

REDFIELD ENERGY, LLC

METHOD 2A APPLICATION LIFE CYCLE ANALYSIS REPORT

Introduction

Redfield Energy, LLC (RFE) owns and operates a dry mill, corn-based, ethanol production facility in Redfield, South Dakota. The facility was constructed in 2007, began operations in November of that year and currently operates an ICM designed process with a production volume of 60 million gallons per year undenatured ethanol.

An average¹ of XXX% of the distillers grain and soluble (DDGS) are dried, and XXX% are a modified wet distillers grain and soluble (WDGS) (45% dry matter). The DDGS and WDGS are produced simultaneously and thus there is not practical means in which to collect data on the emissions associated with solely DDGS or WDGS.

RFE's Life Cycle Analysis Report documents the analysis completed for the RFE facility and includes the facility data for a dry mill ethanol production facility and its corresponding carbon intensity (CI) calculation. The CaGREET model was used to calculate the CI value for the facility. The reference pathway for a mid-west dry mill facility using conventional cook process and 100% natural gas was used in the analysis. The reference CI from the low carbon fuel standard (LCFS) lookup table is 98.4 grams of carbon dioxide equivalent per megajoule (gCO₂e/MJ) for DDGS.

The specific modeling parameters used for this analysis are based on actual facility data including ethanol yield, total energy consumption, and energy consumption by fuel type. The actual usage numbers are based on plant operations from September 2010 through October 2013.

Operational Plant Data

Ethanol Yields

Actual ethanol yields from September 2010 through October 2013 were used to calculate the average plant operation parameters. Figure 1 presents the ethanol yield (gallons of undenatured ethanol per bushel of corn, gal/bu). The average value was XXX gal/bu with a trend line indicating stable yield during the operating period as shown on Figure 1.

Figure 1

Ethanol Yield for Redfield Energy, LLC

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¹ Based on average production values from September 2010 through October 2013.

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Natural Gas Consumption

The entire thermal requirement for the facility is generated with natural gas. Figure 2 presents the actual natural gas consumed in the facility from September 2010 through October 2013. The average natural gas consumption is XXX British thermal units per gallon (Btu/gal) with a trend line indicating decreasing natural gas usage during the operating period as shown in figure 2.

Figure 2

Natural Gas Usage for Redfield Energy, LLC

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Electricity Consumption

Figure 3 presents the actual electricity consumed at the facility from September 2010 through October 2013. The average electricity consumption is XXX kilowatt hours per gallon (kWhr/gal) with a trend line indicating a slight increase in electric usage during the operating period as shown in figure 3. This electricity consumption value equates to XXX Btu/gal energy usage and is about XXX kWhr/gal below the 1.08 kWhr/gal energy use value used for determining the CI value for the reference pathway.

Figure 3

Electricity Usage for Redfield Energy, LLC

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All operational data provided was generated from purchase or sales receipts. Therefore, this data is verifiable.

CaGREET Values

A spreadsheet with the actual (by month) and calculated values used as input in the CaGREET model is included as Attachment 1. In addition, Table 1 provides a summary of key input parameters and identifies them by spreadsheet, the cell location, average value, and the default value of the reference pathway used in the CaGREET model.

Dry Mill was set to 100% to prevent the CaGREET model from including other types of ethanol mills in the calculation. Electricity was set to XXX% of the total energy for dried and modified distillers grains respectively which is equivalent to XXX Btu/gallon or XXX kWhr/gallon. Natural Gas was set to XXX% of the total energy (e.g., Total Energy – Electrical energy). Finally, Energy Type NG was set to 100% and Energy Type Coal was set to 0 so that the CaGREET model would calculate only the use of natural gas.

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Table 1

CaGREET Input Data for the Site-Specific CI Calculations

Sheet	Parameter	Cell	Average Value	Default Value	Notes
Fuel_Prod_TS	Ethanol Yield	C271	XXX	2.72	Fill in all time series data with this value
	Total Energy	K271	XXX	36,000	Fill in all time series data with this value
	Dry Mill	C285	100	85%	Fill in all time series data with this value
	Share of Coal	S271	0	20%	Fill in all time series data with this value
Inputs	Electricity	C247	XXX%	10.2%	Gives 0.544 kWhr/gal
	Natural Gas	C246	XXX%	89.8%	Calculated in spreadsheet

Tables 2 and 3 shows the CaGREET emissions calculations from the EtOH worksheet of the CaGREET model and the application of the emission factors for the calculation of the CI in grams of carbon dioxide equivalents per mega-joule (gCO₂e/MJ) of fuel energy. The site-specific denatured ethanol carbon intensity for RFE is 84.9 gCO₂e/MJ which is 13.5 gCO₂e/MJ lower than the reference pathway CI of 98.4 gCO₂e/MJ. Based on the verifiable and sustainable nature of the site-specific data used for this analysis, the CI value should also be considered verifiable and sustainable.

Table 2

**Site Specific CI Calculation for the Redfield Energy Facility
Energy and Emissions Results**

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