Response to Comment Memorandum to Accompany Montana Advanced Biofuels, LLC Request for Fuel Pathway Determination under the RFS Program

Summary: Montana Advanced Biofuels, LLC (MAB) petitioned the Agency under the Renewable Fuel Standard (RFS) program to approve the generation of advanced (D-code 5) biofuel Renewable Identification Numbers (RINs) for ethanol produced from barley starch through a dry mill process at their production facility to be constructed in Montana. The Agency is issuing a determination in response.

In a notice of data availability (NODA) published on July 23, 2013 (78 FR 44075) (the "Barley NODA"), EPA presented data describing the lifecycle greenhouse gas (GHG) emissions associated with ethanol produced from barley starch using dry mill processes. The Barley NODA included an analysis which showed ethanol produced from barley through a dry mill process could meet the 20 percent GHG emissions reduction threshold necessary to qualify as renewable fuel (D-code 6), as well as the 50 percent GHG emissions reduction threshold necessary to qualify as advanced biofuel (D-code 5) provided there were certain limits on process energy. EPA requested comment on this analysis, including whether these D-code 5 and D-code 6 pathways should be added to Table 1 to 40 CFR 80.1426. In response to this NODA, EPA received a number of comments supporting our analysis, as well as comments that raised concerns about the analysis. In this document we summarize and respond to all comments received that are relevant to the lifecycle analysis. All comments are available through the www.regulatons.gov website, docket number EPA-HQ-OAR-2013-0178.

Comments on Feedstock Production

We received a number of comments on the assumptions used in our modeling for the Barley NODA. One commenter disagreed with our statement in the Barley NODA that international production of barley ethanol for consumption in the United States was unlikely, asserting that about 60 million gallons of ethanol production capacity in Canada either currently does or could process barley as a feedstock and could enter the U.S. market.[1] As with previous Food and Agricultural Policy and Research Institute (FAPRI) analyses, the purpose of this modeling is to quantify the impact of diverting some quantity of an agricultural commodity away from global commodity markets for biofuel feedstock use, forcing those markets to respond. It is this response itself that leads to the potential changes in GHGs that we quantify in our lifecycle analysis (LCA). We continue to believe that our FAPRI modeling of barley accurately depicts the likely international market response to an increase in the price of U.S. barley and increased domestic demand for barley in the U.S., as well as the impact of any resulting declines in U.S. net exports of barley or other commodities. From the perspective of the international commodity trading system, we do not believe that a reduction in U.S. crop exports is significantly different than a reduction in Canadian crop exports. Therefore, we do not have any reason to believe that

[1] EPA-HQ-OAR-2013-0178-0025.

our estimates of the indirect GHG emissions associated with barley-based ethanol production in the U.S. require revision in this area in order to evaluate the MAB petition.

Four commenters criticized the size of the assumed volume of 140 million gallons by 2022, claiming that significantly more than 140 million gallons of barley ethanol may be produced by 2022.[2] Some also argued that EPA should conduct a sensitivity analysis around the 140 million gallon volume shock.[3] When EPA specifies a volume shock for our modeling analyses of biofuel feedstocks, the goal is to choose a volume that will require significant adjustment by agricultural producers, such that we can estimate the types of land use change and other agricultural emissions associated with greater demand for the feedstock. In this case, 140 million gallons of barley-based ethanol would require approximately 30 percent of U.S. Department of Agriculture (USDA)-projected U.S. barley production in 2022, a significant percentage of total production.[4] EPA could have chosen a somewhat larger shock than 140 million gallons, or for that matter a smaller shock. However, the commenters did not provide any information regarding why, from an analytical perspective, choosing a larger shock would provide a more robust estimate, only that more barley-based ethanol could be produced by 2022. Similarly, commenters have not presented evidence that our volume shock was unreasonable or requires additional volume sensitivity analysis. Commenters only stated that a sensitivity analysis should be performed. Therefore, due to staffing and resource constraints, EPA has not conducted a sensitivity analysis in this case. Further, in the absence of evidence that the shock we modeled, which represents 15 to 20 percent of current U.S. barley production, is insufficiently robust, EPA continues to believe that this volume shock is reasonable for the purposes of our analysis.

We also received four comments that more ethanol could be produced from winter-planted barley than the amount (60 million of the 140 million gallon total shock) assumed in our modeling.[5] Similarly to the comments discussed in the previous paragraph, the commenters did not provide any information regarding why, from an analytical perspective, choosing a larger shock would provide a more robust estimate. These commenters argue that significantly more winter-planted barley could be grown in the Mid-Atlantic region to produce ethanol. We agree that somewhat more barley could be produced in this region and that much of that barley could be used for biofuel production. However, the volume shock used in our modeling already accounts for this to a significant extent. A volume shock of 60 million gallons represents approximately 28 million bushels of barley. This amount is more than double the combined

[2] EPA-HQ-OAR-2013-0178-0027; EPA-HQ-OAR-2013-0178-0029; EPA-HQ-OAR-2013-0178-0022; EPA-HQ-OAR-2013-0178-0019.

[3] EPA-HQ-OAR-2013-0178-0023.

[4] USDA projects approximately 195 million bushels of barley production in the United States in the 2022/23 crop year. Our volume shock would require approximately 65 million bushels in that year. USDA Long-Run Agricultural Baseline Projections, http://www.ers.usda.gov/topics/farm-economy/agricultural-baseline-projections.aspx (Last Accessed: October 29, 2015).

[5] EPA-HQ-OAR-2013-0178-0027; EPA-HQ-OAR-2013-0178-0028; EPA-HQ-OAR-2013-0178-0029; EPA-HQ-OAR-2013-0178-0019.

average production of Delaware, Maryland, North Carolina, Pennsylvania, and Virginia (the five states that produce winter barley for the purposes of our modeling) since the year 2000, a very significant amount of production. As with the overall volume shock, we acknowledge that it may be possible to produce even more ethanol from barley. However, the commenters again did not provide any information regarding why, from an analytical perspective, choosing a larger shock would provide a more robust estimate, only that more barley-based ethanol could be produced by 2022.

We received one comment claiming that our analysis underestimated the GHG emissions associated with barley feedstock because our modeling did not appropriately account for GHG emissions from converted natural grassland.[6] We assume in our Forestry and Agricultural Sector Optimization Model (FASOM) modeling that land in the "Rangeland" category will not convert to cropland, because land in this category is not generally of high enough quality to consider for cultivation, based on existing data. The commenter stated that this assumption led to an underestimation of the amount of natural grassland that will be converted to cropland if a pathway for barley-based ethanol is approved.

The research presented in these comments indicates that there has been significant conversion of native grassland in the Dakotas, Minnesota, and other areas of the Great Plains in order to grow corn and soybeans. However, as our Barley NODA explained in detail, our modeling indicates the vast majority of the additional barley needed for ethanol feedstock, and to backfill in other markets, will be grown in Montana. The research presented does not seem to be directly applicable to the current circumstances of Montana agriculture or the likely circumstances of Montana in 2022, the year the RFS is to be fully implemented. As we observed in the Barley NODA, total Montana crop acres have been in long term decline since the 1990s, as have Montana barley acres. Some farmers have switched from barley to wheat, but a very large number of acres have become idle or transitioned to pasture. We did not receive any comments suggesting that this conclusion is incorrect, or providing data that suggest that cropland in Montana is likely to reverse course. Therefore, based on the available data we believe that this trend will continue into the foreseeable future.[7] With considerable additional cropland available in Montana, we do not believe that farmers would choose to convert rangeland to new cropland in this region in response to an increase in demand for biofuel from barley; such conversions are only likely to occur when and if the existing supply of cropland is fully utilized.

It is important to note that the FASOM framework does account for the possibility of converting natural grassland to cropland. The commenter asserts that all natural grassland is assumed to be categorized as "Rangeland" in FASOM. But this is not the case. A significant amount of natural grassland is categorized as "Pasture" in FASOM and is eligible to convert to

[6] EPA-HQ-OAR-2013-0178-0021.
[7] In our conversations with USDA experts, they also supported this line of reasoning and our conclusions.

cropland. The difference between the two is that Rangeland generally represents the lower quality land, which is not generally suitable for growing crops, whereas Pasture represents higher quality land that could conceivably be upgraded to the point where it could support crops. Additionally, there is a category in FASOM called Cropland Pasture, which represents high value agricultural land which is currently used as pasture, but can easily be prepared to support crops from year to year. The Cropland Pasture category does not contain any natural grassland, only managed grassland. In our modeling results, most new cropland is converted from Cropland Pasture since the ample former cropland in Montana that we discuss above is mostly categorized in FASOM as Cropland Pasture. However, we do also see some amount of Pasture land converted to cropland in some regions (though this does not occur in Montana due to the ample availability of former cropland in that region). The GHG impact of this Pasture conversion is included in our land use change GHG impacts. Therefore, even though we find that former cropland reverting back to crop production represents the vast majority of the land use change impact, we do also find some results consistent with the commenter's general claim that grassland is likely to be converted. With these impacts included in our analysis, we find that the petitioner's facility meets the 50 percent lifecycle GHG emissions reduction threshold when using barley as a feedstock and requiring limits on energy use. Therefore, we believe that our existing analysis adequately captures the lifecycle GHG analysis-related points that the commenter raises in their analysis.

Our modeling indicates that using barley planted in the spring to produce ethanol will reduce the scale of future decline in Montana cropland acres as some land that would otherwise exit out of crop production in future years remain in the crop rotation to produce barley sourced for ethanol. However, total Montana crop acres are still projected to decline in our modeling, even with the production of 140 million gallons per year (MGY) of ethanol by 2022. These findings indicate that it is very unlikely that significant amounts of natural grassland will be converted to cropland as a result of increased barley ethanol production. Instead, it is likely that barley producers would draw most, if not all, of the additional cropland they need from the large stock of existing Cropland Pasture in Montana.

While all of the barley MAB intends to use will be planted in the spring, our analysis of barley feedstock included ethanol produced from both spring-planted and winter-planted barley. We received two comments asserting that our analysis should separately consider barley planted in the spring from barley planted in the winter, and that the lifecycle GHG emissions attributable to barley grown in the spring are potentially different than those attributable to barley grown in the winter.[8] We acknowledge that barley growing practices do differ between regions, just as they do for other crops. Our modeling framework explicitly accounts for differences in growing practices, such as planting cycles, fertilizer inputs, tillage practices, and irrigation practices, both between and, where applicable, within regions of the U.S.. However, we do not agree that different regional barley growing practices requires separate lifecycle GHG analyses. We have

[8] EPA-HQ-OAR-2013-0178-0028; EPA-HQ-OAR-2013-0178-0021.

not performed any such analysis for other feedstocks, despite the fact that many of these other feedstocks also have disparate growing practices in different regions. This is because commodity crops, including barley, are traded in national, regional and global markets that do not generally differentiate products by growing practice. This means that as a general matter, it would be very burdensome for biofuel producers to have to trace commodity feedstocks to their place of origin, and to then apply different lifecycle GHG assessments to them based on growing location. The RFS program regulations do not currently require this level of feedstock tracking, and we do not believe that there would be an overall gain in program effectiveness to require it. If a feedstock satisfies the GHG reduction requirements of the CAA on average, when taking into account varied growing practices in the feedstock growing range, then we believe it is appropriate to base RFS lifecycle GHG threshold determinations on average feedstock performance, rather than on performance of subsets of the feedstock grown using particular practices. This approach is far simpler for EPA and the regulated community to implement, and is consistent with the GHG reduction objectives of the statute.

Markets do discriminate based on sets of chemical and nutritional specifications, such as protein or starch content. These factors may be affected by growing practices, but also by factors outside the farmer's control, such as the weather. In the specific case of barley, there is a significant delineation between malt-quality barley and barley that does not meet the specifications necessary for malting. We assumed in our modeling that no malting quality barley would be used to produce fuel ethanol. This assumption was based on expert input from USDA and on historical market data, which demonstrates a significant and consistent price premium for malt-quality barley over feed-quality barley.[9] This price premium for malt-quality barley would lead barley fuel ethanol producers to instead source feed-quality barley, which is simply any barley that does not meet malt specifications. We also assumed based on this same input that all barley grown in the winter is feed-quality. We did not receive any comments that disagreed with any of these assumptions.

From the perspective of the feed and export markets, feed-quality barley planted in the spring and feed-quality barley planted in the winter are assumed to be chemically identical, and are traded as one commodity. Because of this, the net impact on the national and global markets for grain will be the same if some quantity of barley is diverted to fuel production from some other use, regardless of whether that barley was planted in the spring or in the winter. This is no different than, for example, the way that commodity markets treat irrigated and non-irrigated corn with functionally identical physical specifications. Therefore, we continue to believe that modeling all feed-quality barley as a single commodity is the most analytically defensible methodology.

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[9] Personal communication with USDA experts; U.S. Department of Agriculture Economic Research Service, Feed Grains Database, http://www.ers.usda.gov/data-products/feed-grains-database.aspx#.UcMXqDvku2k (Last accessed: August 10th, 2015).

We also received a number of comments specific to barley grown in the winter. To the extent that these comments are relevant to the lifecycle analysis, these comments are summarized and responded to below.

In our agro-economic modeling of barley, we assumed that barley grown in the winter will be double-cropped with soybeans. One commenter questioned this assumption, stating that it could lead EPA to potentially underestimate land use change impacts.[10] This assumption was based on our consultation with experts at USDA prior to the start of our modeling.[11] These experts confirmed that double-cropping with soybeans is the dominant practice for growing barley in the winter. Three commenters provided comments in support of these assumptions.[12] Conversely, we have not received any data to indicate that barley grown in the winter is not double-cropped. In the absence of any such evidence, we believe it is appropriate to rely on the expert input we received from USDA.

Two commenters claimed that barley planted in the winter may be double-cropped with crops other than soybeans.[13] While this may be possible, we have not received any information indicating that such practices are widespread enough to significantly affect national and international-scale modeling, or even significantly influence decisions within a region of the U.S. Available information and expertise indicates that the vast majority of barley planted in the winter is double-cropped with soybeans and that double-cropping with other crops represents, at most, a very small group of outliers. Further, the overall impact on GHG emissions would not be significantly different if we were to model some small amount of barley as double-cropped with some other crop. The primary significance of double-cropping a feedstock such as barley with other high-value products such as corn or soybeans is that the addition of barley does not change the use of the land, and therefore there are no significant indirect land use change emissions associated with the planting. The only differences would be very minor ones, potentially associated with variations in the amounts of agricultural chemical and energy inputs needed for these different crops and with extremely minor shifts in commodity supplies. Any such impact would have relatively minor impacts on the overall emissions profile of barley-based fuels. Therefore, we believe our assumptions in this area to be sufficiently rigorous and we believe that our modeling has adequately captured the GHG implications of these different growing practices.

We received comments that the geographic range we assumed for winter barley, spanning the states of Delaware, Maryland, North Carolina, Pennsylvania, and Virginia, is incomplete, and that some amount of barley grown in California and Arizona is also winter barley.[14] Regarding California, USDA does not delineate barley plantings in California between spring and winter,

[10] EPA-HQ-OAR-2013-0178-0023.
[11] EPA-HQ-OAR-2013-0178-0032.
[12] EPA-HQ-OAR-2013-0178-0022; EPA-HQ-OAR-2013-0178-0027; EPA-HQ-OAR-2013-0178-0029.
[13] EPA-HQ-OAR-2013-0178-0027; EPA-HQ-OAR-2013-0178-0029.
[14] EPA-HQ-OAR-2013-0178-0019.

since that region has unique growing cycles that obscure this distinction. Our modeling does account for California's unique crop rotations in its historical dataset and crop budgets. But there is not sufficient data to definitively say that some portion of the barley grown in this region fits the profile of winter barley better than that of spring barley.

We also received comments that California and Arizona could potentially support a barley ethanol plant.[15] These were options available in our FASOM modeling. However, our models indicated that it would be economically advantageous to site plants in other regions. The historical data also indicate that siting plants in California or Arizona is extremely unlikely. Since 2000, annual barley production in California has averaged about 4 million bushels a year and production in Arizona has averaged 4.5 million bushels a year, respectively equivalent to about 1.2 and 1.4 percent of annual U.S. barley production.[16] These two states are very unlikely to contribute barley to plants in Montana or other major barley producing regions, when ample feedstock is available locally for those plants. Further, California and Arizona are both minor producers of barley and both states are very unlikely to have enough feedstock available within an acceptable radius to support a plant. Assuming, as we do in our analysis, that one bushel of barley yields 2.16 gallons of ethanol when converted via fermentation at a dry mill facility, the annual average production of California would equate to approximately 9 MGY of ethanol, and the annual average production of Arizona would equate to approximately 10 MGY of ethanol. In practice, the volume converted to ethanol would likely be considerably smaller. The scale of production generally necessary to make an ethanol plant commercially viable, especially one relying on a commodity feedstock instead of a waste feedstock, is generally more in the range of 50 to 75 MGY. Even under generous commercial viability assumptions, it would be several times greater than the entire production potential of California or Arizona barley. Considering this, it is very unlikely that either of these states could support a commercial-scale barley ethanol plant. For these reasons, we believe that it is appropriate to assume, as we have, that it is unlikely that a barley ethanol plant will be sited in California or Arizona.

We received comments suggesting that production of barley grown in the winter would increase significantly more in the Mid-Atlantic region than our modeling indicated.[17] These commenters asserted that the lower level of production in this region indicated by our modeling occurred by assumption. However, EPA did not assume that more winter-grown barley could not be produced and indeed production of winter barley did increase in our modeling results. Production could have increased even more in our modeling if it had been determined to be the economically optimal solution. Instead, our modeling indicates that it will be more economically efficient to rely on greater production of spring-planted barley to fill regional, national, and international gaps in demand, because the production costs for the marginal amount of additional

[15] EPA-HQ-OAR-2013-0178-0019.

[16] USDA National Agricultural Statistical Service, "QuickStats Database", http://quickstats.nass.usda.gov/ (Last Accessed: 08/12/2015).

[17] EPA-HQ-OAR-2013-0178-0027; EPA-HQ-OAR-2013-0178-0029.

barley demanded will be significantly lower for spring barley producers than for winter barley producers. In practice, some of the barley used on the Eastern seaboard is already imported from other regions of the United States, whether it be for malting or for animal feed. Further, barley distiller's grains, a byproduct of ethanol production, will be able to fill most of the gap in feed demand that is likely to result from winter-grown barley being diverted to biofuel production. With distiller's grains as an inexpensive option, we do not expect there to be a significant need for additional winter-planted barley production to meet the needs of the Mid-Atlantic feed markets. However, to the extent that this does occur, the cheapest marginal bushels of barley that can be produced and transported to livestock producers are likely to be spring-grown barley, based on the likely marginal costs of production and transport.

We received one comment stating that crop shifting and new crop acreage, both domestically and internationally, would be less than we estimated in our modeling.[18] The commenter argued that there are sufficient underutilized crop acres in the Mid-Atlantic region to satisfy additional barley demand without displacing other crops domestically or expanding acres internationally. We acknowledge that there are further acres in the Mid-Atlantic region that could potentially support double-cropping with barley. However, this does not necessarily mean that producing barley on these acres is likely to be the best economic use of that land. Idle and under-utilized acres exist throughout the U.S., not because they cannot support crop production, but because farmers do not believe it is desirable to plant them. Our modeling, based on input needs and cost data for barley in the Mid-Atlantic States from USDA, indicates that, at the prices that increased barley demand for ethanol production would induce, it would be more profitable to reduce the use of barley for other purposes to some extent and to reduce U.S. exports of barley, and to divert that quantity of barley to ethanol production, and to produce more spring-planted barley, rather than significantly expand production of winter-planted barley. The commenter did not provide data indicating that further expansion of winter-planted barley acres in the Mid-Atlantic region would be economically advantageous for producers, only that doing so is possible. Based on this, we continue to believe that our analysis is appropriate.

We received comments questioning our findings for agricultural emissions associated with barley used for biofuel feedstock. The commenter stated that we did not explain the differences in emissions between corn ethanol and barley ethanol, and questioned our finding that net agricultural emissions associated with barley used for biofuel feedstock, not inclusive of land use change emissions, were negative.[19] For economic reasons that were explained in detail in the Barley NODA, our modeling found that increasing barley area would displace some acreage of corn and hay, which have generally higher input requirements than barley. The net result of displacing corn and hay production with barley production is a reduction in crop inputs and a corresponding reduction in agricultural sector GHG emissions excluding land use change emissions. This is not uncommon when significant indirect emissions are considered, for

[18] EPA-HQ-OAR-2013-0178-0019.
[19] EPA-HQ-OAR-2013-0178-0023.

example it is similar to our findings in the March 2010 RFS rule that the net agricultural emissions from soybean oil were also negative.[20]

We also received comments asking for further explanation of our finding that emissions associated with domestic soil carbon would be negative.[21] As noted in the Barley NODA and in this document, most of the land converted to increase crop area is projected to be cropland pasture, which contains relatively little biomass compared to natural grassland or forest land, and releases relatively fewer emissions during the conversion process. Simultaneously, domestic livestock feed use increases on net due to the influx of barley distiller's grains. This allows livestock producers to become less reliant on pasture land in some regions, allowing that land to accumulate biomass as either grassland or forest land, depending on the region. The combination of these two factors, relatively low land conversion emissions and the accumulation of biomass in some idled pasture land, lead to a net increase in domestic soil carbon. All of these impacts are available in the modeling results that were posted to the docket for the Barley NODA.[22]

Comments on Fuel Production

In the Barley NODA, we requested comment regarding whether or not to place limits on onsite electricity and natural gas consumption at the ethanol production facility, in order to define the energy consumption threshold at which a facility processing barley into ethanol using a standard dry mill plant configuration could meet the 50 percent GHG emission reduction threshold. We identified different combinations of natural gas and electricity limits that might be used to meet this threshold.

We received a number of comments regarding other possible approaches that a producer of barley-based ethanol might utilize to achieve a 50 percent reduction compared to our gasoline baseline. These included comments on pathways that made use of biogas and low-carbon electricity.[23] The MAB fuel production process that is the subject of today's approval does not utilize any of these technologies, so these comments are not relevant to this determination. However, EPA acknowledges different approaches to energy savings are possible. In today's decision, EPA is using a somewhat different approach to ensuring that energy use does not prevent MAB fuel from achieving a 50 percent lifecycle GHG emissions reduction. EPA is requiring that MAB measure and keep track of actual process energy use at the facility, and is specifying that generation of advanced biofuel RINs may only occur when the long-term average

[20] See 75 FR 14688-90.
[21] EPA-HQ-OAR-2013-0178-0023.
[22] EPA–HQ–OAR–2013–0178–0002.
[23] EPA-HQ-OAR-2013-0178-0023; EPA-HQ-OAR-2013-0178-0022.

per-gallon energy investment is consistent with a 50 percent lifecycle GHG emissions reduction.[24]

One commenter asked for clarification regarding whether our assumed ethanol yield of 2.16 gallons per bushel of barley reflected the whole bushel of barley or a de-hulled bushel.[25] Our analysis assumed that the barley is de-hulled before being processed into ethanol. A second commenter asked for clarification regarding the moisture content assumed for this ethanol yield.[26] We assumed that a “bushel” means a 48 pound dry bushel of de-hulled barley. To clarify this assumption generally, we assumed an ethanol yield of 2.16 gallons per 48 pound dry bushel of de-hulled barley for the purposes of our lifecycle GHG analysis. Finally, one commenter suggested that our assumed barley ethanol yield was too high and that other analyses have utilized lower yields.[27] In the specific case of the MAB facility, which is the sole subject of today’s determination, mass and energy balance data indicates that actual yields are likely to exceed our assumed yield of 2.16 gallons per bushel. We consulted extensively with the petitioners and with USDA experts on barley processing for ethanol during the scoping phase of our analysis. Based on this information, we believe that 2.16 gallons per bushel is a conservative estimate, one that may be exceeded in practice in some instances, as data from MAB indicates. However, as a conservative assumption, we have maintained an assumed ethanol yield of 2.16 gallons per 48 pound dry bushel of de-hulled barley for the purposes of this final lifecycle GHG analysis for the MAB processes.

[24] A long-term average is appropriate, because it takes into account a number of important variations, including, but not limited to, seasonal variations in energy use, as well as what may be periodic energy investments, such drying distillers grains. Allowing the producer to use a long-term average prevents the energy use-related recordkeeping and reporting requirements of the Advanced MAB Pathway from becoming overly burdensome, while still maintaining the integrity of the pathway and producing consistent GHG emissions reductions over the period being averaged.

[25] EPA-HQ-OAR-2013-0178-0025.

[26] EPA-HQ-OAR-2013-0178-0023.

[27] EPA-HQ-OAR-2013-0178-0023.