



BRAZILIAN SUGARCANE INDUSTRY ASSOCIATION

ETHANOL • SUGAR • ELECTRICITY

April 23, 2018

Mary Nichols
Chairman
Air Resources Board
1001 I Street
Sacramento, CA 95814

RE: UNICA's Comments on California Air Resources Board's (CARB) Proposed Amendments to the Low Carbon Fuel Standard (LCFS)

Dear Chairman Nichols,

The Brazilian Sugarcane Industry Association ("UNICA") appreciates the opportunity to provide comments on the California Air Resources Board's proposed amendments to the LCFS, which was posted for comments on March 6th, 2018.

UNICA is the largest representative of Brazil's sugar, ethanol and bioelectricity producers. Its members were responsible for 50 percent of Brazil's ethanol production and 54 percent of Brazil's sugar production in 2017/2018 harvest season. UNICA serves as a source for credible scientific and economic data about the competitiveness of sugarcane biofuels. UNICA also works to encourage the continuous advancement of sustainability throughout the sugarcane industry and to promote ethanol as a clean, reliable alternative to fossil fuels.

Brazil is the world's largest sugarcane producer and the second largest producer and exporter of ethanol with 22 percent of global production and 17% of exports in 2017.¹ Despite these volumes, sugarcane ethanol production uses only 0.6 percent of Brazil's territory² and reduces lifecycle greenhouse gas ("GHG") emissions by more than 100 percent³ compared to conventional gasoline. Brazil's innovative use of ethanol in transportation and biomass for power cogeneration has made sugarcane a leading source of renewable energy in Brazil, representing 17.5 percent of the country's total energy supply, ahead of

¹ Percentages calculated by UNICA, based on LMC Ethanol Monthly Update (March 2018).

² Brazilian Institute of Geography and Statistics ().

³ Seabra, J. E. A., Macedo, I. C., Chum, H. L., Faroni, C. E. and Sarto, C. A. (2011), Life cycle assessment of Brazilian sugarcane products: GHG emissions and energy use. *Biofuels, Bioprod. Bioref.*, 5: 519–532. doi:10.1002/bbb.289

hydroelectricity.⁴ Brazil replaced nearly one-third of its gasoline needs with sugarcane ethanol last year.⁵

UNICA is committed to assisting CARB in meeting goals of the LCFS by providing one of the lowest carbon intensive biofuels to be added to gasoline in use in California. Reducing dependence on GHG generating fossil fuels, especially fossil fuels obtained from unstable and even hostile regions, benefits the entire world, including the United States and Brazil. That is why UNICA works with CARB staff to continue supporting implementation of the LCFS, and why its members have provided volumes of low-GHG-producing sugarcane ethanol to help California meet LCFS goals.

We recognize the effort of staff to try to make the pathway registration process more efficient and less complicated. We want to make sure that the amendments proposed will indeed have these consequences and will allow for a closer-to-reality carbon intensity number for sugarcane ethanol. We would like to see more volumes of low carbon Brazilian sugarcane ethanol entering the California market. For this reason, we would like to offer a few suggestions to the proposed amendments to the LCFS because we believe it will help the program better capture the reality of the domestic sugarcane ethanol industry and reap the benefits of this low carbon intensive biofuel.

Most of our comments are directed to the Carbon Intensity (CI) calculator for sugarcane ethanol, but we would also like to suggest a few comments on the verification process CARB is proposing to create. Please see our comments below:

I – Data analysis period

We understand that starting in 2021, by March 31st, fuel pathways holders will have to submit to CARB an Annual Fuel Pathway report that contains, among other things, 24 months of data. We have discussed with ARB staff in the past and would like to reiterate that official sugarcane harvest period in South-Central Brazil is from April thru March⁶. During this time, the majority of mills crush cane up until beginning of December when the intercrop season starts. For those months (December until March), production numbers will likely be zero, and we want to make sure that CARB has fully understood and accepted this nuance/ reality of Brazilian sugarcane ethanol production, without prejudice to the overall analysis of sugarcane ethanol pathway and its carbon intensity score.

II- Straw Emissions and Credits

As per previous conversation with CARB staff, we understand that the agency intends to discount electricity credits generated from straw (or sugarcane residues – leftover

⁴ National Energy Balance – Base Year 2016 (2017).

⁵ *Id.*

⁶ South-Central region responds for more than 90% of Brazil's sugarcane crush. In North-Northeast region, responsible for less than 10% of national sugarcane crush, the harvest runs from September to August in some states (Alagoas, Bahia, Paraíba, Pernambuco, Rio Grande do Norte e Sergipe) and lasts from May to April in Amazonas, Ceará, Maranhão, Pará, Piauí and Tocantins states.

fibers, stalks and leaves) for all sugarcane ethanol pathways. Our understanding is that the technical basis for such move is the belief that straw removal from the field may influence the need for supplementary use of nitrogenous fertilizers (N-Fert).

We agree that this is an important issue for carbon footprint calculation considering the weight of N-Fert has in the overall GHGs emissions of biofuels. Given the importance of this issue for the LCFS program and for the Brazilian sugarcane ethanol producers, we would like to encourage CARB to do a detailed analysis that better reflect the practice in Brazil, accounting straw emissions and credits in a more complete and in-depth manner prior to making these amendments. In the following paragraphs, we provide an indication of the most relevant literature on the subject.

Vitti et al.⁷ (2007) evaluated that Nitrogen (N) and Sulfur (S) stocks of root system are positively correlated with sugarcane yield in the next crop. Figueiredo (2011)⁸ indicates that in green-harvested areas, 1619.8 kgCO₂e.ha⁻¹ are emitted into the atmosphere each year, mainly due to fertilization and diesel use. However, it is worth noting that the results heavily depend on the site-specific characteristics. Fortes et al. (2012)⁹ points out those sugarcane post-harvest residues is an important source of carbon and nutrients to soil-plant system. In a recent literature review, Carvalho et al. (2017)¹⁰ argue that the indiscriminate removal of crop residues can reduce the environmental benefits of bioenergy. The same study indicates that benefits in soil carbon (C) stocks were reduced when total aboveground residue was removed while partial removal of sugarcane residues did not reduce soil C stocks.

However, it is recognized that nitrogen from plant residues goes through complex processes, involving several paths to N₂O, leaching to groundwater and surface water trapping, as well as direct emissions of the soil as N₂O, leaving a small fraction for effective use in the cultivation of the plant. Evidences from Vitti et al. (2008)¹¹ and Vitti et al. (2011)¹² show that nitrogen from straw does not contribute to sugarcane nutrition and that N from straw is below 1%.

⁷Vitti, A.C. et al., (2007). Produtividade da cana-de-açúcar relacionada ao nitrogênio residual da adubação e do sistema radicular. *Pesquisa Agropecuária Brasileira*. Brasília, v.42, n.2, p. 249-256.

⁸Figueiredo, E.B. (2011). *Greenhouse gas balance due to the conversion of sugarcane areas from burned to green harvest in Brazil*. *Agriculture, Ecosystems and Environment* 141. p. 77-85.

⁹Fortes, C. et al. (2012). *Long-term decomposition of Sugarcane harvest residues in São Paulo state, Brazil*. *Biomass and Bioenergy* 42. p. 189-198.

¹⁰Carvalho, J.L.N. et al. (2017). *Contribution of above and belowground bioenergy crop residues to soil carbon*. *Global Change Biology – Bioenergy*.

¹¹ Vitti, A.C. et al., (2008). Mineralização da palhada e crescimento de raízes de cana-de-açúcar relacionados com a adubação nitrogenada de plantio. *Revista Brasileira de Ciência do Solo*. 32:2757-2762, Número Especial.

¹²Vitti, A.C. et al., (2011). Nitrogênio proveniente da adubação nitrogenada e de resíduos culturais na nutrição da cana-planta. *Pesquisa Agropecuária Brasileira*. V. 46, n. 3, p.287-293. Brasília – São Paulo, Brasil.

Recent literature corroborates that **there are levels for soil straw removal, with little or no impact on the need for nutrient replacement.** Neto (2015)¹³ points out that the presence of different amounts of sugarcane straw did not change N₂O emissions relative to bare soil (control). In an extensive literature review, Carvalho et al. (2016)¹⁴ verifies that crop residues remaining on sugarcane fields provide numerous ecosystem services including nutrient recycling, soil biodiversity, water storage, carbon accumulation, control of soil erosion, and weed infestation. Such agronomic and environmental benefits are achieved when 7 Mg ha⁻¹ of straw (dry mater) is maintained on soil surface (about 50% of straw).

We should note that leaving about at least 40%-50% of sugarcane residues on the field leads to a mean annual C accumulation rate of 1.5 Mg ha⁻¹ year⁻¹ for the surface to 30-cm depth (0.73 and 2.04 Mg ha⁻¹ year⁻¹ for sandy and clay soils, respectively). It is caused by the conversion from a burnt to an unburnt sugarcane harvesting system, which is the case of the great majority of sugarcane fields in Brazil (Cerri et al, 2011)¹⁵. This is an additional safety level, once it seems not being captured in the mechanized credits in LCFS.

Considering the above, we suggest that **up to 50% of the straw could be safely removed from sugarcane fields to produce bioelectricity without affecting GHGs emissions in agricultural activities.** We, therefore, would like to suggest/recommended that the new calculator should have a place to input information of collected straw. This is an extremely important issue for the Brazilian producers and we will be glad to collaborate with CARB to ensure that all nuances of sugarcane ethanol production are captured in the calculator.

III- Mechanization

One input in the calculator that is of great importance to the Brazilian sugarcane sector is the mechanization input, given the advances and investments that the industry has made in this front in the last decade and the competitive advantages that set mills apart from their peers.

According to the State-owned Brazilian Food Supply Company (CONAB in Portuguese), from the Ministry of Agriculture, Livestock and Food Supply (MAPA), the South-Central region, where the majority of UNICA members operate, has reached 95.6% of mechanization level in 2017/2018 crop year, compared to 28,5% one decade ago¹⁶. Indeed, this index is even higher according the Sugarcane Technology Center (CTC). Following its data, the mechanical harvesting in areas owned by mills, located in South Central region, reached 98% in the named season.

¹³ Neto, M.S. et al., (2015). *Direct N₂O emission factors for synthetic N-fertilizer and organic residues applied on sugarcane for bioethanol production in Central-Southern Brazil. Global Change Biology – Bioenergy.* Piracicaba, São Paulo – Brazil.

¹⁴ Carvalho, J.L.N. et al. (2016). *Agronomic and environmental implications of sugarcane straw removal: a major review. Global Change Biology – Bioenergy.* Campinas – São Paulo, Brazil.

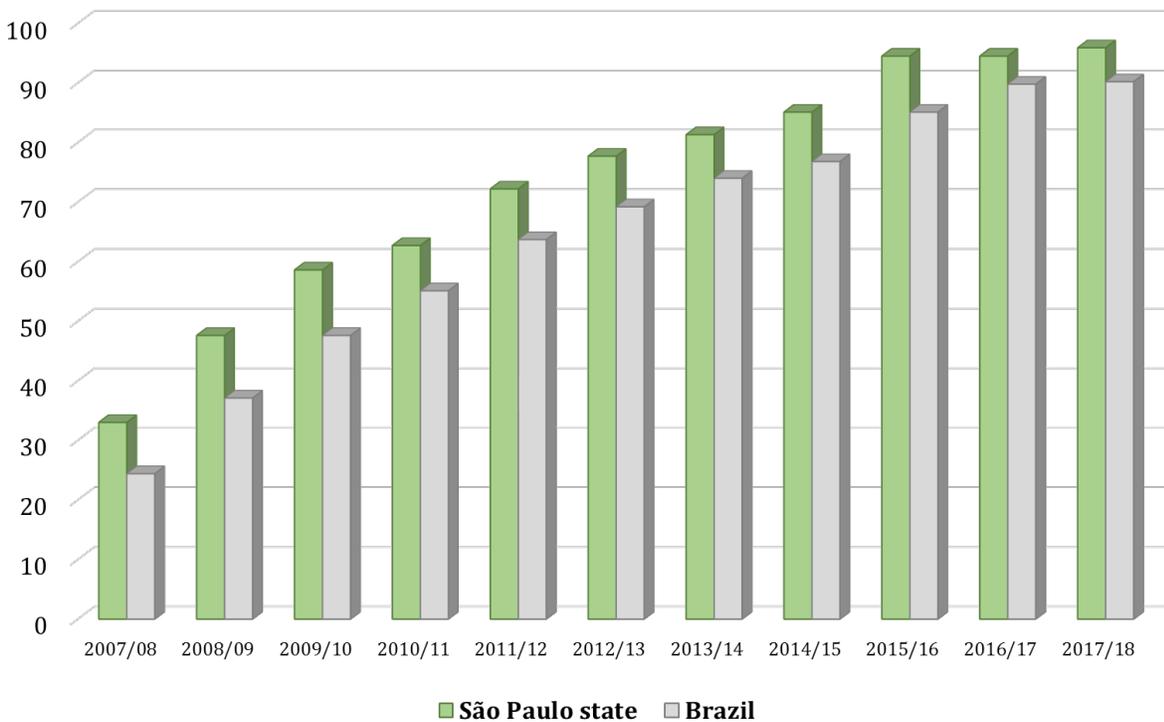
¹⁵ Cerri, C. C., Galdos, M. V., Maia, S. M. F., Bernoux, M., Feigl, B. J., Powlson, D. and Cerri, C. E. P. *European Journal of Soil Science; Special Issue: Soil Organic Matters; Volume 62, Issue 1, pages 23–28, February 2011*

¹⁶ http://www.conab.gov.br/OlalaCMS/uploads/arquivos/17_08_24_08_59_54_boletim_cana_portugues_-_2o_lev_-_17-18.pdf (page 60)

It is important to mention that this is the region responsible for all the ethanol exported from Brazil to countries such as the United States, Japan and the European Union.

As CARB is aware, São Paulo state government, in partnership with UNICA and sugarcane growers association (ORPLANA), created in 2007 a Green Ethanol Protocol, a pioneer initiative that, among other commitments, eliminated pre-harvest field burning in 2017. According to the Environmental Secretary, 95% of all sugarcane processed in the São Paulo state is under the management of certified parties.¹⁷ Since June 2017 this commitment has entered into a new phase, now called More Green Ethanol Protocol, that continues to reiterate the pre-harvest field burning commitment, but includes the important commitment of restoring riparian vegetation around cane fields.

Sugarcane Harvesting- Fast Mechanization Process in Brazil



Source: CONAB (National Supply Company, from the Brazilian Ministry of Agriculture, Livestock and Food Supply)

As previously mentioned, industry has invested a great deal in mechanization in the sector in the last decade. Investments that helped sector reach a level of 57% of GHG emissions reduction from harvesting over the past 10 years (from 4.8 to 2.1 g CO₂eq/MJ of eth-

¹⁷ Slide 3 of the document: http://arquivos.ambiente.sp.gov.br/etanolverde/2017/06/etanol-verde-relatorio-preliminar-safra-16_17-site.pdf

anol), considering the parameters given in Table 1. We believe there is strong evidence that the soil carbon stocks increase due to unburned mechanized harvesting¹⁸. Estimations from Figueiredo and La Scala Jr (2011)¹⁹ indicate that the emissions in the mechanized harvesting are almost 1500 kg CO₂eq ha⁻¹ year⁻¹ lower than those for the burned harvesting, since it leads to a soil carbon sequestration of more than 1170 kg CO₂eq ha⁻¹ year⁻¹.

Table 1: Parameters used for the estimation of emissions balance between burned and mechanized harvesting

Parameter	Value/source
% Mechanized harvesting	CONAB
Sugarcane production	UNICA ²⁰
Sugar and ethanol production	UNICA ²⁰
Straw burning emissions	2.7 kg CH ₄ /t dry matter burnt ²¹ 0.07 kg N ₂ O/t dry matter burnt ²¹
Straw to cane stalk ratio	140 kg (dry basis) per tonne of stalk ²²
Harvester's diesel consumption	74 L/ha ²³
Life cycle diesel emissions	83.8 g CO ₂ eq/MJ ²⁴

¹⁸ Cerri, C. C., Galdos, M. V., Maia, S. M. F., Bernoux, M., Feigl, B. J., Powlson, D. and Cerri, C. E. P. European Journal of Soil Science; Special Issue: Soil Organic Matters; Volume 62, Issue 1, pages 23–28, February 2011

¹⁹ Figueiredo EB, La Scala Jr N. Greenhouse gas balance due to the conversion of sugarcane areas from burned to green harvest in Brazil. Agriculture, Ecosystems and Environment 141 (2011): 77-85.

²⁰ <http://www.unicadata.com.br/>

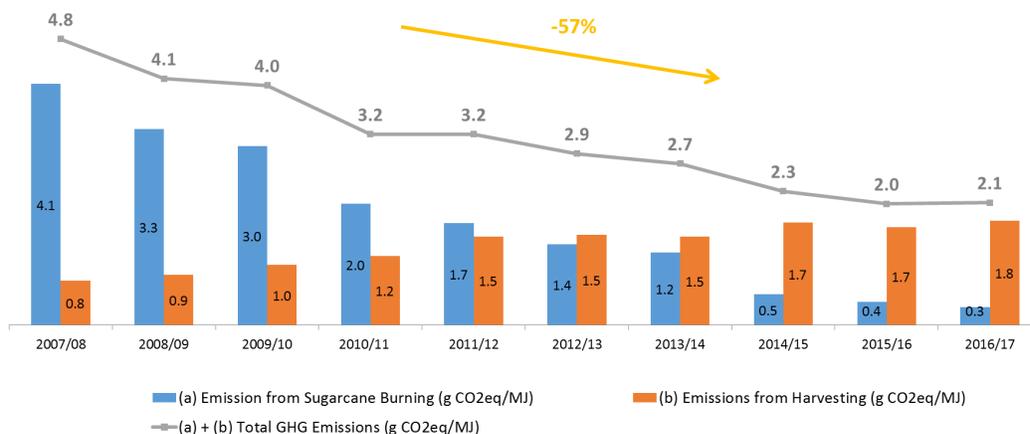
²¹ IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

²² Hassuani SJ, Leal MRLV, Macedo IC. Biomass power generation: sugar cane bagasse and trash. Piracicaba: PNUD Brasil and Centro de Tecnologia Canavieira; 2005.

²³ Adapted from Macedo IC, Seabra JEA, Silva JEAR. Green house gases emissions in the production and use of ethanol from sugarcane in Brazil: The 2005/2006 averages and a prediction for 2020. Biomass and Bioenergy 32 (2008): 582-595.

²⁴ European Parliament and Council of the European Union, Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009, on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Official Journal of the European Union of 5 June (2009).

Emissions Balance (Burning vs. Mechanization)



In the CI calculator for sugarcane ethanol, CARB proposes two default values for sugarcane mechanization for Brazil: 80% for São Paulo state and 65% for other states in the Center-South region. By choosing to use the default values, mills will not need to have this input verified. UNICA will probably have members who will be satisfied using the default value, however, the vast majority of our members located in Sao Paulo, who have nearly all of its sugarcane harvesting mechanized, prefers to prove that they are at highest level, as abovementioned reported by CONAB and CTC.

For this effect, UNICA would like to request that CARB includes an option for self-declared mechanization percentage in the CI calculator, and that mills opting for it will have its data and its mill audited by a CARB authorized third party verification body. In Exhibit A we suggest an outline for proving sugarcane mechanization levels in Brazil. In sum we propose that Brazilian mills be given three options: 1) using the default values proposed by CARB and forgo verification of this input; 2) self-declare and go through verification via auditing of its production record/mill; and 3) use of satellite imaging to show the levels of mechanization and go through the verification process of its records/mill. WE believe that any certification plan CARB develops for proving mechanization levels of Brazilian sugarcane ethanol mills should follow along these lines.

UNICA member mills are highly sophisticated enterprises who invest a great deal in the automatization of their agricultural and industrial processes. Third party verifying bodies in Brazil have for years audited mills' systems for certification schemes like the Bonsucro, EPA's RFS program and the LCFS in itself. We encourage CARB staff to continue to reach out to verification companies in Brazil in order to clarify doubts or misunderstandings regarding the automatized systems used by sugarcane mills.

We believe providing these options are not only the best way to capture the reality of sugarcane mechanization practices in Brazil, but it is also the fairest approach.

IV- Ethanol Pipelines

We would like to request CARB staff to include a pipeline transportation option in the CI Calculator for sugarcane ethanol. Although this modal of transportation is still less prominent than truck in Brazil, it is certainly a trend for the near future, as it represents a unique infrastructure that ensures fast, sustainable and low-cost transportation. We believe the addition of this option in the calculator is crucial in order to benefit mills who decide to use it to gain competitiveness in the California market.

Investments in integrated ethanol storage and distribution systems through pipelines, such those made by our member companies Copersucar, Raizen and Atvos in partnership with other stakeholders to create Logum Logística S.A., are a reality.

Ethanol transport through pipelines uses the LOGUM and Transpetro Pipelines systems which operate with hydrous and anhydrous ethanol, gasoline and diesel. In total these pipelines together can extend to 950 Km (590 miles).



Source: Logum System

We understand CARB is concerned with potential contamination of the product given that these pipelines are not for exclusive use of ethanol. For this same reason, and because ethanol producers need to guarantee the quality of their product to their buyer, quality control practices in pipeline transportation are extremely strict.

In summary, the process of ethanol transportation in pipelines occurs as following: fuels are transported in parcels; the flow is continuous and under pressure, allowing for the existence of a contact zone among the fuels, called “interface”. The interface between hydrous and anhydrous ethanol does not impact the technical specification of the products, as per the National Agency of Petroleum, Natural Gas and Biofuels’ (ANP) requirements.

In the case of ethanol and gasoline interface, ANP has particular requirements to protect the quality of both fuels. This control refers to a product certification in all phases of the transportation, and this is done via automated process, controlling the flows of fuels not to exceed the requirement’s limits. It is important to clarify that, in order to guarantee quality control, ethanol fuel is inspected before leaving the port in Brazil and at arrival in the destination port.

When the pipeline moves diesel, it necessarily has to move gasoline in the sequence because this fuel works to seal the pipeline, allowing for the transport of ethanol without any modification. A small loss of 0,2% is allowed, which is normally due to evaporation. ANP exercises strict control and verification of product quality and specification and the flow of fuels have been taking place without any known quality control incident.

For illustration and clarification purposes we would like to share with staff, in Exhibit B, a paper that addresses the methodology of quality control in pipeline transportation in Brazil. We hope this gives staff a better understanding of how the process works in the country. We urge staff to provide this modal of transportation option in the CI calculator, and we remain at staff's disposal to answer any question and to connect CARB with the right people in order to provide better understanding of this issue.

V - Maritime Transportation

Unfortunately CARB has brought back the notion of back-haul penalties for maritime transportation of sugarcane ethanol to California. It is unknown to us that CARB has obtained data to support its assertion that ocean tankers bringing ethanol fuel from Brazil to California will necessarily return to Brazil, and empty. From conversations with staff we understood that this back-haul emission penalty is due to a conservative approach staff wants to take in case this happens in the future. We decided to verify our observations that ethanol ships from Brazil do not return empty and would like to present our findings to staff in Exhibit C.

In the past two years, nine ships have brought ethanol from Brazil to California, for a total of 10 trips (vessel High Valor has made the trip twice), from California these vessels called other ports to deliver other products. The tracking of these vessels confirmed our observations that ships do not necessarily go back to Brazil, and certainly not empty. Out of 10 trips, only one was back to Brazil, with the vessel carrying diesel. All other nine trips were to Asia, Europe and Mexico.

Maritime transportation would certainly not be efficient and affordable if vessels would travel empty around the world. Assuming that the energy consumption and associated emissions of the ocean tanker's round trip be attributed to sugarcane ethanol is highly speculative and arbitrary and causes a tremendous impact in sugarcane ethanol competitiveness in the California market. We would like to request that staff do not consider the emission of shipments returning to Brazil, since it defers from current market and trading practices. In the images bellow it is possible to compare the impact of the methodology change in terms of CI impact. If we consider the same distance parameter compared to CA-Greet 2.0 and CA-Greet 3.0, the CI impact is almost 4 gCO₂e/MJ:

CA-Greet 2.0

Transportation and Distribution			5.88
<i>From ethanol plant to port</i>	HDD Truck		
Shares	100%		
Miles			
<i>From ethanol plant to port</i>	Pipeline		
Shares	100%		
Miles	0		
<i>From ethanol plant to port</i>	Rail		
Shares	100%		
Miles	0		
<i>From port to CA port</i>	Ocean Tanker		
Shares	100%		
Miles	8.953		
<i>From CA port to blending terminals</i>	HDD Truck		
Miles	40		
<i>From terminals to fueling stations</i>	HDD Truck		
Miles	50		

CA-Greet 3.0

Ethanol Transport and Distribution			9.73
<i>From Ethanol Plant to Brazil Port</i>	Mode: HDD Truck		
Miles	0	68642343,2850547 dry gals	
<i>From Brazil Port to California Port</i>	Mode: Ocean Tanker		
Miles	8.953	100%	
<i>From California Port to Blending Terminal</i>	Mode: HDD Truck		
Miles	40	100%	
<i>California Blending Terminal to Refueling Station</i>	Mode: HDD Truck		
Miles	50	100%	

Conclusion

We commend CARB for its efforts to simplify and make the LCFS registration process more efficient. We also appreciate the opportunity to have an open channel of communication with staff involved in this process. We urge CARB to consider our suggestions and ensure that sugarcane ethanol is fairly scored in the GREET-CA 3.0 modeling and that Californian consumers reap the benefits of sugarcane ethanol. We are at staff's disposal to

work in any aspect of our suggested modifications, or to provide any additional data from the current experiences and anticipated trends in Brazil.

We hope this letter will contribute to improving the development of the LCFS in California and we remain at your disposal to answer any additional questions you or your staff may have.

Sincerely,



Elizabeth Farina
CEO



Leticia Phillips
Representative-North America

EXHIBIT A – Mechanization Percentage Credit Options For Sugarcane Ethanol

EXHIBIT B – Ethanol Pipelines in Brazil

EXHIBIT C – Sugarcane ethanol exports to California - Vessel Routes