



OFFICE OF AIR AND RADIATION

WASHINGTON, D.C. 20460

November 12, 2025

Mr. Rick Vondra
Chief Operating Officer
Cardinal Ethanol
1554 N 600E
Union City, Indiana 47390

Dear Mr. Vondra:

You submitted an Efficient Producer petition to the U.S. Environmental Protection Agency on behalf of Cardinal Ethanol (Cardinal Union) to approve a pathway for the generation of renewable fuel (D code 6) Renewable Identification Numbers (RINs) under the renewable fuel standard (RFS) program for the production of non-grandfathered ethanol. The ethanol is produced through a dry mill process at your production facility located in Union City, Indiana using corn starch as feedstock (the "Cardinal Ethanol Union City Corn Process").

Through the petition process described under 40 CFR 80.1416, Cardinal Union submitted data to the agency to perform a lifecycle greenhouse gas (GHG) emissions analysis of the fuel produced through the Cardinal Ethanol Union City Corn Process. This analysis involved a straightforward application of the same methodology and much of the same modeling used for the final rule published on March 26, 2010 (75 FR 14670) (the "March 2010 RFS rule"). The difference between this analysis and the analyses completed for the March 2010 RFS rule was the evaluation of a more efficient fuel production process.

The attached document "Cardinal Ethanol Fuel Pathway Determination under the RFS Program" describes the data submitted by Cardinal Union, the analysis conducted by the EPA, and our determination of the lifecycle greenhouse gas emissions associated with the fuel production pathway described in the Cardinal Union petition.

Based on our assessment, the non-grandfathered corn starch ethanol produced through the Cardinal Ethanol Union City Corn Process qualifies under the Clean Air Act (CAA) for renewable fuel (D code 6) RINs, provided the fuel meets the conditions and associated regulatory provisions discussed in the attached document, and the other definitional criteria for renewable fuel (e.g., production from renewable biomass, and used to reduce or replace petroleum-based transportation fuel, heating oil or jet fuel) specified in the CAA and EPA implementing regulations.

This approval applies specifically to the Cardinal Ethanol Union City facility, and to the process, materials used, fuel produced, and process energy sources as outlined and described in the petition request submitted by Cardinal Union.

Provided all of the conditions in the attached document are satisfied, this determination allows Cardinal Union to generate RINs for the production of non-grandfathered ethanol from corn starch feedstock using a production process of "Cardinal Ethanol Union City Corn Process."

Sincerely,

A handwritten signature in black ink, appearing to read "Byron J. Bunker", is enclosed within a thin black rectangular border.

Byron J. Bunker, Director
Implementation, Analysis and Compliance Division
Office of Transportation and Air Quality

Cardinal Ethanol Union City Fuel Pathway Determination under the RFS Program
Office of Transportation and Air Quality

Summary: Cardinal Ethanol (Cardinal Union) submitted an Efficient Producer petition (the “Cardinal Union petition”), dated 3-Nov-25 to the U.S. Environmental Protection Agency to approve their generation of renewable fuel (D code 6) Renewable Identification Numbers (RINs) under the Renewable Fuel Standard (RFS) program for non-grandfathered ethanol produced through a dry mill process¹ at their production facility located in Union City, Indiana produced from corn starch feedstock (the “Cardinal Ethanol Union City Corn Process”).

Although Cardinal Union intends to document on an ongoing basis that the non-grandfathered corn ethanol it produces at its Union City, Indiana facility through the Cardinal Ethanol Union City Corn Process meets the appropriate greenhouse gas (GHG) emissions reduction requirements, EPA has performed a threshold lifecycle GHG emissions analysis based on the information in the Cardinal Union petition to determine if it appears that corn ethanol produced at the facility may achieve the required GHG reductions, if certain conditions are met. This lifecycle analysis, the results of which are explained in this document, involved a straightforward application of the same methodology and modeling used for the final rule published on March 26, 2010 (75 FR 14670) (the “March 2010 RFS rule”). The difference between this analysis and the analyses completed for the March 2010 RFS rule was the evaluation of a more efficient fuel production process, in terms of the amount of feedstocks and amount/type of energy used to produce a certain quantity of corn ethanol. Based on the data provided in the Cardinal Union petition, our analysis found that non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process may be able to qualify as renewable fuel if Cardinal Union satisfies all of the conditions specified in this document to demonstrate that such ethanol meets the minimum 20% lifecycle GHG reduction requirement of the Clean Air Act (CAA).²

In this determination EPA is specifying certain conditions designed to ensure that RINs are only assigned to volumes of non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process if the fuel satisfies the corresponding GHG reduction requirements. The EPA is specifying the condition that to generate renewable fuel (D code 6) RINs for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process, Cardinal Union must demonstrate that all corn starch ethanol (including both grandfathered and non-grandfathered corn ethanol) produced during an averaging period (defined as the prior 365 days or the number of days since EPA activated the D code 6 pathway associated with the Cardinal Ethanol Union City Corn Process, whichever is less)³ meets the 20% GHG reduction requirement. To make these demonstrations, Cardinal Union must keep records on the feedstocks used and the lifecycle GHG emissions associated with all the ethanol produced by Cardinal Ethanol Union City, based on the

¹ For purposes of this decision document a “dry mill process” is a process as defined in section I.C of this document.

² Per the RFS regulations at 40 CFR 80.1401, ethanol derived from corn starch does not qualify as advanced biofuel.

³ The full definition of the “averaging time period” is specified in section IV of this document.

monitoring requirements, emissions factors, and lifecycle analysis methodology and other requirements specified in this document.

This document is organized as follows:

- *Section I. Required Information and Criteria for Petition Requests:* This section contains information on the background and purpose of the petition process, the criteria EPA uses to evaluate the petitions and the information that is required to be provided under the petition process as outlined in 40 CFR 80.1416 for Efficient Producer petitions. This section is not specific to the request submitted by Cardinal Union.
- *Section II. Available Information:* This section contains background information on Cardinal Union and describes the information that Cardinal Union provided and how it complies with the petition requirements outlined in section I.
- *Section III. Analysis and Discussion:* This section describes the lifecycle analysis done for the non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process and identifies how the analysis conducted differs from the analysis done for the March 2010 RFS rule. This section also describes how we have applied the lifecycle results to determine the appropriate D code for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process.
- *Section IV. Conditions and Associated Regulatory Provisions:* This section describes the conditions and associated regulatory provisions that must be satisfied to generate RINs for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process.
- *Section V. Public Participation:* This section describes our administrative process to consider the Cardinal Union petition and explains how this petition analysis is an extension of the analysis done as part of the March 2010 RFS rule.
- *Section VI. Conclusion:* This section summarizes our conclusions regarding the Cardinal Union petition, including the D code Cardinal Union may use in generating RINs for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process.

I. Required Information and Criteria for Petition Requests

A. Background and Purpose of Petition Process

As a result of changes to the RFS program in Clean Air Act section 211(o), as amended by the Energy Independence and Security Act of 2007 (EISA), EPA adopted new regulations, published at 40 CFR Part 80. The RFS regulations specify the types of renewable fuels eligible to participate in the RFS program and the procedures by which renewable fuel producers and importers may generate RINs for the qualifying renewable fuels they produce through approved fuel pathways.⁴

Pursuant to 40 CFR 80.1426(f)(1):

⁴ See EPA's website for information about the RFS regulations and associated rulemakings: <http://www.epa.gov/renewable-fuel-standard-program/statutes-and-regulations-under-renewable-fuel-standard-program>

Applicable pathways. D codes shall be used in RINs generated by producers or importers of renewable fuel according to the pathways listed in Table 1 to this section, subparagraph 6 of this section, or as approved by the Administrator.

Table 1 to 40 CFR 80.1426 lists the three critical components of a fuel pathway: (1) fuel type; (2) feedstock; and (3) production process. Each specific combination of the three components, or fuel pathway, is assigned a D code. EPA may also independently approve additional fuel pathways not currently listed in Table 1 for participation in the RFS program, or a party may petition for EPA to evaluate a new fuel pathway in accordance with 40 CFR 80.1416. In addition, producers of facilities identified in 40 CFR 80.1403(c) and (d) that are exempt from the 20% GHG emissions reduction requirement of the Act may generate RINs with a D code of 6 pursuant to 40 CFR 80.1426(f)(6) for a specified baseline volume of fuel (“grandfathered fuel”⁵) assuming all other requirements are satisfied.

The petition process under 40 CFR 80.1416 allows parties to request that EPA evaluate a new fuel pathway’s lifecycle GHG reduction and provide a determination of the D code for which the new pathway may be eligible.

On September 30, 2014, EPA announced a new expedited Efficient Producer petition process for corn starch and grain sorghum ethanol producers using a dry mill process that can demonstrate superior process efficiency through reduced onsite energy consumption, increased fuel output and/or use of biomass or biogas from certain sources to reduce process energy greenhouse gas emissions. For example, this Efficient Producer process, covering a subset of the petitions received pursuant to 40 CFR 80.1416, provides a streamlined, facility-specific review for certain ethanol producers petitioning to generate RINs for the production of ethanol beyond their grandfathered volume. EPA considers Efficient Producer petitions to be those seeking EPA evaluation of fuel pathways involving certain fuel types, feedstocks and fuel production technologies that EPA has evaluated previously. Petitions that seek EPA evaluation of new/creative fuel production technologies will require additional analysis, and therefore will not be able to use this expedited review process.

Corn and sorghum ethanol producers who seek a new pathway approval on terms substantially different than are specified herein may petition the agency pursuant to 40 CFR 80.1416 and request different treatment. However, such petitions will not be eligible for the expedited Efficient Producer petition process, and therefore may take significantly longer to review. The review time will depend on the number and type of other higher priority petitions under review by the EPA.⁶

⁵ “Grandfathered fuel” refers to a baseline volume of renewable fuel produced from facilities that commenced construction before December 19, 2007 and which completed construction within 36 months without an 18 month hiatus in construction and is thereby exempt from the minimum 20% GHG reduction requirement that applies to general renewable fuel. A baseline volume of ethanol from facilities that commenced construction after December 19, 2007, but prior to December 31, 2009, qualifies for the same exemption if construction is completed within 36 months without an 18 months hiatus in construction and the facility is fired with natural gas, biomass, or any combination thereof.

⁶ The prioritization criteria are explained on EPA’s website: <http://www.epa.gov/renewable-fuel-standard-program/renewable-fuel-petition-review-process#step3>

B. Information to be Provided in Petitions

As specified in 40 CFR 80.1416(b)(1), petitions are to include all of the following information, and should also include, as appropriate, supporting documents such as independent studies, engineering estimates, industry survey data, and reports or other documents supporting any claims:

- The information specified under 40 CFR 1090.805.
- A technical justification that includes a description of the renewable fuel, feedstock(s), biointermediate(s) used to make it, and production process. The justification must include process modeling flow charts.
- A mass balance for the pathway, including feedstocks and biointermediates, fuels produced, co-products, and waste materials production.
- Information on co-products, including their expected use and market value.
- An energy balance for the pathway, including a list of any energy and process heat inputs and outputs used in the pathway, including such sources produced off site or by another entity.
- Any other relevant information, including information pertaining to energy saving technologies or other process improvements.
- Other additional information as requested by the EPA to complete the lifecycle greenhouse gas assessment of the new fuel pathway.
- The EPA may ask for additional information to complete the lifecycle greenhouse gas assessment of the new fuel or pathway.

C. Information Needed for Efficient Producer Petitions

Efficient Producer petitions are for a dry mill process with standard co-products. The focus of an Efficient Producer petition is on efficient energy use and/or high ethanol yield per bushel of feedstock. The regulatory requirements for a mass balance (which demonstrates fuel yield) and an energy balance (which demonstrates energy use), are particularly important. In the context of an Efficient Producer petition, the regulatory requirements for information on the production process and co-products can be satisfied by submission of the following certifications (with appropriate facility-specific adjustments reflecting feedstocks and energy sources used by the facility and/or to be used in the proposed pathway to be evaluated):

- Certification by the petitioner that the production process for the requested pathway is an ethanol production process where corn feedstock is ground into a coarse flour, also known as “meal”; the meal is cooked into a hot slurry with the addition of enzymes to produce a mixture commonly known as “mash”; the mash is fermented with the addition of yeast to produce ethanol, carbon dioxide and solids from the grain and yeast, known as “fermented mash”; the fermented mash is distilled to produce a mixture of ethanol and water, and a residue of non-fermentable solids, also known as “stillage”; the mixture of ethanol and water is dehydrated to produce 200-proof ethanol; and co-products produced

include distillers grains, but may also include carbon dioxide, solubles syrup and vegetable oil (a “dry mill process”).

- Certification by the petitioner that the co-product distillers grains are intended for use as animal feed.
- Certification by the petitioner that the dry mill process for the requested pathway uses one or a combination of the following sources for all of its process energy: electricity from the grid, natural gas, coal, biogas or biomass. Any biomass used as process energy meets the RFS regulatory definition for crop residue at 40 CFR 80.1401. Any biogas used for process energy meets the RFS regulatory definition for biogas or treated biogas at 40 CFR 80.1401.
- Certification by the petitioner that the ethanol production facility uses only a combination of corn starch or corn starch and corn kernel fiber as feedstocks to produce ethanol.
- Certification by the petitioner that all of the information provided in the petition is accurate and complete.

II. Available Information

A. Background on the Petitioner

Cardinal Union submitted an Efficient Producer petition, requesting approval for their generation of RINs for non-grandfathered ethanol produced by a dry mill process from corn starch feedstock at their Union City, Indiana facility. A petition is required because the pathway associated with the Cardinal Ethanol Union City Corn Process is not included in Table 1 to 40 CFR 80.1426 and has not otherwise been approved by EPA. Table 1 (relevant portions of which are reproduced below) includes pathways for ethanol from corn starch, but provides only three options for fuel producers using a dry mill process and natural gas, biomass or biogas for process energy: (1) use two advanced technologies from Table 2 to 40 CFR 80.1426, (2) dry no more than 50% of the distillers grains with solubles (DGS) that they produce, or (3) dry no more than 65% of the DGS they produce and use one of the advanced technologies listed in Table 2 to 40 CFR 80.1426. Cardinal Union submitted a petition because they claim that fuel produced through the Cardinal Ethanol Union City Corn Process does not match any of the pathways in Table 1 to 40 CFR 80.1426.

Table 1: Relevant Existing Fuel Pathways from 40 CFR 80.1426

Row	Fuel Type	Feedstock	Production Process Requirements	D code
A	Ethanol	Corn Starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and at least two advanced technologies from Table 2 to this section	6 (Renewable Fuel)
B	Ethanol	Corn Starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and at least one of the advanced technologies from Table 2 to this section plus drying no more than 65% of the distillers grains with solubles it markets annually	6 (Renewable Fuel)
C	Ethanol	Corn Starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and drying no more than 50% of the distillers grains with solubles it markets annually	6 (Renewable Fuel)

B. Information Submitted by Cardinal Ethanol

Cardinal Union provided all of the required information in the petition, including all of the data needed for EPA to perform a threshold determination of the potential for corn ethanol produced through the Cardinal Ethanol Union City Corn Process to satisfy the 20% lifecycle GHG reduction requirement applicable to non-grandfathered renewable fuel if all conditions in this document are satisfied. Cardinal Union included information on their process yield (bushels of corn starch feedstock per gallons of fuel) and the energy used. In addition, Cardinal Union certified that their requested fuel pathway involves the use of corn starch feedstock, a dry mill process, ethanol fuel, distillers grain co-products, and the types of process energy that EPA previously modeled for the March 2010 RFS rule. Cardinal Union also certified that the only feedstocks used to produce ethanol at the Cardinal Ethanol Union City facility are corn starch or corn starch and corn kernel fiber.

C. Information Available Through Existing Modeling

For the pathway addressed in their petition, Cardinal Union would use a feedstock (corn starch) that has already been analyzed as part of the March 2010 RFS rule, as noted in Table 1.

Cardinal Union may also use corn kernel fiber as feedstock to produce ethanol. EPA evaluated corn kernel fiber ethanol in the final rule published on July 18, 2014 (79 FR 42138) (the “July 2014 pathways II rule”). As a result, no new feedstock modeling was required to evaluate the Cardinal Union petition, as modeling for corn starch was already done as part of the March 2010 RFS rule and evaluation of corn kernel fiber was done for the July 2014 pathways II rule. Similarly, no new emissions impact modeling of using ethanol as a transportation fuel was required as that was already done as part of the March 2010 RFS rule. This petition only requires EPA to evaluate a modified fuel production process for an existing fuel type.

The same analytical approach that was used to evaluate the lifecycle GHG emissions of the existing corn ethanol pathways noted above was used to analyze the pathway described in the Cardinal Union petition. The preamble to the March 2010 RFS rule describes the modeling approach used to estimate lifecycle GHG emissions from corn ethanol. The preamble describes the models and data used as well as the input and output streams from those models to calculate the emissions for each of the lifecycle stages. To modify the corn starch analysis to reflect the process described in the Cardinal Union petition, the only change required was replacing the production process data with the Cardinal Ethanol Union City Corn Process data. This resulted in the following changes to the modeling (described in more detail in the following sections):

- Amount of corn used in the fuel production process was modified to reflect the Cardinal Ethanol Union City process yield in terms of bushels of feedstock input per gallons of ethanol produced; and
- Amount of energy used by the fuel production process was changed to reflect data provided in the Cardinal Ethanol Union City energy balance.

This was a straightforward analysis based on existing modeling done for the March 2010 RFS rule and substituting the Cardinal Ethanol Union City process data, which only altered the amounts of certain inputs and outputs of the fuel production process.

III. Analysis and Discussion

A. Lifecycle Analysis

Determining a fuel pathway’s compliance with the lifecycle GHG reduction thresholds specified in the CAA for different types of renewable fuel requires a comprehensive evaluation of the renewable fuel, as compared to the gasoline or diesel fuel that it replaces, on the basis of its lifecycle GHG emissions. As mandated by the CAA, the GHG emissions assessments must evaluate the aggregate quantity of GHG emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes) related to the fuel’s full lifecycle, including all stages of fuel and feedstock production, distribution, and use by the ultimate consumer.

In examining the full lifecycle GHG impacts of renewable fuels for the RFS program, EPA considers the following:

- Feedstock production – based on agricultural sector models that include direct and indirect impacts of feedstock production.
- Fuel production – including process energy requirements, impacts of any raw materials used in the process, and benefits from co-products produced.
- Fuel and feedstock distribution – including impacts of transporting feedstock from production to use, and transport of the final fuel to the consumer.
- Use of the fuel – including combustion emissions from use of the fuel in a vehicle.

EPA's evaluation of the lifecycle GHG emissions for the pathway described in the Cardinal Union petition is consistent with the CAA's applicable requirements, including the definition of lifecycle GHG emissions and threshold evaluation requirements. It was based on information provided in the petition, including mass and energy balance data for the pathways associated with the Cardinal Ethanol Union City Corn Process.

For our evaluation of this petition, we made straightforward updates to our original estimate of the upstream GHG emissions associated with corn starch production and transport. These updates did not involve any revisions to the agricultural sector (FASOM or FAPRI) modeling conducted for the March 2010 RFS2 rule. First, in places where the original analysis used data from a prior version of the GREET model, we replaced these data with the default estimates, without modification, from the GREET-2022 Fuel Cycle Model.⁷ The GREET data updates were applied to the following elements: emissions factors for natural gas production and use, LPG production and use, coal production and use, nitrogen fertilizer production, phosphate fertilizer production, hydrogen production, herbicide and pesticide production and use, and feedstock transport energy use and emissions. Second, we updated the foreign land use change emissions factors based on more recent data on forest carbon stocks in Latin America, Sub-Saharan Africa, parts of Africa and Europe. We have used and documented these data updates in prior rules and Federal Register publications.⁸ Third, we updated

⁷ Wang, Michael, Elgowainy, Amgad, Lee, Uisung, Baek, Kwang H., Bafana, Adarsh, Benavides, Pahola T., Burnham, Andrew, Cai, Hao, Cappello, Vincenzo, Chen, Peter, Gan, Yu, Gracida-Alvarez, Ulises R., Hawkins, Troy R., Iyer, Rakesh K., Kelly, Jarod C., Kim, Taemin, Kumar, Shishir, Kwon, Hoyoung, Lee, Kyuha, Liu, Xinyu, Lu, Zifeng, Masum, Farhad, Ng, Clarence, Ou, Longwen, Reddi, Krishna, Siddique, Nazib, Sun, Pingping, Vyawahare, Pradeep, Xu, Hui, and Zaines, George. *Greenhouse gases, Regulated Emissions, and Energy use in Technologies Model*® (2022 Excel). Computer Software. USDOE Office of Energy Efficiency and Renewable Energy (EERE). 10 Oct. 2022. Web. doi:10.11578/GREET-Excel-2022/dc.20220908.1.

⁸ These updates are described in the following technical report available in a public docket: Harris, N.L. 2011. Revisions to Land Conversion Emission Factors since the RFS2 Final Rule. Report submitted to EPA. EPA-HQ-OAR-2011-0542-0058. They have been applied in the following actions: January 2012 Palm Oil NODA (77 FR 4300), December 2012 grain sorghum rule (77 FR 74592), October 2015 Jatropha Oil Notice (80 FR 61406), July 2015 Sugar Beets Notice (82 FR 34656), April 2022 Canola Oil Pathways NPRM (87 FR 22823).

our estimates of the GHG emissions associated with changes in foreign on-farm energy use.⁹ Finally, we updated from using global warming potential values from the IPCC Second Assessment Report to values from the Fifth Assessment Report.¹⁰

The lifecycle GHG emissions of fuel produced using the pathway associated with the Cardinal Ethanol Union City Corn Process were determined as follows:

Feedstock production and transport (upstream emissions) – Cardinal Union uses only corn starch or corn starch and corn kernel fiber as feedstocks for the production of ethanol, but corn starch is used exclusively in the Cardinal Ethanol Union City Corn Process. As previously noted, corn starch is a feedstock already listed in Table 1 to 40 CFR 80.1426 of the RFS regulations. Since corn starch has already been evaluated by EPA, no new feedstock production modeling was required for EPA to evaluate the Cardinal Ethanol Union City Corn Process. Cardinal Union has certified through its petition that it uses a dry mill production process that is consistent with the definition of “dry mill process” specified in section I.C. of this decision document. Therefore, the Cardinal Ethanol Union City Corn Process is the same type of dry mill process as that modeled for the March 2010 RFS rule, and the existing agricultural sector modeling analyses for corn as feedstock remains valid for use in estimating the lifecycle impact of renewable fuel produced using the Cardinal Ethanol Union City Corn Process.

The Forest and Agricultural Sector Optimization Model (FASOM) and Food and Agricultural Policy Research Institute (FAPRI) models were used to analyze the GHG impacts of the feedstock production portion of the ethanol lifecycle. The same FASOM and FAPRI results representing the emissions from an increase in corn production that were generated as part of the March 2010 RFS rule analysis of the corn ethanol pathways were used in our analysis of the corn ethanol production process described in the Cardinal Union petition.

In the corn ethanol analysis for the March 2010 RFS rule, we projected approximately 960 million bushels of corn (assuming 56 pounds per bushel at 15.5 percent moisture) used to produce 2.6 billion additional gallons of ethanol compared to a baseline scenario (based on a yield of 2.71 gallons per bushel), and we calculated GHG emissions from feedstock production for that amount of corn. The FASOM and FAPRI agricultural sector GHG results were divided by the total energy value of fuel produced to get emissions per mmBtu of ethanol.¹¹ For the modeled scenario we estimated lifecycle GHG emissions of 10.11 kgCO₂e per bushel of corn used to make ethanol. This includes the

⁹ These updates are explained in the April 2022 Canola Oil Pathways NPRM (87 FR 22834-22835). Data and estimates are available on the docket: “Canola RD Intl Ag Energy GHG NPRM v2” (EPA-HQ-OAR-2021-0845-0014).

¹⁰ IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

¹¹ For the purposes of this determination document, Btus are expressed on a lower heating value (LHV) basis, gallons of ethanol are expressed on an undenatured (neat) basis, and bushels of corn are expressed in terms of 15.5% moisture content unless otherwise specified.

upstream emissions associated with producing the corn feedstock and transporting it to the ethanol production facility, and also includes significant direct and indirect emissions (such as emissions from land use change). Therefore, to estimate the lifecycle GHG emissions from the corn feedstock used to make ethanol in the Cardinal Ethanol Union City Corn Process, the bushels of corn used as feedstock provided in the Cardinal Union petition were multiplied by the emissions factor of 10.11 kgCO₂e per bushel. In the same manner as described in section IV.D. of this document, these emissions were then normalized by the mmBtu of ethanol produced from the same amount of bushels of corn.

Fuel production (process emissions) – The fuel production method used by Cardinal Ethanol Union City involves the production of ethanol from corn starch or corn starch and corn kernel fiber in a dry mill process. However, the process described in the Cardinal Union petition is more efficient in terms of energy use than the average dry mill ethanol production technologies analyzed for the March 2010 RFS rule.

To analyze the GHG impacts of the corn ethanol production process used by Cardinal Ethanol Union City, EPA utilized the same approach that was used to determine the impacts of processes in the corn ethanol pathways analyzed in the March 2010 RFS rule, taking into account differences in the types and amounts of process energy used.

Cardinal Union submitted average annual mass and energy balance data for operations at Cardinal Ethanol Union City, including all of the process energy used from the point of delivery of the feedstock through feedstock processing, and fuel and co-product production, to the point of final storage of the end product fuel and co-products at the fuel production facility. This includes the energy used to produce all of the ethanol (regardless of feedstock origin or regulatory characterization as grandfathered, non-grandfathered, or fuel for which no RINs are generated) produced by Cardinal Ethanol Union City.

To evaluate the fuel production GHG emissions (i.e., the emissions associated with Cardinal Ethanol Union City's use of grid electricity and process heat fuels) per gallon of corn starch ethanol produced through the Cardinal Ethanol Union City Corn Process, we use lifecycle GHG emissions factors used for process energy from the GREET-2022 model:

- Natural gas = 7.34×10^{-5} kgCO₂e/Btu
- Coal = 1.06×10^{-4} kgCO₂e/Btu
- Biogas and treated biogas CH₄ = 1.15×10^{-6} kgCO₂e/Btu
- U.S. average grid electricity = 0.467 kgCO₂e/kWh
- Crop residue biomass used onsite for process energy upstream emissions = 1.98×10^{-2} kgCO₂e per dry pound (based on the corn stover lifecycle analysis for the March 2010 RFS rule)

Fuel distribution and use (downstream emissions) – The fuel type, ethanol, and hence the fuel distribution and use for ethanol, was already considered as part of the March 2010 RFS rule. The updated emissions factor, based on data from GREET-2022, for ethanol distribution and use, otherwise known as downstream emissions, is 1.4 kgCO₂e per mmBtu of ethanol. We applied this emissions factor for corn ethanol to our analysis of the Cardinal Union petition

Lifecycle GHG emissions – The lifecycle GHG emissions associated with Cardinal Ethanol Union City’s fuel was then compared to the baseline lifecycle GHG emissions, using the GHG estimates for baseline gasoline as in the March 2010 RFS rule analysis, but with the global warming potentials updated from the values from the IPCC Second Assessment Report to values from the Fifth Assessment Report. Based on the data submitted by Cardinal Union, our analysis indicates that corn starch ethanol produced using the Cardinal Ethanol Union City Corn Process would result in at least a 20 percent GHG emissions reduction compared to the baseline lifecycle GHG emissions.

Table 2 below breaks down by stage the lifecycle GHG emissions for corn ethanol produced using the Cardinal Ethanol Union City Corn Process, compared to such emissions for a corn ethanol pathway analyzed as part of the March 2010 RFS rule that does not use any of the advanced technologies specified in the RFS regulations and dries all of its co-product DGS, and the 2005 gasoline baseline. This table demonstrates the contribution of each stage in the fuel pathway and its relative significance in terms of GHG emissions.

In the table, upstream emissions include the GHG emissions associated with producing the corn feedstock and transporting it to the fuel production facility. Process emissions include the GHG emissions associated with the corn ethanol production process. Downstream emissions include the GHG emissions associated with distributing and using the finished fuel. Table 2 provides EPA’s mean estimate of GHG emissions for each of these stages of the lifecycle.

Table 2: Lifecycle GHG Emissions for Corn Starch Ethanol Produced through the Cardinal Ethanol Union City Corn Process (kgCO₂e/mmBtu)¹²

	Corn Ethanol, Natural Gas Fired Dry Mill, 100% Dry DGS, No Advanced Technologies	Corn Ethanol Produced Through the Cardinal Ethanol Union City Corn Process	Baseline Lifecycle GHG Emissions for Gasoline
Upstream Emissions	48.6	47	*
Process Emissions	31.7	26.9	20.2
Downstream Emissions	1.4	1.4	78.8
Lifecycle Emissions	81.7	75.4	99.0
Percent Reduction	17.4%	23.8%	--

* Emissions included in Process Emissions stage.

¹² Net emissions may not be the sum of the rows due to rounding.

B. Application of the Criteria for Petition Approval

Based on the information provided in the Cardinal Union petition, and the requirements specified in section IV limiting RIN generation for non-grandfathered corn ethanol to fuel for which ongoing monitoring and assessment allow documentation of compliance with appropriate lifecycle greenhouse gas reduction requirements, EPA is approving this petition request. Specifically, we have determined that ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process using corn starch feedstock satisfies the minimum 20% greenhouse gas reduction threshold required in the CAA for non-grandfathered renewable fuel if the ethanol is produced in accordance with the fuel yield and energy use information specified in the Cardinal Union petition. As detailed in section IV, EPA is specifying certain conditions that must be satisfied for ethanol produced through the approved pathway to be eligible for RIN generation. Where all the conditions are satisfied, EPA is authorizing the generation of renewable fuel (D code 6) RINs for non-grandfathered ethanol produced through the Cardinal Ethanol Union City Corn Process from corn starch, provided that the fuel meets the other criteria for renewable fuel specified in the CAA and EPA implementing regulations.

IV. Conditions and Associated Regulatory Provisions

The authority for Cardinal Union to generate RINs for non-grandfathered corn starch ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process is expressly conditioned on Cardinal Union satisfying all of the following conditions as detailed in this section, in addition to other applicable requirements for renewable fuel and renewable fuel producers set forth in the RFS regulations. The conditions in this section are enforceable under the CAA. They are established pursuant to the informal adjudication reflected in this decision document, and also pursuant to regulations cited below and 40 CFR 80.1426(a)(1)(iii), 40 CFR 80.1416(b)(1)(vii), 80.1450(i), and 80.1451(b)(1)(ii)(W). In addition or in the alternative to bringing an enforcement action under the CAA, EPA may revoke this pathway approval if it determines that Cardinal Union has failed to comply with any of the conditions specified herein.¹³

The pathway for corn ethanol approved in this document is in addition to the existing pathways for corn ethanol listed in rows A, B, C and D of Table 1 to 40 CFR 80.1426. Cardinal Union may also generate RINs under 40 CFR 80.1426(f)(6) for fuel that qualifies for the “grandfathering” exemption under 40 CFR 80.1403. This document does not impact the ability of Cardinal Union to generate RINs for volumes of fuel pursuant to 40 CFR 80.1426(f)(6) or the approved pathways in Table 1 to 40 CFR 80.1426.

This section details the registration, compliance monitoring, lifecycle GHG computation, recordkeeping, reporting, attest engagement and other requirements that apply to the non-grandfathered corn ethanol pathway associated with the Cardinal Ethanol Union City Corn Process and it is organized as follows:

¹³ As with all pathway determinations, this approval does not convey any property rights of any sort, or any exclusive privilege.

- *Sub-section A*: definitions
- *Sub-section B*: registration requirements
- *Sub-section C*: compliance monitoring
- *Sub-section D*: lifecycle GHG conditions and associated computational requirements
- *Sub-section E*: recordkeeping requirements
- *Sub-section F*: reporting requirements
- *Sub-section G*: additional requirements

As described in the following sections, one condition for Cardinal Union to generate RINs for non-grandfathered corn starch ethanol produced through the Cardinal Ethanol Union City Corn Process during a specified averaging period (typically 365 days) is documentation by Cardinal Union that RINs are only generated if, on average, all corn starch ethanol produced during the specified averaging period satisfies the 20% lifecycle GHG reduction requirement. The 365-day (or shorter in certain circumstances) rolling average is calculated based on the daily data monitored and collected by Cardinal Union and the formula specified in section IV.D.

A. Definitions

For the purposes of this petition approval, the following terms are defined as follows:

- 365-day rolling average lifecycle GHG emissions* means the average lifecycle GHG emissions for the corn starch ethanol produced by Cardinal Union during the averaging time period, calculated as specified in section IV.D. based on the daily data collected and recorded by Cardinal Union through continuous monitoring.¹⁴
- Averaging time period* means the 365 calendar days prior to the day that Cardinal Union wishes to generate RINs for corn starch ethanol produced during the averaging period through the Cardinal Ethanol Union City Corn Process, or the number of days prior to the day that Cardinal Union wishes to generate RINs since EPA activated the pathway,¹⁵ whichever is less.¹⁶ Cardinal Union may not generate RINs for non-grandfathered corn

¹⁴ The EPA has provided spreadsheets on its website to help ethanol producers understand the correct calculation of 365-day rolling average lifecycle GHG emissions.

¹⁵ A fuel pathway is activated under the RFS program when EPA accepts the registration application for the pathway, allowing it to be used in EMTS for RIN generation. When EPA accepts a registration application, an email is automatically sent from otaqfuels@epa.gov to the responsible corporate officer (RCO) of the company that submitted the registration application. The subject line of such an email includes the name of the company and the company request (CR) number corresponding with the registration application submission, and the body of the email says the company request “has been activated.” If Cardinal Ethanol Union City has already successfully registered for a prior corn starch ethanol EP3 pathway, the averaging time period for the updated EP3 pathway approved in this document shall begin on the day after the updated Compliance Monitoring Plan described in section IV.C. is submitted to the EPA via OTAQDCFUEL. Cardinal Ethanol Union City should notify the EPA that these documents have been submitted by sending an email to FuelsProgramSupport@epa.gov.

¹⁶ This expedited Efficient Producer petition process is intended for facilities that consistently use efficient production methods (i.e., who meet the applicable lifecycle GHG reduction thresholds) throughout the year. Parties who only use efficient methods during part of the year, and wish approval for such partial-year production, may submit a standard petition.

starch ethanol produced through the Cardinal Ethanol Union City Corn Process on the same day that such ethanol is produced.

- c. *Continuous monitoring* means the collection and use of measurement data and other information to record the data inputs required to calculate the 365-day rolling average lifecycle GHG emissions, in accordance with the Compliance Monitoring Plan described in section IV.C.
- d. *Energy used for feedstock, fuel and co-product operations* means energy used in all buildings or other areas that are used in any part for the storage and/or processing of feedstock (both corn and corn kernel fiber), the production and/or storage of fuel intermediates, the production and/or storage of finished fuel or co-products, and the handling of feedstocks, fuel, co-products and wastes. It includes any energy used offsite for these purposes, including for example energy used offsite to dry the co-product distillers grains produced by Cardinal Ethanol Union City before it is sold to the ultimate consumer.
- e. *Period of missing data* includes each day for which Cardinal Union does not have valid data collected through continuous monitoring for any of the daily data inputs required to calculate the 365-day rolling average lifecycle GHG emissions, as specified section IV.D.

B. Registration

Cardinal Ethanol Union City must comply with all registration provisions in 40 CFR Part 80 that apply to renewable fuel producers to register for the production of non-grandfathered corn ethanol through the Cardinal Ethanol Union City Corn Process. The description of the Cardinal Ethanol Union City production process that is required for registration pursuant to 40 CFR 80.1450(b)(1)(ii) shall contain the following (see items a through e listed below).¹⁷ If Cardinal Union has already successfully registered for the EP3 pathway for corn starch ethanol produced through the Cardinal Ethanol Union City Corn Process, Cardinal Union does not need to submit a new registration application, but Cardinal Union must submit a new Compliance Monitoring Plan to EPA as a registration update for the existing EP3 pathway.

- a. A Compliance Monitoring Plan including technical specifications detailing how Cardinal Union will accurately and reliably measure and record all of the daily data required in section IV.D. and calculate and record the 365-day rolling average lifecycle GHG emissions. If Cardinal Union has already successfully registered for the EP3 pathway for corn starch ethanol produced through the Cardinal Ethanol Union City Corn Process, Cardinal Union must submit a new Compliance Monitoring Plan to EPA as a registration update for the existing EP3 pathway. The updated Compliance Monitoring Plan must include the equipment and procedures Cardinal Ethanol Union City will use to measure and report the volume of ethanol produced from corn kernel fiber at Cardinal Ethanol Union City, in

¹⁷ All of the registration materials required by 80.1450(b)(1), including those specifically described in this document, must be reviewed and verified pursuant to the independent third-party engineering review required in 80.1450(b)(2).

accordance with the methods and techniques specified in Cardinal Union's activated registration on file with EPA for the crop residue (i.e., corn kernel fiber) ethanol pathway in row K of Table 1 to 40 CFR 80.1426 (process code 280).

- b. A process flow diagram showing all of the following:
1. The supply and continuous monitoring of all energy used for feedstock, fuel and co-product operations.
 2. The continuous monitoring of bushels of corn used in fuel production processes for all of the ethanol produced by Cardinal Ethanol Union City, including non-grandfathered ethanol for which RINs are generated, ethanol for which RINs are not generated and ethanol that is exempt from the 20% GHG reduction requirement per 40 CFR 80.1403.
 3. The continuous monitoring of volume and temperature¹⁸ for all of the ethanol produced by Cardinal Ethanol Union City, including non-grandfathered ethanol for which RINs are generated, ethanol for which RINs are not generated and ethanol for which RINs are generated that is exempt from the 20% GHG reduction requirement per 40 CFR 80.1403.
 4. Information for each of the continuous monitoring systems (e.g., scales, fuel flow meters and electricity meters) shown in the process flow diagram including the name of the manufacturer, the manufacture date and all relevant serial numbers.
- c. A certification signed by a Responsible Corporate Officer containing the following statement: "I hereby certify that: (1) I have reviewed and understand the process flow diagram submitted with this application for registration as required pursuant to section IV.B.b of the petition approval document for the pathway associated with the Cardinal Ethanol Union City Corn Process; (2) To the best of my knowledge the process flow diagram is accurate and complete; (3) All monitoring devices specified in the process flow diagram will be calibrated and maintained according to the manufacturer specifications or more frequently (if the manufacturer does not provide calibration or maintenance records then the company shall meet standards for similar monitoring devices); and (4) All of the monitoring devices included in the process flow diagram monitor all of the information specified in sections IV.B.b.1, 2 and 3 of the petition approval document for the pathway associated with the Cardinal Ethanol Union City Corn Process."¹⁹
- d. If Cardinal Union wishes to exclude any amount of energy used at Cardinal Ethanol Union City when calculating the 365-day rolling average lifecycle GHG emissions, the description of the facility's production process must include all of the following:

¹⁸ Temperature readings must take place at the same time the volume is measured.

¹⁹ A new RCO certification is needed every time a new or updated Compliance Monitoring Plan is submitted to EPA.

1. An explanation of why such energy should not be included.
 2. A plan showing how the energy that will not be included in the calculation of the 365-day rolling average lifecycle GHG emissions will be kept completely segregated, separately metered and recorded.²⁰
- e. If Cardinal Union wishes to take credit for exported electricity in calculating GHG_{Pc} pursuant to section IV.D, Cardinal Union must include a certification signed by a Responsible Corporate Officer stating that any exported electricity would be the result of combined heat and power technology as defined in the RFS regulations at 40 CFR 80.1401.

C. Compliance Monitoring

Cardinal Union must implement the Compliance Monitoring Plan and must use data obtained and recorded in accordance with this plan to calculate the 365-day rolling average lifecycle GHG emissions.

D. Corn Ethanol Lifecycle GHG Emissions

Cardinal Union may not generate RINs for non-grandfathered corn starch ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process unless it can demonstrate through records produced in accordance with 40 CFR 80.1454(b)(3) that are available as of the date of RIN generation and maintained by Cardinal Union for a minimum of five years from the date of RIN generation that it has satisfied all of the following requirements:

- a. All of the ethanol produced at Cardinal Ethanol Union City was produced by a dry mill process using only corn starch, or a combination of corn starch and corn kernel fiber as feedstocks during the averaging time period.
- b. The 365-day rolling average lifecycle GHG emissions are calculated using the following formula, and do not exceed 79.17 kgCO₂e/mmBtu of corn ethanol:²¹

$$LC_{GHGc} = GHG_{Uc} + GHG_{Pc} + GHG_D$$

Where:

²⁰ There are only two valid reasons for excluding any amount of energy used by Cardinal Ethanol Union City when calculating the 365-day rolling average lifecycle GHG emissions. The first is that the energy is used in a stand-alone and separately metered building that is used solely for administrative or other purposes that are not directly related to the feedstock, fuel and co-product operations. The second is that the energy is used in a stand-alone and separately metered tower grain dryer to dry the corn kernel feedstock prior to grinding. The lifecycle GHG emissions from energy used at such a tower grain dryer may be excluded because they have been taken into account as part of the feedstock production stage of the EPA's lifecycle assessment of corn starch ethanol as modeled for the March 2010 RFS rule.

²¹ As discussed in section II of this document, the statutory petroleum gasoline baseline is 99.0 kgCO₂e/mmBtu. Fuel meeting the twenty percent lifecycle GHG reduction threshold produces 79.17 kgCO₂e/mmBtu or less.

LC_{GHG_C} = Lifecycle GHG emissions, in kgCO₂e/mmBtu, of the volume of all corn starch ethanol produced at the facility during the averaging time period.

GHG_{U_C} = Upstream GHG emissions, in kgCO₂e/mmBtu, related to the production and transport of the volume of corn starch feedstock used to produce all corn starch ethanol produced at the facility during the averaging time period, calculated per section IV.D.c.

GHG_{P_C} = Process GHG emissions, in kgCO₂e/mmBtu, related to the processes used for conversion of corn into ethanol during the averaging period, including energy used for feedstock, fuel and co-product operations; calculated per section IV.D.d.

GHG_D = Downstream GHG emissions, in kgCO₂e/mmBtu, related to the distribution and use of all corn ethanol produced during the averaging period, calculated per section IV.D.e.

- c. For the purposes of the formula in section IV.D.b, GHG_{U_C} is calculated according to the following formula:

$$GHG_{U_C} = \frac{10.11 * B_C}{(V_{CSS} * 0.076)}$$

Where:

10.11 = Upstream emissions factor for corn, in kgCO₂e per bushel, based on the lifecycle GHG modeling done by EPA for the March 2010 RFS rule.

B_C = Bushels of corn used by Cardinal Ethanol Union City as feedstock to produce ethanol during the averaging time period in terms of a standard bushel at 15.5% moisture.

For the purposes of this paragraph, B_C , shall be calculated according to the following formula:

$$B_C = B_{C_m} * \left(\frac{1 - m_c}{1 - 0.155} \right)$$

B_{C_m} = Bushels of corn used by Cardinal Ethanol Union City as feedstock to produce ethanol during the averaging time period based on measurements recorded by Cardinal Ethanol Union City.

m_c = Average moisture content of corn, in mass percent, for the corn delivered to Cardinal Ethanol Union City for use as feedstock to produce ethanol during the averaging time period. The moisture content tests performed by Cardinal Union shall sample corn that, based on good engineering judgment, is representative of each delivery of corn feedstock to Cardinal Ethanol Union City. Cardinal Union shall test the moisture content of the corn delivered in each and every truck load, train load, or other delivery of corn to Cardinal Ethanol Union City, and for any given delivery must measure the corn moisture content no less frequently than once for every 10,000

bushels. The moisture content shall be measured and recorded in accordance with the most recent version of the USDA Moisture Handbook.²² Cardinal Union shall calculate the average moisture content as a weighted average, by summing the products of the mass and corresponding moisture content of each corn delivery, and then dividing by the total mass of corn feedstock delivered to Cardinal Ethanol Union City during the averaging time period.

0.155 = Moisture content of a standard bushel of corn at 56 pounds per bushel.

$V_{CSS} = V_S - V_{CFS}$, the standardized volume of corn starch ethanol produced during the averaging time period, in gallons of undenatured ethanol.

V_S = Standardized volume of all ethanol produced at the Cardinal Ethanol Union City facility during the averaging time period, in gallons of undenatured ethanol. In determining the standardized volume, the actual volumes of ethanol shall be adjusted to a standard temperature of 60 degrees Fahrenheit using the following formula:

$$V_S = V_A * \left(1 - \left(0.00114 * \left(\left[\{T + 459.67\} * \frac{5}{9} \right] - \left[\{60 + 459.67\} * \frac{5}{9} \right] \right) \right) \right)$$

Where:

V_A = Actual volume of undenatured ethanol, in gallons.

T = Actual temperature of ethanol, in degrees Fahrenheit, measured at the same time that V_A is measured.

0.00114 = Coefficient to standardize volumes of undenatured ethanol.

60 = Standard temperature, in degrees Fahrenheit, for volumes of ethanol.

459.67 and 5/9 = Conversion factors for Fahrenheit to Kelvin

V_{CFS} = Standardized volume of ethanol produce from corn kernel fiber at the Cardinal Ethanol Union City facility during the averaging time period, in gallons of undenatured ethanol, determined in accordance with the methods and techniques specified in Cardinal Union's activated registration on file with EPA for the crop residue (i.e., corn kernel fiber) ethanol pathway in row K of Table 1 to 40 CFR 80.1426.

0.076 = Energy content of ethanol, in mmBtu/gallon (lower heating value).

²² USDA. (2022). Moisture Handbook. United States Department of Agriculture. Federal Grain Inspection Service. Washington, DC. March 14, 2022.

- d. For the purposes of the formula in section IV.D.b, GHG_{PC} is calculated according to the following formula:

$$GHG_{PC} = \frac{GHG_{THERM} + GHG_{ELEC}}{V_S * 0.076}$$

Where:

GHG_{THERM} = The greenhouse gas emissions, in kgCO₂e, associated with thermal energy used for feedstock, fuel and co-product operations, as measured by Cardinal Union by continuous monitoring, and calculated according to the following formula:

$$GHG_{THERM} = \sum_{p=1}^3 (PE_p * LHV_{PE,p} * EF_{PE,p}) + BIO * EF_{bio}$$

Where:

p = Type of fuel used.

PE_p = a measure of the amount of fuel p used as energy used for feedstock, fuel and co-product operations, as follows:

PE_1 = Standard cubic feet (scf) of natural gas used in feedstock, fuel and co-product operations, as measured by Cardinal Union by continuous monitoring.

PE_2 = Standard cubic feet (scf) of biogas or treated biogas CH₄ from landfills, waste treatment plants and/or waste digesters used as energy used for feedstock, fuel and co-product operations, as measured by Cardinal Union by continuous monitoring.²³

PE_3 = Tons of coal, used as energy used for feedstock, fuel and co-product operations, as measured by Cardinal Union by continuous monitoring.

$LHV_{PE,p}$ = Lower Heating Value factor for fuel type p, as follows:

$LHV_{PE,1}$ = 983 Btu per scf of natural gas.

$LHV_{PE,2}$ = 983 Btu per scf of biogas CH₄.

$LHV_{PE,3}$ = 19,546,300 Btu per ton of coal.

$EF_{PE,p}$ = Lifecycle GHG emissions factor for fuel type p, (based on lower heating value) as follows:

²³ This shall only represent the methane in the biogas used. If the amount of methane present in the biogas is not metered directly, Cardinal Union shall determine the amount of methane present in the biogas used by Cardinal Ethanol Union City, using the monitoring protocols and test procedures specified in the Compliance Monitoring Plan submitted by Cardinal Union as part of their registration materials for the Cardinal Ethanol Union City Corn Process. Any biogas used for process energy meets the RFS regulatory definition for biogas or treated biogas at 40 CFR 80.1401.

$EF_{PE,1} = 7.34 * 10^{-5}$ kgCO₂e per Btu of natural gas.

$EF_{PE,2} = 1.15 * 10^{-6}$ kgCO₂e per Btu of biogas CH₄.

$EF_{PE,3} = 1.06 * 10^{-4}$ kgCO₂e per Btu of coal.

BIO = Dry pounds (0% moisture) of crop residue biomass used as energy used for feedstock, fuel and co-product operations, as measured by Cardinal Union by continuous monitoring.

$EF_{bio} = 1.98 * 10^{-2}$ kgCO₂e per dry lbs of crop residue biomass.

GHG_{ELEC} = The greenhouse gas emissions, in kgCO₂e, associated with electricity used for feedstock, fuel and co-product operations, as measured by Cardinal Union by continuous monitoring, and calculated according to the following formula:

$$GHG_{ELEC} = ELEC * EF_{elec}$$

Where:

ELEC = kWh of Grid electricity used as energy used for feedstock, fuel and co-product operations, as measured by Cardinal Union by continuous monitoring.

$EF_{elec} = 0.467$ kgCO₂e per kWh of grid electricity, based on the United States grid average.

- e. For the purposes of the formula in section IV.D.b, GHG_D is calculated to be 1.4 kgCO₂e per mmBtu of ethanol.
- f. For the purposes of section IV.D., for all corn ethanol produced by Cardinal Union during a day where Cardinal Union has missing data on any of the factors described in this section, Cardinal Union shall assess the corn ethanol produced on all such days as having lifecycle GHG emissions of 99.0 kgCO₂e per mmBtu,²⁴ and use this value in their calculation of the 365-day rolling average lifecycle GHG emissions.

E. Recordkeeping

In addition to the specific recordkeeping requirements stated at 40 CFR 80.1454(b)(3)(i)-(xii), the following records related to the generation and assignment of RINs must be produced and maintained pursuant to 40 CFR 80.1454(b)(3) when Cardinal Union generates RINs for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process.

²⁴ The value of 99.0 kgCO₂e/mmBtu was selected because it is the value for baseline lifecycle GHG emissions from gasoline, as evaluated by EPA for the March 2010 RFS rule. We recognize this is a conservative approach for substituting missing data, and we believe a conservative approach is necessary to eliminate any incentive for parties to fail to collect and document accurate data.

- a. Records documenting the data required to calculate lifecycle GHG emissions per the requirements specified in section IV.D., and which are collected in accordance with the compliance monitoring plan described in section IV.B.a. This includes comprehensive and reliable information with respect to the amount of feedstock and energy used and the amount of fuel produced, such as meter readings and energy bills that span the entire averaging time period for each instance that RINs are generated for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process.
- b. Records presenting accurate calculations verifying compliance with the requirement specified in section IV.D., above, that the 365-day rolling average lifecycle GHG emissions do not exceed 79.17 kgCO₂e/mmBtu of corn ethanol as calculated in accordance with section IV.D.b, and that are prepared on each day that RINs are generated for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process. The information must include identifiable unique references to all documents and metering data used in the calculations.²⁵

F. Reporting

As part of the quarterly RIN generation reports required under 40 CFR 80.1451(b), Cardinal Union shall follow all of the instructions in the RFS Efficient Producer Data Form (RFS2500) (EPA Form 5900-374) to submit the required information that was prepared during the relevant quarter.²⁶ Cardinal Union shall submit reports in accordance with the RFS Efficient Producer Data Form for each and every quarter that it has an activated pathway for ethanol produced through the Cardinal Ethanol Union City Process.

G. Additional Conditions

The authority for Cardinal Union to generate RINs for non-grandfathered corn ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process is expressly conditioned on Cardinal Union satisfying all of the following additional conditions:

- a. For any biogas or treated biogas used for feedstock, fuel and co-product operations, Cardinal Union must satisfy the applicable requirements specified at 40 CFR 80.1426(f)(12) of the RFS regulations.
- b. All of the biomass used onsite as process energy used for feedstock, fuel and co-product operations must be one or any combination of the types of biomass that is a crop residue, as defined at 40 CFR 80.1401 in the RFS regulations.²⁷

²⁵ The EPA has provided spreadsheets on its website to help ethanol producers understand the correct calculation of 365-day rolling average lifecycle GHG emissions. These spreadsheets can also be used to help with recordkeeping.

²⁶ Since the information prepared pursuant to section IV.E. must be included in the Cardinal Union quarterly RIN generation reports to EPA, it follows that this information is subject to attest engagement requirements pursuant to 80.1464(b).

²⁷ See the July 2014 RFS rule (79 FR 42128) for more details on what EPA considers to be residue.

Cardinal Union may not generate RINs for non-grandfathered corn ethanol produced through the Cardinal Ethanol Union City Corn Process if Cardinal Union fails to comply with any of the conditions in this section IV. However, this does not prevent Cardinal Union from generating RINs for fuel produced pursuant to any of the pathways specified in Table 1 to 40 CFR 80.1426, or pursuant to 40 CFR 80.1426(f)(6), to the extent that Cardinal Union is authorized to do so under applicable regulations.

If Cardinal Union chooses to generate grandfathered RINs pursuant to 40 CFR 80.1426(f)(6) and also generate RINs for non-grandfathered corn ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process during any calendar year, Cardinal Union may only generate RINs for non-grandfathered corn ethanol after it generates RINs for all of its grandfathered baseline volume. In other words, Cardinal Union must first produce and generate RINs for its grandfathered volume before generating RINs under the pathway being approved in this document.²⁸

EPA may modify the conditions specified above, as it deems necessary and appropriate to ensure that non-grandfathered corn ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process achieves the required lifecycle GHG reductions, including to make the conditions align with any future changes to the RFS regulations. If EPA makes any changes to the conditions noted in this document for non-grandfathered corn ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process, the agency will explain such changes in a public determination letter, similar to this one, and specify in that letter the effective date for any such changes.

V. Public Participation

As part of the March 2010 RFS rule, we took public comment on our lifecycle assessment of the corn ethanol pathways listed in Table 1 to 40 CFR 80.1426, including all models used and all modeling inputs and evaluative approaches. In the March 2010 RFS rule, we also acknowledged that it was unlikely that our final regulations would address all possible qualifying fuel production pathways, and we took comment on allowing the generation of RINs using a temporary D code in certain circumstances while EPA was evaluating such new pathways and updating its regulations. After considering comments, we finalized the current petition process, where we allow for EPA approval of certain petitions without going through additional notice and public comment if we can do so as a reasonably straightforward extension of prior analyses, whereas notice and public

²⁸ There are several reasons for the inclusion of this condition. There are data reliability benefits associated with requiring the generation of grandfathered RINs first. Since Cardinal Union will be required to start tracking energy use once this pathway is activated in EMTS, they will have a more robust set of data that contributes to their 365-day rolling average, compared to having just one data point on the first day of approval. In addition, this condition will help to reduce the agency's administrative burden related to enforcement and compliance. If Cardinal Union were able to switch back and forth between generating grandfathered and non-grandfathered RINs, auditing their records would require EPA to do a more complex review of historical data. Furthermore, alternating between the grandfathered and non-grandfathered RIN generation creates more opportunities for errors in the calculations required to meet the GHG emission reduction threshold, and also provides more opportunities for errors when generating RINs in EMTS. EPA has approved pathway petitions in the past with conditions allowing parties to switch back and forth between the production of grandfathered and non-grandfathered volume during a calendar year. However, for the reasons described above, we have decided not to grant additional petitions allowing such an approach.

comment would be conducted to respond to petitions requiring significant new analysis and/or modeling. *See* 75 FR 14797 (March 26, 2010).

In responding to the petition submitted by Cardinal Union, we have relied on the corn ethanol modeling that we conducted for the March 2010 RFS rule and have simply adjusted the analysis to account for the specific production process used by Cardinal Ethanol Union City. We relied on the same agricultural sector modeling (FASOM and FAPRI results) that was conducted and commented on as part of the March 2010 RFS rule to represent feedstock production. This also includes use of the same emission factors and types of emission sources that were used in the March 2010 RFS rule analysis. Thus, the fundamental analyses relied on for this decision have already been made available for public comment as part of the March 2010 RFS rule. Our approach today is also consistent with our description of the petition process in the preamble to the March 2010 RFS rule. Our evaluation in response to the petition is a logical extension of analyses already conducted for the March 2010 RFS rule.

VI. Conclusion

This document specifies conditions designed to ensure that D code 6 RINs are generated for non-grandfathered corn starch ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process only if the ethanol satisfies the 20% lifecycle GHG reduction requirements specified in the CAA for renewable fuel. The fuel must also meet other applicable requirements specified in the CAA and EPA implementing regulations to qualify for RIN generation, including being produced from renewable biomass, and for use as transportation fuel, heating oil or jet fuel.

This approval applies specifically to the Cardinal Ethanol Union City facility and to the process, materials used, fuel and co-products produced, and process energy sources as outlined and described in the Cardinal Union petition. This approval is effective as of signature date. However, RINs may only be generated for non-grandfathered corn starch ethanol produced pursuant to the Cardinal Ethanol Union City Corn Process that is produced after the date of activation of Cardinal Union's registration for this pathway. If Cardinal Ethanol Union City has already successfully registered for a prior corn starch ethanol EP3 pathway, RINs may be generated for fuel produced through the updated EP3 pathway approved in this document on the day after the updated Compliance Monitoring Plan described in section IV.C. is submitted to the EPA.

If Cardinal Union has not received a prior EP3 pathway approval for corn starch ethanol produced through the Cardinal Ethanol Union City Corn Process, the OTAQ Reg: Fuels Programs Registration and OTAQ EMTS: OTAQ EMTS Application (OTAQ Reg and EMTS) will be modified to allow Cardinal Union to register to generate RINs for the production of non-grandfathered ethanol from corn starch feedstock using a production process of "Cardinal Ethanol Union City Corn Process." If Cardinal Union has already successfully registered for the EP3 pathway for corn starch ethanol produced through the Cardinal Ethanol Union City Corn Process, EPA will now accept an updated Compliance Monitoring Plan from Cardinal Union that includes co-production of D code 6 corn starch ethanol through the Cardinal Ethanol Union City Corn Process and D code 3 corn kernel fiber ethanol

produced through a cellulosic production process (process code 280). This document has no impact on the ability of Cardinal Union to use the OTAQ Reg and EMTS to register and generate RINs for the facility's baseline volume of grandfathered ethanol fuel or to register and generate RINs for ethanol produced using any of the pathways specified in Table 1 to 40 CFR 80.1426.