VALERO

November 5, 2014

Re: Method 2A Application- Lifecycle Analysis- Excluding Confidential Business Information

California Air Resources Board
Industrial Strategies Division
Transportation Fuels Branch
Fuels Evaluation Section
1001 I Street
Sacramento, CA 95812

To: The Executive Officer

Herewith, please find the application and supporting documents by Valero Renewable Fuels Company, LLC ("VRF") for new fuel lifecycle GHG emissions pathways using the Method 2A application process described in "Establishing New Fuel Pathways under the California Low Carbon Fuel Standard (LCFS) Procedures and Guidelines for Regulated Parties" report by ARB (California Air Resources Board) as updated on January 3, 2013, as well as the recently revised LCFS Regulations.

We seek two new pathways for VRF's ethanol plant located near Aurora, South Dakota ("Aurora").

At Aurora, VRF produces ethanol from corn. The facility uses natural gas for its process energy and electrical power from the local grid. It co-produces modified (nominal 50% moisture) distillers grains solubles (MDGS) and dry (nominal 10% moisture) distillers grains solubles (DDGS), syrup, and distillers corn oil[1]. The co-product mix of distillers grains solubles (modified and dried) is expected to vary in the future depending on market conditions. Distiller's corn oil is used for a variety of purposes, but mainly as animal feed and feedstock for biodiesel and renewable diesel. Since the distiller's oil extracted is expected to be less than xxx% by weight (dry matter basis) of our co-product production, it has been considered part of the DGS production for the purpose of the CI calculations.

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[1] Distiller's oil is oil recovered from the distillers grains prior to drying and is a fraction of the oil in the corn feedstock.

The CARB LCFS regulations stipulate that only pathways lower in carbon intensity value than the main pathway they deviate from can use the Method 2A application. Aurora's pathways are a sub-pathway of the Ethanol from Corn (Dry Mill; Dry DGS, NG) Pathway, because except for the points of deviation summarized in this report, our pathways are identical to the Corn Ethanol (Dry Mill; Wet DGS, NG) Pathway described in the Detailed California-Modified GREET Pathway for Corn Ethanol Well-to-Wheel (WTW) lifecycle analysis and the Detailed California-Modified GREET Pathway for Sorghum Ethanol.[2]

VRF has used the CA-GREET Model 1.8b to calculate the lifecycle greenhouse gas emissions of these sub-pathways. The pathway descriptions and carbon intensity values, based on the input changes to the model described in the attachments, are shown in the following table.

Table 1: Aurora Pathway Descriptions and Carbon Intensity Values Summary

Valero Aurora Dry Mill Ethanol Plant New Pathway CI Values and Cross-Reference for Key Tables in Lifecycle Analysis						
Pathway Number	Feedstock	Co-Product	CI, gCO2/MJ	Input Value Tables	Calculation of Input Values	CI Calculation Tables
1	Corn	100% DDGS	88.85	Table 2	Table 7	Table 10
2	Corn	100% MDGS	85.39	Table 3	Table 8	Table 11

These CI intensity values and our production volumes more than meet the "5-10" substantiality rule and the other requirements of a new pathway.

The following sections of this lifecycle analysis provide the details and documentation of VRF's application for new pathways under Method 2A. Portions of the following information are considered confidential business information and each page with "Contains Confidential Information" in the page header should be considered to contain confidential business information. Pages that have been redacted to remove confidential business information have "Non-Confidential, Redacted Version" in the header. Where redaction has occurs in the text, it is marked with one or more "x" symbols. The number of "x" symbols has no meaning. Each electronic file that includes the word "CONFIDENTIAL" in the file name should be considered

[2] Detailed California-Modified GREET Pathway for Corn Ethanol Well-to-Wheel (WTW) lifecycle analysis, Version 2.1, published February 27, 2009.

to contain confidential business information. If the electronic file does not contain any confidential business information the file name includes the word "PUBLIC".

VRF requests your approval and would be glad to answer any questions you may have about its application. Following please find the names and contact information of the persons who are available to answer questions about the application. Please note that Houston BioFuels Consultants, LLC are assisting us with the application and may be contacted if you have questions or comments about our application

Affiliation:	VRF	Houston BioFuels Consultants, LLC
Name:	Mr. Jordan Penney	Mr. Logan Caldwell, Consultant
Telephone number:	1-210-345-2080	1-281-360-8515
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Respectfully,

Attachments

Attachments

I. WTW Diagram of Aurora Sub-Pathway of the Midwest Corn Ethanol Pathway

Figure 1: WTW Components of the Aurora Pathway are Essentially Identical to the Corn Ethanol (Midwest; Dry/Wet Mill; Dry DGS, NG) Pathway[3]

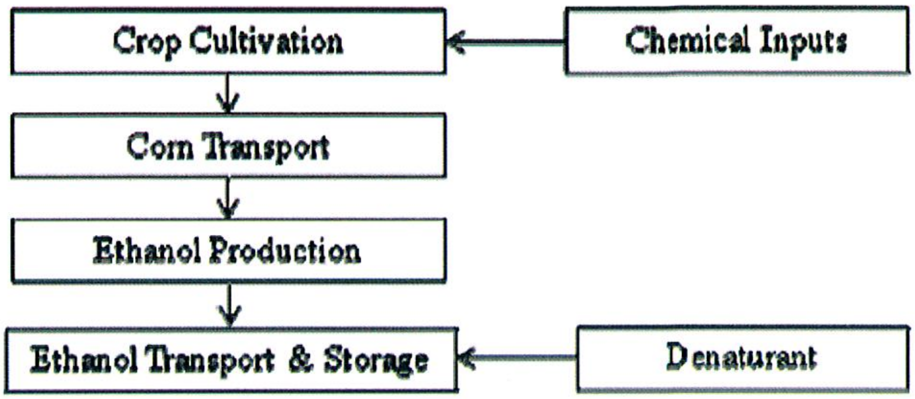


Figure 1. WTT Components for Ethanol Transported to California

Tank-To-Wheel (TTW) analysis includes actual combustion of fuel in a motor vehicle for motive power. Together WTT and TTW analysis are combined to provide Well-To-Wheel (WTW) analysis.

[3] Detailed California-Modified GREET Pathway for Corn Ethanol Well-to-Wheel (WTW) lifecycle analysis, Page 4, Version 2.1, published February 27, 2009.

II. Aurora Plant Information

Aurora Plant Info

1. Facility Name - Valero Renewable Fuels Company, LLC d/b/a Valero Aurora Plant
2. Plant Location – One Valero Place, Aurora, SD
3. History – The facility was built by Verasun Energy in 2003, started in December 2003 and in April 2009 Valero purchased from Verasun Energy.
4. Capacity Notes – 120,000,000 gallons per year
5. Technology – ICM Design
6. Feedstock Type – Corn
7. Product - Ethanol
8. Co-Products – MDGS, DDGS, syrup and distillers corn oil.
9. Process fuel – Natural Gas by pipeline.
10. Power supply – From local utilities.

11. Process Flow Description – The following is a description of the dry mill process.

Milling/Grinding:
Incoming corn is screened for large material and ground to the consistency of coarse flour in the hammermills. After the corn passes through the mill it is called meal. The purpose of this step is to physically prepare the corn for the efficient and rapid introduction of water and enzymes to the starch and make the final mixture reasonably consistent and easy to pump. Grinding to the proper consistency is important for maximizing the conversion of corn starch into ethanol and for the operation of separation devised later in the process.

Cooking:
The meal is mixed with water and an enzyme (alpha-amylase) and passed through cookers where the starch is liquefied at high temperatures to partially sterilize the meal. The term mash is used for product resulting from the cook step.

Liquefaction:
The liquefaction process takes place during the holding period. The mash is heated to approximately 180 – 190 degrees F for up to 8 hours. More alpha amylase is added during the liquefaction phase. Alpha amylase chemically breaks the starch polymers into short sections. A second enzyme, gluco amylase, chemically breaks the short starch polymer sections into individual glucose (sugar) molecules. The mash from the liquefaction phase is cooled and the secondary enzyme (gluco-amylase) is added to convert the liquefied starch to the fermentable sugars (dextrose).

Fermentation:
Mash is pumped into fermentation tanks along with a large amount of yeast. Yeast is added to the mash to convert the sugars to ethanol and carbon dioxide. While in the fermentation tanks, yeast cells efficiently convert simple sugars into ethanol, CO_2 and heat. The fermentation time can vary considerably based on several factors such as yeast strain, rate of enzyme addition, temperature at which fermentation is conducted and final targeted ethanol concentration. During batch fermentation process, the mash stays in one fermenter for approximately 48 hours before it is transferred to the Beerwell, prior to the start of the distillation process.

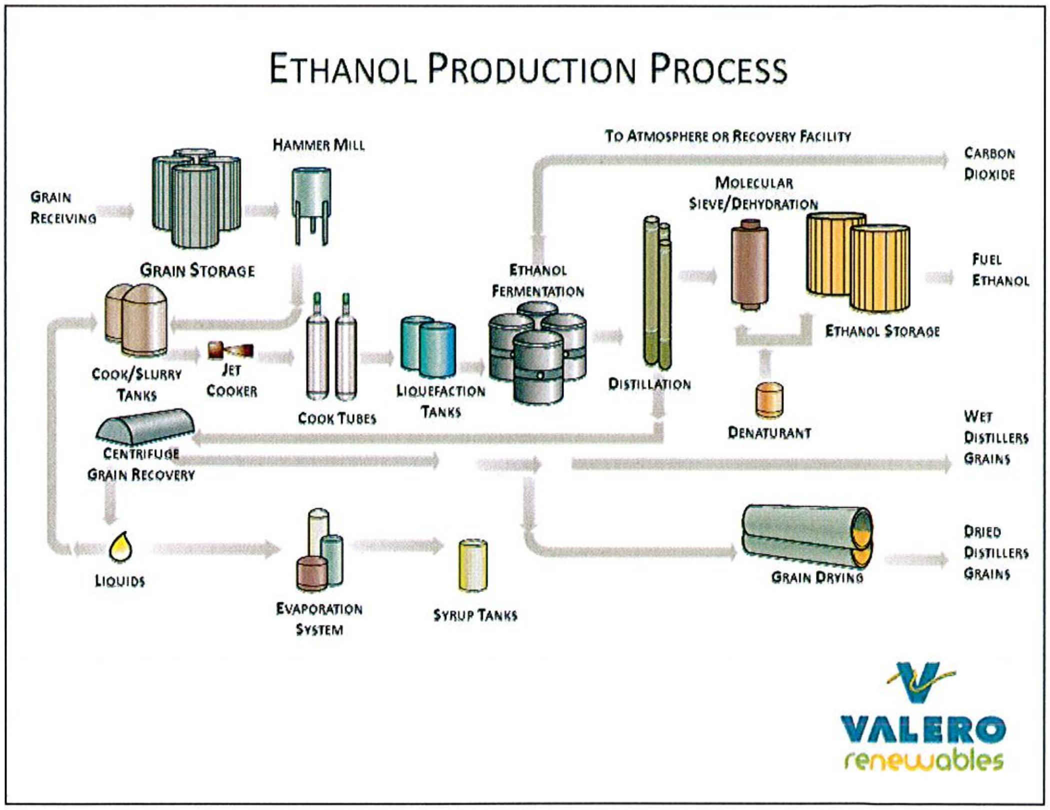
Distillation:
The fermented mash contains approximately 10% alcohol plus water and all the non-fermentable solids from the corn and yeast cells. This mash is fed into the continuous flow, multi-column distillation system where heat is added to boil off the ethanol. The alcohol leaves the top of the column at about 96% strength. Residue water and non-fermentable components commonly referred to as whole stillage, collect at the base of the beer column. Stillage is transferred from the base of the column to the co-product processing area.

Dehydration:
Under optimum conditions distillation produces ethanol which contains approximately 5% water (190 proof ethanol). The alcohol from the top of the rectifier column passes through a dehydration system where the remaining water will be removed. The last of the water is removed through dehydration beds called molecular sieves. The alcohol product after this stage is approximately 200 proof and contains about 1% water. This dehydration step produces a final product that is essentially 100% ethanol.

Denaturing:
Ethanol that will be used for motor fuel is denatured by blending 200 proof product with a small amount (2-5%) of natural gasoline.

Co-Products:
After distillation, the non-fermentable components of the feedstock are processed before sale. This processing generally consists of a minimum of centrifugation to separate the majority of the water from the solids. Centrifugation generally brings the solids content up from a starting point of 10-15% to roughly 25-40%, resulting in syrup. The coarse grain and the syrup are then dried together to produce dried distillers grains with solubles (DDGS). The CO2 is released during fermentation is not captured.

12. Process Block Flow Diagram



13. Energy and Material Balance. For legibility, the energy and material balance for the Aurora ethanol plant is contained in a separate pdf file accompanying the electronic version of this application and is a separate document in the printed, hard copy version of this application. File name: *Aurora Energy and Material Balance CONFIDENTIAL 26Aug14.pdf*

14. In separate documents/electronic files accompanying this application due to file size, please find the latest version of the plant's air permit. This permit contains information about the equipment in the plant that generates emissions from the combustion of fuel. File name: *Aurora Air Permit PUBLIC 26Aug14.pdf.*

III. Table of CA-GREET Model Inputs for Aurora Pathways

The following table depicts the inputs to the CA-GREET Model for the Aurora ethanol plant with Midwest corn feedstock, using natural gas for fuel and power from the local grid with 100% DDGS production.

Table 2: CA-GREET Model Inputs for the Aurora Corn Ethanol DDGS Co-Product Pathway

CA-GREET Model Sheet Name	Cell number	Default Pathway Value	Valero Aurora 100% DDGS Pathway Value	Units	Description	Comments and Table Reference
Regional LT	C2	U.S. Avg and Midwest	Business Confidential	n/a	Region for Analysis	No change. Shown for reference only
Fuel_Prod_TS	L277	36,000	Business Confidential	btu/gal (LHV)	Corn Ethanol Plant Energy Use, Dry Mill	Table 7, Total Energy use
Inputs	C247	10.19%	Business Confidential	%	Electricity % of total process energy	Table 7
Fuel_Prod_TS	D277	2.72	Business Confidential	gal/bu	Ethanol yield of Corn Ethanol Plant, Dry Mill	Table 7

The following table depicts the inputs to the CA-GREET Model for the Aurora ethanol plant with Midwest corn feedstock, using natural gas for fuel and power from the local grid with 100% MDGS production.

Table 3: CA-GREET Model Inputs for the Aurora Corn Ethanol MDGS Co-Product Pathway

CA-GREET Model Sheet Name	Cell number	Default Pathway Value	Valero Aurora 100% MDGS Pathway Value	Units	Description	Comments
Regional LT	C2	U.S. Avg and Midwest	Business Confidential	n/a	Region for Analysis	No change. Shown for reference only
Fuel_Prod_TS	L277	36,000	Business Confidential	btu/gal (LHV)	Corn Ethanol Plant Energy Use, Dry Mill	Table 8, Total Energy use
Inputs	C247	10.19%	Business Confidential	%	Electricity % of total process energy	Table 8
Fuel_Prod_TS	D277	2.72	Business Confidential	gal/bu	Ethanol yield of Corn Ethanol Plant, Dry Mill	Table 8

IV. Basis for the Input Values

Ethanol Production - Selection of Production Period for Calculations

The input values presented in this application are based on the 24-month period from June 2012 through May 2014, the "Production Period." This period was selected based on the plants operating history and the most recent monthly data available at the start of the Method 2A application process.

Distillers Corn Oil Considerations

The Aurora plant started producing distillers corn oil from the distillers grains co-product stream in May 2013. Once production stabilized distillers corn oil production has averaged xxx pounds of distiller's oil per gallon of ethanol produced.[4] This production amount is consistent with other dry-mill ethanol plants extracting distiller's oil. By comparison, the default DGS production on a bone dry basis is xxx pounds of DGS per gallon of ethanol in the default corn dry-mill pathway. The DGS in the default pathway includes the distillers corn oil since there is no extraction of distillers corn oil in the default pathway process flow sequence. The distiller's oil extracted by Aurora is approximately xxx of the DGS production before distillers corn oil extraction. Distillers corn oil from the Aurora plant is used mainly as animal feed and feedstock for biodiesel and renewable diesel. Given the relatively small amount of extracted distiller's oil to the total DGS production, and the relatively small fraction of the CI represented by co-product production, for the purpose of calculating the CI of the Aurora new pathways, the distiller's oil has been assumed to be part of the DGS production.

Measuring Natural Gas Used for MDGS and DDGS Production

The Aurora ethanol plant dries its distillers grains in xxx

Figure 2: Schematic of the Aurora DGS Driers

This figure is considered Confidential Business Information and is not included in this non-confidential, redacted version of the application.

Table 4: xxx

This table is considered Confidential Business Information and is not included in this non-confidential, redacted version of the application.

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[4] Distillers corn oil production during June 2013 through May 2014 averaged xxx pounds per gallon of anhydrous ethanol production and xxx pounds per bushel of corn.

Table 5: xxx

This table is considered Confidential Business Information and is not included in this non-confidential, redacted version of the application.

Table 6: Calculation of NG Use for the 100% MDGS and 100% DDGS Co-Product Pathways Based on Metered NG Use

This table is considered Confidential Business Information and is not included in this non-confidential, redacted version of the application.

Natural Gas Heating Lower Value Basis

xxx

Table 7: Calculation of the Input Values for the Aurora 100% DDGS Pathway

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Table 8: Calculation of the Input Values for the Aurora 100% MDGS Pathway

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V. CA-GREET Model Output, CI Calculations and Analysis of Results

The Aurora corn ethanol pathway carbon intensity values are a sub-pathway of the Midwest, Dry-Mill, 100% DDGS Co-product, 100% natural gas fuel ethanol plant pathway that has a carbon intensity value of 98.40 gCO2e/MJ. The following table shows the calculation of the default pathway using the same downloaded version of the CA-GREET 1.8b model as was used to calculate the CI of the new pathways in this report.

Table 9: CI of Default Corn Ethanol Dry Mill, 100% DDGS, Natural Gas Fuel Pathway

CARB Lookup Table Reference Pathway: Midwest Dry Mill Ethanol Plant, 100% DDGS, NG Fuel Pathway							
		CA-GREET Model Output					
	IPPC factors	Corn	Ethanol	Calculations to convert Output to g/CO2e/MJ			
	gCO2e/g	*Btu or Grams per mmbtu of Fuel Throughput*				gCO2e/mmbtu	**gCO2e/MJ**
		US Avg Corn	Midwest Location	Corn w/loss	Total corn + EtOH		
Total energy		187,247	1,469,428	187,342	1,656,770		
VOC		16.8	55.5	17	72		
CO		151.3	31.4	151	183		
CH4	25	17.4	73.7	17	91	2,276.8	2.16
N2O	298	41.7	0.4	42	42	12,564.9	11.91
CO2	1	15,064	41,354	15,071	56,426	56,425.9	53.48
Sub-total lifecycle CI before denaturant and lt. vehicle combustion						71,267.6	67.55
Denaturant and lt. vehicle combustion effects factor							0.80
Total Lifecycle CI before ILUC with denaturant and lt. vehicle combustion effects included							68.35
Indirect Land Use Change Factor (ILUC)							30
Total CI of Pathway including Indirect Land Use Change							98.35
Note: The calculated result of this pathway prior to making the input changes for the Method 2A application ethanol plant is 67.55 gCO2e/MJ. This matches the Corn Ethanol WTW Analysis result of 67.6 gCO2e/MJ (Table B. GHG Emissions Summary for Dry and Wet Mill Corn Ethanol, page 5) before the denaturant and light vehicle combustion factor of 0.8 gCO2e/MJ is added.							

The carbon intensity values for the new pathways of the Aurora ethanol plant with 100% DDGS production is 88.85 gCO2e/MJ.

Table 10: CI Calculation of Aurora Corn Ethanol, 100% DDGS Pathway:

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The carbon intensity values for the new pathways of the Aurora ethanol plant with 100% WDGS production is 85.39 gCO2e/MJ.

Table 11: CI Calculation of Aurora Corn Ethanol, 100% DDGS Pathway:

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VI. Production Range of Aurora Pathway

As stated in the Aurora Method 2A application form, the new pathways are applicable to the Aurora facilities for at least 118 MGY to 161.5 MGY of denatured ethanol production. The maximum permitted annual production is 165 MGY. Should Aurora plan to produce more than this amount per year, it will first obtain a revised air permit to allow the higher production amount.

VII. Sustainability of Aurora Pathway

The Aurora facility 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.

VIII. Impact on Land Use

There is negligible difference between the land use of this sub-pathway and that of the Corn Ethanol (Corn Ethanol Dry Mill; Dry DGS, NG) Pathway described in the Detailed California-Modified GREET Pathway for Corn Ethanol Well-to-Wheel (WTW) lifecycle analysis [5].

[5] Detailed California-Modified GREET Pathway for Corn Ethanol Well-to-Wheel (WTW) lifecycle analysis, Version 2.1, published February 27, 2009..

IX. Documents supporting Annual Quantities of Feedstock, Utilities and Production

The input values presented in this application are based on the 24-month period from June 2012 through May 2014, the "Production Period." The basis for selecting this period is explained in Section IV of this report.

The following table shows the Aurora input and output data during the production period.

Table 12: Summary of Inputs and Outputs during the "Production Period"

This table is considered Confidential Business Information and is not included in this non-confidential, redacted version of the application.

The utilities quantities in the preceding table showing the actual monthly utility use are documented by the utility invoices with the files named:

NG Invoices

- *Aurora Natural Gas Invoices CONFIDENTIAL 20Oct14.pdf*

Electricity Invoices

- *Aurora Electric Invoices CONFIDENTIAL 20Oct14.pdf*

The monthly electricity invoices are pro-rated into the calendar months they cover in a separate spreadsheet, with the file named:

- *Aurora Electricity Use Monthly Invoice Reconciliation CONFIDENTIAL 20Oct14.xlsx*

The accuracy and authenticity of all the data in this new pathway application are attested to in a letter from Mr. Martin Parrish, Vice President of Alternative Energy and Development at Valero Renewable Fuels, LLC, in an accompanying file named:

- *Aurora Transmittal Letter Attesting to Accuracy of Data PUBLIC 5Nov14.pdf.*