Staff Summary
Method 2B (Feedstock Only) Application
Sustainable Oils
Camelina Sativa to Camelina Oil

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Pathway Summary

Sustainable Oils, a wholly owned subsidiary of Global Clean Energy Holdings, Inc., has applied for a Method 2B (feedstock only) pathway for the conversion of camelina sativa to either biodiesel or renewable diesel. A feedstock-only pathway would allow a fuel producer interested in producing either biodiesel or renewable diesel from a camelina feedstock using Sustainable Oils' proprietary seed varieties to combine the carbon intensity (CI) of this pathway for the production of a camelina oil feedstock with the carbon intensity components of the fuel producer's fuel production and transportation processes. This feedstock-only pathway includes only the CI components for farming, agricultural chemicals, camelina transportation, and oil extraction. Any fuel producer interested in using as a feedstock camelina produced using Sustainable Oils' seed varieties would be required to apply to the ARB under the Method 2B process. The fuel producer would have to include in its application the CI values particular to its fuel production process for oil transportation, biodiesel or renewable diesel production, biodiesel or renewable diesel transportation and distribution, and biodiesel or renewable diesel combustion. Because it is not a full well-to-wheel fuel pathway, the Sustainable Oils feedstock-only pathway will not be available for reporting purposes in the Low Carbon Fuel Standard Reporting Tool-Credit Bank and Transfer System (LRT-CBTS).

Camelina sativa (camelina) is a member of the mustard family and a distant relative to canola. Camelina is primarily grown in Montana, eastern Washington, the Dakotas, and Alberta, Canada. Camelina has historically been grown in rotation with row crops or cereals, and has not been grown for human consumption. Camelina contains about 35 to 38 percent oil, which makes it suitable for biofuels production. Camelina meal can be used as livestock feed. Camelina has been evaluated most intensively as a rotation crop that can fit into the traditional winter wheat, spring wheat and fallow crop cycles on dryland wheat farms. In addition to growing camelina on fallow wheat acreage, its agronomic attributes allow it to be inter-cropped with perennials, double-cropped with row crops and fit into other shoulder periods between primary crop harvesting and next crop planting.

Sustainable Oils has developed three proprietary Camellia seed varieties. These seed varieties are referred to as SO-40, SO-50, and SO-60. Superior yield is the most favorable characteristic of the varieties developed by Sustainable Oils. The yields are up to about 1,700 pounds of grain per acre, for an oil yield of up to about 670 pounds per acre, on average. Sustainable Oils has three more varieties of Camelina that are pending for submittal for patent, which will produce shorter gestation periods, greater yield, and increased seed size. However, these three see varieties are not included in this feedstock-only pathway.

The primary steps in a camelina-to-biodiesel/renewable diesel pathway are the following: 1) Camelina cultivation, 2) Harvesting and seed transport to an extraction facility, 3) Oil extraction, 4) Oil transport to a biodiesel/renewable diesel production facility, 5) Production of biodiesel/renewable diesel fuel, 6) Transport of biodiesel/renewable diesel to a fuel distribution center, and 7) Combustion in a motor vehicle. These steps are essentially the same as for the production of biodiesel from other crops, such as soybean. However, as mentioned earlier, as a feedstock-only pathway, the Sustainable Oils camelina pathway would include only the first three steps. Any fuel producer using the Sustainable Oils feedstock-only pathway described in this Summary would be required also to calculate using the applicable CA GREET model the greenhouse gas emissions particular to its pathway for steps four through seven.

Carbon Intensity (CI) of Biodiesel/Renewable Diesel Feedstock Produced

The carbon intensity value of Sustainable Oils' feedstock-only pathway has been evaluated using the CA-GREET1.8b spreadsheet. Sustainable Oils is using values for farming energy, nitrogen use, phosphorous use, and potassium use specific to its pathway as inputs to CA-GREET 1.8b. The values used by Sustainable Oils are available in a peer-reviewed publication of the American Institute of Chemical Engineers[1].

The energy required to extract camelina oil was assumed to be equal to the canola oil extraction energy specified in ARB's Pathway for the conversion of canola to biodiesel: 1,225.92 Btu per pound of oil. Sustainable Oils considers canola to be the seed most similar to camelina, and for this reason, used the Canola Pathway energy extraction value.

The carbon intensity (CI) value for the Sustainable Oils feedstock-only pathway using the CA GREET inputs and the assumptions described above is 7.58 gCO_2e/MJ of biodiesel or renewable diesel. The table below shows the proposed LCFS Lookup Table entry for the proposed Sustainable Oils Camelina Feedstock-Only Pathway. The table shows only direct emissions associated with this pathway. Staff has concluded that the emissions associated with indirect land use change (ILUC) are negligible, and has assigned an ILUC factor of zero to this pathway carbon intensity value. This is discussed in more detail in the following section.

[1] Shonnard, David R., et. al, June, 2010, Camelina-Derived Jet Fuel and Diesel: Sustained Advanced Biofuels, Environmental Progress & Sustainable Energy (Vol. 29, No. 3).

Proposed Lookup Table Entry for Camellia Oil Produced from Sustainable Oils' Seed Variety

Feedstock	Pathway Identifier	Pathway Description	Carbon Intensity (gCO_2e/MJ)		
			Direct Emissions	Land Use or other Indirect Effects	Total[a]
Camelina Oil Produced Using Sustainable Oils' Camelina Seed Variety	Not Applicable	Method 2B (Feedstock Only) Application*; Production of Camelina Oil in North America Using Sustainable Oils' Seed Variety for Use as a Feedstock for Producing Biodiesel or Renewable Diesel	7.58	0	7.58

* Special operating conditions apply.

a The CI values reflect feedstock-production only emissions, including both the direct and the indirect emissions components. Staff concludes that the greenhouse gas emissions from indirect land use change (ILUC) are zero.

Indirect Land Use Change Emissions

Camelina is currently a low-value crop, as it has limited uses other than for biofuels. The revenue per acre for camelina is about half that of wheat and about a quarter that of soybeans. Current market conditions indicate that camelina will most likely be grown in rotation with wheat on non-irrigated land during periods when wheat fields would otherwise be left fallow. Camelina is typically integrated into the traditional wheat rotation by replacing the fallow period every third or fourth year. It fits into the fallow-cropping approach because of its low moisture and nutrient requirements. Substituting fallow land with camelina production would not typically displace another crop, so it is unlikely that new land would need to be brought into agricultural use to increase camelina production.

It is not expected that the market dynamics of camelina with respect to other crops such as soy and wheat will change significantly in the near term. It is expected that returns on camelina will remain relatively low, and farmers are not expected to grow camelina on land that would otherwise be used to grow cash crops with well-established prices and markets. Also, since camelina currently does not have other significant markets, expanding production and use of camelina for biofuel purposes is not likely to have impacts on other agricultural commodity markets. Therefore, expanded camelina production is not expected to result in any significant indirect land use change impacts. For this reason, staff has assigned an indirect land use change (ILUC) emissions component of zero gCO2e/MJ to the carbon intensity of camelina. This is consistent with the analysis of the United States Environmental Protection Agency (US EPA). The US EPA concluded that because of the

limited production and use of camelina, there would be no expected impacts on other crops and therefore no indirect land use change impacts[2]. Staff will continue to follow the development of camelina and its penetration into the agricultural commodity market and its potential to displace any other crop in the market. If it appears that an increase in camelina production has the potential to cause indirect land use changes, staff will consider revising the zero ILUC emission factor.

Applicable Operating Conditions

Use of the CI values specified in this summary will be subject to the following operating conditions designed to ensure that the CI of camelina oil produced from camelina using Sustainable Oils' seed varieties will remain at or below the value shown in the above table. These conditions will also be used to evaluate whether the assumptions behind this camelina feedstock-only pathway need to be adjusted for future camelina production.

- The camelina from which the camelina oil is produced is restricted to certified Sustainable Oils United States Trademark and Patent Office (USTPO) registered seed varieties SO-40, SO-50, and SO-60.
- The camelina from which the camellia oil is produced is restricted to certified USTPO Sustainable Oils seed varieties, SO-40, SO-50, and SO-60 grown in a fashion that does not displace other crops.
- To help ensure that the emissions from agricultural chemical use does not exceed the values used to calculate the CI for this feedstock-only pathway, Sustainable Oils shall report annually to the ARB the actual applications of all chemicals used that are used as CA-GREET inputs to calculate CI.
- To help ensure that the assumptions on which the zero land use change assumption is based are valid, Sustainable Oils shall report annually to the ARB the amount and type of land that is used to produce pathway compliant camellia oil produced from USTPO Sustainable Oils seed varieties, SO-40, SO-50, and SO-60. The annual reports shall include the number of acres on which camelina from Sustainable Oils' seed varieties is being grown, the amount of camelina from Sustainable Oils' seed varieties that is produced on this land, and the type and the amount of the primary crop produced on this land.

Staff Analysis and Recommendation

Staff has reviewed Sustainable Oil's Method 2B application, and finds the following:

- Staff has replicated, using the CA-GREET 1.8b spreadsheet, the carbon intensity value calculated by the applicant and shown in the table above; and
- Staff has concluded that the CI value of camelina oil produced using Sustainable Oils' camelina seed varieties is not likely to exceed the value shown in the table above.
- Staff has concluded that Sustainable Oils is capable of complying with the operating conditions set forth in this document.

On the basis of these findings, staff recommends that Sustainable Oils' application for a camelina feedstock-only pathway, as described in this Summary, be approved.

[2] Federal Register, Vol. 78, No. 43, March 5, 2013, Page 14197