6560-50-P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 80

[EPA-HQ-OAR-2011-0542; FRL-9680-8]

Notice of Data Availability Concerning Renewable Fuels Produced from Grain Sorghum under the RFS Program

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of data availability (NODA).

SUMMARY: This notice of data availability provides an opportunity to comment on EPA's analyses of grain sorghum used as a feedstock to produce ethanol under the Renewable Fuel Standard (RFS) program. EPA's analysis shows that ethanol from grain sorghum has estimated lifecycle greenhouse gas (GHG) emission reductions of 32% compared to the baseline petroleum fuel it would replace. This analysis indicates that grain sorghum ethanol qualifies as a conventional renewable fuel under the RFS program. Furthermore, this analysis shows that, when produced via certain pathways that utilize advanced process technologies (e.g., biogas in addition to combined heat and power), grain sorghum ethanol has lifecycle GHG emission reductions of over 50% compared to the baseline petroleum fuel it would replace, and would qualify as an advanced biofuel under RFS.

DATES: Comments must be received on or before [Insert date 30 days after publication in the Federal Register.]

ADDRESSES: Submit your comments, identified by Docket ID No. EPA-HQ-OAR-2011-0542, by one of the following methods:

- www.regulations.gov: Follow the on-line instructions for submitting comments.
- Email: asdinfo@epa.gov
- Mail: Air and Radiation Docket and Information Center, Environmental Protection Agency, Mailcode: 2822T, 1200 Pennsylvania Ave., NW., Washington, DC 20460.
- Hand Delivery: Air and Radiation Docket and Information Center, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW, Washington DC 20004. Such deliveries are only accepted during the Docket's normal hours of operation, and special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to Docket ID No. EPA-HQ-OAR-2011-0542. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at www.regulations.gov, including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through www.regulations.gov or asdinfo@epa.gov. The www.regulations.gov website is an "anonymous access" system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an e-mail comment directly to EPA without going through www.regulations.gov your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD-ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at http://www.epa.gov/epahome/dockets.htm.

Docket: All documents in the docket are listed in the www.regulations.gov index. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in www.regulations.gov or in hard copy at the Air and Radiation Docket and Information Center, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW, Washington, DC 20004. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air Docket is (202) 566-1742.

FOR FURTHER INFORMATION CONTACT: Jefferson Cole, Office of Transportation and Air Quality, Transportation and Climate Division, Environmental Protection Agency, 1200 Pennsylvania Ave., NW, Washington, DC 20460 (MC: 6041A); telephone number: 202-564-1283; fax number: 202-564-1177; email address: cole.jefferson@epa.gov.

SUPPLEMENTARY INFORMATION:

Outline of This Preamble

I. General Information

A. *Does this Action Apply to Me?*

Entities potentially affected by this action are those involved with the production, distribution, and sale of transportation fuels, including gasoline and diesel fuel or renewable fuels such as biodiesel and renewable diesel. Regulated categories include:

Category	NAICS[1] Codes	SIC[2] Codes	Examples of Potentially Regulated Entities
Industry	324110	2911	Petroleum Refineries
Industry	325193	2869	Ethyl alcohol manufacturing
Industry	325199	2869	Other basic organic chemical manufacturing
Industry	424690	5169	Chemical and allied products merchant wholesalers
Industry	424710	5171	Petroleum bulk stations and terminals
Industry	424720	5172	Petroleum and petroleum products merchant wholesalers
Industry	454319	5989	Other fuel dealers

[1] North American Industry Classification System (NAICS)

[2] Standard Industrial Classification (SIC) system code.

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to engage in activities that may be affected by today's action. To determine whether your activities would be affected, you should carefully examine the applicability criteria in 40 CFR Part 80, Subpart M. If you have any questions regarding the applicability of this action to a particular entity, consult the person listed in the preceding section.

B. *What Should I Consider as I Prepare My Comments for EPA?*

1. *Submitting CBI.*

Do not submit this information to EPA through www.regulations.gov or e-mail. Clearly mark the part or all of the information that you claim to be CBI. For CBI information in a disk or CD ROM that you mail to EPA, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is claimed as CBI. In addition to one complete version of the comment that includes information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

2. *Tips for Preparing Your Comments.* When submitting comments, remember to:

- Identify the rulemaking by docket number and other identifying information (subject heading, Federal Register date and page number).
- Follow directions - The agency may ask you to respond to specific questions or organize comments by referencing a Code of Federal Regulations (CFR) part or section number.
- Explain why you agree or disagree; suggest alternatives and substitute language for your requested changes.
- Describe any assumptions and provide any technical information and/or data that you used.
- If you estimate potential costs or burdens, explain how you arrived at your estimate in sufficient detail to allow for it to be reproduced.
- Provide specific examples to illustrate your concerns, and suggest alternatives.
- Explain your views as clearly as possible, avoiding the use of profanity or personal threats.
- Make sure to submit your comments by the comment period deadline identified.

II. Analysis of Lifecycle Greenhouse Gas Emissions

A. Methodology

1. *Scope of Analysis*

On March 26, 2010 (75 FR 14670), the Environmental Protection Agency (EPA) published changes to the Renewable Fuel Standard program regulations as required by 2007 amendments to CAA 211(o). This rulemaking is commonly referred to as the "RFS2" final rule. As part of the RFS2 final rule we analyzed various categories of biofuels to determine whether the complete lifecycle GHG emissions associated with the production, distribution, and use of those fuels meet minimum lifecycle greenhouse gas reduction thresholds as specified by CAA 211(o) (i.e., 60% for cellulosic biofuel, 50% for biomass-based diesel and advanced biofuel, and 20% for other renewable fuels). Our final rule focused our lifecycle analyses on fuels that were anticipated to contribute relatively large volumes of renewable fuel by 2022 and thus did not cover all fuels that either are contributing or could potentially contribute to the program. In the preamble to the final rule EPA indicated that it had not completed the GHG emissions impact analysis for several specific biofuel production pathways but that this work would be completed through a supplemental rulemaking process. Since the final rule was issued, we have continued to examine several additional pathways. This Notice of Data Availability ("NODA") focuses on our analysis of the grain sorghum ethanol pathway. The modeling approach EPA used in this analysis is the same general approach used in the final RFS2 rule for lifecycle analyses of other biofuels.[1] The RFS2 final rule preamble and Regulatory Impact Analysis (RIA) provides further discussion of our approach.

This notice of data availability provides an opportunity to comment on EPA's analyses of lifecycle GHG emissions related to the production and use of ethanol from grain sorghum prior to EPA taking any final rulemaking action to add ethanol from grain sorghum as an available pathway in the RFS program. We intend to consider all of the relevant comments received. In

[1] EPA. 2010. Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis. EPA-420-R-10-006. http://www.epa.gov/oms/renewablefuels/420r10006.pdf

general, comments will be considered relevant if they pertain to EPA's analysis of lifecycle GHG emissions of grain sorghum ethanol, and especially if they provide specific information for consideration in our modeling.

2. *Models Used*

The analysis EPA has prepared for grain sorghum ethanol uses the same set of models that was used for the final RFS2 rule. To estimate the domestic agricultural impacts presented in the following sections, we used the Forestry and Agricultural Sector Optimization Model (FASOM) developed by Texas A&M University. To estimate the international agricultural section impacts presented below, we used the Food and Agricultural Policy and Research Institute international models as maintained by the Center for Agricultural and Rural Development (FAPRI-CARD) at Iowa State University. For more information on the FASOM and FAPRI-CARD models, refer to the RFS2 final rule preamble (75 FR 14670) or the RFS2 Regulatory Impact Analysis (RIA).[2] The models require a number of inputs that are specific to the pathway being analyzed, including projected yields of feedstock per acre planted, projected fertilizer use, and energy use in feedstock processing and fuel production. The docket includes detailed information on model inputs, assumptions, calculations, and the results of our assessment of the lifecycle GHG emissions performance for producing ethanol from grain sorghum ("grain sorghum ethanol").

3. *Scenarios Modeled for Impacts of Increased Demand for Grain Sorghum*

[2] EPA. 2010. Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis. EPA-420-R-10-006. http://www.epa.gov/oms/renewablefuels/420r10006.pdf. Additional RFS2 related documents can be found at http://www.epa.gov/otaq/fuels/renewablefuels/regulations.htm.

To assess the impacts of an increase in renewable fuel volume from business-as-usual (what is likely to have occurred without the RFS biofuel mandates) to levels required by the statute, we established reference and control cases for a number of biofuels analyzed for the RFS2 final rulemaking. The reference case includes a projection of renewable fuel volumes without the RFS renewable fuel volume mandates. The control cases are projections of the volumes of renewable fuel that might be used in the future to comply with the volume mandates. The final rule reference case volumes were based on the Energy Information Administration's (EIA) Annual Energy Outlook (AEO) 2007 reference case projections. In the RFS2 rule, for each individual biofuel, we analyzed the incremental GHG emission impacts of increasing the volume of that fuel to the total mix of biofuels needed to meet the EISA requirements.

For the analysis of grain sorghum ethanol, a new control case was developed to account for the current production of grain sorghum ethanol which is approximately 200 million gallons per year (see Chapter 1 of the RFS2 RIA). All other volumes for each individual biofuel in this new control case remain identical to the control case used in the RFS2 rule. For the "grain sorghum" case, our modeling assumes approximately 300 million gallons of sorghum ethanol would be consumed in the United States in 2022. The modeled scenario includes 2.06 billion lbs of grain sorghum to be used to produce the additional 100 million gallons of ethanol in 2022.

Our volume scenario of approximately 200 million gallons of grain sorghum ethanol in the new control case, and 300 million gallons in the grain sorghum case in 2022, is based on several factors including historical volumes of grain sorghum ethanol production, potential feedstock availability and other competitive uses (e.g., animal feed or exports). Our assessment is described further in the inputs and assumptions document that is available through the docket (EPA 2011). Based in part on consultation with experts at the United States Department of Agriculture (USDA) and industry representatives, we believe that these volumes are reasonable for the purposes of evaluating the impacts of producing additional volumes of ethanol from grain sorghum.

The FASOM and FAPRI-CARD models, described above, project how much grain sorghum will be supplied to ethanol production from a combination of increased production, decreases in others uses (e.g., animal feed), and decreases in exports, in going from the control case to the grain sorghum case.

4. *Model Modifications*

Based on information from industry stakeholders, as well as in consultation with USDA, both the FASOM and FAPRI-CARD models assume perfect substitution in the use of grain sorghum and corn in the animal feed market in the U.S. Therefore, when more grain sorghum is used for ethanol production, grain sorghum used in feed decreases. Either additional corn or sorghum will be used in the feed market to make up for this decrease, depending upon the relative cost of additional production. This assumption is based on conversations with industry and the USDA, reflecting the primary use of sorghum in the U.S. as animal feed, just like corn.

The United States is one of the largest producers and exporters of grain sorghum. However, two large producers of grain sorghum, India and Nigeria, do not actively participate in the global trade market for sorghum. Rather, all grain sorghum in those two countries is produced for domestic consumption. Therefore, as the U.S. diverts some of its exports of grain sorghum for the purposes of ethanol production, we would expect close to no reaction in the production levels of grain sorghum in India and Nigeria. Historical data on prices, production, and exports from USDA, FAOSTAT, and FAPRI support this assumption.[3]

B. Results

As we did for our analysis of other feedstocks in the RFS2 final rule, we assessed what the GHG emissions impacts would be from the use of additional volumes of sorghum for biofuel production. The information provided in this section discusses the assumptions and outputs of the analysis using the FASOM and FAPRI-CARD agro-economic models to determine changes in the agricultural and livestock markets. These results from FASOM and FAPRI-CARD are then used to determine the GHG emissions impacts due to land use change and other factors. Finally, we include our analysis of the GHG emissions associated with different processing pathways and how these technologies affect the lifecycle GHG emissions associated with grain sorghum ethanol.

As discussed in the final RFS2 rule and the accompanying peer review, there are inherent challenges in reconciling the results from two different models. However, using two models provides a more complete and robust analysis than either model would be able to provide alone. We have attempted to align as many of the key assumptions as possible to get a consistent set of

[3] See Memo to the Docket, Docket Number EPA–HQ–OAR–2011–0542, Dated May 18, 2012 and personal communication with USDA.

modeling results although there are structural differences in the models that account for some of the differences in the model results. For example, since FASOM is a long-term dynamic optimization model, short-term spikes are smoothed out over the five year reporting period. In comparison, the FAPRI-CARD model captures annual fluctuations that may include short-term supply and demand responses. In addition, some of the discrepancies may be attributed to different underlying assumptions pertaining to elasticities of supply and demand for different commodities. These differences, in turn, affect projections of imports and exports, acreage shifting, and total consumption and production of various commodities.

1. *Agro-Economic Impacts*

As biofuel production causes increased demand for a particular commodity, the supply generally comes from a mix of increased production, decreased exports, increased imports, and decreases in other uses of the commodity. In the case of grain sorghum, FASOM estimates that the majority of sorghum necessary to produce 100 million additional gallons of ethanol (2.06 billion lbs) by 2022 comes from a decrease in grain sorghum used in the animal feed market (2.05 billion lbs). This gap in the feed market is primarily filled by distillers grains (627 million lbs), a byproduct from the grain sorghum ethanol production process also known as DG, as well as additional corn production (1.6 billion lbs). This is reasonable given the close substitutability of corn and grain sorghum in the U.S. animal feed markets. When DG are produced at an ethanol facility, they contain a certain amount of moisture and are referred to as “wet” DG. If an ethanol facility is interested in transporting DG long distances to sell to distant feedlots, then the DG must be dried so they do not spoil. Information about the energy required for this drying process, as well as the different amounts of wet versus dry DG production that we considered can be found below in Sections II.B.3 and II.B.5. In those sections, we detail not only how much energy is required for drying DG, but show that this amount of energy is not significantly large enough to affect the overall threshold determinations.

Table II-1. Summary of Projected Change in Feed Use in the U.S. in 2022 in the FASOM Model

(Millions of Lbs)

	Control Case	Grain Sorghum Case	Difference
Sorghum	38,998	36,947	-2,051
Corn	324,731	326,365	1,635
Distillers Grains (DG)	79,388	80,014	627
Other	71,881	71,873	-8
Total	514,998	515,200	202

As demand for both grain sorghum for ethanol production and corn for animal feed increases, harvested crop area in the U.S. are predicted to increase by 92 thousand acres in 2022. The increase in grain sorghum area harvested is relatively modest, at an additional 4 thousand acres, due to the fact that demand for grain sorghum for use in ethanol production is being met by a shift of grain sorghum from one existing use (in the animal feed market) to another (ethanol production). Meeting the subsequent gap in supply of animal feed, however, leads to an increase of 141 thousand corn acres in 2022. Due to the increased demand for corn production and harvested area, soybean harvested area would decrease by 105 thousand acres (corn and soybeans often compete for land). Other crops in the U.S., such as wheat, hay, and rice, are projected to have a net increase of 53 thousand acres.

Table II-2. Summary of Projected Change in Crop Harvested Area in the U.S. in 2022 in the FASOM Model

(Thousands of Acres)

	Control Case	Grain Sorghum Case	Difference
Sorghum	11,108	11,111	4
Corn	77,539	77,680	141
Soybeans	69,896	69,791	-105
Other	154,511	154,564	53
Total	313,054	313,146	92

As demand for grain sorghum increases for ethanol production in the U.S., the FAPRI-CARD model estimates that the U.S. will decrease exports of grain sorghum by 789 million lbs. Additionally, the U.S. will increase exports of corn by 106 million lbs to partially satisfy the gap of having less grain sorghum in the worldwide feed market. This combination of impacts on the world trade of grain sorghum and corn has effects both on major importers, as well as on other major exporters. For example, Mexico, one of the largest importers of grain sorghum, decreases its imports of grain sorghum by 395 million lbs, and increases its imports of corn by 256 million lbs. Brazil also contributes more corn to the global market by increasing its exports by 198 million lbs. Details for other major importers and exporters of grain sorghum and corn can be found in Table II-3 and Table II-4, respectively.

Table II-3. Summary of Projected Change in Net Exports of Grain Sorghum by Country in 2022 in the FAPRI-CARD Model

(Millions of Lbs)

	Control Case	Grain Sorghum Case	Difference
U.S.	10,580	9,791	-789
Mexico	-4,735	-4,340	395
Japan	-3,159	-3,106	53
Argentina	2,577	2,653	75
India	-219	-219	0
Nigeria	110	110	0
Rest of World	-4,655	-4,389	266

Note: A country with negative Net Exports is a Net Importer

Table II-4. Summary of Projected Change in Net Exports of Corn by Country in 2022 in the FAPRI-CARD Model

(Millions of Lbs)

	Control Case	Grain Sorghum Case	Difference
U.S.	122,688	122,795	106
Brazil	24,661	24,859	198
China	12,748	12,840	93
Japan	-38,787	-38,877	-91
Mexico	-29,008	-29,264	-256

Rest of World	-91,423	-91,474	-51

Note: A country with negative Net Exports is a Net Importer

The change in trade patterns directly impacts the amount of production and harvested crop area around the world. Harvested crop area for grain sorghum is not only predicted to increase in the U.S., but also in Mexico (7.8 thousand acres) and other parts of the world. Worldwide grain sorghum harvested area outside of the U.S. would increase by 39.3 thousand acres. Similarly, the increase in the demand for corn would lead to an increase of 36.8 thousand harvested acres outside of the U.S. While soybean harvested area would decrease in the U.S., Brazil would increase its soybean harvested area (18.4 thousand acres) to satisfy global demand. Although worldwide soybean harvested area decreases by 11.7 thousand acres, non-U.S. harvested area increases by 11.2 thousand acres.

Overall harvested crop area in other countries also increase, particularly in Brazil. Brazil's total harvested area is predicted to increase by 32.6 thousand acres by 2022. This is mostly comprised of an increase in corn of 18.1 thousand acres, and an increase in soybeans of 18.4 thousand acres, along with minor changes in other crops. More details on projected changes in world harvested crop area in 2022 can be found below in Table II-5, Table II-6, Table II-7, and Table II-8.

Table II-5. Summary of Projected Change in International (non-U.S.) Harvested Area by Country in 2022 in the FAPRI-CARD Model

(Thousands of Acres)

	Control Case	Grain Sorghum Case	Difference
Brazil	137,983	138,016	33
China	272,323	272,334	11
Africa and Middle East	315,843	315,892	48
Rest of World	1,301,417	1,301,441	24
International Total (non-U.S.)	2,027,567	2,027,682	115

Table II-6. Summary of Projected Change in International (non-U.S.) Harvested Area by Crop in 2022 in the FAPRI-CARD Model

(Thousands of Acres)

	Control Case	Grain Sorghum Case	Difference
Sorghum	95,108	95,148	39
Corn	307,342	307,379	37
Soybeans	202,980	202,991	11
Other	1,422,137	1,422,165	28
International Total (non-U.S.)	2,027,567	2,027,682	115

Table II-7. Summary of Projected Change in International (non-U.S.) Grain Sorghum Harvested Area by Country in 2022 in the FAPRI-CARD Model (Thousands of Acres)

	Control Case	Grain Sorghum Case	Difference
Mexico	4,569	4,576	8
Argentina	1,915	1,917	2
India	22,261	22,261	0
Nigeria	18,841	18,841	0
Other Africa and Middle East	37,833	37,856	23
Rest of World	9,689	9,695	6
International Total (non-U.S.)	95,108	95,148	39

* The change in grain sorghum harvested area in India and Nigeria is zero.

Table II-8. Summary of Projected Change in International (non-U.S.) Corn Harvested Area by Country in 2022 in the FAPRI-CARD Model (Thousands of Acres)

	Control Case	Grain Sorghum Case	Difference
Africa and Middle East	77,220	77,223	4
Asia	108,751	108,764	13
Brazil	20,935	20,953	18
India	20,176	20,180	5
Other Latin America	39,599	39,594	-5

Rest of World	40,661	40,664	2
International Total (non-U.S.)	307,342	307,379	37

More detailed information on the agro-economic modeling can be found in the accompanying docket. We invite comment on all aspects of these modeling results.[4]

2. International Land Use Change Emissions

The methodology used in today's assessment of grain sorghum as an ethanol feedstock is the same as was used in the final RFS2 rule for analyses of other biofuel pathways. However, we have updated some of the data underlying the GHG emissions from international land use changes therefore we are providing additional detail on these modifications in this section.

In our analysis, GHG emissions per acre of land conversion internationally (i.e., outside of the United States) are determined using the emissions factors developed for the RFS2 final rule following IPCC guidelines. In addition, estimated average forest carbon stocks were updated based on a new study which uses a more robust and higher resolution analysis. For the RFS2 final rule, international forest carbon stocks were estimated from several data sources each derived using a different methodological approach. Two new peer-reviewed analyses on forest carbon stock estimation were completed since the release of the final RFS2 rule, one for three continental regions by Saatchi et al.[5] and the other for the EU by Gallaun et al.[6] We have

[4] See Memo to the Docket, Docket Number EPA–HQ–OAR–2011–0542, Dated May 18, 2012
[5] Saatchi, S.S., Harris, N.L., Brown, S., Lefsky, M., Mitchard, E.T.A., Salas, W., Zutta, B.R., Buermann, W., Lewis, S.L., Hagen, S., Petrova, S., White, L., Silman, M. And Morel, A. 2011. Benchmark map of forest carbon stocks in tropical regions across three continents. *PNAS* doi: 10.1073/pnas.1019576108.
[6] Gallaun, H., Zanchi, G., Nabuurs, G.J., Hengeveld, G., Schardt, M., Verkerk, P.J. 2010. EU-wide maps of growing stock and above-ground biomass in forests based on remote sensing and field measurements. *Forest Ecology and Management* 260: 252-261.

updated our forest carbon stock estimates based on these new studies because they represent significant improvements as compared to the data used in the RFS2 rule. These updated forest carbon stock estimates were previously used in EPA's January 27, 2012, Notice of Data Availability Concerning Renewable Fuels Produced From Palm Oil Under the RFS Program (77 FR 4300). Forest carbon stocks across the tropics are important in our analysis of grain sorghum ethanol because a significant amount of the land use changes in the scenarios modelled occur in tropical regions such as Brazil. In the scenarios modelled there are also much smaller amounts of land use change impacts in the EU related to grain sorghum ethanol production. In the interest of using the best available data we have incorporated the improved forest carbon stocks data in our analysis of lifecycle GHG emissions related to grain sorghum ethanol.

Preliminary results for Latin America and Africa from Saatchi et al. were incorporated into the final RFS2 rule, but Asia results were not included due to timing considerations. The Saatchi et al. analysis is now complete, and so the final map was used to calculate updated area-weighted average forest carbon stocks for the entire area covered by the analysis (Latin America, sub-Saharan Africa and South and Southeast Asia). The Saatchi et al. results represent a significant improvement over previous estimates because they incorporate data from more than 4,000 ground inventory plots, about 150,000 biomass values estimated from forest heights measured by space-borne light detection and ranging (LIDAR), and a suite of optical and radar satellite imagery products. Estimates are spatially refined at 1-km grid cell resolution and are directly comparable across countries and regions.

In the final RFS2 rule, forest carbon stocks for the EU were estimated using a combination of data from three different sources. Issues with this 'patchwork' approach were that the biomass estimates were not comparable across countries due to the differences in methodological approaches, and that estimates were not spatially derived (or, the spatial data were not provided to EPA). Since the release of the final rule, Gallaun et al. developed EU-wide maps of above-ground biomass in forests based on remote sensing and field measurements. MODIS data were used for the classification, and comprehensive field measurement data from national forest inventories for nearly 100,000 locations from 16 countries were also used to develop the final map. The map covers the whole European Union, the European Free Trade Association countries, the Balkans, Belarus, the Ukraine, Moldova, Armenia, Azerbaijan, Georgia and Turkey.

For both data sources, Saatchi et al. and Gallaun et al., we added belowground biomass to reported aboveground biomass values using an equation in Mokany et al.[7]

In our analysis, forest stocks are estimated for over 750 regions across 160 countries. For some regions the carbon stocks increased as a result of the updates and in others they declined. For comparison, we ran our grain sorghum analysis using the old forest carbon stock values used in the RFS2 rule and with the updated forest carbon values described above. Using the updated forest carbon stocks increased the land use change GHG emissions related to grain sorghum ethanol by approximately 1.2 kilograms of carbon-dioxide equivalent emissions per million British thermal units of grain sorghum ethanol (kgCO_2e/mmBtu). Table II-9 includes the international land use change GHG emissions results for the scenarios modeled, in terms of

[7] Mokany, K., R.J. Raison, and A.S. Prokushkin. 2006. Critical analysis of root:shoot ratios in terrestrial biomes. Global Change Biology 12: 84-96.

$kgCO_2e/mmBtu$. International land use change GHG emissions for grain sorghum is estimated at 30 $kgCO_2e/mmBtu$.

Table II-9. International Land Use Change GHG Emissions

($kgCO_2e/mmBtu$)

Region	Emissions
Africa and Middle East	9
Asia	5
Brazil	14
India	1
Other Latin America	1
Rest of World	1
International Total (non-U.S.)	30

More detailed information on the land-use change emissions can be found in the accompanying docket. We invite comment on all aspects of these modeling results.[8]

3. Grain Sorghum Ethanol Processing

We expect the dry milling process will be the basic production method for producing ethanol from grain sorghum and therefore this is the ethanol production process considered here. In the dry milling process, the grain sorghum is ground and fermented to produce ethanol. The

[8] See Memo to the Docket, Docket Number EPA–HQ–OAR–2011–0542, Dated May 18, 2012

remaining DG are then either left wet if used in the near-term or dried for longer term use as animal feed.

For this analysis the amount of grain sorghum used for ethanol production as modeled by the FASOM and FAPRI-CARD models was based on yield assumptions built into those two models. Specifically, the models assume sorghum ethanol yields of 2.71 gallons per bushel for dry mill plants (yields represents pure ethanol).

As per the analysis done in the RFS2 final rule, the energy consumed and emissions generated by a renewable fuel plant must be allocated not only to the renewable fuel produced, but also to each of the by-products. For grain sorghum ethanol production, this analysis accounts for the DG co-product use directly in the FASOM and FAPRI-CARD agricultural sector modeling described above. DG are considered a replacement animal feed and thus reduce the need to make up for the grain sorghum production that went into ethanol production. Since FASOM takes the production and use of DG into account, no further allocation was needed at the ethanol plant and all plant emissions are accounted for there.

In terms of the energy used at grain sorghum ethanol facilities, significant variation exists among plants with respect to the production process and type of fuel used to provide process energy (e.g., coal versus natural gas). Variation also exists between the same type of plants using the same fuel source based on the design of the production process such as the technology used to separate the ethanol from the water, the extent to which the DG are dried and whether other co-products are produced. Such different pathways were considered for ethanol made from corn. Since for the most part these same production processes are available for ethanol produced from sorghum, our analyses considered a similar set of different production pathways for grain sorghum ethanol production. Our focus was to differentiate among facilities based on key differences, namely the type of plant and the type of process energy fuel used. As shown in Section C, the current data shows that the type of RIN that different sorghum facilities will be able to generate will depend upon the types of process energy used and whether advanced technologies are included (but not on the amount of DG that are dried).

Ethanol production is a relatively resource-intensive process that requires the use of water, electricity, and steam. In most cases, water and electricity are purchased from the municipality and steam is produced on-site using boilers fired by natural gas, coal, or in some cases, alternative fuels (described in more detail below).[9]

Purchased process fuel and electricity use for grain sorghum ethanol production was based on the energy use information for corn ethanol production from the RFS2 final rule analysis. For the RFS2 final rule, EPA modeled future plant energy use to represent plants that would be built to meet requirements of increased ethanol production, as opposed to current or historic data on energy used in ethanol production. The energy use at dry mill ethanol plants was based on ASPEN models developed by USDA and updated to reflect changes in technology out to 2022 as described in the RFS 2 final rule RIA Chapter 1.

The work done on grain ethanol production for the RFS2 final rule was based on converting corn to ethanol. Converting grain sorghum to ethanol will result in slightly different

[9] Some plants pull steam directly from a nearby utility.

energy use based on difference in the grains and how they are processed. For example, grain sorghum has less oil content than corn and therefore requires less processing and mass transfer of the oil which results in a decrease in energy use compared to processing corn to ethanol. The same ASPEN USDA models used for corn ethanol in the final rule were also developed for grain sorghum ethanol. Based on the numbers from USDA, a sorghum ethanol plant uses 96.3% of the thermal process energy of a corn ethanol plant (3.7% less), and 99.3% of the electrical energy (0.7% less).

The GHG emissions from production of ethanol from grain sorghum were calculated in the same way as other fuels analyzed as part of the RFS2 final rule. The GHG emissions were calculated by multiplying the BTUs of the different types of energy inputs at the grain sorghum ethanol plant by emissions factors for combustion of those fuel sources. The BTU of energy input was determined based on analysis of the industry and work done as part of the RFS2 final rule as well as considering the impact of different technology options on plant energy needs. The emission factors for the different fuel types are the same as those used in the RFS2 final rule and were based on assumed carbon contents of the different process fuels. The emissions from producing electricity in the U.S. were also the same as used in the RFS2 final rule, which were taken from the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model (GREET) and represent average U.S. grid electricity production emissions.

One of the energy drivers of ethanol production is drying of the DG. Plants that are co-located with feedlots have the ability to provide the co-product without drying. This energy use has a large enough impact on overall results in previous analyses that we defined a specific category for wet versus dry co-product as part of the RFS2 final rule. For grain sorghum ethanol production we also consider wet versus dry DG. For corn ethanol production, as discussed in the RFS2 final rule, the industry average for wet DG is approximately 37%. Industry provided data that approximately 92% of grain sorghum DG is wet. However, in the case of grain sorghum ethanol production, the current data shows that energy used for DG drying does not change whether a facility meets the 20% GHG emission threshold (conventional renewable fuel) or the 50% GHG emission threshold (advanced renewable fuel). The amount of btu per gallon of ethanol produced for processes where DG are dried, and where they are not, can be found in Table II-10 below. Overall lifecycle GHG emission reductions for grain sorghum ethanol facilities that do and do not dry DG can be found below in Table II-11.

For this NODA, we analyzed several combinations of different advanced process technologies and fuels to determine their impacts on lifecycle GHG emissions from grain sorghum ethanol. As noted above, many of the same technologies that were considered as part of the RFS2 final rule for corn ethanol can also be applied to grain sorghum ethanol production. Based on discussion with industry, we understand there is interest in building grain sorghum ethanol plants which incorporate such advanced technologies. Therefore, as was the case with corn ethanol in the RFS2 final rule, our intent is to provide different processing technology options that producers could use to meet the lifecycle threshold requirements required by EISA. This section describes the different GHG impacts associated with alternative processing technology and fuel options and outlines specific process pathways that would be needed to meet different GHG threshold requirements. If finalized, these pathways would allow producers to use the updated Table 1 in Section 80.1426 to determine whether their combination of technologies and process fuels would allow them to qualify as an advanced grain sorghum ethanol pathway.

Several technologies and fuel choices affect emissions from process energy use. Fuel choice has a significant impact on process energy emissions; switching from natural gas to biogas[10], for example, will reduce lifecycle GHG emissions by approximately 20 percentage points. Another factor that influences GHG impacts from process energy use is the percentage of DG that is dried. If a plant is able to reduce the amount of DG it dries, process energy use, and therefore GHG emissions, decrease. The impact of going from 100% dry DG to 100% wet DG is larger for natural gas plants (approximately a 10% reduction in overall GHG emissions relative to the petroleum baseline) compared to biogas plants because biogas plants already have low emissions from process energy.

Production facilities that utilize combined heat and power (CHP) systems can also reduce GHG emissions relative to less efficient system configurations. CHP, also known as cogeneration, is a mechanism for improving overall plant efficiency by using a single fuel to generate both power and thermal energy. The most common configuration in ethanol plants involves using the boiler to power a turbine generator unit that produces electricity, and using waste heat to produce process steam. While the thermal energy demand for an ethanol plant using CHP technology is slightly higher than that of a conventional plant, the additional energy used is far less than what would be required to produce the same amount of electricity in an offsite (central) power plant. The increased efficiency is due to the ability of the ethanol plant to effectively utilize the waste heat from the electricity generation process.

[10] Biogas in the context of use as a fuel source at ethanol plants refers to biogas from landfills, waste treatment plants, and waste digesters.

In addition to CHP (or sometimes in combination), a growing number of ethanol producers are turning to alternative fuel sources to replace traditional boiler fuels (i.e., natural gas and coal), to improve their carbon footprint and/or become more self-sustainable. Alternative boiler fuels currently used or being pursued by the ethanol industry include biomass, co-products from the ethanol production process (bran, thin stillage or syrup), manure biogas (methane from nearby animal feedlots), and landfill gas (generated from the digestion of municipal solid waste). The CO_2 emissions from biomass combustion as a process fuel source are not specifically shown in the lifecycle GHG inventory of the biofuel production plant; rather, CO2 emissions from biomass use are accounted for as part of the land use change calculations for each feedstock.

Since CHP technologies on natural gas plants reduce purchased electricity but increase process energy use emissions (because of increased natural gas use on-site), the net result is a small reduction in overall emissions. CHP at biogas facilities result in greater reductions since the increased biogas use for electricity production does not result in significant increases in on-site emissions.

Although not exhaustive, Table II-10 shows the amount of process fuel and purchased electricity used at a grain sorghum ethanol facility for the different technology and fuel options in terms of Btu/gal of ethanol produced.

Table II-10. Process Fuel and Electricity Options at Grain Sorghum Ethanol Facilities

(Btu / Gallon of Ethanol Produced)

Fuel Type and Technology	Natural Gas Use	Biogas Use	Purchased Electricity
Sorghum Ethanol – Dry Mill Natural Gas			
No CHP, 100% Wet DG	16,449		2,235
Yes CHP, 100% Wet DG	18,605		508
No CHP, 0% Wet DG	27,599		2,235
Yes CHP, 0% Wet DG	29,755		508
Sorghum Ethanol – Dry Mill Biogas			
No CHP, 100% Wet DG		16,449	2,235
Yes CHP, 100% Wet DG		18,605	508
No CHP, 0% Wet DG		27,599	2,235
Yes CHP, 0% Wet DG		29,755	508

As discussed previously in Section II.B.3, there are a number of different process technologies available for grain sorghum ethanol production. The following Table II-11 shows the mean lifecycle GHG reductions compared to the baseline petroleum fuel for a number of different technology pathways including natural gas and biogas fired plants.

Table II-11. Lifecycle GHG Emission Reductions for Dry Mill Grain Sorghum Ethanol Facilities

(% change compared to petroleum gasoline)

Fuel Type and Technology	% Change
Sorghum Ethanol – Dry Mill Natural Gas	
No CHP, 92% Wet DG	-32%
No CHP, 100% Wet DG	-33%
Yes CHP, 100% Wet DG	-36%
No CHP, 0% Wet DG	-22%
Yes CHP, 0% Wet DG	-25%
Sorghum Ethanol – Dry Mill Biogas	
No CHP, 100% Wet DG	-48%
Yes CHP, 100% Wet DG	-53%
No CHP, 0% Wet DG	-47%
Yes CHP, 0% Wet DG	-52%

The docket for this NODA provides more details on our key model inputs and assumptions (e.g., crop yields, biofuel conversion yields, and agricultural energy use). These inputs and assumptions are based on our analysis of peer-reviewed literature and consideration of recommendations of experts from within the grain sorghum and ethanol industries, USDA, and academic institutions. EPA invites comment on all aspects of its modeling of grain sorghum ethanol, including all assumptions and modeling inputs.

4. Results of Lifecycle Analysis for Ethanol from Grain Sorghum (Using Dry Mill Natural Gas)

Consistent with our approach for analyzing other pathways, our analysis for grain sorghum ethanol includes a mid-point estimate as well as a range of possible lifecycle GHG emission results based on uncertainty analysis conducted by the Agency. The graph below (Figure II-1) depicts the results of our analysis (including the uncertainty in our land use change modeling) for grain sorghum ethanol produced in a plant that uses natural gas.[11]

Figure II-1 shows the results of our grain sorghum ethanol modeling. It shows the percent difference between lifecycle GHG emissions for 2022 grain sorghum ethanol, produced in a plant that uses the "basic" technology stated above, and those for the petroleum gasoline fuel 2005 baseline. Lifecycle GHG emissions equivalent to the statutory gasoline fuel baseline are represented on the graph by the zero on the X-axis. The midpoint of the range of results is a 32% reduction in GHG emissions compared to the 2005 gasoline baseline.[12] As in the case of other biofuel pathways analyzed as part of the RFS2 rule, the range of results shown in Figure II-1 is based on our assessment of uncertainty regarding the location and types of land that may be impacted as well as the GHG impacts associated with these land use changes (See Section II.B.1. for further information). These results and those in Table II-11, if finalized, would justify a determination that grain sorghum ethanol produced in plants that use natural gas would meet the 20% reduction threshold required for the generation of conventional renewable fuel RINs.

[11] This analysis assumed 92% wet DG and 8% dry DG.
[12] The 95% confidence interval around that midpoint results in range of a 19% reduction to a 44% reduction compared to the 2005 gasoline fuel baseline.

Figure II-1. Distribution of Results for Grain Sorghum Ethanol Produced in Plants that Use Natural Gas and Produce an Industry Average of 92% Wet Distillers Grains

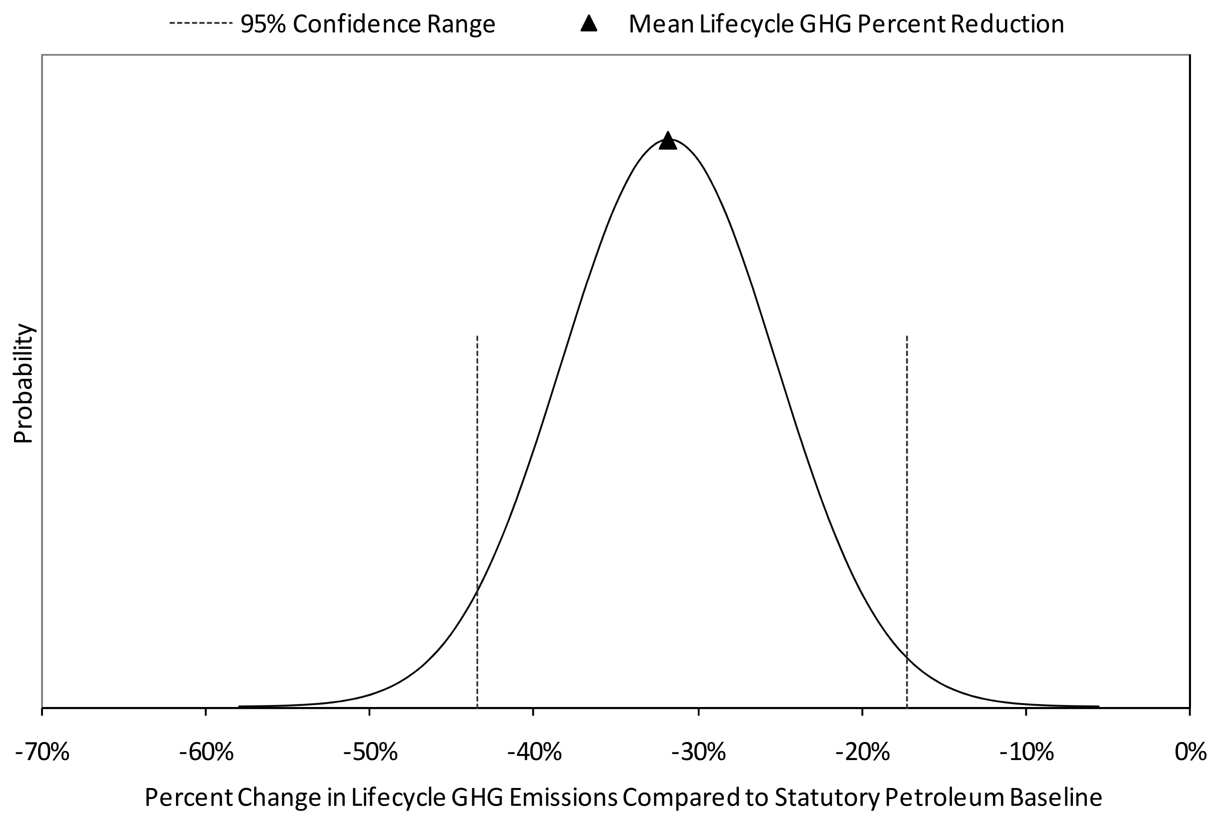

Table II-12 breaks down by stage the lifecycle GHG emissions for grain sorghum ethanol in 2022 and the statutory 2005 gasoline baseline.[13] Results are included using our mid-point estimate of land use change emissions, as well as with the low and high end of the 95% confidence interval. Net agricultural emissions include impacts related to changes in crop inputs, such as fertilizer, energy used in agriculture, livestock production and other agricultural changes in the scenarios modeled. The fuel production stage includes emissions from ethanol production

[13] Totals in the table may not sum due to rounding.

plants. Fuel and feedstock transport includes emissions from transporting bushels of harvested grain sorghum from the farm to ethanol production facility.

Table II-12. Lifecycle GHG Emissions for Grain Sorghum Ethanol Produced in Plants that Use Natural Gas and Produce an Industry Average of 92% Wet Distillers Grains (gCO_2e / mmBtu)

Fuel Type	Grain Sorghum Ethanol	2005 Gasoline Baseline
Net Agriculture (w/o land use change), Domestic and International	12,698	
Land Use Change, Mean *(Low/High),* Domestic and International	27,620 *(16,196/41,903)*	
Fuel Production	22,111	19,200
Fuel and Feedstock Transport	3,661	*
Tailpipe Emissions	880	79,004
Total Emissions, Mean *(Low/High)*	**66,971 *(55,547/ 81,254)***	**98,204**
Midpoint Lifecycle GHG Percent Reduction Compared to Petroleum Baseline	**32%**	

*Emissions included in fuel production stage.

5. *Results of Lifecycle Analysis for Ethanol from Grain Sorghum (Using Biogas and CHP)*

To illustrate an example where a combination of various advanced processing technologies can result in an overall reduction of greater than 50% compared to the 2005 petroleum baseline, the graph included below (Figure II-2) depicts the results of our analysis (including the uncertainty in our land use change modeling) for grain sorghum ethanol produced in a dry mill plant that uses biogas, 0% wet DG, and CHP technology.

Figure II-2 shows the results of our grain sorghum ethanol modeling. It shows the percent difference between lifecycle GHG emissions for 2022 grain sorghum ethanol, produced in a plant that uses biogas as well as combined heat and power, and those for the petroleum gasoline fuel 2005 baseline. Lifecycle GHG emissions equivalent to the statutory gasoline fuel baseline are represented on the graph by the zero on the X-axis. The midpoint of the range of results for this sorghum ethanol plant configuration is a 52% reduction in GHG emissions compared to the 2005 gasoline baseline.[14] As in the case of other biofuel pathways analyzed as part of the RFS2 rule, the range of results shown in Figure II-2 is based on our assessment of uncertainty regarding the location and types of land that may be impacted as well as the GHG impacts associated with these land use changes (See Section II.B.1 for further information). These results, if finalized, would justify our determination that sorghum ethanol produced in dry mill plants that use biogas and combined heat and power meets the 50% reduction threshold required for the generation of advanced renewable fuel RINs.

[14] The 95% confidence interval around that midpoint results in range of a 38% reduction to a 64 % reduction compared to the 2005 gasoline fuel baseline.

Figure II-2. Distribution of Results for Grain Sorghum Ethanol Produced in Plants that Use Biogas, 0% Wet DG and Combined Heat and Power

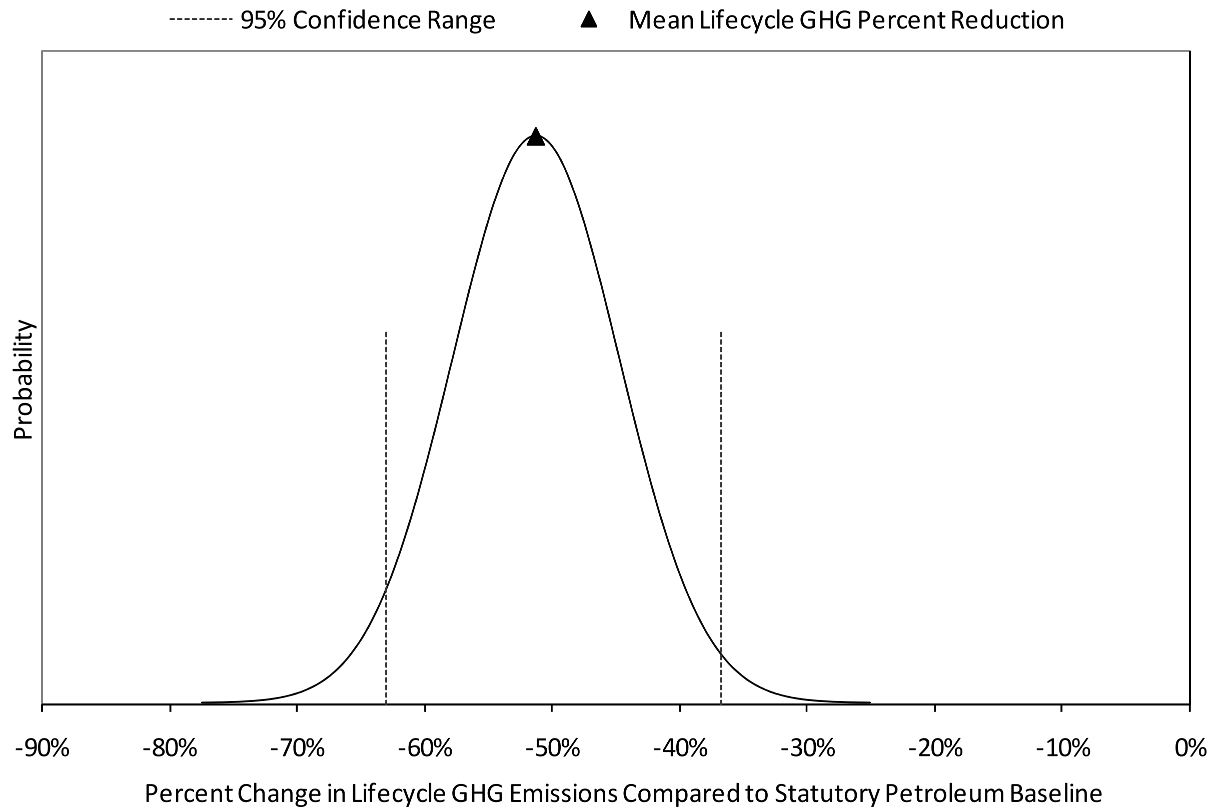

Table II-13 breaks down by stage the lifecycle GHG emissions for grain sorghum ethanol in 2022 and the statutory 2005 gasoline baseline.[15] Results are included using our mid-point estimate of land use change emissions, as well as with the low and high end of the 95% confidence interval. Net agricultural emissions include impacts related to changes in crop inputs, such as fertilizer, energy used in agriculture, livestock production and other agricultural changes in the scenarios modeled. Emissions from fuel production include emissions from ethanol production plants. Fuel and feedstock transport includes emissions from transporting bushels of harvested grain sorghum from the farm to ethanol production facility.

[15] Totals in the table may not sum due to rounding.

Table II-13. Lifecycle GHG Emissions for Grain Sorghum Ethanol Produced in Plants that Use Biogas as well as Combined Heat and Power (gCO_2e / mmBtu)

Fuel Type	Grain Sorghum Ethanol	2005 Gasoline Baseline
Net Agriculture (w/o land use change), Domestic and International	12,698	
Land Use Change, Mean *(Low/High),* Domestic and International	27,620 *(16,196/41,903)*	
Fuel Production	1,612	19,200
Fuel and Feedstock Transport	4,276	*
Tailpipe Emissions	880	79,004
Total Emissions, Mean *(Low/High)*	**47,086 *(35,662/61,369)***	**98,204**
Midpoint Lifecycle GHG Percent Reduction Compared to Petroleum Baseline	**52%**	

*Emissions included in fuel production stage.

6. Other Ethanol Processing Technologies

Since the promulgation of the RFS2 final rule, we have learned that in an effort to reduce the overall use of fossil fuels at their facilities, a number of renewable fuel producers are using or are intend to use electricity that is derived from renewable and non-carbon sources, such as wind power, solar power, hydropower, biogas or biomass, as power for process units and equipment. EPA, through a separate rulemaking process, is evaluating and seeking comment on the possibility of adding a new definition for renewable process electricity, and the related distribution tracking, registration, recordkeeping, and reporting requirements. Depending on the outcome of that process EPA could also evaluate the use of renewable process electricity as an option for reducing grain sorghum ethanol process GHG emissions.

Capturing and sequestering CO_2 emissions from an ethanol plant represents another potential technology pathway that could reduce lifecycle GHG emissions associated with ethanol. Carbon capture and sequestration (CCS) is defined by IPCC as, "a process consisting of the separation of CO_2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere."[16] Although the analysis presented in this NODA for sorghum ethanol does not include a pathway for reducing GHG emissions reductions through CCS, EPA is interested in developing methodologies that would allow us to properly evaluate CCS as an emissions reduction technology as a part of the lifecycle analysis of fuel production for a variety of feedstocks under the RFS2 program. We are taking initial steps to that end in this NODA: we seek comment on the broad concept of how to properly account for CO_2 emissions associated with CCS, including CCS in conjunction with CO_2 enhanced oil and gas recovery (ER), in the context of our RFS lifecycle GHG calculations.

While some systems and technologies associated with CCS have been in use for many years, for purposes of evaluating lifecycle emissions under the RFS program CCS can still be considered an emerging field. Data on CCS is limited, particularly data relating to geologic sequestration (GS) and GS in conjunction with ER. While EPA recently established monitoring and reporting requirements for geologic sequestration under the Greenhouse Gas Reporting Program, no U.S. facilities have submitted data as of publication of this NODA. We therefore invite comment and the submission of data regarding the concept and practice of using CCS technologies to lower the lifecycle emissions of biofuels. Specifically, we seek data on the amount of CO_2 capture that is economically and technically feasible at the ethanol facility and

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[16] Intergovernmental Panel on Climate Change. 2005. A Special Report of Working Group III: Summary for Policymakers. <http://www.ipcc.ch/pdf/special-reports/srccs/srccs_summaryforpolicymakers.pdf>.

the amount of additional energy and fuel such capture would require. We also seek comment on emissions leakage throughout the process of capturing, compressing, transporting, and sequestering the CO_2. In addition, we invite comment on the effectiveness and energy use of the ER CO_2 recycling system, any fugitive emissions associated with such recycling, and energy use and leakage rates with respect to injecting CO_2 for GS with and without ER. We also invite comment on the amount of CO2 that remains sequestered and the length of time of sequestration, and how EPA should account for this as part of a lifecycle analysis for purposes of the RFS program, including how to account now for emissions sequestration that is planned to last for a long period of time into the future.

We believe it is important for facilities that receive credit for GHG emissions reductions using CCS verify that these emissions reductions actually take place. However, we recognize that the ethanol facility that generates RINs is most likely not the same party that will be operating the GS or EOR site, therefore we invite comment on whether it is feasible and enforceable for the ethanol facility to verify that the CO_2 has actually been captured and stored at the GS or EOR site, and how to account for a period of sequestration that stretches many years into the future. Furthermore, we invite comment on the most appropriate way for ethanol producers to validate and credit the GHG emissions reductions from CCS. We recognize that the actual GHG emission reductions from CCS can be very site specific, therefore we request comments on whether it would be more appropriate for EPA to make individual facility determinations using the 40 CFR 80.1416 petition process rather than provide a general pathway in Table 1 of 40 CFR 80.1426.

C. Consideration of Lifecycle Analysis Results

1. Implications for Threshold Determinations

As discussed above, EPA's analysis shows that, based on the mid-point of the range of results, ethanol produced from grain sorghum using biogas and combined heat and power at a dry mill plant would meet the 50 percent GHG emissions reduction threshold needed to qualify as an advanced biofuel (D-5 RINs). Grain sorghum ethanol meets the 20% lifecycle GHG emissions reduction threshold for conventional biofuels (D-6 RINs) when natural gas or biogas is used. If finalized, Table 1 to Section 80.1426 would be modified to add these three new pathways. Table II-14 illustrates how these new pathways would be included in the existing table. Data, analysis and assumptions for each of these processing technologies are provided in the docket for this NODA. We invite comment on all aspects of this analysis.

Table II-14.

Applicable D Codes for Grain Sorghum Ethanol Produced with Different Processing Technologies for Use in Generating RINs

Fuel Type	Feedstock	Production Process Requirements	D-Code
Ethanol	Grain Sorghum	Dry mill process, using Natural Gas for Process Energy	6
Ethanol	Grain Sorghum	Dry mill process, using Biogas for Process Energy, without Combined Heat and Power	6
Ethanol	Grain Sorghum	Dry mill process, using Biogas for Process Energy, with Combined Heat and Power	5

2. Consideration of Uncertainty

Because of the inherent uncertainty and the state of evolving science regarding lifecycle analysis of biofuels, any threshold determinations that EPA makes for grain sorghum ethanol will be based on an approach that considers the weight of evidence currently available. For this pathway, the evidence considered includes the mid-point estimate as well as the range of results based on statistical uncertainty and sensitivity analyses conducted by the Agency. EPA will weigh all of the evidence available to it, while placing the greatest weight on the best-estimate value for the scenarios analyzed.

As part of our assessment of the grain sorghum ethanol pathway, we have identified key areas of uncertainty in our analysis. Although there is uncertainty in all portions of the lifecycle modeling, we focused our analysis on the factors that are the most uncertain and have the biggest impact on the results. The indirect, international emissions are the component of our analysis with the highest level of uncertainty. The type of land that is converted internationally and the emissions associated with this land conversion are critical issues that have a large impact on the GHG emissions estimates.

Our analysis of land use change GHG emissions includes an assessment of uncertainty that focuses on two aspects of indirect land use change – the types of land converted and the GHG emissions associates with different types of land converted. These areas of uncertainty were estimated statistically using the Monte Carlo analysis methodology developed for the RFS2 final rule.[17] Figure II-1 and Figure II-2 show the results of our statistical uncertainty assessment.

Based on the weight of evidence considered, and putting the most weight on our mid-point estimate results, the results of our analysis indicate that grain sorghum ethanol would meet the minimum 20% GHG performance threshold for qualifying renewable fuel under the RFS program when using natural gas and average 2022 dry mill plant efficiencies, and would meet the minimum 50% GHG performance threshold for advanced biofuels under the RFS program when using biogas for process energy at a dry mill plant, with combined heat and power. These conclusions are supported by our midpoint estimates, our statistical assessment of land use change uncertainty, as well as our consideration of other areas of uncertainty.

The docket for this NODA provides more details on all aspects of our analysis of grain sorghum ethanol. EPA invites comment on all aspects of its modeling of grain sorghum ethanol. We also invite comment on the consideration of uncertainty as it relates to making GHG threshold determinations.

Dated: May 24, 2012.

Margo T. Oge, Director,
Office of Transportation & Air Quality.

[FR Doc. 2012-13651 Filed 06/11/2012 at 8:45 am; Publication Date: 06/12/2012]

[17] The Monte Carlo analysis is described in EPA (2010a), Section 2.4.4.2.8