

**California LCFS fuel pathway modification: The Adkins Energy LLC Corn Ethanol  
Pathway GREET modeling technical support document**

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## **I. Introduction**

We are applying to add a new pathway to the California LCFS fuel carbon-intensity lookup table. This pathway is for the Adkins Energy LLC (referred to as Adkins hereafter) dry mill ethanol plant, and is a modification to the current corn ethanol pathway. We have replaced certain CA GREET default values with production data specific to Adkins for the period between Jan 2013 and Dec 2014.

Based on our modeling in CA-GREET, we find that the modified pathway has a carbon intensity of **86.33** gCO<sub>2</sub>e MJ<sup>-1</sup>.

## **II. Company Details:**

The Adkins Energy LLC ethanol facility is located at 4350 West Galena Road, Lena, IL 61048. The facility is a corn ethanol production facility located in Stephenson County about one mile southeast of Lena, IL. The facility uses a dry milling process to produce ethanol from corn starch. The facility commenced construction in September 2001 and reached substantial completion in August 2002.

The facility uses typical dry mill and corn starch fermentation technology for ethanol production. The process heat for the ethanol production process is provided by natural gas. The facility is permitted by the Illinois Environmental Protection Agency for an annual production of 60 million US gallons of ethanol per year. The facility is currently operational. The facility has previously been registered for Grandfathered (Dry Mill, Natural Gas Fired) ethanol production on the EPA Moderated Transaction System (EMTS). The facility is currently registered on EMTS with a Baseline Volume and Permitted Capacity of 60,000,000 gallons per year. Under RFS system, the facility is capable of producing Non-cellulosic Ethanol (Fuel Category Code 10) under a D code of 6 utilizing Starch - Corn (Feedstock Code 10) using a Grandfathered, Dry Mill, Natural Gas Fired process (Process Code 10). Significant changes since the original registration include installation of a fourth fermenter and addition of another finished product tank in August 2012.

On October 25<sup>th</sup>, 2012, EcoEngineers performed an-site 3rd party engineering review of the Adkins facility, where EcoEngineers staff met with Joan Humphrey, Chris Posey, and Ray Baker of Adkins Energy LLC. The on-site review included the following activities:

- Review of information provided by the facility on the questionnaires prepared by EcoEngineers
- Tour of the quality control laboratory and ethanol plant

### III. Table of changes to baseline CA-GREET model inputs for the Adkins pathway

The modified input values to CA GREET spreadsheet (ca\_greet1.8b\_Dec09, [1]) are all listed in Table 1, and in the “1.0 Changes made to CA GREET” tab of a separate spreadsheet named “Adkins Original Data File” as well. CI calculation results can be found in the “EtOH” tab of the modified CA-GREET spreadsheet. Cells that needed modified calculations have been marked red in the modified CA-GREET spreadsheet.

Table 1: Changes from CA\_GREET default spreadsheet to Adkins pathway

Parameter	Cell location	CA-GREET default value	Adkins value	Units
<b>Region</b>	Regional LT!C2	US Average	[redacted]	
<b>Fraction dry milling</b>	Fuel_Prod_TS!C285	85%	[redacted]	%
<b>Dry milling NG use</b>	Inputs!C254	32,300	[redacted]	btu/gal
<b>Electricity demand for ethanol production</b>	Inputs!C258	1.08	[redacted]	kWh/gal
<b>Ethanol yield</b>	Fuel_Prod_TS!C271	2.72	[redacted]	gal/bushel
<b>DGS yield*</b>	EtOH!C101	5.34	[redacted]	bone-dry lb/gallon ethanol
<b>Corn transport distance from stack to plant</b>	T&D!FL93	40	[redacted]	miles
<b>Corn ethanol transport distance by rail</b>	T&D!HC93	1,400	[redacted]	miles

\*For Adkins, DGS yield includes mass of corn oil produced

### IV. Basis for the Input Values

This pathway is similar to the published CA-GREET model [1] for corn ethanol production, with changes in the following areas as further detailed below. Next to each item in parentheses is the supporting documentation reference in the “Adkins Original Data File” reference.

1. Fuel production and energy use (2.0 Ethanol production; 3.0 Electricity use; 4.0 NG use)
2. Transport distances (5.0 Transportation)

The modified CA-GREET spreadsheet is included in the application package; results can be found in the “EtOH” tab.

Adkins uses lower natural gas and electricity energy during dry milling compared to default CA-GREET. The fraction of dry milling energy use as electricity is also lower. Adkins has a higher ethanol yield than the default CA-GREET. They produce corn oil and both dry and wet Distillers Grain with Solubles (DGS) as co-products. They sell the DDGS and WDGS into the feed market and the corn oil into the biodiesel market. However, owing to the lack of explicit pathways in the baseline CA-GREET model for corn oil, we assume that they are both sold into the feed market on a mass-equivalent basis with DGS. The corn transportation distance (22 miles) is shorter than default in CA-GREET (40 miles), while the rail transport distance of ethanol (2,000 miles, rounded number from 1,932 miles based on Google map distance of Lena, IL to Los Angeles, CA) is longer than default (1,400 miles). Energy use values in the submitted pathway are based on facility data from January 2013 to December 2014.

## V. CA-GREET Model Output

Table 2: Energy use and emissions from corn ethanol produced at Adkins compared to the default CA-GREET, separated by life cycle stage. Figures are rounded.

Stage	CA GREET default GHG emissions[2] (g/MJ)	Adkins GHG emissions (g/MJ)	Difference (%)
Corn farming and transportation	38.07	36.80	-3%
DGS corn displacement	-11.51	-11.08	-4%
Feedstock total	26.56	25.72	-3%
Dry mill ethanol production	38.30	26.27	-31%
Ethanol transportation and distribution	2.69	3.55	32%
Fuel production total	40.99	29.82	-27%
Fuel combustion	0.80	0.80	0%
Land use change	30.00	30.00	0%
<b>Grand total (WTW)</b>	<b>98.35</b>	<b>86.33</b>	<b>-12%</b>

## VI. Discussion of Results

Table 2 compares GHG emissions from the Adkins pathway to the default Midwest corn ethanol pathway. Due to the higher ethanol yield, lower energy use and lower transport distance of corn, the total GHG emissions of Adkins ethanol decrease 12% compared to

those of the default Midwest corn ethanol. The GHG emissions from ethanol transportation and distribution does increases 32% due to the longer rail transport distance. GHG emissions caused by land use change (LUC) are assumed the same for both pathways, at 30 g CO<sub>2</sub>e MJ<sup>-1</sup>.

## **VII. Production Range of the Adkins Pathway**

The new pathway should be applicable to the Adkins for 100% (60 million gallons/year) of Permitted Capacity.

## **VIII. Sustainability of the Adkins Pathway**

The Adkins plant was designed and constructed using well-established modern designs and equipment and is managed by professional staff well-qualified to assure that over time the energy efficiency of and emissions from the facility do not deteriorate. Any deterioration would result in a less profitable business. Thus the sustainability of the plant is well aligned with the business objectives of the owners.

## **IX. Impact on Land Use**

The GHG emissions from land use change (LUC) is 30 g CO<sub>2</sub>e MJ<sup>-1</sup>, assumed the same as for other corn ethanol pathways in LCFS lookup tables.

## **X. Conclusion**

Based on our modeling in CA-GREET and the available data, we find that corn ethanol produced the Adkins plant has a carbon intensity of **86.33** g CO<sub>2</sub>e MJ<sup>-1</sup>.

## **XI. References:**

1. *CA-GREET model. Available 03/17/2015, at <http://www.arb.ca.gov/fuels/lcfs/software.htm>*
2. *CARB. Detailed California-Modified GREET Pathway for Corn Ethanol. Version 2.1, Feb. 27, 2009. Available 03/17/2015 at [http://www.arb.ca.gov/fuels/lcfs/022709lcfs\\_cornetoh.pdf](http://www.arb.ca.gov/fuels/lcfs/022709lcfs_cornetoh.pdf)*

## **XII. Documents supporting Annual Quantities of energy use and ethanol production**

The data supporting the annual quantities of electricity, natural gas use and corn ethanol production, as well as the modifications to the CA-GREET model are documented in a separate spreadsheet named “Adkins Original Data File”.