Production of Biodiesel from Corn Oil Extraction at at Dry Mill Corn Ethanol Plants

Summary

ARB staff has developed a California corn oil biodiesel (BD) pathway in which the feedstock is produced in Midwestern corn ethanol plants and shipped to California for fuel production. The resulting pathway CI is 4.00 grams of CO_2-equivalent greenhouse gas emissions per mega joule of biodiesel produced (gCO_2e/MJ). Although the feedstock transport, biodiesel production, and finished fuel transport portions of this pathway are identical to those found in ARB's soybean-to-biodiesel pathway,[1] the feedstock production portion has no precedent in any other pathway. Calculation of the CI for that step requires that the energy consumption and greenhouse gas (GHG) generation associated with the production of corn oil be appropriately allocated between corn ethanol and corn oil.

In order to begin co-producing corn oil, standard dry mill corn ethanol plants need only be retrofitted with a centrifuge-based extraction system. This system extracts corn oil from the distillers' grains that emerge from the fermentation and distillation processes. As such, it has no direct impacts on the production of corn ethanol. It does, however, reduce the volume and lipid content of the distillers' grains with solubles (DGS) the plant produces.

The corn oil that is extracted from the DGS stream is an unrefined product that has two primary uses: a livestock feed additive and a biodiesel feedstock. This document summarizes a California Low Carbon Fuel Standard (LCFS) pathway in which corn oil produced at dry mill corn ethanol plants is used to produce biodiesel. This pathway does not apply to production processes in which the extracted corn oil is used for purposes other than the production of biodiesel for use as a transportation fuel. In addition, it is specific to ethanol production environments in which all DGS is fully dried. Dry DGS has a moisture content of around ten percent.

ARB staff's estimate of the carbon intensity (CI) of corn oil biodiesel is based on information made available by Greenshift Inc.—a company that has commercialized a corn oil extraction process. Although Greenshift's is not the only available extraction process, more information is publicly available on its process than is available on alternative systems.

Under the Greenshift process, corn oil is removed from the DGS process stream through a combination of washing and centrifuging. The extracted corn oil is shipped to a biodiesel production plant where it is converted to fatty acid methyl

[1] ARB (2009). Detailed California-Modified GREET Pathway for Conversion of Midwest Soybeans to Biodiesel (Fatty Acid Methyl Esters-FAME); version 3.0: http://www.arb.ca.gov/fuels/lcfs/121409lcfs_soybean.pdf

ester (FAME) biodiesel using a transesterification process—the same process that is used to produce biodiesel from soy oil and other oil- and fat-based feedstocks.

The equipment used to extract corn oil at corn ethanol plants consumes both thermal and electrical energy. This additional energy consumptions is more than offset, however, by energy savings realized during the DGS drying process. Energy is saved because the removal of corn oil both reduces the mass of the DGS entering the dryers, and improves the efficiency with which that DGS transfers heat. Based on information from Greenshift, ARB staff estimates that the production of corn oil at an ethanol plant reduces the net energy consumption of that plant by about nine percent. These savings would be realized only when all DGS is fully dried.

At dry mill plants that produce both ethanol and corn oil, the primary product is ethanol. Staff has no reason to believe that corn oil will ever replace ethanol as the primary product at such plants. Since corn oil production is incremental and secondary to ethanol production, staff has concluded that no portion of the GHG gas emissions associated with the production of ethanol should be allocated to corn oil biodiesel. Because corn oil extraction equipment can be installed in existing corn ethanol plants, ARB staff believes that the carbon intensity of corn oil should be calculated as a marginal, or incremental, carbon intensity, consisting only the additional energy requirements and savings that occur as a result of operating corn oil extraction equipment.

Staff is confident that corn oil biodiesel produced according to the pathway summarized above would have a carbon intensity of 4.00 gCO_2e/MJ. For that reason, staff recommends that the Executive Officer approve that pathway.