ethanol. The model result indicated that the great majority of additional corn would be 2ndcrop in the Center-West region of the model (this region has a low cost and high supply elasticity). The result already takes into account market-mediated effects and could be valid for any crop-corn in Brazil. This scenario was labeled as scenario 1 (S1).

The paper conducted simulations of alternative scenarios to analyze the sensitivity of the results to DDG nutrition efficiency (in feed displacement) and the role of planted eucalyptus forests in ILUC value. The findings are presented in Figure 2. For scenario S2, which was like S1 but excluded area expansion for eucalyptus, the ILUC result was 0.4 gCO_2e/MJ. This result shows that eucalyptus expansion contributes to further reducing ILUC values. It is important to note that even if eucalyptus expansion is not considered, the ILUC value is very close to zero. For scenario S3, which was like S1 but assumed a conservative lower nutritional equivalence for the DDGS, ILUC emissions were -2.6 gCO_2e/MJ. Finally, for scenario S4, which was like S1 but assumed a more optimistic assumption of DDGS nutrition efficiency, emissions were -7.4 gCO_2e/MJ. The main reason for this reduction in emissions was the reduced planting of annual crops and pasture.

[17] Moreira, M.M.R., Seabra, J.E.A., Lynd, L.R. *et al.* Socio-environmental and land-use impacts of double-cropped maize ethanol in Brazil. *Nat Sustain* **3**, 209–216 (2020). https://doi.org/10.1038/s41893-019-0456-2

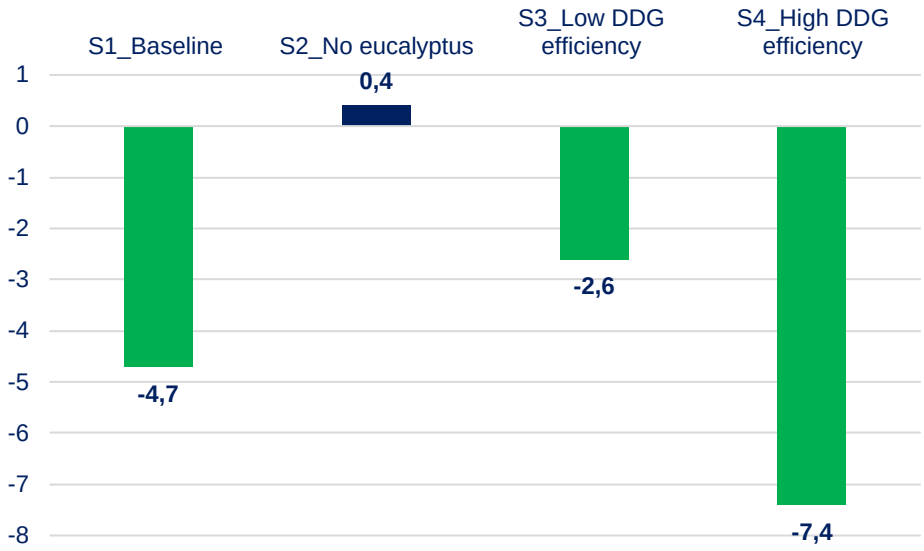

Figure 2. ILUC results for multi-cropping corn ethanol in Brazil (gCO_2e/MJ)
Source: Moreira et al. (2020).

Based on the current operational conditions of this application, Scenario 4 appears to be the most suitable option. It involves the use of eucalyptus as the primary fuel source and incorporates improved fiber separation technology that increases DDG efficiency. The sensitivity analysis shows that this pathway has low emissions of ILUC, which remain robust across a range of potential uncertainties, with emissions ranging from 0.4 to -7.4 gCO_2e/MJ.

Second crop corn SAF stands out as having a robust negative ILUC Integrated Assessment Model (IAM) that explicitly considered multi-cropping in Brazil. Fiorini et al. (2023)[18] estimated the ILUC for SAF in various scenarios using the BLUES (Brazilian Land Use and Energy System) model. The BLUES model is a processed-based IAM that uses least-cost optimization and mixed-integer programming to forecast long-term outcomes until 2050 in 5-year intervals. The model includes five macro-regions in Brazil and covers both conventional and new energy and land use technologies. The model was evaluated in the latest IPCC report on mitigation strategies (IPCC, 2022). Although the model is not a perfect fit for the analysis of RFS, it provides valuable insights. The study analyzes the impact of ILUC for five different feedstocks, two political scenarios for combating deforestation in Brazil, and five different blending targets for SAF. The results showed that ATJ produced from maize was the best-performing feedstock in most cases. Additionally, it was the only route that consistently showed negative ILUC values in all scenarios, even when deforestation was not well controlled in Brazil.

[18] Fiorini et al. 2023. Sustainable Aviation fuels must control induced land use change: an integrated assessment modelling exercise for Brazil. Enviorn. Res. Lett. 18 014036

Table 2. Cumulative LUC GHG emissions of the assessed scenarios (gCO_2e/MJ) in 2050

Bio-SAF blends	Maize		Sugarcane		Palm		Macaw low productivity		Macaw high productivity	
	Def	ZeroDef	Def	ZeroDef	Def	ZeroDef	Def	ZeroDef	Def	ZeroDef
10%	−298.0	−286.8	−108.9	−186.9	−169.5	−125.0	−208.0	−170.7	−223.8	−196.8
20%	−74.5	−95.2	−13.7	−107.8	−22.0	−98.8	−3.8	−58.0	7.2	−43.1
30%	−48.9	−53.3	1.0	−36.6	5.4	−31.7	9.2	−34.0	12.5	−24.2
40%	−56.9	−64.0	−5.1	−33.7	3.8	−21.6	15.0	−18.8	10.3	−17.0
50%	−48.4	−37.4	0.2	−23.5	3.8	−13.7	10.4	−4.3	7.9	−13.6

Source: Fiorini et al. (2023).

VII. Multi-cropping corn has a low land-use change risk and should be considered under the LCFS/CARB framework.

It is widely recognized that ILUC values are not precise and can vary significantly, depending on different models and approaches. These models can only indicate risk levels and do not provide exact data points. The ILUC value for second-crop corn can vary significantly, ranging from 0.4 g CO_2e/MJ to -298 gCO_2e/MJ, depending on various factors such as the model, premise, and efficiency. These results are quite different from the original evaluation of US regular corn as defined in LCFS/CARB. Based on the current analysis, multi-cropping corn can be considered with a low chance of generating ILUC emissions.

VIII. Brazilian corn ethanol is classified as a Low LUC risk by the ISCC/CORSIA.

According to ISCC (2022)[19], the implementation of low LUC risk practices to produce Sustainable Aviation Fuel (SAF) should avoid actions that result in LUC. It is essential to encourage the production of additional raw materials concerning a baseline without increasing the demand for land.

To obtain certification as Low LUC risk under ISCC CORSIA, there are two approaches for raw material production that qualify as low risk, considering practices implemented after January 2016 (2013 for exceptional cases): (i) increased yield, and (ii) use of unused land (degraded areas). According to ISCC (2022), an increase in the yield of harvested raw material can be achieved through various actions such as improving agricultural practices, forming consortiums, sequential cultivation, reducing post-harvest losses, and making mechanical and non-mechanical improvements.

FS has become the first ethanol producer in the world to receive the ISCC CORSIA international certification, along with the low LUC risk add-on[20]. This certification confirms that their

[19] ISCC (2022). *International Sustainability and Carbon Certification. ISCC CORSIA. Guidance for Low LUC Risk certification.*

[20] https://ethanolproducer.com/articles/brazilian-ethanol-producer-receives-iscc-corsia-low-luc-risk-certification-for-saf-production
https://www.argusmedia.com/en/news-and-insights/latest-market-news/2544002-iscc-clears-brazil-s-fs-corn-ethanol-for-saf
https://www.prnewswire.com/news-releases/fs-is-the-first-ethanol-producer-in-the-world-to-receive-iscc-corsia-low-luc-risk-certification-for-saf-production-302078553.html
https://www.biofuelsdigest.com/bdigest/2024/03/06/brazilian-firm-fs-receive-iscc-corsia-low-luc-risk-certification-for-saf-production/

production process meets the global standards for the production and supply of ethanol and corn oil for SAF and validates that Brazilian second-crop corn ethanol is a raw material with zero emissions associated with indirect land use change. This approach aims to ensure that the production of biofuels positively contributes to the reduction of carbon emissions, especially in sectors that are difficult to decarbonize, such as aviation.

IX. Challenges for CARB's 2028 Sustainability Certification Program

Sustainable certification is pivotal for development, yet practical application faces challenges. These challenges can limit certification reach among varied stakeholders. FS has extensive experience with international sustainable certifications[21]. FS provides the following recommendations regarding the development of an optimal certification program for the LCFS.

Establish Clear Guidelines: Develop and establish clear rules and definitions to ensure that products have the required sustainability attributes, preventing misinterpretation and ensuring compliance with stakeholder involvement and learning from existing programs.

Focus on Fuel Value Chain: Certify production meeting the LCFS's requirements, without interfering with other sectors of local economies, respecting national sovereignty.

- Recognize that raw materials and fuel production may serve multiple sectors with diverse certification standards.
- Certifications should not overreach but rather be confined to the fuel production chain, respecting each nation's laws, and avoiding interference.
- Certification processes should be tailored to and concentrated within the specific sector of the product in question, honoring the sovereignty of the countries that provide the raw materials.

Avoid Market Reserves: Promote competition and diversity in certifications by establishing comprehensive rules compatible with various schemes, thus reducing bureaucracy, and providing more options for qualifying materials.

- Sustainability certification for LCFS should be a process that encourages ongoing improvement and educates a growing number of producers about the benefits of sustainable practices rather than imposing restrictive and unnecessary criteria that could monopolize the market by qualifying a limited number of producers or processes.
- There is a risk of sustainability certifications becoming exclusive to certain reduction schemes. Uniformity should be balanced to prevent market monopolization.

https://www.qcintel.com/biofuels/article/brazil-ethanol-producer-fs-gets-iscc-corsia-and-low-luc-risk-certification-22067.html

[21]Currently, FS is certified under ISO.14.064 for Colombian Government Program (Resolución 1962/2017), RenovaBio, RSB EU, and ISCC, with modules including EU, PLUS, and CORSIA Low LUC Risk Add-on.

- CARB should aim to set comprehensive rules that accommodate multiple certification programs without being too restrictive, fostering competition, expanding options for qualifying materials, and cutting down on bureaucracy.
- CARB should adopt a comprehensive evaluation for certification programs, focusing on broad sustainability criteria to encompass various systems, including regional ones such as Brazil's Renovabio Program if the certification scheme meets or is committed to meeting/implementing the LCFS's required sustainability criteria.

Interchangeability of Certifications: Allow interchangeability with other certifications that are equally or more rigorous, avoiding duplication of efforts and promoting efficiency and adherence to required attributes, such as transparency and traceability. Avoid creating LCFS-exclusive modules in certifications such as ISCC and RSB to minimize complexity and duplication of efforts.

- Avoid the association of each market or program with a unique certification scheme prevents duplicative efforts, multiple management systems, extra documentation, additional costs, and slow processes.
- Encourage the use of interchangeable certifications that meet equivalent standards to save time and resources.
- The LCFS could broaden its Certification Schemes to include those that are compatible and interchangeable, aligning with its principles and criteria throughout the chain of custody.
- Certifications could align with strict national environmental laws that require socio-environmental responsibility, mirroring the standards of the LCFS.
- Ensuring transparency and traceability in the production chain is vital, especially for proving land use changes and ensuring products meet required attributes. Compliance with laws related to unverified requirements could affirm respect for the required LCFS attributes.

Optimize Time and Reduce Costs: Adopt strategies to optimize time and reduce costs for implementing and maintaining certifications, enhancing efficiency and accessibility using default values, remote audits, investment in qualified auditors, and training local professionals can mitigate logistical challenges and reduce expenses for producers.

- Using regional default values can streamline certification and monitoring by reducing data and document demands, as opposed to relying on actual GHG values which may cause delays.
- In addition to the required audits by Certification Programs, LCFS applicants must also undergo on-site visits by independent auditors to obtain traceable certificates. This requirement can significantly increase both the time and costs associated with the certification process. Implementing remote audits where possible and investing in qualified auditors and training for local professionals, especially in developing regions, could save time and resources.

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- Annual fees, volume-based fees, and production unit fees required by the Certification Programs alongside implementation costs like infrastructure adjustments in farms, evidence preparation and staff training, and onsite audits can be prohibitive across all producers, especially in small ones.
- Certification costs can raise biofuel prices, placing a financial strain on producers and the entire supply chain, potentially leading to reduced production and supply volumes due to high costs and bureaucracy thereby reducing LCFS program effectiveness.

Scalability: Implementing regional eligibility criteria and a modular certification approach could simplify the certification process, reduce costs, and promote scalability by allowing different areas of the production chain to adhere independently to certification standards.

- Implementing regional eligibility could address these complexities by accommodating specific regional characteristics and streamlining the certification process.
- Enable sampling-based auditing using the square root of the number of farms to be certified to reduce audit time.
- Global scalability must account for potentially prohibitive costs for all producer types, including fees for Certification Bodies, property adaptations, and staff training to meet evolving standards.
- A scalable solution might involve a modular adherence mechanism within the production chain, where certification is independent for different product batches or areas, thereby simplifying management and reducing costs.

Based on what was presented on April 10th, default values will only apply to locations that already have defined pathways, so we urgently request that a default value for Brazilian second-crop corn ethanol be considered in the rulemaking. Additionally, the certification process should be robust and efficient, considering that various certification processes should not be evaluated in overlap and should be easily scalable.

Therefore, we request that CARB reevaluate the Brazilian case and facilitate the development and establishment of a regional default value that reflects the reality of Brazil's second-crop corn.

Please count on FS for providing data and evidence, or any other support that CARB may need to pursue the listed topics.

Respectfully,

DocuSigned by:
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Executive VP Sustainability & Businesses Development