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Production of Biodiesel from Corn Oil Extraction at Corn Ethanol Plants: Pathway Summary

ARB staff has estimated the carbon intensity for the production of biodiesel fuel using corn oil extracted at dry mill corn ethanol plants producing dry distillers' grains with solubles (DDGS). The estimated carbon intensity for this pathway is 5.9 gCO2e/MJ of biodiesel produced. This value does not include any emissions due to indirect land use changes (ILUC). ARB staff's estimate for the emissions associated with corn oil extraction at corn ethanol production facilities is based on information provided by Greenshift Corporation, a company that has commercialized corn oil extraction processes. It is the ARB staff's understanding that a number of companies have developed, or are developing, processes for the extraction of corn oil from distillers' grains with solubles (DGS) at corn ethanol production facilities. There is much more publicly available information on the Greenshift processes, and it is for this reason that ARB staff used the Greenshift information as the basis for its analysis. If information from other corn extraction processes is published, ARB staff will incorporate this into its analysis.

The Greenshift corn oil extraction processes extract corn oil from the thin stillage produced at corn ethanol plants following fermentation and distillation. The Greenshift processes use a combination of washing and centrifuging to extract 60 to 75 percent of the corn oil contained in the stillage. This translates to about 6.5 gallons of corn oil per 100 gallons of ethanol produced at corn ethanol plants. The extracted corn oil is sent to biodiesel production plants where the corn oil is converted to fatty acid methyl esters (FAME) biodiesel using a transesterification process, as is done to produce biodiesel from soy oil.

Corn oil extraction facilities using the Greenshift process can be added to pre-existing corn ethanol plants with little modification to the plant and no effect on the ethanol production. ARB staff believes that as corn oil-based biodiesel becomes a more attractive option for compliance with the Low Carbon Fuel Standard (LCFS), corn oil extraction facilities will be added in this manner to pre-existing corn ethanol plants. ARB staff believes that corn ethanol will always be the primary fuel produced with corn oil being secondary.

The extraction of corn oil using the Greenshift process requires additional thermal energy that is used to heat the stillage and additional electricity requirements to run the motors on the pumps and centrifuges. However, there are energy savings that exceed the additional thermal and electricity requirements. These savings occur because the removal of the corn oil reduces the mass of the stillage that needs to be dried while also increasing the heat transfer characteristics of the stillage that is dried. Using the Greenshift information, ARB staff has estimated that the installation of corn oil extraction at pre-existing ethanol plants reduces the energy use at the plant by about nine percent.

ARB staff has assumed that the carbon intensity values for corn oil biodiesel pathway components other than the corn oil extraction (production of biodiesel from corn oil, corn oil transportation, biodiesel transportation, etc.) are the same as those in the other published ARB pathways. For example, the carbon intensity for transesterification of the corn oil is the same as the transesterification carbon intensity calculated in the ARB's pathway for the conversion of soy beans to FAME biodiesel. Because two fuel products (ethanol and corn oil) are produced at corn ethanol plants, the allocation of some of the emissions associated with the corn production and transportation can be complicated. Various schemes for allocating these emissions have been suggested. But ARB staff decided to allocate all of the emissions associated with corn production and transportation to the carbon intensity of corn ethanol, and none of the emissions to corn oil. The reason for this lies in the incremental and secondary nature of the corn oil production. Because corn oil production facilities will be added to pre-existing corn ethanol plants, ARB staff believes that the carbon intensity of corn oil should be calculated as a marginal, or incremental, carbon intensity including only the additional energy requirements and savings that occur as a result of adding the corn oil extraction facility. For the same reason, ARB staff believes that any and all emissions associated with indirect land use changes should all be allocated to corn ethanol. Staff recommends that the Executive Officer approve this pathway.