Method 2B Pathway Application Summary: PT Indolampung Distillery—Production of Fuel Ethanol from Molasses

Plant Summary

The PT Indolampung Distillery (ILD) produces fuel grade ethanol from molasses, a low-value byproduct of sugar production. The company is located in Lampung Province of Southeastern Sumatra and is Indonesia's largest ethanol distillery. The distillery's sources of molasses are three nearby sugar factories that together produce approximately 500,000 metric tons of raw sugar annually.

ILD's ethanol production process parallels the Brazilian sugarcane ethanol production process in terms of both the fermentation technology used, and the generation of process heat and electricity from bagasse combustion. The ethanol plant uses a standard yeast-based sugar fermentation technology that is almost identical to the Brazilian process. The plant cogenerates heat and electricity for all its industrial operations from sugarcane bagasse and is not connected to the local electrical grid. The major difference between these pathways is the feedstock: whereas the Brazilian mills ferment sugarcane juice, ILD ferments molasses.

ILD has an annual ethanol production capacity of 18.5 million gallons, 13.2 million gallons of which it intends to sell into the California transportation fuel market. ILD will ship its product to California by ocean tanker. ILD fuel ethanol will be marketed in the United States by Nature Products Ltd of Palo Alto, California.

Carbon Intensity of the Fuel Produced

ILD has estimated that the carbon intensity (CI) of the ethanol it produces is 29.19 gCO_2e/MJ. This CI is low relative to even the lowest LCFS CI for sugarcane ethanol: 66.4 gCO_2e/MJ. The CI of the production stage in the fuel life cycle is identical for sugarcane and molasses ethanol; however, molasses' CI advantage is a result of its status as a sugar production byproduct. The GHG emissions generated by the production of sugar (including those associated with sugarcane cultivation), must be allocated between the primary product (raw sugar), and the byproduct (molasses).

The allocation of emissions between raw sugar and molasses is based on the proportion of sales revenues that accrue to each product for each ton of fermentable sugar that enters the sugar production process.[1] Because sugar generates significantly more revenue than molasses, most of the emissions associated with sugar production are allocated to the sugar. The molasses that ILD uses as a feedstock cannot be refined into a food-grade product. If it is not used to produce ethanol, it is used primarily as a livestock feed amendment.

[1] Gopal and Kammen. Molasses for ethanol: the economic and environmental impacts of a new pathway for the lifecycle greenhouse gas analysis of sugarcane ethanol. Environmental Research Letters (2009) vol. 4 (4) pp. 044005.

The CI of sugar production, including the agricultural and feedstock transport processes, is 47.58 gCO_2e/MJ. Based on sugar and molasses market price data going back six years, ILD calculates that 14.19 gCO_2e/MJ accrues to the molasses.

The emissions that require allocation are those generated by the upstream (agriculture-related) and sugar-manufacturing phases of the pathway. The purpose of the allocation step is to subtract from the ethanol production totals emissions that are associated only with the production of final raw sugar (which is not an ethanol feedstock). Those upstream and sugar-production emissions that are allocated to molasses are added to the ethanol production and finished fuel transport emissions. The result is the total lifecycle CI value for ILD's molasses ethanol.

The CI of each primary stage in the molasses ethanol lifecycle, as well as the total direct CI of the finished fuel, is shown in Table 1.

Table 1: Carbon Intensities of the Primary Stages in the Molasses Ethanol Lifecycle

GHG Emissions for molasses prod. (gCO_2e/MJ of anhydrous ethanol)--Ag phase and cane transport	Ethanol processing GHG Emissions (gCO_2e/MJ of anhydrous ethanol)	Transportation and Distribution of Finished Ethanol (gCO_2e/MJ of anhydrous ethanol)	Total WTT GHG Emissions (gCO_2e/MJ of anhydrous ethanol)
14.19	2.61	5.15	21.95

ARB staff has not yet estimated the land-use-change (LUC) component of the molasses ethanol CI. Until that value is estimated, staff proposes the use of an interim value calculated from the LUC value for Brazilian sugarcane ethanol. The proposed interim molasses ethanol value consists of the Brazilian value of 46 gCO_2e/MJ multiplied by the proportion of fermentable sugars in sugarcane juice that ends up in the molasses used as feedstock for ILD's process. That proportion is 0.14. The result is a proposed interim value of 6.44 gCO_2e/MJ. Adding this interim LUC value and denaturant to the direct CI from Table 1 produces a total CI of 29.19 gCO_2e/MJ, as shown in Table 2.

Table 2: Proposed Lookup Table Entries

Fuel/Feedstock	Proposed Lookup Table Pathway Description	Carbon Intensity in gCO_2e/MJ (Including Indirect Effects)	Do Special Conditions Apply? (Y/N)[1]
Ethanol/Molasses	Indonesian Ethanol produced from molasses, a byproduct of Indonesian sugar production	29.19	Y

[1] The special conditions to which this column refers are discussed in the "CI of the Fuel Produced" section of this summary.

The operations at the ILD plant will be subject to conditions designed to ensure that the CI value in Table 2 will be met during real time operations. The thermal and electrical energy use values at ILD's plant will become operating conditions upon approval by the Executive Officer of the proposed CI value. The applicant will also provide ARB staff with annual data on the relative revenue shares accruing to Southeast Asian molasses and sugar so that staff may monitor the direct CI of the ILD product. Sustained significant changes in the direct CI of ILD's fuel will require an amended Method 2B application.

Staff Analysis and Recommendation

Staff has reviewed ILD's pathway application, and finds the following:

- Staff has replicated, using ILD's allocation formula and the CA-GREET spreadsheet, the CI values reported by ILD;
- Staff agrees that the plant energy consumption values reported in ILD's application accurately represent the plant's actual energy consumption; and
- Staff agrees that the market-based method used to allocate GHG emissions to the molasses feedstock is valid and compliant with applicable ISO 14000 guidelines.

On the basis of these findings, the staff recommends that the ILD's application for a Method 2B pathway be approved.