Regulatory Announcement

EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels

Background

As part of revisions to the National Renewable Fuel Standard program (commonly known as the RFS program) as mandated in the Energy Independence and Security Act of 2007 (EISA), EPA has analyzed lifecycle greenhouse gas (GHG) emissions from increased renewable fuels use. EISA established eligibility requirements for renewable fuels, including the first U.S. mandatory lifecycle GHG reduction thresholds, which determine compliance with four renewable fuel categories. The regulatory purpose of EPA's lifecycle GHG emissions analysis is therefore to determine whether renewable fuels produced under varying conditions meet the GHG thresholds for the different categories of renewable fuel. Determining compliance with the thresholds requires a comprehensive evaluation of renewable fuels, as well as of gasoline and diesel, on the basis of their lifecycle emissions.

EISA defines lifecycle GHG emissions as follows:

> The term 'lifecycle greenhouse gas emissions' means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the Administrator, related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.[1]

EISA established specific lifecycle GHG emission thresholds for each of four types of renewable fuels, requiring a percentage improvement compared to lifecycle GHG emissions for gasoline or diesel (whichever is being replaced by the renewable fuel) sold or distributed as transportation fuel in 2005. EISA required a 20% reduction in lifecycle GHG emissions for any renewable fuel produced at new facilities (those

[1] Clean Air Act Section 211(o)(1)

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constructed after enactment), a 50% reduction in order to be classified as biomass-based diesel or advanced biofuel, and a 60% reduction in order to be classified as cellulosic biofuel.

Threshold Determinations

EPA is making threshold determinations based on a methodology that includes an analysis of the full lifecycle of various fuels, including emissions from international land-use changes resulting from increased biofuel demand. EPA has used the best available models for this purpose, and has incorporated many modifications to its proposed approach based on comments from the public, a formal peer review, and developing science. EPA has also quantified the uncertainty associated with significant components of its analyses, including important factors affecting GHG emissions associated with international land use change. EPA is confident that its modeling of GHG emissions associated with international land use is comprehensive and provides a reasonable and scientifically robust basis for making threshold determinations. Based on this analysis, EPA is determining that:

- Ethanol produced from corn starch at a new natural gas, biomass, or biogas fired facility (or expanded capacity from such a facility) using advanced efficient technologies (ones that we expect will be most typical of new production facilities) will meet the 20% GHG emission reduction threshold compared to the 2005 gasoline baseline.
- Biobutanol from corn starch also meets the 20% threshold.
- Biodiesel and renewable diesel from soy oil or waste oils, fats, and greases will meet the 50% GHG threshold for biomass-based diesel compared to the 2005 petroleum diesel baseline.
- Biodiesel and renewable diesel produced from algal oils will also comply with the 50% threshold should they reach commercial production.
- Ethanol from sugarcane complies with the applicable 50% reduction threshold for advanced biofuels.
- For cellulosic ethanol and cellulosic diesel, the pathways modeled in our analysis (for feedstock and production technology) would comply with the 60% GHG reduction threshold for cellulosic biofuel.
- Determinations for additional fuels and fuel pathways can be found in Section V of the preamble.

In addition to finalizing threshold compliance determinations for pathways that we specifically modeled, as shown above, in some cases our technical judgment indicates that other pathways are likely to be similar enough that we can extend these determinations. These include fuels that are produced from five categories of feedstocks similar to those already modeled and which are expected to have less or no indirect land use change:

1. Crop residues such as corn stover, wheat straw, rice straw, citrus residue
2. Forest material including eligible forest thinnings and solid residue remaining from forest product production
3. Secondary annual crops planted on existing crop land such as winter cover crops
4. Separated food and yard waste including biogenic waste from food processing
5. Perennial grasses including switchgrass and miscanthus

Threshold determinations for certain other pathways were not possible at this time because sufficient modeling or data is not yet available. In some of these cases, we recognize that while a renewable fuel is already being produced from an alternative feedstock and we have the data needed for analysis, we did not have sufficient time to complete the necessary lifecycle GHG impact assessment for this final rule. EPA anticipates modeling grain sorghum ethanol, woody pulp ethanol, and palm oil biodiesel after this final rule and including the determinations in a rulemaking within 6 months.

For other fuels, we are establishing a process whereby a biofuel producer or importer can petition the Agency to also consider whether a fuel pathway would be eligible for use in complying with an EISA standard. EPA will use the data supplied in the petition to evaluate whether the information for the fuel pathway, combined with information developed in this rulemaking for other fuel pathways, is sufficient to allow EPA to determine whether the new fuel pathway qualifies. EPA will process these petitions as expeditiously as possible, taking into consideration that some fuel pathways are closer to the commercial production stage than others.

Our Analysis

In order to calculate the lifecycle GHG emissions of various fuels, EPA utilized models that take into account energy and emissions inputs for fuel and feedstock production, distribution, and use, as well as economic models that predict changes in agricultural markets. In developing this analysis, the Agency employed a collaborative, transparent, and science-based approach. Through technical outreach, the peer review process, and the public comment period, EPA received and reviewed a significant amount of data, studies, and information on our proposed lifecycle analysis approach. We incorporated a number of new, updated, and peer-reviewed data sources in our final rulemaking analysis, including better satellite data for tracking land use changes and improved assessments of N2O impacts from agriculture.

We also performed dozens of new modeling runs, uncertainty analyses, and sensitivity analyses which are leading to greater confidence in our results. We have updated our analyses in conjunction with, and based on, advice from experts from government, academia, industry, and not for profit institutions.

The new studies, data, and analysis performed for the final rulemaking impacted the lifecycle GHG results for biofuels in a number of different ways. In some cases, updates caused the modeled analysis of lifecycle GHG emissions from biofuels to increase, while other updates caused the modeled emissions to be reduced. Overall, the revisions since our proposed rule have led to a reduction in modeled lifecycle GHG emissions as compared to the values in the proposal. For example, for corn ethanol the final rule analysis found less overall indirect land use change (less land needed), thereby improving the lifecycle GHG performance of corn ethanol. The main reasons for this decrease are:

- Based on new studies that show the rate of improvement in crop yields as a function of price, crop yields are now modeled to increase in response to higher crop prices. When higher crop yields are used in the models, less land is needed domestically and globally for crops as biofuels expand.

- New research available since the proposal indicates that distillers grains and solubles (DGS), a corn ethanol production co-product, is more efficient as an animal feed (meaning less corn is needed for animal feed) than we had assumed in the proposal. Therefore, in our analyses for the final rule, domestic corn demand and exports are not impacted as much by increased biofuel production as they were in the proposal analysis.
- Improved satellite data allowed us to more finely assess the types of land converted when international land use changes occur, and this more precise assessment led to a lowering of modeled GHG impacts. Based on previous satellite data, the proposal assumed cropland expansion onto grassland would require an amount of pasture to be replaced through deforestation. For the final rulemaking analysis we incorporated improved satellite data, as well as improved economic modeling of pasture demand, and found that pasture is also likely to expand onto existing grasslands. This reduced the GHG emissions associated with an amount of land use change.

Next Steps/Future Work

While EPA is using its current lifecycle assessments to inform regulatory determinations in this final rule, as required by EISA, we also recognize that as the state of scientific knowledge continues to evolve in this area, the lifecycle GHG assessments for a variety of fuel pathways will continue to be enhanced. Therefore, the Agency is committing to further reassess these determinations and lifecycle estimates. As part of this ongoing effort, we will ask for the expert advice of the National Academy of Sciences, as well as other experts, and incorporate their advice and any updated information we receive into a new assessment of the lifecycle GHG emissions performance of the biofuels being evaluated in this final rule. EPA will request that the National Academy of Sciences evaluate the approach taken in this rule, the underlying science of lifecycle assessment, and in particular indirect land use change, and make recommendations for subsequent lifecycle GHG assessments on this subject. This new assessment could result in new determinations of threshold compliance compared to those included in this rule. These would apply to future production from plants that are constructed after each subsequent rule incorporating a revised lifecycle assessment methodology.

Additional detail on the different components of EPA's lifecycle analysis can be found in the preamble and the Regulatory Impact Analysis that accompany the Final Rule.

For More Information

For more information on this proposal, please contact EPA's Office of Transportation and Air Quality, Assessment and Standards Division information line at:

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