Staff Summary
Method 2B Application
Great Plains Ethanol, LLC dba. Poet Biorefining Chancellor
Corn and Sorghum Ethanol
(ETHC096 and ETHG014)

Deemed Complete Date: January 23, 2014
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Certified Date: March 3, 2014

Pathway Summary

POET Biorefining Chancellor (Chancellor) produces ethanol from corn and sorghum at a dry mill plant in Chancellor, South Dakota. According to the plant's Title V Air Quality Operating Permit from the South Dakota Department of Environment and Natural Resources, the plant can produce up to 120 million gallons of undenatured ethanol per rolling twelve-month period. The plant utilizes biogas and waste wood products in addition to natural gas (NG) and electricity for process energy. The biogas originates as landfill gas from the Sioux Falls Regional Sanitary Landfill (SFRSL). It is collected and processed at SFRSL, and delivered to the plant via a dedicated pipeline. NG, which is delivered to the plant through a separate pipeline, is used in the distiller's grains with solubles (DGS) dryers, in the thermal oxidizer, and in the boilers during periods when biogas from the landfill is unavailable. The plant obtains NG and electricity from local utility distribution grids. The plant dries 100 percent of the DGS it produces. Both feedstocks are obtained from Midwestern suppliers.

Chancellor applied for one corn and one sorghum ethanol pathway under the Method 2B provisions of the California Low Carbon Fuel Standard (LCFS). All DGS produced under both pathways is dried to a moisture content of approximately 9.7 percent. Adding to the complexity of the plant's process power mix is the fact that the biogas the plant utilizes results in a carbon intensity (CI) credit for the methane emissions avoided at the SFRSL.

The Sioux Falls Regional Sanitary Landfill

SFRSL— the largest landfill in the state of South Dakota—is operated under a permit issued by the South Dakota Department of Environment and Natural Resources.[1] It was established at its current location, approximately five miles west of the city of Sioux Falls, in 1979. Landfill gas is extracted from 134 wells on site. Extracted LFG is either flared or processed into biogas and conveyed to the Chancellor plant via a dedicated 11-mile, 12-inch diameter, low-pressure pipeline. [2]

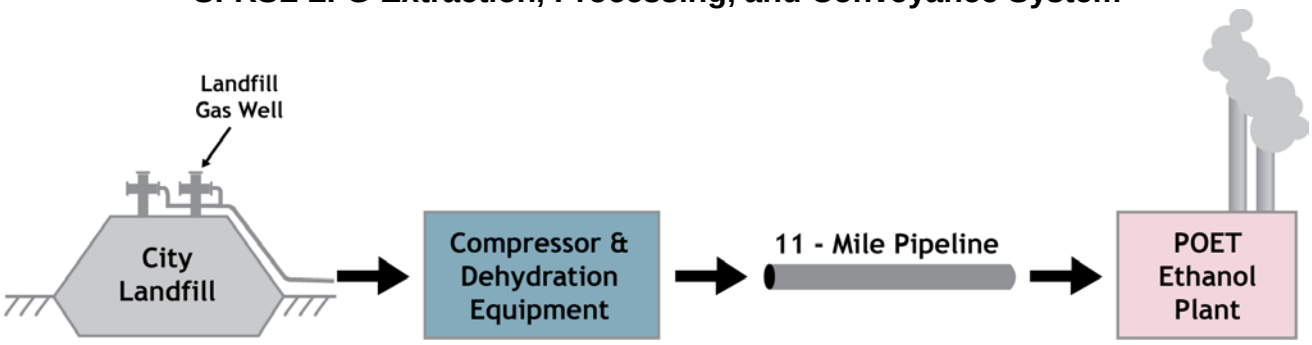
[1] Sioux Falls Sanitary Landfill: http://www.siouxfalls.org/public-works/landfill.aspx
[2] City of Sioux Falls Landfill Gas Pipeline: http://www.siouxfalls.org/~/media/Documents/publicworks/solidwaste/2010/Landfill_Gas_Pipeline_Informational_Handout.pdf

The design capacity of the SFRSL exceeds the 2.5 million megagram and 2.5 cubic meter thresholds that trigger review under the federal New Source Performance Standards (NSPS), Emission Guidelines (EG) and National Emission Standard for Hazardous Air Pollutants (NESHAP). That review, completed in 2008, revealed that the emissions threshold that would trigger the requirement to install an LFG extraction and destruction system (50 Mg/year of nonmethane organic compounds, or NMOCs) was not exceeded. NMOC emissions from the SFRSL only reached 21.1 Mg/year, and were projected to reach a maximum of only 24.2 Mg/year.[3]

Even though an LFG extraction and destruction system was not required under any applicable regulatory program, The City of Sioux Falls installed an extraction system in 2005-2006 for the sole purpose of supplying the Chancellor plant with biogas for process energy. After the installation of the first test wells in 2005, up until the signed agreement between the City of Sioux Falls and Chancellor plant for supply of biogas in 2008, the city of Sioux Falls and POET Biorefining worked closely together to determine quantity, quality, and engineering for the project. Under that agreement, the City of Sioux Falls owns and operates the extraction, processing, and biogas conveyance facilities. Chancellor purchases the biogas these facilities produce and convey.

Landfill gas generally contains about 40 to 60 percent methane. Most of the impurities (including moisture, hydrogen sulfide, and siloxane) are stripped at a processing plant at the SFRSL. These impurities are identified and monitored by an on-site continuous data monitoring system. All LFG collection, processing, and biogas conveyance facilities are powered by electricity from the local grid. A typical LFG to biogas fuel system is shown in the schematic, below.

SFRSL LFG Extraction, Processing, and Conveyance System



[3] AquaTerra Environmental Solutions, Inc. Tier II testing report, 2008. Discussed in the Verification Report for Sioux Falls Regional Sanitary Landfill (CAR 462), pages 10-11

Avoided Methane (CH_4) Credit

Under the fuel pathway described in this summary, the CI of ethanol produced at the Chancellor plant includes a credit for avoided methane emissions. This credit is based on the amount of methane combusted for process energy at the plant. Most of this combusted methane would otherwise have been emitted to the atmosphere at the SFRSL. The CA-GREET 1.8b model was modified to estimate the emissions credit. The final credit consists of the methane in the biogas combusted at the Chancellor plant, adjusted to reflect the

- oxidation that occurs as LFG passes through the upper layers of the landfill on its way to the surface,
- emissions from the energy consumed in processing the LFG and in transporting the resulting biogas to the Chancellor plant, and
- combustion emissions from the biogas consumed in the Chancellor plant.

Biomass (Waste Wood Products) Energy

Chancellor obtains a portion of its process thermal energy from the combustion of waste wood products which includes downed trees, broken wood pallets, storm damaged trees, forest residues, and other wood milling products. Chancellor employs a solid fuel boiler to produce steam from these waste wood streams. This boiler also combusts natural gas and biogas as needed. All wood is chipped before arriving via truck at the POET facility. The wood vendor estimated that the fuel needed to process or chip the wood delivered to the Chancellor plant is 2.10 gallons of diesel fuel per ton of wood.[4] The average distance from the wood collection site to the plant is about 27.5 miles. The residue ash from waste wood combustion is transported to a landfill for use as daily landfill cover. The CA-GREET 1.8b was modified to estimate the emissions from wood processing and transport as well as ash handling and transport.

Carbon Intensity of Ethanol Produced

Due to the nature and complexity of these pathways, Chancellor modified the CA-GREET to estimate the CIs for both corn and sorghum-based ethanol. Chancellor has provided empirical data to validate its corn ethanol yield, but, as yet, has no data on sorghum ethanol yields. Chancellor therefore used the CA-GREET sorghum ethanol yield of 2.72 gal/bu, a value that is consistent with values from the literature validated with three reputable published studies demonstrated sorghum ethanol yield of 2.80[5] gal/bu, 2.65[6] gal/bu, and

[4] Email from Mr. Chad Fodness of Mueller Pallets, LLC to Ms. Rachel Kloos, July 30, 2013. (Mueller Pallets, 27059 Mueller Place, Sioux Falls, SD 57108. http://www.mpallets.com

[5] Yan, S. et al. (2011) Evaluation of Waxy Grain Sorghum for Ethanol Production. *Cereal Chemistry*, 88(6): 589-595. Ethanol yield 2.80 gal/bu listed on page 591.

[6] Wu, X et al. (2013) Evaluation of Nebraska Waxy Sorghum Hybrids for Ethanol Production. *Cereal Chemistry*, 90(3): 198-203. Ethanol yield 2.65 gal/bu listed on page 200, page 4 of pdf.

2.74[7] gal/bu respectively. The average of these yields estimated to be 2.73 gal/bu, which is consistent with the CA-GREET model.

As shown in the following Table, the applicant has calculated the CIs of its corn and sorghum ethanol pathways to be 63.88 gCO_2e/MJ and 67.50 gCO_2e/MJ respectively. The LCFS lookup table currently contains no pathways that utilize an energy mix consisting of biogas from a landfill, biomass from waste wood products, natural gas, and electricity. Therefore, the Chancellor pathways fall under the Method 2B provisions of the LCFS. As such, these pathways are not subject to the substantiality requirements with which Method 2A applications must comply (a minimum improvement of five gCO_2e/MJ, and a minimum production volume of ten million gallons per year).

Proposed Lookup Table Entries for Chancellor Plant

Fuel	Pathway Identifier	Pathway Description	Carbon Intensity in gCO_2e/MJ (Including Indirect Effects)		
			Direct Emission	Land Use or Other Indirect Effect	Total
Ethanol from Corn	ETHC096	2B Application*: Midwest Corn; Dry Mill; Dry DGS; 66% NG, 19% Landfill Gas, and 15% Biomass (waste wood products)	33.88	30	63.88
Ethanol from Sorghum	ETHG014	2B Application*: Midwest Sorghum; Dry Mill; Dry DGS; 66% NG, 19% Landfill Gas, and 15% Biomass (waste wood products)	37.50	30	67.50

*Specific Conditions Apply.

Operating Conditions–Green Plains Ethanol, LLC (Chancellor, SD)

Certification of the two pathways described herein will be subject to the following operating conditions:

1. All gallons produced under all certified LCFS Method 2B pathways shall inherit the same CI increment from the consumption of process energy at the plant. The applicants may not allocate process energy CIs so as to reduce the total life cycle CI of some subset of the gallons produced (e.g., those being shipped to California) and

[7] POET (2012) Milo Trial Presentation part 2. *Internal research collected at POET in Laddonia, MO*. Ethanol yield 2.74 gal/bu listed on slide 7.

increase the CI of the remaining gallons. An example of such a reallocation would be associating California-bound gallons with the consumption of biogas and non-California-bound gallons with the consumption of natural gas. In the case of this application, all gallons produced under each pathway will inherit the same process energy CI.

2. Chancellor's corn ethanol pathway CI (ETHC096) is based on ethanol production and DGS yields that are different from the default yield values in the CA-GREET model. These yields must be maintained such that the pathway CI remains at or below the CI certified under this pathway. Yields may be calculated using any accounting period up to and including one year, and may exclude periods of abnormal operations, such as planned maintenance or unpredictable, unavoidable, and uncontrollable *force majeure* events. Should these yields change significantly, Chancellor shall not sell the volumes associated with the changed yields in California under the pathway described in this Staff summary.
3. Chancellor's sorghum ethanol pathway CI (ETHG014) is based values from the literature, which are consistent with the default yield value in the CA-GREET model. This yield must be maintained such that the pathway CI remains at or below the CI certified under this pathway. Yields may be calculated using any accounting period up to and including one year, and may exclude periods of abnormal operations, such as planned maintenance or unpredictable, unavoidable, and uncontrollable *force majeure* events. Should these yields change significantly, Chancellor shall not sell the volumes associated with the changed yield in California under the pathway described in this Staff summary.
4. Total pathway-specific thermal or electrical energy use values, as reported in the Chancellor Method 2B application, may only be exceeded if the actual production CIs remain at or below the LCFS-certified CIs. These process energy consumption values are classified by the applicant as confidential business information. Pathway-specific energy use values may be calculated using any accounting period up to and including one year.

In order for Chancellor plant to sell ethanol (produced from both corn and sorghum feedstocks) in California under the CIs appearing in Table above, these five conditions must be met for every gallon sold.

Staff Analysis and Recommendation

Staff has reviewed the Chancellor application and has replicated, using the CA-GREET model, the carbon intensity values calculated by the applicant for pathways ETHC096 (63.88 gCO_2e/MJ) and ETHG014 (67.50 gCO_2/MJ). Chancellor has provided documentation verifying the plant's thermal (from NG, biogas, and waste wood products) and electrical energy use. The operational information provided by the applicant indicates that the plant is capable of reliably producing ethanol at or below the CIs appearing in the above table. Therefore, staff recommends that POET's application for Method 2B corn and sorghum ethanol pathways for its Chancellor plant be approved, subject to the operating conditions established in this Staff summary. Staff further recommends that these CIs take

effect on the date Chancellor's application is posted to the public LCFS Method 2 website, and apply solely to fuel volumes sold on and after that date.