Advanced Biofuels Association

Comments of the Advanced Biofuels Association

RENEWABLE FUEL STANDARD ASSESSMENT WHITE PAPER
Greenhouse Gas Emissions and Other Environmental Impacts

Committee on Energy and Commerce
United States House of Representatives
May 24, 2013

Overview:

On behalf of the Advanced Biofuels Association (ABFA), a collection of over 40 member companies who produce advanced biofuels and biofuels feedstocks, we welcome the opportunity to comment on the "Green House Gas Emissions and other Environmental Impacts" White Paper posted by the Energy and Commerce Committee. As an Association we have appreciated the Committee's support and attention to the Renewable Fuels Standard program.

ABFA reiterates our perspective that Congress' vision in creating RFS2 was to surpass the Energy Policy Act of 2005 to stimulate the creation of an advanced biofuels industry that would deliver larger greenhouse gas reduction, higher energy density renewable fuels, advanced ethanol and "drop-in" fuel molecules that are totally compatible with our existing engines, pipeline system and fuel pumps. We continue to believe that the vision to create a diverse set of options for America's transportation fuels sector was a wise one. Advanced and cellulosic companies have broken ground and are moving forward with that vision. This is a time to stay the course and allow EPA to utilize its authority, when merited, to make the necessary adjustments to keep a sound program on solid footing and on a sustained path forward.

As your briefing document notes, "in addition to enhancing energy security and providing support for rural economies, the RFS was intended to produce environmental benefits from using a cleaner, renewable fuel." That was one of the principle reasons the RFS2 created the advanced, biomass based diesel and cellulosic pools each defined with mandatory GHG reduction requirements and totaling 21 billion gallons by 2022. Many of the specific provisions written into this law and carried forward in the EPA rulemaking have made the environmental performance of these advanced biofuels a key component of the RFS program.

As a general response to the questions in this white paper, we recommend a "keep it simple" approach. Many of the specific definitions, rules and implementation decisions of this statute have frankly been far too prescriptive. If the object was to create 36 billion gallons of renewable fuels by 2022 then many of the current definitions and decisions to date have undercut the basic objective. We believe that the more the Congress can stick to providing performance objectives and targets (such as the 36 billion gallons goal) and let the market operate within a reasonable and objective set of boundaries, the more likely it will be to meet the targets and do it in a manner which best meets the needs of the stakeholders. Despite the fact that every gallon of biofuel production built since 2007 has delivered significantly greater GHG reductions over existing gasoline and diesel, we could do even better. Ironically several of the current implemented regulatory definitions have limited the amount of flexibility to utilize feedstocks that could provide enhanced environmental benefits.

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For example, the parsing of the definitions of waste or woody biomass in an extremely limited manner is impeding the ability to achieve both environmental performance as well as the number of produced gallons. Without the ability to expeditiously get new pathways in place or update current regulatory impediments which block the newer molecules coming to market, we are limiting both the GHG and other environmental benefits that could be derived from a wide range of drop in molecules and advanced ethanol.

Question 1: Is the RFS reducing greenhouse gas emissions below that of the baseline petroleum-derived fuels? Is the RFS incentivizing the development of a new generation of lower greenhouse gas emitting fuels? Will the RFS produce further greenhouse gas emissions reductions when it is fully implemented?

Answer: Since the inception of the RFS2 the advanced biofuels market has grown rapidly and successfully from nascent technology to industrial scale deployment. Last year alone, the program saw 2.25 billion gallons of advanced biofuels produced. By statutory configuration and regulatory implementation the RFS is requiring fuels to deliver significant reductions over the baseline hydrocarbon based fuels in order to be compliant with the RFS program. For any advanced biofuels producer the minimum reduction required to participate in the program is a 50% reduction off a 2005 baseline gasoline or diesel fuel. Many of these new fuels exceed these reduction requirements, while others which achieve at least a 20% reduction may be compliant in the general renewable fuels pool. The RFS is working and reducing greenhouse gas emissions from fuels.

For every company who seeks to be enrolled in the program EPA requires a Clean Air Act 'Part 80' submission which approves their feedstocks and calculates their specific greenhouse gas reductions. In addition this comprehensive process also requires the energy density and equivalency calculations to be part of the submission to determine their RIN credits. Without achieving carefully scrutinized GHG reductions, fuels are not compliant with the program and therefore not able to take advantage of the value of the RIN program.

As for incentivizing the development of a new generation of lower greenhouse gas emitting fuels, both the Renewable Volume Obligation (RVO) gallon mandates in the advanced pools and the RIN credits assist in the development of these lower GHG emitting fuels. Unequivocally, the RFS is incentivizing the development of a new generation of lower greenhouse gas emitting fuels. The three dollar price floor created for the cellulosic pool has also proved to be a helpful mechanism for those seeking financing to build new commercial plants. These are key components of the RFS, which is one of the single most effective programs in the history of the renewable fuels industry dating back to 1978.

Many advanced and cellulosic technologies go well beyond the requirements and more. They are contributing significantly to reducing GHG emissions, even at small volumes, thanks to the tremendously positive GHG improvements. Under the California Low Carbon Fuel Standard, these fuels can get rewarded for there additional reductions, which provides another source of value to the technologies and encourages their development. However, the RFS does not provide extra RIN credits for those fuels which exceed the minimum GHG reduction levels. If the regulations were to afford extra credit, producers might make additional decisions to further reduce their emission levels beyond the current requirements. This type of flexible performance based reward approach would extend the existing success stories and further overall environmental performance.

There are two specific examples of which you should be aware. The Dynamic Fuels Plant in Louisiana uses many feedstocks and produces a fuel with 80% GHG reduction from a 2005 baseline fuel and that is totally fungible in the current infrastructure. In another example, KiOR has begun operation in Mississippi manufacturing gasoline and diesel from woody biomass. Both these plants exceed the GHG reduction requirements.

There is no question that, when fully implemented, the existing RFS will deliver significant reductions of GHG and other environmental elements. However, this will not be uniform across all fuels as some molecules exhibit vastly different characteristics from others and some feedstocks deliver greater GHG reductions than others. This is not a one size fits all industry (see attached appendix, OMB comment of Butanol). Moreover, the positive effects of the RFS are greatly diminished by the “grandfathering” provisions that exempted existing ethanol facilities from demonstrating the minimum 20% GHG baseline that define a renewable fuel. As the nation’s only policy directly targeted to reduce GHG creation, a plan to sunset these grandfathering provisions should be strongly considered. A provision that would incentivize existing corn ethanol producers to either meet the 20% GHG reduction standard or be backed out by better performing, advanced biofuels should be considered.

Question 2: Could EPA methodology for calculating lifecycle greenhouse gas emissions be improved, including its treatment of indirect land use changes. If so how.

Answer: Since its inception, indirect land use change analysis has been contentious. Life cycle analysis is a well developed and accepted approach. We have worked closely with EPA and a wide number of academic institutions on the issue. We would encourage the Committee to review the sizable body of work generated by both the academic community as well as the National Academy of Science for insight into these issues. The current law requires EPA to continue to review, report and update new findings in regard to GHG impacts. The body of knowledge is continuing to deepen and evolve since the law was originally enacted. We believe that EPA is required to update the carbon intensity of the baseline gasoline and diesel fuels, as well as update the indirect land use models commensurate with new scientific findings and market developments.

The RFS rules regulate indirect land use impacts, but do not adjust the rising level of gasoline CO_2 on a regular basis. This has created an advantage for one of the largest and most financially stable incumbent industries on the planet. “Well-to-Wheel” emissions from gasoline from the Canadian tar sands emit 14-20% more GHGs than the weighted average of transportation fuels – and US oil imports from Canada have increased substantially since 2005, the baseline year. EPA needs to update their data and bring forward their LCA on gasoline.

Question 3: Is the definition of renewable biomass adequate to protect against unintended environmental consequences? If not, how should it be modified?

Answer: The current definitions found in the RFS2 are narrow and prescriptive. If one looks across the body of federal law from the Farm Bill to the forestry provisions in the Department of Interior, the RFS woody biomass definition is extremely limiting. This is counter productive given the overall objectives of the RFS to lower GHG emissions and deliver 36 billion gallons of fuels by 2022.

To the maximum extent practical the EPA should seek to simplify and ease the use of all feedstocks to afford the producers of biofuels the full range of options. Current inconsistencies prohibit some woody biomass that is eligible to produce renewable power from producing renewable fuel. States should be given authority to create their best management practices in terms of deployment of new energy crops moving forward. A one size fits all federal model is too restrictive and does not take into account the local knowledge and specific farming practices and opportunities. Recently, North Carolina approved the use of Arundo Donax only to have the federal government unable to complete the pathway, putting in jeopardy the building of a cellulosic biofuel plant. These are the types of challenges which are currently limiting the ability to deliver sustainable fuels and gallons to the market place.

A broad range of issues has been raised concerning types of feedstocks and whether they meet the definition of waste. Many of these efforts block advanced technologies that may use a less expensive feedstock relative to first generation technologies. For both the municipal solid waste definitions, as well as the woody biomass definitions, the statue is too prescriptive, driving up the cost to producers and reducing many of the available feedstock options. ABFA does not support logging in sensitive areas or national parks, however there are opportunities on private lands which could add to the overall feedstock base available for cellulosic production.

Question 4: What are the non-greenhouse gas impacts of the RFS on the environment relative to a comparable volume of petroleum-derived fuels? Is there evidence of a need for air quality regulations to mitigate any adverse impacts of the RFS?

Answer: Many of the advanced biofuels incentivized by the RFS2 can have an improved environmental profile compared to petroleum fuels, over and above greenhouse gas reductions. We see no need to promulgate further air quality regulations beyond EPA's existing authority.

The greenhouse gas reduction requirements in fact drive better overall performance, as is also taken into account by the lifecycle analysis. A number of advanced biofuels will reduce their emissions of other air pollutants such as sulfur, NOx, and CO. Some companies are developing and deploying technologies to utilize industrial waste gases like carbon dioxide (CO_2) and carbon monoxide (CO) as the feedstocks to generate a wide range of transportation fuels. At the current time, some of these waste gases are not included as a feedstock under the RFS and EPA should move to do so. This is a missed opportunity.

Question 5: Has implementation of the RFS revealed any environmental challenges or benefits not fully anticipated in the statute?

Answer: Given the restrictive nature of the woody biomass definition which limits the use of naturally regenerative woods (hard woods), we have seen a significant increase in the purchase of hard wood for the use of wood pellets to be shipped overseas. This has not restricted the harvesting of private forest but has effectively excluded the biofuels industry from having access to the same resource as a feedstock. This policy should be reviewed by EPA.

Question 6: What is the optimal percentage of ethanol in gasoline? What is the optimal percentage of biomass based diesel in diesel fuel?

Answer: The basic assumption in this question is fundamentally flawed. Not only is the advanced biofuels industry delivering new fuels which go beyond ethanol, but depending on the type of molecule (fuel) the answer could be anywhere from 0 to100%. Many of these fuels have no blend wall restrictions and in fact can be utilized as neat, drop-in fuels. Some are diesel fuels and do not require a drop of gasoline in which to be blended. Further, the answer varies for existing and potential future vehicles. In an "all of the above" energy strategy the markets should be allowed to create the optimum portfolio of transportation fuels alternatives within the policy framework of the RFS and evolving vehicle fleet. The automotive industry can create engines to run on many different types of fuel. Their decisions consider the availability, cost, operability, energy density, volatility, and safety of the fuel, as well as the environmental performance. Again, the attached appendix (OMB comment of Butanol) may be helpful. The challenge is to balance the wide array of consumer and public health consideration in order to find the right balance. The enactment of EISA and the provisions which amended the RFS were intended to stimulate and build an advanced biofuels industry moving well past corn ethanol to fuels with greater greenhouse gas reduction and full compatibility with existing fuel infrastructure.

Many ABFA members are making drop-in replacements for gasoline, diesel, jet fuel or marine diesel. These fuels could augment the current refinery system and be up to 100% drop-in replacements. At a minimum they would add to our overall supply and give consumers a greater array of choices. While it has been over forty years since a new petroleum refinery has been built in this country, in the last three years several new advanced biorefineries have been completed. Drop in fuels are creating jobs, and can add throughput to the existing refinery infrastructure, helping grow those businesses.

Since the ABFA inception we have been technology neutral and molecule neutral. Congress should not pick a winning fuels much less the percentage it should be used.

Question 7: What are the best options for substantially further reducing greenhouse gas emissions from the transportation sector? Is the RFS an important component of such efforts?

Answer: Demand for liquid fuels will be a permanent feature of the US and global economy. There are real, proven, and significant economic and security benefits to the production of biofuels. In this context, the RFS, and specifically the advanced biofuel pool, are the best tool to drive down the greenhouse gas emissions from the transportation sector's persistent liquid fuel demands. Further, the RFS and advanced biofuels have shown greenhouse gas emissions reductions can be made without a comparative disadvantage internationally, showing economic potential and encouraging job creation.

Consider several factors in answering this question: where are the highest emissions likely to come from in the transportation sector (airplanes, ships, cars); where in the world are these trend lines going to be most prevalent (China, India, etc…); and what is the best mechanism to address the reductions (government, markets)? Recent evidence demonstrated in the United States that when the price of gasoline goes beyond a certain point there is real demand destruction in the size of the gasoline pool. The US is undergoing a significant change in driving patterns. CAFE standards have been updated, pushing fuel efficiency and deploying an increasing variety of electric vehicles. All of these have had impact in America, but may not make a dent in the worldwide trend line of increased global fuel demand.

The RFS has been a significant tool in America's arsenal to lower the carbon footprint of liquid transportation fuels. It is not a silver bullet, but it is a cost effective tool in providing low greenhouse gas transportation fuels as part of our national energy portfolio.

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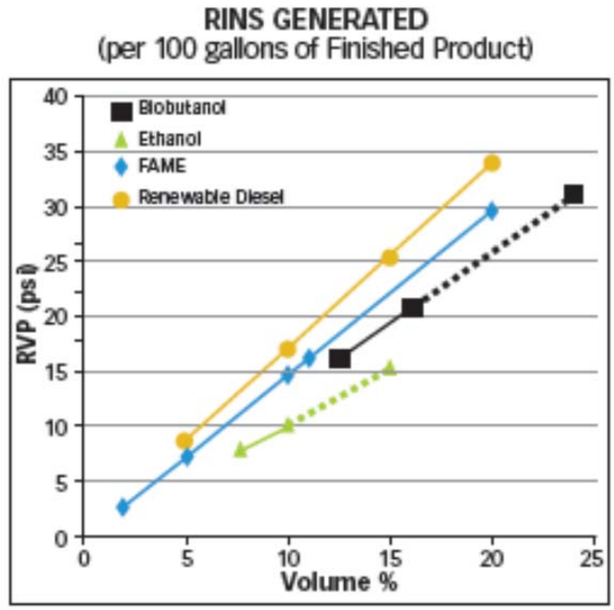
Blend Wall

Engine manufacturers are concerned about exceeding 3.5 percent–by-weight oxygen levels (E10) and obligated parties need to create more RINs than can be generated within this oxygen limit (the "blend wall"). Isobutanol provides a solution to these needs. If isobutanol were used at E10 oxygen content levels (16 vol% or 3.5 percent–by-weight oxygen), it would generate more than twice the RINs in a blend which has an EPA waiver applicable to all vehicles. Even at transitional "substantially similar" oxygen levels (12 vol% or 2.7 percent–by-weight oxygen), isobutanol generates more RINs than either E10 or E15.



	OXYGEN CONTENT (%)	EV	RINS GENERATED PER 100 GALLONS FINISHED PRODUCT
12.5% Isobutanol	2.7	1.3	16.25
10% Ethanol	3.5	1.0	10.00
16.1% Isobutanol	3.5	1.3	20.93
15% Ethanol	5.2	1.0	15.00

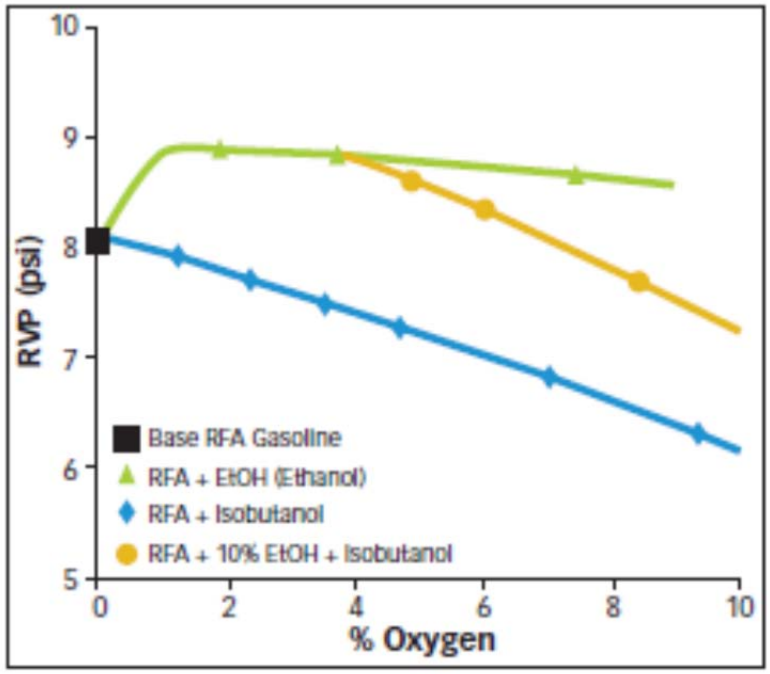
Commingling

The Clean Air Act (§ 211(h)(4)) requires EPA to provide a one pound per square inch (psi) Reid Vapor Pressure (RVP) exemption from EPA's RVP regulations for ten percent ethanol blends (E10). EPA's implementation of this requirement (40 CFR 80.27(d)(2)) prohibits the blending of E10 with other gasoline/renewable fuel blends at any point in the gasoline distribution system (wholesale or retail) in conventional gasoline areas. The reason for this prohibition is the RVP increase, (increase in evaporative emissions) if E10 blends were commingled with clear gasoline or at the time, MTBE-blended gasoline's.

Certain renewable biofuels such as butanol do not have this unfavorable impact on RVP when blended with E10 at wholesale or retail. Thus, it would be appropriate to adopt a modified commingling prohibition to permit E10 blending with butanol blends at wholesale and retail as there is no degradation of the air quality benefits which the regulations are intended to protect.

- <u>No Impact on RVP and Emissions</u>

  Blending E10 and gasoline blended with butanol does not cause the RVP of the resulting gasoline blend to increase, meaning that such commingling has no negative impact on VOC emissions and thus no negative environmental impact. The commingling prohibition was implemented to prohibit the blending of E10 with gasoline blended with MTBE (an oxygenate additive no longer used in gasoline in the United States) due at least in part to the increased RVP that resulted from blending two batches of gasoline with these additives. No such RVP "bump" results from commingling E10 with a butanol/gasoline mixture. EPA has reviewed the data supporting this and concurs.



- <u>Does not Violate "anti-backsliding"</u>

  Since all blends of E10 with butanol-blends decrease the overall starting RVP of E10 this will not violate the "anti-backsliding" provisions in the Clean Air Act ("CAA").

- <u>Environmental Benefits</u>

  Broadening market access for advanced biofuels also will have important environmental benefits. By definition, a fuel with lower RVP is less volatile. The use of lower RVP fuel blends containing butanol will therefore result in lower evaporative emissions at all stages of fuel use, from service station tank loading and vehicle refueling to vehicle in-use evaporative emissions.

<u>Practical benefits</u>

The commingling prohibitions as they currently exist were workable because they were put in place to manage market conditions where both ethanol-blended and clear or MTBE-blended gasolines were generally in abundant supply. The commercialization of isobutanol, however, creates a different challenge. By necessity, the first isobutanol production will be in limited supply, available at a very small number of terminals. Without redundant supply points for isobutanol, the existing commingling rule is a barrier to adoption of isobutanol with its abundant benefits. The proposed revisions to the commingling rule will serve to greatly reduce this barrier without compromise to environmental quality.

May 24, 2013

The Honorable Fred Upton
Chairman, Committee on Energy and Commerce
U.S. House of Representatives

The Honorable Henry Waxman
Ranking Member, Committee on Energy and Commerce
U.S. House of Representatives

RE: AEC Comments RFS White Paper: Greenhouse Gas Emissions and Other Environmental Impacts

Dear Chairman Upton and Ranking Member Waxman,

The Advanced Ethanol Council (AEC) appreciates the opportunity to comment on the Renewable Fuel Standard Assessment White Paper: Agricultural Sector Impacts. The AEC represents worldwide leaders in the effort to develop and commercialize the next generation of ethanol fuels, ranging from cellulosic ethanol made from dedicated energy crops, forest residues and agricultural waste to advanced ethanol made from municipal solid waste, algae and other feedstocks. The AEC is the only advanced biofuel group with the singular purpose of promoting advanced ethanol fuels and technologies.

General Comments on the RFS: As discussed in prior comments submitted as part of the white paper process, it is important to consider why the Renewable Fuel Standard (RFS) is necessary as an underlying component of any review of the program. If you investigate the history of renewable fuel use in the United States, it becomes evident that the U.S. liquid fuels industry is not price driven, open or competitive. In a competitive marketplace, if an innovator presents a valuable product for a competitive price, there is a reasonable expectation of demand. This free market principle gives investors a durable benchmark against which to judge the value of their product, which in turn attracts investment to better products. This important market dynamic is largely absent from the global liquid fuels marketplace for a number of reasons, including but not limited to the highly consolidated, vertically integrated characteristics of the oil industry, particularly with regard to wholesale markets, the anti-competitive price distorting behavior of OPEC, and blending constraints such as the blend wall. There is no better example of the consequence of this problem than ethanol, which has generally been offered at a significant discount to gasoline without increased demand significantly beyond the volume of fuel required for blending by the U.S. government.[1] With specific regard to the advanced biofuels industry, it

[1] Some have argued that this discount reflects the lower energy density of ethanol relative to gasoline. This is a misleading argument, because ethanol also contains much higher octane (with lower toxicity) than gasoline, which puts ethanol in a much more expensive class of premium fuel products that are relied upon to meet the minimum performance and environmental standards for gasoline. It is not a coincidence that the primary alternatives to ethanol for octane trade at prices that often exceed $5.00 per gallon.

is important to emphasize that one of the primary problems with a non-competitive marketplace is its failure to properly reward innovation. In other words, if the market does not necessarily demand a better and cheaper product, then there is no impetus to create one (both from within and outside of the fossil fuel sector). This is one of the primary reasons why the United States remains largely dependent on petroleum to meet consumer demand for liquid fuels. It is also the overarching reason why the RFS is necessary. The RFS provides innovators with a predictable (and flexible) expectation for demand in a marketplace that does not otherwise properly reward innovation. Most importantly, the RFS is working. The RFS statutory schedule required 15.2 billion gallons of renewable fuel blending in 2012, of which 2 billion were advanced biofuels. The renewable fuels industry met the challenge with all 15.2 billion gallons, including 2 billion gallons of advanced biofuel. Just five years after the enactment of RFS2, the cellulosic biofuels industry is breaking through at commercial scale (see attached: AEC Cellulosic Biofuels Progress Report).[2] Given the realities of world and domestic liquid fuels markets, the cornerstone of ongoing investment and development in the advanced biofuels sector is the consistent, unchanged and durable administration of the RFS. The alternative to the RFS – or any gallons waived from the RFS – is not innovation in other areas; it is simply more fossil fuels that are increasingly scarce and carbon intensive.

General Comments on the Greenhouse Gas and Environmental Impacts of the RFS: In order to properly understand the true environmental impact of the RFS, it is critical to take into account broader trends in the (liquid fuel) marketplace itself. As part of the analysis of the environmental impacts of the RFS, the AEC encourages the Committee to consider more broadly two important issues:

1. **The era of cheap oil is over.** As stated by Petrobras chief Jose Sergio Gabrielli, "the era of cheap oil is over." This means that oil companies are shifting very quickly to increasing reliance on more expensive and more carbon intensive "unconventional" fuels – including tight oil (e.g. the Bakken) and Canadian tar sands (e.g. Keystone) – to meet the global demand for fuel energy.[3] In essence, what the RFS does is send a signal to an oil-dominated marketplace to include renewable fuels in the quest to commercialize the next gallon of transportation fuel. More simply, the RFS ensures that low carbon renewable fuels emerge as a significant part of the portfolio of unconventional fuels in the future. As discussed above, the renewable fuels industry needs federal policy to drive this outcome because the global liquid fuels marketplace lacks the free market forces – due to an over reliance on one type of fuel produced by a highly consolidated, vertically integrated industry – that would otherwise drive innovation and the commercialization of alternative fuels. This is an important consideration along a number of critical environmental fronts because, in almost all cases, the real world alternative to renewable fuel on the margin of the global liquid fuel marketplace is going to be

[2] See AEC Progress report, http://ethanolrfa.3cdn.net/96a2f9e04eb357bbbd_1sm6vadqk.pdf.
[3] See http://www.eia.gov/forecasts/aeo/MT_liquidfuels.cfm#crude_oil

unconventional oil in the near to intermediate term. These fuels are not just more carbon intensive than the average gasoline baseline established by the RFS, they are far worse than average petroleum and renewable fuels in a number of other areas. For example, numerous studies show that drilling through rock formations has the potential to release (in the absence of containment) a number of hazardous radioactive compounds, such as uranium and thorium, into local waterways and ecosystems.[4] There is also the issue of groundwater contamination from oil and gas wells. The oil industry claims that these incidences are rare, and that generally speaking, oil and gas wells are constructed and abandoned following regulations that protect freshwater aquifers. In fact, this industry is largely unregulated, and the incidences of groundwater pollution are much higher than that. For example, a recent study of documented groundwater contamination incidents in Ohio uncovered ~ 1 incident for every 180 O&G wells drilled during the 25-year study period, and that 22 % (41 out of 185) of these documented O&G-related incidents were related to leakage from orphaned wells.[5] These oil and gas extraction processes, and their environmental impacts, are relevant to the RFS discussion because: (a) these are the types of petroleum-based fuels that will be used more intensively in the absence of renewable fuels, or instead of waived RFS gallons; and, (2) these fuels make up the real baseline when it comes to assessing the real environmental impacts of ethanol and other biofuels. As such, it is critical to assess the environmental impacts of ethanol and other biofuels relative to the most viable set of fuel alternatives in the immediate to intermediate term.

2. **Assessing biofuels in a vacuum could lead to worse environmental consequences.** All fuel production has impacts on atmospheric, airshed and water quality. Congress is right to ask and answer questions about the environmental impacts of different fuels. However, we encourage Congress to avoid assessing biofuel production in a vacuum. It is one thing to be responsible about minimizing the potential negative impacts of a certain fuel, but it is quite another to arrest the development of one fuel (based on these concerns) if the real world alternative is measurably worse. For example, many critics of the biofuel industry point to the impact of biofuel production and agriculture on water use and water quality. There is no question that biofuel production and agriculture require water usage. However, as noted by a recent report by several analysts from the Oak Ridge National Laboratory, the oil and gas industry generates more solid and liquid waste than municipal, agricultural, mining and other industrial sources *combined*.[6] And any literature review will demonstrate that while biofuel producers are using less and less water (more than 20 percent reduction in the last ten years), the processes required for the extraction of unconventional oil

[4] See Esther S. Parish, Keith L. Kline, Virginia, H. Dale, Rebecca A. Efroymson, Allen C. McBride, Timothy L. Johnson, Michael R. Hilliard, et al., *Comparing Scales of Environmental Effects from Gasoline and Ethanol Production, (2012).*
[5] See http://fracfocus.org/sites/default/files/publications/state_oil__gas_agency_groundwater_investigations_optimized.pdf
[6] See Esther S. Parish, Keith L. Kline, Virginia, H. Dale, Rebecca A. Efroymson, Allen C. McBride, Timothy L. Johnson, Michael R. Hilliard, et al., *Comparing Scales of Environmental Effects from Gasoline and Ethanol Production (2012), p. 26.*

require more and more water. To the degree that renewable fuels are assessed more closely given that the RFS requires renewable fuel blending, it is difficult to imagine a federal energy policy being any more environmentally responsible when it comes to promoting alternative fuels. To be eligible for the conventional biofuels pool, which constitutes 15 of the 36 billion gallon per year market created by the program, biorefineries must produce a renewable fuel with a lifecycle greenhouse gas (GHG) score that is at least 20 percent better than gasoline. To be eligible for the advanced biofuel pool, which constitutes 21 of the 36 billion gallon per year market created by the program, the renewable fuel must be *at least* 50 percent better than petroleum. Cellulosic biofuels, which constitute 16 of the 21 billion gallon per year advanced biofuel market created by the program, must be 60 percent better than petroleum. The standard used to determine the GHG intensity of each type of renewable fuel relative to petroleum actually underestimates the real world GHG benefits of renewable fuels by comparing each type of renewable fuel to an average 2005 petroleum baseline that does not reflect the carbon intensity of petroleum fuels today (i.e. the petroleum fuels coming online today are significantly more carbon intensive than the 2005 average, which means that the GHG benefit of displacing them with biofuel is greater than quantified by comparison to a 2005 petroleum average). In addition, RFS-eligible biofuel must be sourced from only a certain type of renewable biomass, which excludes (among other things) feedstock from federal lands and any land cleared after December 2007. None of the fuels are exempt from any other environmental regulations, such as the Clean Air Act. And the standard has a reasonable waiver provision. The primary purpose of enacting the RFS in 2007 was to move the United States toward greater energy independence and security via the increased production and use of clean renewable fuels.[7] However, the RFS also happens to be the most environmentally protective fuel energy policy ever enacted by Congress by virtue of the coexistence of: (a) aggressive biofuel blending targets; (b) high-reaching greenhouse gas eligibility standards; (c) tight minimum environmental eligibility standards; and, (d) flexibility provisions to allow for uncertainties in the marketplace. Stakeholders from many sectors will be submitting their ideas for how the RFS could be more (or less) protective of the environment, but the AEC does not believe that opening up the RFS under any of these pretenses will ultimately result in a more effective policy when it comes to its primary objective of moving the United States toward greater energy independence and security via the increased production and use of clean renewable fuels. In fact, and as discussed in previous public comments submitted by the AEC as part of this process, changing the rules just one-third of the way through a 15-year policy commitment will discourage existing and future investors from relying on Congress to hold course when it comes to making clean energy investments. As former

[7] The preamble to H.R. 6 – the "Energy Independence and Security Act of 2007" – states that H.R. 6 was enacted "To move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government, and for other purposes." The primary stated purpose of Title II – the "Energy Security Through Increased Production of Biofuels" – was to increase U.S. energy security and reduce U.S. dependence on oil via the increased production and use of biofuels.

Shell Oil President John Hofmeister recently stated, "[w]e need a competitor for oil. We need to open the market to replacement fuels … Competition will drive transportation fuel prices down, structurally and sustainably." The RFS is succeeding, and it is very important that Congress not waiver on the 15-year program structure it established in 2007.

Please find below responses to the specific questions outlined by the Committee:

Questions for Stakeholder Comment

1. Is the RFS reducing greenhouse gas emissions below that of baseline petroleum-derived fuels? Is the RFS incentivizing the development of a new generation of lower greenhouse gas emitting fuels? Will the RFS produce further greenhouse gas emissions reductions when it is fully implemented?

Yes. The methodology for assessing the GHG impact of different categories of renewable fuel actually undercounts the real world GHG benefits of producing and using renewable fuels. The Energy Independence and Security Act of 2007 requires U.S. EPA to compare existing and prospective types of renewable fuel against the average carbon intensity of U.S. gasoline in 2005. This legislated baseline clarifies the assessment methodology for U.S. EPA, but under values the real world benefits of blending renewable fuels because the new types of petroleum coming into the global liquid fuel marketplace on the "margin" are significantly more carbon intensive than average gasoline in 2005. Put another way, while U.S. EPA has concluded that the biofuels being used under the RFS today meet or exceed the GHG standards legislated as part of EISA07 (i.e. as compared to 2005 gasoline), these renewable fuels are an alternative to other (petroleum-derived) liquid fuels on the margin that are significantly more carbon intensive than the 2005 petroleum baseline. For example, with the Keystone Pipeline question in mind, a recent report released by the Congressional Research Service (CRS) found that Canadian oil sands are 14-20 percent more carbon intensive than the 2005 EPA baseline.[8] The report also quantified the carbon intensity of a number of other types of "marginal" petroleum, and found that many of the most common imports (e.g. Venezuela, Mexico, and Nigeria) are significantly more carbon intensive than the 2005 petroleum baseline.

Even using a 2005 baseline, U.S. EPA concluded in 2010 that first generation corn ethanol is more than 20 percent better than gasoline. With regard to advanced ethanol, the authors of the GREET model (one of the most well-respected lifecycle GHG models in the world, built by the DOE Argonne National Laboratory) recently updated their findings with regard to the GHG impacts of various types of ethanol in comparison to gasoline. The new GREET model runs show that all types of renewable fuel required for use under the RFS meet – or in most cases, greatly exceed – the minimum GHG standards legislated as

[8] See http://www.fas.org/sgp/crs/misc/R42537.pdf

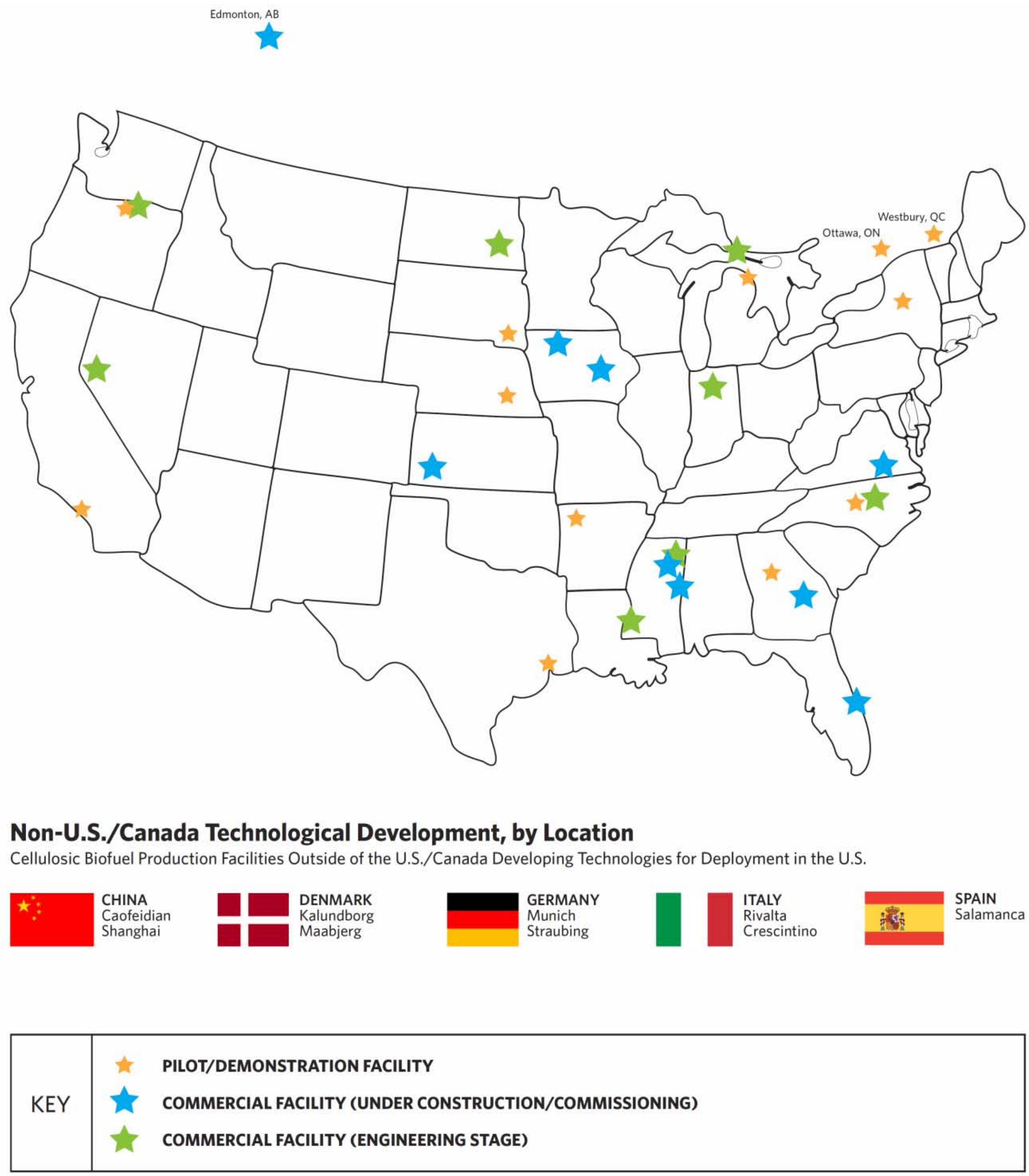
part of RFS2.[9] The three types of cellulosic ethanol assessed reduced GHG emissions by a range of 77-115 percent, even with the inclusion of land use change impacts. These are the types of advanced biofuels required for production and use going forward with regard to the RFS.

With regard to the emergence of a new generation of lower greenhouse gas emitting fuels, much has been made of the alleged delays in the commercial deployment of cellulosic biofuels. However, as shown in the AEC Progress Report released in December 2012 (see U.S. Map below), the industry is breaking through at commercial scale just five years after the enactment of the amended RFS and notwithstanding the global recession.[10] As noted in recent documentation released by U.S. EPA, the production cost of cellulosic biofuels continues to fall; the industry continues to make significant progress towards producing cellulosic biofuel at prices competitive with petroleum fuels; cellulosic biofuel producers faced not only the challenge of the scale-up of innovative, first-of-kind technology, "but also the challenge of securing funding in a difficult economy;" that it is reasonable to expect production and capital costs to continue to decline as more facilities come online and the so-called "commercial learning curve" is achieved; and, first commercial projects in the pipeline for cellulosic biofuels have made great progress in securing the necessary feedstock for their plants.[11] These industrial benchmarks are also widely reported in a number of academic studies.[12] For example, an industry survey conducted by Bloomberg New Energy Finance concluded that "[t]he operating costs of the [cellulosic biofuel] process have dropped significantly since 2008 due to leaps forward in the technology … [f]or example, the enzyme cost for a litre of cellulosic ethanol has come down 72% between 2008 and 2012."[13] As cellulosic biofuel production technology continues to mature, the U.S. advanced biofuels industry is ramping up to compete in the $2.5 trillion global clean energy marketplace and deliver the advanced renewable fuels required by the federal Renewable Fuel Standard (RFS).

In addition, we do believe that the RFS will produce further greenhouse gas emissions reductions when it is fully implemented. As demonstrated by the evolution of the first generation ethanol industry, new industries optimize their commercial facilities over time. First plants are rarely, if ever, as efficient as "Nth" plants because first-of-kind plants must be (over) engineered to account for unknown variables inherent with the commercialization of new technologies. First generation ethanol facilities, for example, have reduced their use of natural resources (water, energy, pre-treatment, etc.) by 15-50% or more over the last ten years. The RFS, if maintained as is, will provide a critical foothold for the first wave of advanced biorefineries. But further GHG reductions will be achieved as these plants are optimized and replicated across the United States and abroad.

[9] See http://iopscience.iop.org/1748-9326/7/4/045905/pdf/1748-9326_7_4_045905.pdf, p. 7.
[10] See AEC Progress Report: Cellulosic Biofuels at http://ethanolrfa.3cdn.net/96a2f9e04eb357bbbd_1sm6vadqk.pdf.
[11] See Docket ID No. EPA-HQ-OAR-2012-0546: Regulation of Fuels and Fuel Additives: 2013 Renewable Fuel Standards
[12] See: *Cellulosic Ethanol Heads for Cost-Competiveness by 2016, http://about.bnef.com/press-releases/cellulosic-ethanol-heads-for-cost-competitiveness-by-2016/*; Brown, T., Brown, R. "A review of cellulosic biofuel commercial-scale projects in the United States." Biofuels, Bioprod. Bioref. DOI:10.1002/bbb.1387 (2013).
[13] See http://about.bnef.com/press-releases/cellulosic-ethanol-heads-for-cost-competitiveness-by-2016/

Locations of Projects Profiled by AEC Progress Report[14]



[14] To view full AEC Progress report, see http://ethanolrfa.3cdn.net/96a2f9e04eb357bbbd_1sm6vadqk.pdf.

2. <u>Could EPA's methodology for calculating lifecycle greenhouse gas emissions be improved, including its treatment of indirect land use changes? If so, how?</u>

The third RFS white paper released by the Energy and Commerce Committee asserts that some aspects of the field carbon lifecycle accounting remain unsettled and controversial. This is true. However, it is important to recognize which aspects of the field are, and are not, controversial.

Carbon lifecycle emissions almost always fall into one of two categories: direct or indirect emissions. Direct emissions are those attributable to the primary production chain or lifecycle of producing and using the fuel from well-to-wheels. There is very little controversy around this part of the discussion because the emissions can be measured and validated using widely accepted methodologies. When you compare biofuels to petroleum based on direct "supply chain/combustion" emissions, virtually all types of biofuels (including corn ethanol) are significantly better than petroleum from a GHG perspective.

The controversy and uncertainty stems from indirect emissions. As discussed during proceedings in California pursuant to the Low Carbon Fuel Standard (LCFS), indirect emissions are market-mediated second/third/fourth order effects of a change in the marketplace (i.e. more biofuel production), often along the margins of the economic/resource system. For supporters of the inclusion of indirect effects in the lifecycle GHG impact of a fuel, the belief is that any significant change in the marketplace will cause a market (behavioral) response, and the (new) fuel should be held accountable for this response. Groups and individuals claiming that certain types of biofuel are not better than petroleum rely on the introduction of indirect effects into the carbon lifecycle equation. The science around carbon indirect effects is controversial for a number of reasons, including: (a) the science itself is new and unsettled, irrespective of result; (b) to date, only biofuels have been debited for indirect carbon effects in federal and state regulations; and, (c) there are important unanswered policy questions about whether debiting fuels/products for indirect carbon effects actually facilitates GHG emissions reductions.

In this context, it is important to clarify a few pieces of the indirect effects debate as it relates to biofuel production. First, indirect land use change is not the land used to produce the biofuel (biofuel is already debited for the land it uses as part of the direct effects analysis), it is the land used to produce another product (e.g. corn for animal feed) that is theoretically displaced (to new land) by increased land use for biofuels. Second, indirect effects are certainly not unique to biofuels and EISA07 does not limit the inquiry to biofuels or indirect land use change. Any increased utilization of a finite resource (e.g. land, oil, gas, electricity, etc.) has the indirect effect of pushing existing users of that resource deeper into the margin to supply demand for their respective product. This was a topic of discussion during the working group process in California pursuant to the Low Carbon Fuel Standard (LCFS), and the working group paper outlined a number of areas where there are indirect effects for other fuels.[15]

Either way, the solution to the unsettled nature of the science covering indirect land use change and indirect effects does not involve legislative amendment to the RFS. EISA07 provides U.S. EPA with the right balance of methodological structure and administrative flexibility. EISA07 requires U.S. EPA to assess the lifecycle GHG impact of each and every fuel and/or fuel category eligible for the RFS. EISA07 requires U.S. EPA to compare these GHG scores to gasoline or diesel fuel "sold or distributed as transportation fuels in 2005."[16] As discussed above, the use of a 2005 gasoline/diesel baseline actually leads to an underestimation of the real world GHG benefits of producing and using renewable fuels because the petroleum alternatives to renewable fuels (e.g. tight oil, heavy oil and tar sands) available today are significantly more carbon intensive than the 2005 baseline. One way to look at the 2005 baseline is it provides room for error when it comes determining (as U.S. EPA has) that both conventional and advanced biofuels meet the RFS GHG standards.

With regard to indirect land use change, the methodology prescribed by Congress also strikes the right balance between structure and flexibility. It directs U.S. EPA to consider both direct emissions and "significant indirect emissions such as significant emissions from land use changes [.]" In essence, this directive gives U.S. EPA the discretion to consider all significant direct and indirect effects when it comes to GHG evaluation. U.S. EPA should be considering the indirect effects of petroleum in its administrative assessments of the relative GHG impacts of petroleum and biofuels. The Act clearly does not limit the inquiry into indirect effects as only applying to indirect land use change. But the solution to the problem is entirely administrative. As such, there is no need for Congress to intervene to address the methodologies used by U.S. EPA to assess the relative GHG impacts of biofuels and petroleum.

3. <u>Is the definition of renewable biomass adequate to protect against unintended environmental consequences? If not, how should it be modified?</u>

For a fuel to qualify under the RFS2 program it must be derived from feedstocks that meet the definition of renewable biomass. The definition of renewable biomass is highly restrictive, and is more than adequate to protect against unintended environmental impacts. We encourage the Committee to consider the following features of the definition when it comes to eligible renewable biomass:

- Generally speaking, the definition enforces a series of exclusions based on land ownership and management categories. The two most prevalent controls on eligible renewable biomass are: (a) the definition prohibits the use of renewable biomass derived from federal lands; and, (b) the

[15] See http://www.arb.ca.gov/fuels/lcfs/workgroups/ewg/010511-final-rpt-alternative-modeling.pdf.
[16] CAA Section 211(o)(1).

definition prohibits the use of renewable biomass from lands cleared after December 19, 2007. So, as applied in the hypothetical, woody residues (i.e. wood waste) from saw mills and paper mills only meet the definition if the woody residues are from planted trees from actively managed tree plantations on non-federal land cleared at any time prior to December 19, 2007. Even some environmental groups view this definition as overly restrictive because it excludes certain highly viable feedstocks and renewable biomass that is sustainably harvested.[17] Either way, the definition is more than adequate from an environmental protection perspective and does not need to be modified legislatively.

- There are stringent record-keeping requirements for feedstock eligibility. For example, and as discussed on the U.S. EPA website, all renewable fuel producers must report and maintain records concerning the type and amount of feedstocks used for each batch of renewable fuel produced (for guidance, see 80.1451(b)(1)(ii)(K) and 80.1454(b)(3)(vi)). With regard to the renewable biomass recordkeeping and reporting requirements, the producer (whether foreign or domestic) must maintain records for each type of fuel unless the fuel is produced from existing U.S. agricultural land. In essence, renewable fuel produced from any new and/or foreign type of feedstock must be accompanied by feedstock records pursuant to section 80.1454(c) and (d). Additionally, the producer must report to EPA on a quarterly basis concerning the source of the feedstocks, as required in section 80.1451(d).

- Eligible and non-eligible feedstocks (e.g. wood residues from different origins) must be segregated in order for the eligible feedstock to be eligible for the RFS. In other words, producers cannot mix feedstock and claim (on faith) that a percentage of the feedstock meets the renewable biomass definition. This requirement assures that the feedstock reported can be validated when necessary.

- U.S. EPA has been extremely cautious regarding the approval of pathways, in part because of the renewable biomass definition. For example, there are a number of alternative energy crops and wood pathways that have not been approved for use under the RFS due to ongoing assessments. In essence, with regard to wood eligibility, only slash and pre-commercial thinnings from non-federal forestland that is not ecologically sensitive forestland qualify as renewable biomass under RFS2. As such, both the definition and the administration of the definition are conservative with regard to resource utilization under the RFS.

[17] See http://www.eesi.org/renewable_biomass_def.

The AEC is concerned about delays in the administration of the RFS with regard to advanced biofuel pathway eligibility. We have gotten to the point at which uncertainty about pathway eligibility is slowing down the deployment of advanced biofuels. It would be helpful if Congress weighed in to encourage U.S. EPA to expedite pathway approval, consistent with the protections contained in EISA07, for immediately viable advanced biofuel projects. But in either case, this is an administrative challenge, not a legislative one. There is no need to change the definition of renewable biomass at this time.

4. What are the non-greenhouse gas impacts of the RFS on the environment relative to a comparable volume of petroleum-derived fuels? Is there evidence of a need for air quality regulations to mitigate any adverse impacts of the RFS?

There is absolutely no need for air quality regulations to address the RFS. The RFS exists within – not outside of – the comprehensive air quality controls enforced as part of the Clean Air Act (CAA).

Generally, ethanol is the most ubiquitous alternative liquid fuel in the world with a decades-old record of success with regard to air quality. Ethanol reduces tailpipe carbon monoxide emissions by as much as 30%, toxics content by 13% (mass) and 21% (potency), and tailpipe fine particulate matter (PM) emissions by 50%. The air quality benefits of ethanol are even greater if compared to what the molecule replaces in the gasoline blend. Ethanol is, by a significant margin, the cleanest and most affordable source of octane in the world, displacing toxic and carcinogenic aromatics such as benzene and toluene.

Critics of ethanol often throw out a number of misleading or outdated arguments on air quality. For example, some critics point to emissions increases of acetaldehyde – a tailpipe air toxin. What these critics fail to point out is that while ethanol blending does increase acetaldehyde emissions in some cases, ethanol reduces net toxics emissions across the board relative to gasoline. So while no fuel compound reduces *all* categories of toxins, ethanol blending makes tailpipe emissions significantly less toxic in the aggregate.

Lastly, the wide and affordable availability of ethanol provides U.S. EPA with a significant opportunity to further reduce tailpipe emissions via the ensuing Tier 3 regulation. Ethanol is virtually sulfur free (which facilitates the primary objective of Tier 3 to reduce sulfur in gasoline) and displaces the need for some of the most toxic and unhealthy compounds in gasoline. We are working with U.S. EPA to ensure that ethanol is properly valued in the regulation.

5. Has implementation of the RFS revealed any environmental challenges or benefits not fully anticipated in the statute?

As discussed above, the RFS is not recognized for its primary environmental benefit of providing an alternative to unconventional, "marginal" sources of oil. The RFS is often treated as an additive policy (i.e. over and above our use of conventional, petroleum-based fuels), in which we contemplate to what degree we want to promote renewable fuels and whether or not the RFS does so effectively. Calls to waive or reduce the RFS targets are often made without apparent consideration for the fact that these gallons would need to be replaced in the near and intermediate term with another (likely petroleum) liquid fuel, or that the world's mature conventional oil fields are depleting much more quickly than unconventional oil resources are being developed. For example, a recent IMF Working Paper discusses the possible effects of the latter problem, in which depletion overwhelms new oil supply: "our prediction of small further increases in world oil production comes at the expense of a near doubling, permanently, of real oil prices over the coming decade. This is uncharted territory for the world economy, which has never experienced such prices for more than a few months."[18] John Hofmeister, former President of Shell Oil, recently told CNBC that, "I think OPEC is about maxed out … when people talk about spare capacity in OPEC, I don't see it. I just don't see it coming through and I'm not sure it's there. And it's not just that they're greedy, but they're really producing what they can produce."[19]

In practical terms, the RFS is both a hedge against and an alternative to unsustainable and insufficient reserves of both conventional and unconventional sources of oil. Depleting conventional (which often requires thermal injectants) and unconventional types of petroleum carry with them tremendous environmental risk in the areas of water, air and climatological pollution. Generally, cellulosic biofuels are the most sustainable, emerging unconventional liquid fuel in the world.

Critics of the RFS – usually oil and livestock groups – have a list of "unintended consequences" that are offered not to protect consumers or the environment, but rather, to defend their monopolistic control of the marketplace (in the case of the oil industry) or reprise access to below-cost, government subsidized corn (in the case of livestock). The AEC would like to respond to a few of these claims:

- Water Use. A 2007 National Academy of Sciences report noted that "consumptive use of water is declining as ethanol producers increasingly incorporate water recycling and develop new methods of converting feedstocks to fuels that increase energy yields while reducing water use." Ethanol plants have little or no wastewater discharge, and they recycle a significant portion of their process water through centrifuges, evaporation, and anaerobic digestion. In addition, nearly nine out of every 10 corn acres in the U.S. are rain-fed and require no irrigation. For those

[18] See http://www.imf.org/external/pubs/ft/wp/2012/wp12109.pdf.
[19] See http://video.cnbc.com/gallery/?video=3000073805.

acres that require additional water resources, farmers are using 23% less water today than they were in 1988. On the petroleum side, and as noted above, the oil and gas industry generates more solid and liquid waste than municipal, agricultural, mining and other industrial sources *combined*.[20] Either way, most of the future gallons required by the RFS are advanced biofuel gallons. Many see the emergence of the advanced biofuel industry as an opportunity to diversify what is grown agriculturally in the United States and abroad. There is tremendous potential to further reduce water usage in the agricultural sector via the increased production and use of advanced biofuels.

- Impact on Food and Feed Prices. Food prices are not increasing. Food prices rose 1.8% in 2012, the second-lowest annual rate in the last 20 years. Corn (for feed) prices have increased. However, a basic correlation analysis shows that corn prices have tracked oil prices since the inception of the RFS (including a very significant price drop in 2009 when ethanol use was still increasing). As discussed in previous AEC comments, livestock producers prefer $1.80/bushel corn (which required farmer subsidization) to $6/bushel corn. This is also the case for ethanol producers. But the primary cause of the increase in corn prices is oil prices, not the RFS.

- Corn Shortages. The AEC does not represent corn ethanol, but specious claims about corn markets are being used to attack the RFS. There is no shortage of corn for food and feed. In 1980, farmers averaged a yield of 91 bushels of corn per acre and produced a crop of 6.6 billion bushels. In 2009, farmers produced an average yield of 164.7 bushels per acre and harvested 13.1 billion bushels. This doubling of the American corn crop was achieved by planting just 3% more corn acres in 2009 than was planted in 1980 due to critical breakthroughs at the technological and harvesting levels. Historically, the problem with corn has been over (not under) supply. The price of corn has changed, but this is true for all agricultural commodities due to the new equilibrium in the oil markets. The AEC discusses the correlation between corn and oil prices at length in previous comments submitted pursuant to the White Paper process.

- GHG Emissions. As discussed, those who claim that biofuels are as bad as or worse than gasoline with regard to GHG emissions rely on the inclusion of indirect effects for biofuels only. Even with the inclusion of indirect effects for biofuels only, U.S. EPA has confirmed that biofuels are 20-90 percent (or more) better than gasoline from a full lifecycle carbon perspective. Some cellulosic biofuels are actually more than 100 percent better than gasoline, which means they are a net carbon sink.

[20] See Esther S. Parish, Keith L. Kline, Virginia, H. Dale, Rebecca A. Efroymson, Allen C. McBride, Timothy L. Johnson, Michael R. Hilliard, et al., *Comparing Scales of Environmental Effects from Gasoline and Ethanol Production (2012), p. 26.*

– Unmet RFS Targets and/or lower gasoline demand. Critics claim that the RFS targets are too aggressive and need to be revised based on either the lack of cellulosic biofuel or lower than expected gasoline demand. First and foremost, the RFS is whole through 2012. The original schedule required 15.2 billion gallons of renewable fuel blending in 2012 (including 2 billion gallons of advanced biofuel blending), and the renewable fuels industry has produced and supplied those gallons to the oil industry. Second, Congress fully anticipated possible delays in the commercialization of new biofuel technologies, which is why they provided U.S. EPA with the discretion to adjust or eliminate certain blending requirements. U.S. EPA has eliminated nearly the entire blending requirement for cellulosic biofuels to date while maintaining the overall advanced biofuel targets with other sources of advanced biofuels. Now, with a better economy, the cellulosic biofuels industry is breaking through at commercial scale just five years after the signing of RFS2. The program is working as anticipated in 2007.

6. <u>What is the optimal percentage of ethanol in gasoline? What is the optimal percentage of biomass-based diesel in diesel fuel?</u>

The AEC has not supported any "one size fits all" optimal percentage of ethanol in gasoline in part because the answer to that question depends on a number of dynamic market variables related to ethanol supply, consumer preference, and the price of ethanol relative to petroleum and other alternatives. The RFS does not prescribe or discourage specific ethanol percentages, and this is appropriate given that a number of other market and regulatory variables (including the Clean Air Act) are the primary determinants of ethanol blending from a percentage/blend perspective.

The problem with regard to ethanol blending is the current "blend wall" protects 90 percent of every gallon of gasoline from the threat of free market competition from ethanol. Put another way, the blend wall distorts ethanol/gasoline markets by forcing ethanol producers (including advanced ethanol producers) to compete among themselves in a constrained marketplace capped at 10 percent of the blend, instead of allowing ethanol to compete with gasoline in an open marketplace. The problem with this dynamic is it leaves consumers vulnerable to sharp increases in world crude oil prices, because there is no fungibility between ethanol and gasoline that would otherwise allow for alternatives to be used when gasoline prices spike. It also limits the economic and environmental upside of the American renewable fuels industry.

There are immediate term solutions to the problem (E15, E85) and there are comprehensive solutions to the problem (predominant penetration of Flex Fuel Vehicles or FFVs). E15 blends are now certified for use in 2001 model year and later vehicles, which together account for 75% of the miles driven today.[21] In

[21] See http://www.epa.gov/otaq/regs/fuels/additive/e15/

addition, E85 blends are becoming increasingly popular given the price-per-gallon discount offered by ethanol over gasoline. However, the question then moves to the rate of change in the marketplace. In simple terms, if the production of ethanol outpaces the deployment of ethanol in the marketplace, ethanol markets become over-saturated, ethanol prices drop, innovation is dampened, and the oil industry's control of the marketplace remains. Incumbents in the fuel energy industry understand this market dynamic, which explains why the oil industry has done everything possible to curtail the use of E15, higher ethanol blends, and FFVs. As noted by energy economic Phil Verleger, "[t]he oil industry doesn't like to sell less oil, so they are trying hard to kill the [RFS] program … so they can sell more gasoline and not have to use as much ethanol."

The chief underlying rationale for addressing the blend wall problem more comprehensively is related to cost. While the consumer expense of remaining dependent on oil is immense, comprehensive solutions to the blend wall are not. For example, there would be no blend wall if the majority of vehicles in the United States were flex-fuel vehicles (FFVs). The additional manufacturing cost of making a conventional vehicle flex-fuel at the manufacturing plant is roughly $100 per vehicle. With the predominant penetration of FFVs, ethanol/gasoline blending markets become fungible and marketers/consumers are free to choose higher ethanol blends (or not) based on performance and price. The most efficient way to deploy FFVs is to require them, as proposed by various Open Fuel Standard (OFS) proposals. Requiring FFVs would cost automakers very little – especially given that about 50% of new vehicles are already FFVs – but would have far reaching positive effects on the consumer marketplace (e.g. increased competition, consumer choice, cheaper fuel, low carbon fuels, etc.). There are two additional advantages of a vehicular FFV requirement: (1) virtually zero cost to the U.S. Treasury; and, (2) market access certainty for advanced ethanol producers and technology developers, who will then have the opportunity to compete based on price in an unconstrained, fungible marketplace.

Irrespective of the ultimate resolution to the ethanol blending/blend wall issue, we encourage the Committee to take into consideration two underlying points.

First, the advanced ethanol industry needs a marketplace to reach its potential. Current constraints on ethanol blending retard the development of advanced ethanol by forcing investors in next generation ethanol fuels to face the possibility that, despite price competitiveness with gasoline, one factor or another could prevent more ethanol blending. As such, the blend wall is as much an issue for advanced ethanol as it is for first generation ethanol.

Second, the primary underlying problem with the global liquid fuels marketplace is the lack of competition. Competition facilitates consumer choice, which in turn breeds innovation, price stability and efficiency. Ethanol is now in position to compete with petroleum based on price, but does not have access to 90 percent of the marketplace by virtue of a number of unnecessary constraints at the regulatory and vehicle manufacturing levels. The RFS and the design of the Renewable Identification Number (RIN) program are designed to help break through some of these “blend wall” market constraints, and current trends in the RIN markets provide additional incentives for the use of higher ethanol blends (E15-E85) *while saving consumers at the pump*. Our comments on the blend wall elaborate on how higher RIN prices open the market to ethanol without costs to the consumer, but one fundamental point bears repeating: oil companies acquire the RIN for free when they acquire the RFS gallon on renewable fuel, and are often on the profit-side of the RIN transaction when prices are higher. The key for those reviewing the RFS is to realize that the oil industry’s focus on RIN prices is not about cost (to consumer or otherwise), it’s about targeting a credit trading mechanism (within a well-designed policy) that actually threatens their monopolistic control of the marketplace. We encourage the Committee to continue to let the RFS work, as it is working today, toward promoting greater competition in the transportation fuels marketplace.

7. <u>What are the best options for substantially further reducing greenhouse gas emissions from the transportation sector? Is the RFS an important component of such efforts?</u>

With the notable exception of federal tax policy, the pieces are in place to significantly reduce greenhouse gas emissions from the transportation sector. The combination of the CAFE/GHG program (which addresses vehicles and promotes viable alternatives like hybridization and electrification) and the RFS (which addresses liquid fuels) puts the United States in a position to lead the global innovation race when it comes developing next generation vehicle and fuel technologies. However, in order for this vision to become a reality, we recommend the following:

i. *Congress needs to make longer term policy commitments and stick to them.* It is well understood that the oil industry wants to repeal the RFS for reasons related to their monopolistic control of the liquid transportation fuel marketplace. However, repeal is not the only way to weaken the RFS. The mere prospect of repeal, year after year, increases the investment uncertainty in the biofuels industry which in turn results in fewer projects being financed and built. Congress makes matters worse when it entertains efforts to create uncertainty around programs like the RFS, even when the ultimate result is non-repeal. One of the many extraordinary aspects of the RFS is the duration of the commitment (15+ years). One of the oil industry’s primary goals is to short-circuit the investment certainty created by this level of commitment by creating the perpetual prospect that Congress will not honor its original 15 year commitment to the RFS. This political landscape stands in stark contrast to the extensive, multiyear commitments made by our competitors (e.g. China) to the development of renewable energy. The fuel energy sector is consolidated and non-competitive enough to be dependent on federal policy (rather than free market forces) for innovation and change. But if there is no certainty around the policy commitments that have been made, the private sector is not going to take the capital risk in these projects despite the obvious value proposition of producing next generation, renewable fuels at cost competitiveness with oil. As stated, game changing policies are in place. Congress must now make clear that they will be enforced.

ii. *Congress must reform the federal tax code to reflect 21st century energy objectives.* While not the jurisdiction of Energy and Commerce Committee, it is nonetheless important to take into consideration that the energy policies built into the current federal tax code – which de-risk and allow cost recovery for fossil fuel projects to a far greater degree than renewable energy/fuel projects – run counter to goals set forth by the RFS (and other clean energy policies). The three most important things Congress can do to further reduce GHG emissions from the transportation sector are: (1) maintain, publicly support and facilitate the RFS; (2) maintain, publicly support and facilitate the new CAFE/GHG standards; and, (3) reform the federal tax code to reflect 21st century needs.

iii. *Regulators should be syncing various GHG programs, to the degree possible, to create consistency and efficiencies, and avoid inefficiencies.* While largely an administrative issue, the AEC recommends a more coordinative approach to addressing energy-related GHG emissions. For example, we are concerned that the current CAFE/GHG approach does not complement the goals of the RFS. The recent CAFE/GHG standards have the potential to facilitate compliance with the RFS by driving the use of higher octane fuels, which in turn facilitates the use of more advanced engine technology. Advanced ethanol, for example, retains all the clean, octane-enhancing benefits of first generation ethanol, but also brings to the table tremendous carbon intensity reductions over gasoline. In fact, cellulosic ethanol is the lowest carbon liquid fuel in the world, and is significantly less carbon intensive than natural gas, hydrogen and electricity (for vehicles).[22] The big question with regard to these and future fuel/vehicle regulations is whether ethanol will be properly valued as part of the regulation. For example, the current version of the CAFE/GHG does not seem to provide substantive incentives for FFVs beyond 2016, while offering a variety of more robust incentives for natural gas and electric vehicles. FFV deployment is critical to the ongoing evolution of the ethanol industry, particularly with regard to ultra-low carbon ethanol. EPA should balance its approach to alternative fueled vehicles in the rule to ensure that cellulosic biofuels are allowed to compete in the marketplace with gasoline based on price.

[22] See http://www.arb.ca.gov/fuels/lcfs/workgroups/workgroups.htm#pathways; and, http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf.

As discussed in our prior written responses to the white paper review, the RFS is the global gold standard when it comes to advanced biofuel policy. It is the U.S. advantage when it comes to attracting a quickly innovating industry to the Unites States. Legislative intervention at this point in its deployment is unwarranted and would be the equivalent of exporting the advanced biofuels industry opportunity to other countries that are maintaining their long-term commitment to renewable energy.

Thank you for the opportunity to comment on the RFS.

Sincerely,

R. Brooke Coleman
Executive Director
Advanced Ethanol Council (AEC)

Comments of the
American Fuel & Petrochemical Manufacturers
on the House Energy and Commerce Committee's
"Renewable Fuel Standard Whitepaper- Environmental Impacts"

The American Fuel & Petrochemical Manufacturers (AFPM)[1] submits these comments in response to the House Energy & Commerce Committee's whitepaper on the Renewable Fuels Standard (RFS) and its environmental impacts. As refiners and importers of liquid transportation fuels, AFPM members are "obligated parties" under the RFS. Our nation's domestic petroleum refiners are committed to manufacturing safe, reliable and clean transportation fuels, and we will continue to oppose any actions that could endanger the safety of the American families, farmers and truckers we serve every day. We take the confidence Americans place in our products – demonstrated by the millions of times each day that consumers purchase gasoline and diesel fuel – very seriously.

AFPM opposes the mandated use of alternative fuels and supports the sensible and workable integration of alternative fuels into the marketplace that allows consumers to choose the fuels that best fulfill their needs. Energy policy based on mandates ultimately disadvantages consumers. There is no free market if every gallon of biofuels – including those that do not exist – is mandated. Mandates distort markets and result in stifled competition and innovation.

Policymakers should carefully consider the potential impact of policies on the environment, energy security, and consumers. Unfortunately, market interfering regulations or legislation, especially involving energy and environmental policies, can and do have significant unintended negative consequences. An example of such consequences can be seen with biofuels mandates that are being rethought across the globe amid serious economic and environmental concerns. As our responses to the Committee's questions indicate, EPA's own data and the National Academy of Sciences report show that the RFS is – at best – marginal for the environment and in many cases is compounding environmental challenges. What is clear, however, is yet another one of the central justifications for the RFS, environmental benefits, no longer holds true. For this and many other reasons, AFPM urges Congress to repeal this anti-consumer law.

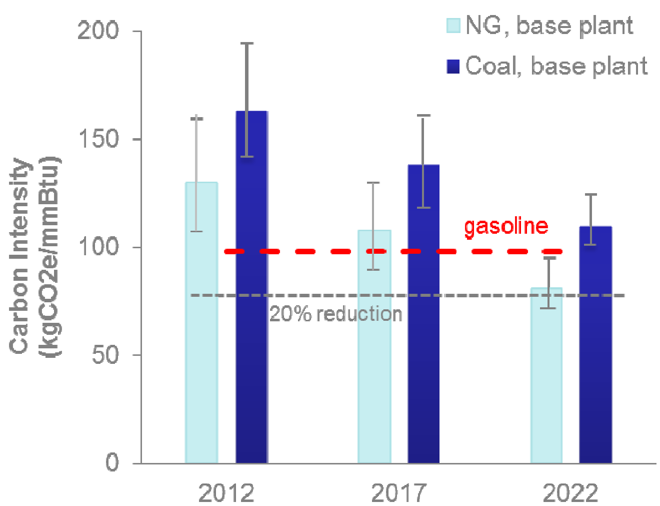
Question 1: Is the RFS reducing greenhouse gas emissions below that of baseline petroleum-derived fuels? Is the RFS incentivizing the development of a new generation of lower greenhouse gas emitting fuels? Will the RFS produce further greenhouse gas emissions reductions when it is fully implemented?

According to EPA's own data, the Renewable Fuel Standard (RFS) is currently raising greenhouse gas emissions (GHG) compared to gasoline. Figure 1 summarizes data from docket

[1] AFPM is a trade association representing high-tech American manufacturers of virtually the entire U.S. supply of gasoline, diesel, jet fuel, other fuels and home heating oil, as well as the petrochemicals used as building blocks for thousands of products vital to everyday life.

EPA-HQ-OAR-2005-0161-3173 for biorefineries powered by natural gas (NG) and coal; the error bars illustrate uncertainty in GHG estimates. For reference, EPA estimated that 88 percent of corn ethanol capacity uses dry-milling technology, and 80 percent uses natural gas as its primary power source.[2] 15 percent of corn ethanol facilities are powered by coal. As Figure 1 shows, EPA estimates that natural gas powered dry mill ethanol plants caused greenhouse gas emissions to increase by 33 percent last year.[3] In 2017 ethanol will continue to have higher GHG emissions than gasoline. In year 2022, EPA estimates that after significant investments in separation technologies and energy efficiencies in biorefineries, ethanol plants may reduce GHGs below gasoline. As such, future reductions in greenhouse gas emissions are speculative at best.

Figure 1 Corn ethanol GHG estimates per EPA

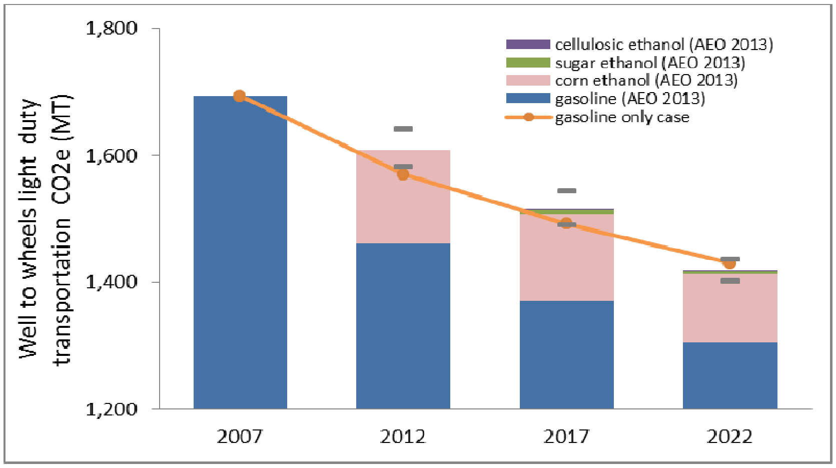


According to the Energy Information Administration (EIA), the RFS volumes will not be fully implemented by 2022 mainly due to substantial shortfalls in cellulosic biofuel production. In 2022, EIA projects that less than 0.5 of the 16 billion gallon mandate will be met, and only 95 million gallons of drop in biofuels will be produced, enough to satisfy 0.07 percent of gasoline demand. In other words, the vast majority of emissions impacts will fall on the corn ethanol mandate, which will raise greenhouse gas emissions over the life of the mandate and beyond. Figure 2 shows emissions impacts of ethanol/gasoline blends compared to a gasoline only baseline. The chart uses EIA's AEO 2013 demand and biofuel volumetric projections and EPA's GHG data shown in Figure 1 above, as well as GHG data for sugar cane and cellulosic ethanol in the referenced EPA docket. It bears repeating that the benefits in 2022 are only achieved using undetermined technological advancements and assumes corn ethanol plants (which are grandfathered from meeting RFS2 emissions reduction requirements) will adopt those technologies as they become available.

[2] Environmental Protection Agency, Renewable Fuel Standard Program (RFS 2) Regulatory Impact Analysis at 131-32 (Feb. 2010).

[3] National Academy of Sciences, *Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuels Policy*, at 201 (2011).

Figure 2 GHG Emission Comparison



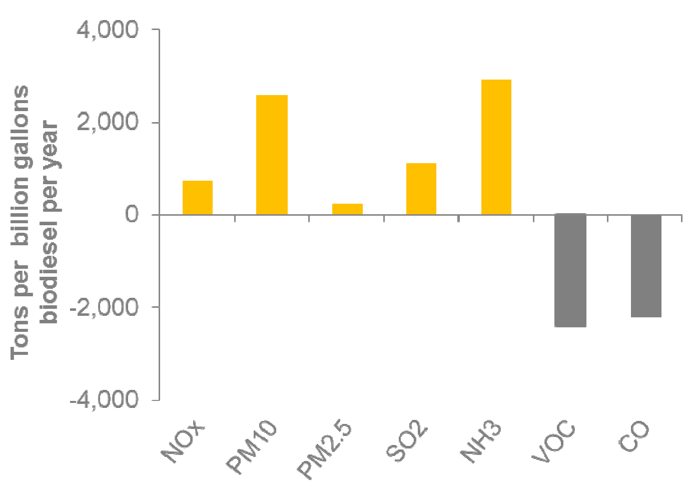
Question 4: What are the non-greenhouse gas impacts of the RFS on the environment relative to a comparable volume of petroleum-derived fuels? Is there evidence of a need for air quality regulations to mitigate any adverse impacts of the RFS?

Air Quality Deterioration

In 2011 the National Academy of Sciences (NAS) reported that the lifecycle emissions of major air pollutants (such as CO, NOx, PM2.5, VOC, SOx, and NH3) are higher for corn and cellulosic ethanol than for gasoline.[4]

NAS states: "The current focus of tailpipe emissions of biofuels compared to petroleum-based fuels is misguided as it misses the majority of the emissions of air pollutants affecting air quality in each of the fuels' lifecycles. Overall production and use of ethanol was projected to result in increases in pollutant concentration for ozone and particulate matter than gasoline on a national average, but the local effects could be variable. Those projected air-quality effects from ethanol fuel would be more damaging to human health than those from gasoline use."[5] Similarly, EPA reports that biodiesel is increasing the level of several pollutants over petroleum diesel (see Figure 3).[6]

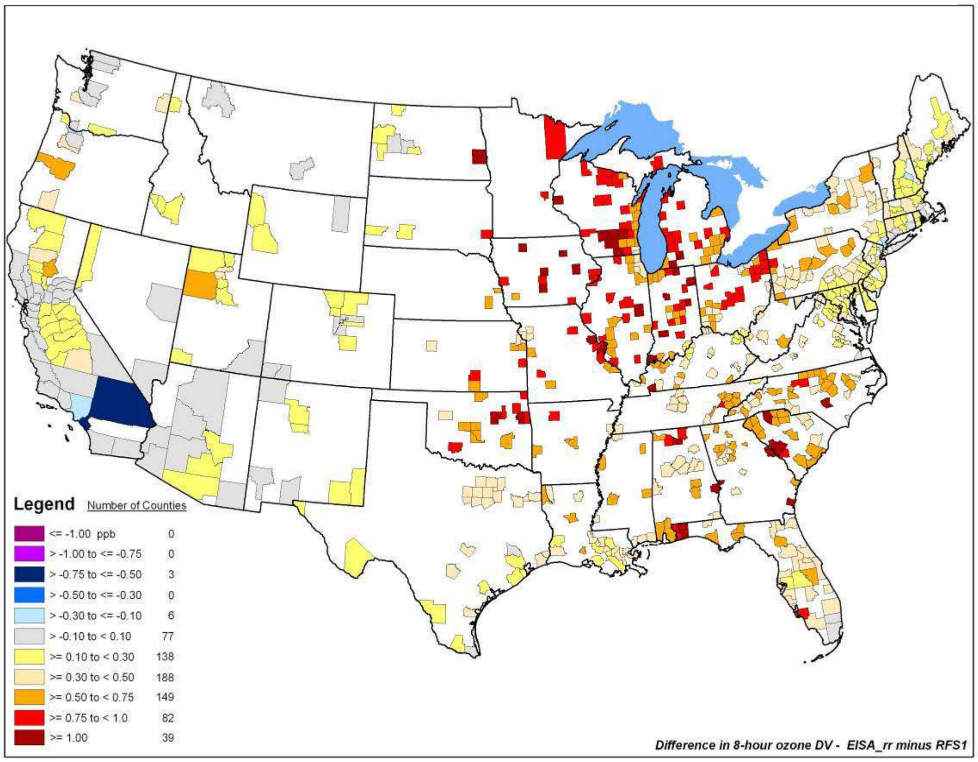
Figure 3 Air Quality Impacts: Biodiesel vs. Petroleum Diesel



[4] National Academy of Sciences at 204.
[5] *Id.* at 246.
[6] Regulation of Fuels and Fuel Additives: 2013 Biomass-Based Diesel Renewable Fuel Volume, 77 Fed. Reg. 59,743 (Sept. 27, 2012).

For these reasons, the RFS is compounding the challenges that states and municipalities face as they seek to stay in compliance with ever-tightening ozone and PM2.5 national ambient air quality standards. According to EPA's Regulatory Impact Analysis of RFS2, the RFS2 will raise ozone levels 0.46 ppb over the RFS1 baseline, placing dozens of counties in many states in danger of falling into non-attainment with ozone NAAQS.[7] See Figure 4 for EPA's map comparing the RFS1 baseline to RFS2.

Figure 4: Projected Change in 2022 8-hour Ozone Design Values Between the RFS2 Control Scenario and RFS1 Mandate Reference Case Scenario



Water

As water becomes an increasingly valuable global resource, it is worth noting that biofuels require significantly higher quantities of water than gasoline due to cultivation. According to NAS's compilation of various studies, using a well to wheels basis, it takes 1.4 - 6.6 gallons of water to produce a gallon of gasoline. By comparison, corn starch ethanol requires 15 to 2400 gallons and switchgrass ethanol requires 2.9 to 1307 gallons of water per one gallon of fuel.[8]

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[7] EPA Regulatory Impact Analysis at 602.
[8] National Academy of Sciences at 227.

Water Quality

According to NAS, "the increase in corn production has contributed to environmental and surface effects on surface and ground water, including hypoxia, harmful algal blooms, and eutrophication. Additional increases in corn production under RFS2 likely will have additional negative environmental effects."[9]

Question 6: What is the optimal percentage of ethanol in gasoline? What is the optimal percentage of biomass-based diesel in diesel fuel?

In general, the optimal percentage of ethanol in gasoline, or biodiesel in diesel fuel, is whatever the free market demands. RFS mandates blending of ethanol and biodiesel; both are more expensive on an energy basis than gasoline and diesel. Furthermore, as discussed in this and in the agricultural whitepaper, first generation biofuels offer no environmental benefits. Currently most of the gasoline contains 10% ethanol, or E10.

Question 7: What are the best options for substantially further reducing greenhouse gas emissions from the transportation sector? Is the RFS an important component of such efforts?

The key finding of the NAS study is that "RFS2 may be an ineffective policy for reducing global GHG emissions because the effect of biofuels on GHG emissions depends on how the biofuels are produced and what land-use or land-over changes occur in the process." Furthermore, NAS points out that as volumes of dedicated energy crops continue to grow in order to meet the mandate, conversion of uncultivated crop land or displacements of crops and pastures will be required. Such a market-mediated land use change will result in GHG increase.

EIA projects that between 2007 and 2022, improvements in vehicle technology will drive energy used per mile down by 22 percent, and energy use will drop by 15 percent even as miles driven increase by 7.7 percent.[10] According to EPA's data, the best thing Congress can do to reduce GHG emissions from the transportation sector is to repeal the RFS, since the cumulative GHG emissions will exceed those of gasoline over the life of the RFS and beyond. Put another way, transportation GHG emissions will decrease with or without the RFS, but will decrease more if the RFS is repealed.

[9] National Academy of Sciences at 10.

[10] Calculated using data from the Energy Information Administration: AEO 2010 for 2007 data, AEO 2013 Early release for 2012, 2017, 2022 data

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Algae Biomass Organization

Comments to the Renewable Fuel Standard Assessment White Paper:

Greenhouse Gas Emissions and Other Environmental Impacts

The Algae Biomass Organization (ABO) appreciates the opportunity to provide comments to the Energy and Commerce Committee on the Renewable Fuel Standard (RFS) and its impact on the environment. ABO represents the entire algae value chain, from algae growers, researchers, fuel and oil producers to end users, including Fortune 500 companies, national laboratories and major universities.

ABO strongly supports the RFS because the RFS plays a critical role in driving the innovation needed for a strong American biofuel industry. The RFS provides the market "pull" for biofuels, incentivizing private industry to conduct the research, development, and deployment needed to commercialize their products at a competitive cost.

Based on studies reviewing ABO member technologies, we are confident that greenhouse gas emissions from algae-derived biofuels are significantly lower than those from fossil fuels, while algae-derived hydrocarbon fuels produced (gasoline, diesel, jet) are molecularly identical and have the same quality and performance as petroleum fuels. One published, peer reviewed scientific study of an ABO member's process for producing ethanol determined that algae-derived ethanol would realize a 67%-87% carbon footprint reduction compared to gasoline on an energy equivalent basis.[1] Many other peer reviewed studies have reached similar conclusions. We believe the RFS is an important tool, and fundamentally the only federal tool, to help reduce greenhouse gas impacts from transportation.

[1]Dexin Luo, Zushou Hu, Dong Gu Choi, Valerie M. Thomas, Matthew J. Fealff, Ronald R. Chance "Life Cycle Energy and Greenhouse Gas Emissions for an Ethanol Production Process Based on Blue-Green Algae," *Environmental Science & Technology* 44, No. 22 (2010).

Furthermore, the RFS provides a long term, stable policy to promote sustainable aviation biofuels for the aviation sector -- a sector that has no other low carbon energy source option but is committed to carbon neutral growth. ABO members like FedEx, United and Boeing are interested in the development of alternative fuels in order to meet their strict sustainability standards and the RFS is an important tool in helping them reach their goals.

As an organization, ABO has been working to assist our members in developing Life Cycle Assessments of products produced from algae biomass. Industrial processes being developed and piloted for the production of biofuels from algae are diverse in nature and relatively complex in implementation. To enable more accurate environmental and economic modeling across this diversity, the Algae Biomass Organization is promoting an adaptive "Green Box" approach as outlined on its website in the publication: *Minimum Descriptive Language: Guidance to Evaluate Life Cycle Inputs and Outputs*. A full accounting of the upstream and downstream environmental and carbon balance impacts of algal operations is supported by ABO's Green Box approach as outlined in that guidance document. ABO encourages the EPA and DOE to work with industry groups like ABO to help implement lifecycle analyses which are specific to their industries.

Analyses done to date by ABO members strongly indicate that the production of fuel from algae could potentially alleviate some environmental challenges associated with the use of other types of fuels. For example, like most crops, algae consume CO2 as part of its growing process. In the case of algae, however, this CO2 can be derived from industrial sources, providing CO2 emitters the potential to produce a product of value from the CO2.

In addition to the aggressive use of CO2, algae have some environmental benefits with regard to water. For example, algae can be grown using wastewater, many non-potable sources including industrial process water, saline and brackish water environments. In general, algae biofuel processes are able to recycle nutrients and in some cases recover nutrients from wastewater thereby eliminating the negative environmental impact of nutrient release into the environment and damaging eutrophication of natural bodies of water. .

With regard to land use changes, algal biofuel production does not require fertile or carbon bearing soil and so is unlikely to directly or indirectly cause the release of greenhouse gasses from land use changes.

Furthermore, the building of an algae based biofuel production industry will likely spawn a companion industry of algae based food and animal feed production that will relieve food growth pressure on land due to population growth and displacement.

Regarding unforeseen issues related to the RFS, ABO believes that the separation of fuel categories into “cellulosic” and “other advanced” did not take into account the possibility that non-cellulosic fuels would be produced at a large scale. Congress did not anticipate the emergence of some non-cellulosic fuels and, logically, did not anticipate other non-cellulosic biomass sources which are not currently being used for fuel production. While we strongly support the inclusion of cellulosic fuel in the RFS, we believe that the RFS can be strengthened by a feedstock neutral approach where the “cellulosic” and “advanced” biofuels designations are combined, thereby allowing existing non-cellulosic feedstock as well as any unforeseen future feedstock the same market growth opportunity as cellulosic feedstock.

In conclusion, the ABO supports the RFS and believes that increased production and use of biofuels will significantly reduce the United States’ greenhouse gas emissions while improving environmental health overall.

Sincerely,

Mary Rosenthal
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ALGENOL BIOFUELS
Harnessing the sun to fuel the world®

May 24, 2013

The Honorable Fred Upton
Chairman
Energy and Commerce Committee
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

The Honorable Henry A. Waxman
Ranking Member
Energy and Commerce Committee
U.S. House of Representatives
2322A Rayburn House Office Building
Washington, DC 20515

Dear Chairman Upton and Ranking Member Waxman:

Thank you for the opportunity to comment on the U.S. House of Representatives Committee on Energy and Commerce's (Committee) third Renewable Fuel Standard (RFS) assessment white paper reviewing the RFS's Greenhouse Gas Emissions and Other Environmental Impacts. Algenol Biofuels Inc. (Algenol) is aggressively pursuing plans to commercialize its Direct to Ethanol® technology to produce transportation fuels using an algae-based platform with carbon dioxide (CO_2) as the primary feedstock. The Renewable Fuel standard is the single most important government program driving Algenol's commercialization in the US. It is the basis for significant job creation, technical innovations and investment that will manifest important environmental benefits as the technology is deployed in the near term. The importance of RFS will be especially acute over the next several years as Algenol works with strategic partners and investors to construct commercial scale projects.

Algenol's Expertise and Advantages in CO_2 Capture

Our process requires CO_2 as the primary feedstock, and Algenol's proprietary algae convert that CO_2 into ethanol at the rate of over 9,000 gallons per acre per year. Algenol intends to co-locate Direct to Ethanol® facilities with a CO_2 source in order to feed CO_2 directly from that source into fields of our closed and sealed photobioreactors filled with algae. Since neither high purity nor high pressure CO_2 is required for our algae-based process, algae-ready CO_2 capture has fundamental cost advantages in comparison to that for underground geologic sequestration (CSS) or enhanced oil recovery (EOR) ready CO_2. A variety of sources have been considered, one ideal scenario is to co-locate a Direct to Ethanol® project with a natural gas fired power plant adjacent to a significant amount of marginal land. Natural gas power plants are preferable because their flue gas lacks certain contaminants found in coal fired plants. Algenol is also considering other CO_2 sources, such as steam methane reformers, fermentation based CO_2 and fertilizer plants.

Algenol already has considerable experience and expertise with carbon capture and utilization. For example, a portion of a US Department of Energy grant Algenol received was dedicated to a project with the National Renewable Energy Laboratory to study the effects on algae from several simulated versions of flue gas with differing levels of purity and potential contaminants. A strategic relationship with a leading engineering firm has been leveraged on technical issues related to both upstream and downstream elements of deploying the technology. These collaborative efforts focused on process engineering and modeling for gas management, product separation and CO_2 management. As well, collaborations with Georgia Institute of Technology's Strategic Energy Institute have focused on publishing a life cycle analysis of the Algenol process and technical innovations with respect to CO_2 management and delivery, gas management in working cultures and downstream separations technologies.

The cost of CO_2 recovery/delivery and the overall "wells to wheels" lifecycle analysis of the CO_2 consumed have been the primary focus of these efforts. Algenol's scientists and engineers, along with consultants and our strategic partners, have studied post-combustion CO_2 capture and utilization from power plants, and have estimates of CO_2 delivery costs in the context of deploying our technology. Data developed with, or provided by, strategic partners suggest carbon capture technologies exist today that would be compatible and economical for a Direct to Ethanol® project. Further reductions in CO_2 capture cost may be achieved by utilizing technologies being developed, such as using advanced membrane processes, which remove the need to reverse chemical interactions between CO_2 and a solvent.

The environmental benefits of Direct to Ethanol® technology extend beyond CO_2 considerations. Our algae are grown in saltwater in closed photobioreactor systems and the downstream processing and refining of ethanol produces freshwater as a byproduct. As well, deployment of commercial facilities will take place on marginal land that is not suitable for other types of agriculture. Most importantly, utilizing fuels produced with Algenol's technology will displace petroleum based fuels, the sources of which, like the tar sands, are major sources of CO_2 emissions.

Blending or otherwise utilizing biofuels at the highest levels possible will drive demand and support Algenol's construction of significant capacity. As well, ethanol's high octane content offers benefits for meeting CAFÉ standards. High compression engines designed for higher ethanol blends are lighter and smaller. Increased deployment of the infrastructure necessary for higher blends of biofuels should be a focus for Congress in order to continue the success of RFS.

Algenol's Direct to Ethanol® Technology, Current Operations and Commercialization

Algenol's Direct to Ethanol® technology takes a holistic approach to sustainable biofuel production. The heart of the process lies within genetically enhanced cyanobacteria that convert CO_2 into high carbon fuels: typically one tonne of CO_2 will produce approximately 131 gallons of ethanol and 14 gallons of biodiesel or jet fuel. The cyanobacteria are grown in saltwater using proprietary photobioreactors on non-arable land (Fig. 1). Over-expression of genes for intracellular fermentation pathway enzymes in the cyanobacteria enables ethanol production rates that are vastly superior to other biofuel technologies. After the ethanol process is complete, the waste algae are converted into diesel and jet fuels by hydrothermal liquefaction and traditional refining. The high photosynthetic efficiency in these enhanced organisms for both ethanol and biomass production leads to correspondingly high product concentrations, making dewatering and ethanol purification less challenging.

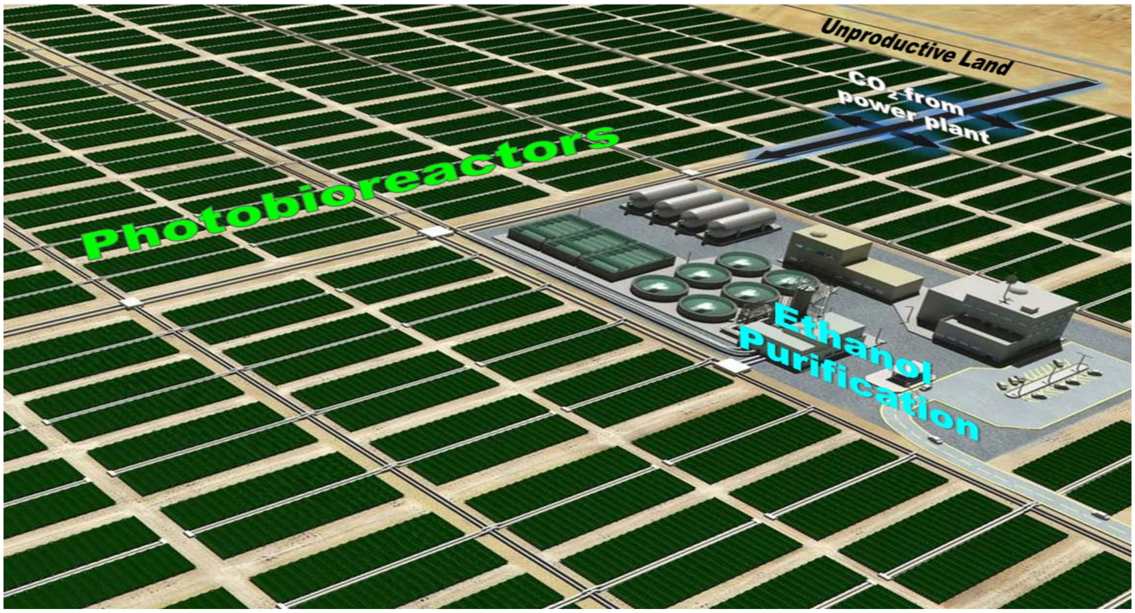

Figure 1: Conceptual overview of Algenol Direct to Ethanol® integrated biorefinery

Currently, our ethanol productivity rates exceed 9,000 gallons of ethanol per acre-year (gepay) at our 36-acre IBR located in Ft. Myers, FL, which is part of our commercial development campus that also includes a four-acre process development unit and 60,000 square feet of laboratory and office space. Algenol is targeting the commercial production of ethanol at or below operating expenses of $1.20 per gallon. Overall, Algenol's goal is to drive operating expenses below $1.00 per gallon. CO_2 cost is an important contributor to operating expenses as we assume that we will pay a negotiated price per tonne of CO_2 delivered. A published analysis of Direct-to-Ethanol® technology indicates a lifecycle greenhouse gas reduction of 60-80% vs. gasoline.[1]

In 2013 Algenol is focused on operating the IBR to continue demonstrating the commercial viability of the technology and, on a parallel path, evaluating potential sites for a first commercial project. Florida is first among a variety of locations worldwide that are being considered for such a project. Permitting, engineering and other pre-production activities will begin in early 2014 once a site is selected and production is expected to begin near the end of 2014 or the beginning of 2015. Economies of scale for the technology are achieved at 1,500 -

[1] Dexin Luo, Zushou Hu, Dong Gu Choi, Valerie M. Thomas, Matthew J. Fealff, Ronald R. Chance "Life Cycle Energy and Greenhouse Gas Emissions for an Ethanol Production Process Based on Blue-Green Algae," *Environmental Science & Technology* 44, No. 22 (2010).

2,000 acres; therefore, larger projects in the future will essentially consist of replicating 1,500 - 2,000 acre facilities over the available land. Peak rates of ethanol production have exceeded 9,000 gepay and our target has become 10,000 gepay. A 2,000 acre facility will produce approximately 20 million gallons of ethanol and 1.7 million gallons of biodiesel annually from 155,000 tonnes of CO_2. Algenol's goal is to be producing 20 billion gallons of fuel per year using our technology in 20 years.

RFS is a critical policy for a variety of positive economic and environmental considerations and long term stability of the program is essential for its continued success. Congress should continue to let this good policy work as Algenol initiates commercial deployment building on RFS's success to date.

***

May 23, 2013

The Honorable Fred Upton
Chairman
House Energy and Commerce Committee
2125 Rayburn House Office Building
Washington, DC 20515

The Honorable Henry Waxman
Ranking Member
House Energy and Commerce Committee
2125 Rayburn House Office Building
Washington, DC 20515

Dear Chairman Upton and Ranking Member Waxman:

On behalf of the 600 members of the American Coalition for Ethanol (ACE), I appreciate the opportunity to comment on the Committee's third Renewable Fuel Standard (RFS) White Paper, this time focusing on "Greenhouse Gas Emissions and other Environmental Impacts."

ACE was founded in 1987 by advocates who believed ethanol would revitalize rural America by enabling farmers sustainably harness resources to help reduce U.S. dependence on foreign oil. Today ACE includes farmers, ethanol producers, Main Street businesses, science and technology firms, engineers and manufacturers, and industry suppliers who have stood shoulder to shoulder to innovate and grow the domestic ethanol industry in communities throughout the U.S.

With respect to impacts on our environment, petroleum represents the most harmful and dangerous source of transportation fuel while renewable fuels such as ethanol represent the safest. Recent crude oil spills have killed fish, animals, and plant life. Ethanol, on the other hand, is derived from plant life and ethanol coproducts are fed to fish and livestock. At the same time ethanol's lifecycle greenhouse gas (GHG) emissions and production efficiencies are dramatically improving, extracting and processing crude oil into gasoline is becoming more expensive, inefficient, and destructive to the environment.

We appreciate the opportunity to explain how the RFS is a classic American success story, delivering clean air, environmental, and octane benefits. Below please find our responses to your questions.

Sincerely,

Brian Jennings, Executive Vice President
American Coalition for Ethanol (ACE)

1. Is the RFS reducing greenhouse gas emissions below that of baseline petroleum-derived fuels? Is the RFS incentivizing the development of a new generation of lower greenhouse gas emitting fuels? Will the RFS produce further greenhouse gas emissions reductions when it is fully implemented?
The RFS and use of renewable fuels such as ethanol is helping reduce lifecycle greenhouse gas (GHG) emissions below baseline petroleum. Prior to enactment of the first RFS in 2005, ethanol use approached 4 billion gallons. This year, under the RFS, U.S. ethanol use is expected to reach more than 13 billion gallons. According to peer reviewed data published in the *Journal of Industrial Ecology*, ethanol reduces GHGs compared to petroleum by as much as 48 to 59 percent.[1]

As the Committee knows, EPA must determine that conventional biofuel reduces lifecycle GHGs by at least 20 percent compared to baseline petroleum, that advanced biofuel reduced GHGs by at least 50 percent, and that cellulosic biofuel reduces GHGs by at least 60 percent.

It's important for the Committee to recognize that today's so-called "baseline petroleum" isn't the same petroleum biofuels are compared to under EISA. EISA requires biofuel lifecycle GHG emissions to be compared to U.S. average petroleum use in 2005. Today, the U.S. is significantly more reliant on Tar Sands and tight oil, both of which are much more carbon-intensive and harmful to the environment than oil use in 2005.[2]

The RFS is absolutely providing the market signals for investment and innovation in cellulosic and advanced biofuels that, according to lifecycle GHG calculations by EPA and others, will reduce GHGs even further. One example is the use of grain sorghum as a feedstock at ethanol facilities, which EPA has determined will reduce lifecycle GHG emissions by at least 50 percent when coupled with cogeneration for heat and power. Plants are gearing up to generate advanced biofuel under this pathway in 2013.[3] Still additional progress is being made with respect to the construction and start-up of cellulosic biofuel facilities, as cited in a recent report by the Advanced Ethanol Council.[4]

EPA estimates that full implementation of the RFS in 2022 will result in a 138 million metric ton reduction on GHG emissions.

2. Could EPA's methodology for calculating lifecycle greenhouse gas emissions be improved, including its treatment of indirect land use changes? If so, how?

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[1] Liska, Adam J.; Yang, Haishun S.; Bremer, Virgil R.; Klopfenstein, Terry J.; Walters, Daniel T.; Erickson, Galen; and Cassman, Kenneth G., "Improvements in Life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn-Ethanol" (2009). Published in *Journal of Industrial Ecology* (2009); doi 10.1111/j.1530-9290.2008.00105.x http://www3.interscience.wiley.com/journal/121647166/abstract. Published online January 21, 2009.

[2] Huot, Marc, and Grant, Jennifer. PEMBINA Institute,"Clearing the Air on Oilsands Emissions" http://www.pembina.org/pub/2393

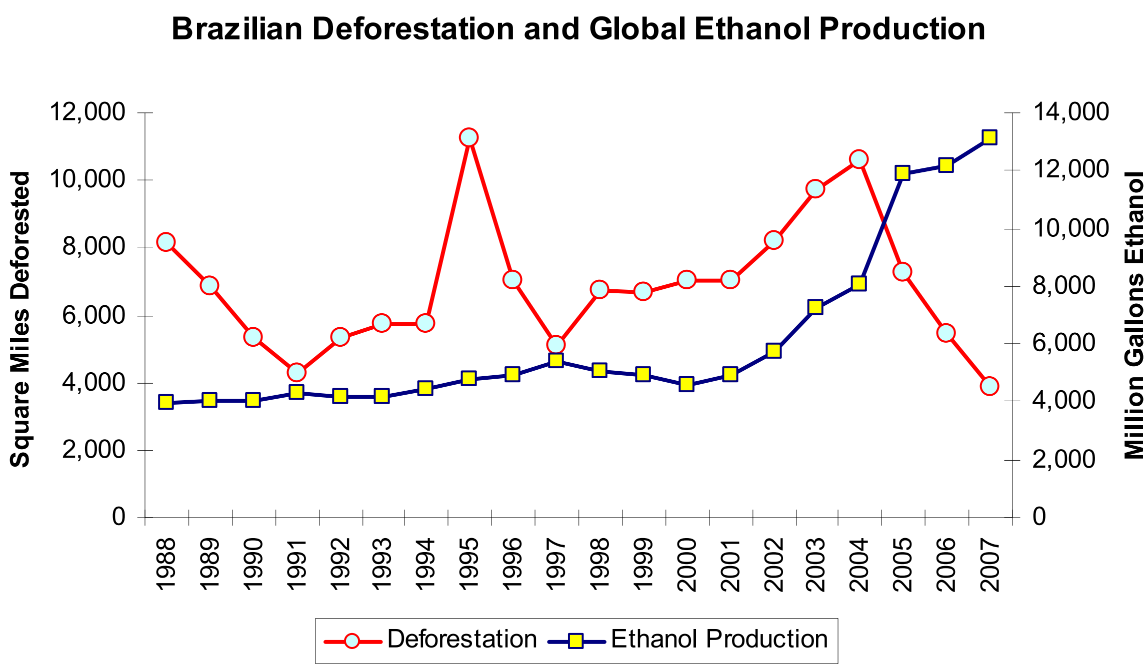
[3] EPA Final Rule, Supplemental Determination for Renewable Fuels Produced Under the Final RFS2 Program From Grain Sorghum http://www.gpo.gov/fdsys/pkg/FR-2012-12-17/pdf/2012-30100.pdf

[4] Cellulosic Biofuels Progress Report 2012-2013, Advanced Ethanol Council. http://ethanolrfa.3cdn.net/d9d44cd750f32071c6_h2m6vaik3.pdf

ACE does not support action by this Committee or Congress to open or modify the statue to amend the RFS. While we have serious objections to so-called indirect or international land use changes (ILUCs), which we articulate below, we also believe EPA has sufficient authority to review and improve its modeling of lifecycle GHG emissions related to renewable fuels.

ILUCs are relatively new, unreliable, and controversial computer-generated predictions that are being selectively applied to renewable fuels in the RFS. The theory is that if more corn is used for ethanol in the U.S., somehow less corn is available for livestock feed rations, causing land owners literally halfway around the world to plow grasslands or slash rainforests to plant soybeans to replace the "lost" opportunity to feed the corn used for ethanol. In reality, ethanol is distilled from just one-third of a bushel of corn, the starch, and another one-third of that corn bushel, the fat, fiber, and protein, is processed into a high-protein source of feed, a coproduct of the ethanol production process called distillers grains. This distillers animal feed product has proven to successfully replace corn and soybean meal in livestock feed rations, therefore mitigating the need to expand the global crop base.

To illustrate that ILUC models predict an outcome that in fact does not occur, it is instructive to review deforestation rates in Brazil. Real-world data shows that deforestation of the Amazon Rainforest actually declined from 2004-2007, the same period of time in which U.S. ethanol production enjoyed its most aggressive compounded average growth rate under the RFS.



Sources: IEA; Butler, Mongabay.com (FAO, NISR).

In a 2008 effort to better understand lifecycle analysis and indirect effects, ACE commissioned a study by Global Insight entitled "Lifecycle Analysis of Greenhouse Gas Emissions Associated with Starch-based Ethanol." Key findings from that report include:

- Changes in land use have always occurred and are not new, nor are biofuels the primary driver of them. Global population growth cannot be ignored as a factor.

- The scientific literature available to date shows a huge variation in estimates of carbon release from land clearing in general, on the order of 50 percent plus or minus – a huge margin of error that should not be relied upon to make policy.
- *If* some land use change is due to increased biofuels production, the overriding challenge is to quantify which changes can indeed be directly attributed to biofuels.
- If the indirect GHG emissions of biofuels are counted toward the carbon footprint, so should be the indirect emissions associated with petroleum production.

According to the study, it is virtually impossible to accurately ascribe greenhouse gas impacts to biofuels based on indirect land use change. The report also discusses how technology innovations are making both corn and ethanol production more efficient and carbon-friendly, developments that have not been captured nor quantified adequately in measuring the carbon intensity of future sources of biofuels against future sources of petroleum.

ACE believes that if proper credit is provided to distillers grains (DDGs) co-products, which replace the need for corn and soybean meal in livestock feed, and if increased corn yields are considered, the 15 billion gallons of corn ethanol called for under RFS2 can be produced without any global land use penalties. Dr. Jerry Shurson, professor of Animal Science at the University of Minnesota, has also pointed out the lack of attention and understanding given to the use of DDGs in animal feeds. He and USDA now both report that one metric ton of DDGs replaces 1.22 to 1.24 metric tons of corn and soybean meal in livestock feed rations.[5] In other words, because ethanol production simply borrows the starch portion of the corn kernel to make ethanol, the remaining protein and nutrients in the corn kernel are concentrated in such a way that a resulting metric ton of DDGs replaces more than one metric ton of corn and soybean meal in feed rations. This shows that the RFS helps make more feed, and food, available without indirect land use changes.

ACE believes there is insufficient scientific consensus and real-world data of so-called ILUC effects to apply them to biofuels. That said, as scientists and economists try to develop more credible models and boundaries regarding what should and should not count as a carbon penalty, and as corn and ethanol production become more efficient, even with an ILUC penalty the carbon intensity for corn-based ethanol will continue to improve. We encourage EPA to monitor and update assumptions surrounding corn-based ethanol as doing so will show increased reductions in GHG emissions compared to petroleum.

Finally, trending sources of petroleum have appreciable indirect effects due to the expenditures in energy made annually by the U.S. military to protect oil supplies and transportation routes around the world, as well as land use effects and energy-intensive extraction methods (i.e. Alberta Tar Sands Oil). To ignore these petroleum-related indirect effects means that the comparison of emissions from biofuels versus petroleum is misleading. While attention has turned in recent months to "new" sources of oil in North America, such as Alberta Tar Sands or "tight oil" found in the Bakken Shale Oil Formation in North Dakota and surrounding states, it is only fair that the indirect effects associated with increased U.S. reliance of petroleum from these sources should be calculated.

[5] October 2011 USDA-ERS Report "Estimating the Substitution of Distillers' Grains for Corn and Soybean Meal in the U.S. Feed Complex" http://www.ers.usda.gov/media/236568/fds11i01_2_.pdf

3. Is the definition of renewable biomass adequate to protect against unintended environmental consequences? If not, how should it be modified?

The definition of renewable biomass included in the RFS is one of the more complex and idiosyncratic definitions on the subject in federal law as it was crafted in large part to prevent the use of many viable biofuel feedstocks. We believe that the definition is more than adequately protecting against "unintended environmental consequences" and is requiring many advanced and cellulosic companies to work diligently with EPA to fully understand what is and is not a permissible feedstock under the definition as they develop projects. There is no need to statutorily modify the definition to further restrict feedstock eligibility as it would only further burden the commercialization of many advanced and cellulosic projects.

4. What are the non-greenhouse gas impacts of the RFS on the environment relative to a comparable volume of petroleum-derived fuels? Is there evidence of a need for air quality regulations to mitigate any adverse impacts of the RFS?

There is no credible scientific debate whether ethanol and other renewable fuels are better for the environment than petroleum and there is no evidence that the RFS is leading to adverse environmental impacts.

Conversely, there is substantial evidence on the harmful consequences of fossil fuels, from the deadly impacts that recent crude oil spills have had on animal and plant life to the damaging impact the combustion of fossil fuels has on the environment, climate change, and public health. Indeed, one rationale for the RFS and GHG thresholds contained in the law is in response to the damage fossil fuel does to our environment.

What is often overlooked, however, are the non-GHG impacts of fossil fuels, such as public health impacts. Columbia University published a report entitled, "Children are likely to suffer most from our fossil fuel addiction" in the August 2008 edition of *Environmental Health Perspectives*[6] indicating the periods of fetal and child development represent the stages of greatest vulnerability to the dual impacts of fossil fuel combustion: the multiple toxic effects of emitted pollutants (polycyclic aromatic hydrocarbons, particles, sulfur oxides, nitrogen oxides, metals) and the broad health impacts of global climate change attributable in large part to carbon dioxide released by fossil fuel burning.

Combustion of fossil fuels also likely contribute to an array of cardiac and pulmonary health risks, according to research.[7]

5. Has implementation of the RFS revealed any environmental challenges or benefits not fully anticipated in the statute?

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[6] Perera, Frederica, Columbia University. Children Are Likely to Suffer Most from Our Fossil Fuel Addiction. *Environmental Health Perspectives.* Environ Health Perspect. 2008 August; 116(8): 987–990. Published online 2008 April 17. doi: 10.1289/ehp.11173 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2516589/

[7] Doug Brugge, John L. Durant, and Christine Rioux. Near-highway pollutants in motor vehicle exhaust: A review of epidemiologic evidence of cardiac and pulmonary health risks. Published: 9 August 2007, *Environmental Health* - 2007, 6:23 doi:10.1186/1476-069X-6-23 Received: 2 January 2007Accepted: 9 August 2007. http://www.scribd.com/doc/925849/NearHighway-Pollutants-in-Motor-Vehicle-Exhaust-a-Review-Of

It is unmistakable that the RFS has led to benefits not fully anticipated by the statue, such as crop genetic advancements and other biotechnology innovations, increased crop yields, and improved farming practices and conservation.

The RFS provides a market-based incentive for scientists and farmers to innovate – delivering nearly 20 bushels of more corn on an acre of existing land than before the RFS. Over the last several years improvements in corn yield have corresponded with increased ethanol production under the RFS. Moreover, a body of emerging data indicates that since enactment of the RFS, corn yields and farming practices have advanced to capture more soil organic carbon which improves corn ethanol's lifecycle GHG emissions[8]. Some of this data presents unanticipated results. For example, a study comparing soil carbon sequestration between switchgrass and no-till corn found that no-till corn sequestered 30 percent more soil organic carbon than switchgrass. The study authors hypothesize the difference is likely because corn is an annual plant, its root system breaks down each year and builds the soil profile with carbon, whereas switchgrass, as a perennial plant, does not.[9]

The RFS has also spurred breakthroughs in biotechnology and engineering that are reshaping the American marketplace. Developments in pretreatment technologies for advanced and cellulosic biofuel, enzymatic hydrolysis, fermentation, microbes, syngas, and more are creating new industries such as renewable chemistry, bioplastics, precision agriculture, and energy crops.

6. What is the optimal percentage of ethanol in gasoline?

If Congress allows the RFS to remain intact, one of its most important market-based benefits for consumers will be to empower them to choose the blend of ethanol and gasoline that works best in their vehicles. This is particularly true as more blender pumps are installed at retail stations which enable consumers to make the choice between straight gasoline and ethanol blends such as E10, E15, E20, E30, or E85. (However, it should be noted that blender pumps are not necessary for E15, existing pumps will dispense E15 safely.)

ACE has commissioned studies to investigate the optimal blend of ethanol in gasoline, and much of the scientific and anecdotal evidence from this works seems to indicate there is a particularly beneficial mileage and emissions benefit from a 30 percent blend of ethanol.[10] Still other scientific research has

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[8] Corn Yields and No-Tillage Affects Carbon Sequestration and Carbon Footprints David E. Clay, Jiyul Chang, Sharon A. Clay, James Stone, Ronald H. Gelderman, Gregg C. Carlson, Kurtis Reitsma, Marcus Jones, Larry Janssen, and Thomas Schumacher https://www.agronomy.org/publications/aj/abstracts/104/3/763

[9] Soil Carbon Sequestration by Switchgrass and No-Till Maize Grown for Bioenergy. Ronald F. Follett, Kenneth P. Vogel, Gary E. Varvel, Robert B. Mitchell & John Kimble BioEnergy Research ISSN 1939-1234, Vol. 5, No. 4, Bioenerg. Res. (2012) 5:866-875 DOI 10.1007/s12155-012-9198-y.
http://link.springer.com/article/10.1007%2Fs12155-012-9198-y#page-1

[10] Optimal Blend Level Investigation, 2007, American Coalition for Ethanol, U.S. Department of Energy, and University of North Dakota Energy and Environment Research Center.
http://www.ethanol.org/pdf/contentmgmt/ACE_Optimal_Ethanol_Blend_Level_Study_final_12507.pdf
Fuel Economy Study, 2005, American Coalition for Ethanol
http://www.ethanol.org/pdf/contentmgmt/ACEFuelEconomyStudy_001.pdf

been conducted which underscores the benefits of a blend of approximately E30 from a fuel economy and emissions standpoint.

Perhaps the greatest value proposition ethanol offers the internal combustion engine is clean and affordable octane. In addition to reducing lifecycle GHGs compared to gasoline, ethanol is a high-octane, clean-burning fuel that removes toxic particulate matter from tailpipe emissions. There are two principle ways to boost octane in internal combustion engines today. One way is to add more ethanol to motor fuel. The other is to increase the use of petroleum-based aromatic compounds in motor fuel. Aromatics such as benzene, toluene, and xylene are considered hazardous air pollutants and are the most expensive ingredients in gasoline today. Increasing aromatics does nothing to reduce our nation's reliance on petroleum and only causes more air pollution.

A recent *New York Times* article discussed how technical and automotive experts believe ethanol's octane is an important benefit largely overlooked, but that allowing automakers to certify their vehicles on E30 could improve fuel economy and reduce tailpipe emissions.[11]

In a recent interview published by *Car and Driver Magazine*, William H. Woebkenberg, senior engineer for fuels policy in the U.S. for Mercedes-Benz said, "Due to the higher octane easily obtainable with E30, an engine's design and operating parameters are not knock-limited. You can crank up the compression and alter the spark timing to take advantage of the fuel's properties. Although it has less volumetric energy, you can counteract that effect in blends with 30 percent ethanol. With E30, we can also take advantage of its high latent-heat properties – an advantage not necessarily reflected in octane ratings – to guarantee proper catalyst function by ensuring the exhaust arrives at the catalyst at the ideal temperature for maximum scrubbing benefit."[12]

ACE believes that the science shows that clean octane from higher ethanol blends (for example E30) helps automakers meet the new GHG-CAFE standard requirements without any of the negative air quality impacts associated with increasing aromatics. No changes are necessary to the RFS at this time to enable consumers and automakers to take advantage of the octane benefits of ethanol and we continue to engage with automakers on ways that ethanol and ethanol's octane can help them comply with the GHG-CAFE requirements.

7. What are the best options for substantially further reducing greenhouse gas emissions from the transportation sector? Is the RFS an important component of such efforts?

The combination of the RFS, 2017-2025 GHG-CAFE standards, and potential Tier III fuel standards being proposed by EPA together make up the best option for substantially further reducing GHG emissions from the transportation sector because they will result in the use of higher blends of ethanol.

These higher ethanol blends will replace the marginal gallon of petroleum (that has significantly higher GHG emissions) and are much more practical in the near term than electric cars (powered by coal and

[11] Wald, Matthew. "Squeezing more from ethanol." *New York Times*. May 3, 2013. http://www.nytimes.com/2013/05/05/automobiles/squeezing-more-from-ethanol.html?_r=0

[12] Wendler, Andrew. "EPA's low-sulfur fuel proposal a mixed bag for refineries, manufacturers. May 16, 2013. http://blog.caranddriver.com/epas-low-sulfur-fuel-proposal-a-mixed-bag-for-refineries-manufacturers/

natural gas) and LNG vehicles that also have significant infrastructure issues. The RFS wasn't enacted to make oil companies more comfortable or to reward them for damaging the environment, it was enacted to reduce U.S. fossil fuel use. Likewise, GHG-CAFE requirements and proposed Tier III standards help signal to oil companies and automakers that future vehicle technologies will need to be capable of taking advantage of ethanol's clean octane and the many other benefits that ethanol-blended fuels have to offer.

RESPONSE TO HOUSE ENERGY & COMMERCE STAKEHOLDER QUESTIONS

PREFACE: We have reviewed two sets of draft comments in response to the questions sent out by your committee in the form of a White Paper. Consequently, we thought it would not be helpful to simply rephrase the answers you will be likely be receiving from many sources, but have instead attempted herein to provide a more complete picture of the ethanol industry and issues at hand. This document is our attempt to fill in the blanks about the ways in which the ethanol industries of the future may look, and to cover points not likely to surface in the comments of others.

Overview

Biofuels reduce our dependence on oil, stimulate our economy, create jobs, enhance our national security, reduce greenhouse gas emissions, enhance our environments and help put us on the path to sustainability. From an economic standpoint, the U.S. ethanol industry stimulates our local economy to grow and prosper by keeping U.S. dollars circulating within, thus supporting American communities. In 2007, the U.S. reduced $50 billion[1] in petroleum fuel costs by blending in ethanol instead, and this number has increased as more and more ethanol is included in our fuel supply. Since the advent of the Renewable Fuels Standard (RFS) in 2005[2], there has been active discussion as to whether the EPA should adjust the mandates outlined in the RFS. This short paper will identify key areas, not well understood, in which biofuels can be advanced as solutions for some of the problems being debated.

1) Food vs. Fuel – A Propaganda Machine

The food vs. fuel debate has taken center stage over whether corn ethanol should be a promoted asset in our diverse energy portfolio. Contrary to common belief, the use of corn in ethanol for fuel does not impact the price of food at the supermarket[3]; in fact, the greatest impact on food prices comes from the fluctuation of oil (due, in part, to transportation costs)[4]. Up until the year 2000, ethanol production only gradually increased to about 2 billion gallons/year. With the passing of the Renewable Fuels Standard in 2005, production has exponentially increased to

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[1] Goldemberg, J. (2007). Ethanol for a sustainable energy future. *Science*,*315*(5813), 808-810.
[2] Bipartisan Policy Center, (2013). *America's energy resurgence: Sustaining success, confronting challenges*. Retrieved from Bipartisan Policy Center website: http://bipartisanpolicy.org/sites/default/files/BPC SEPI Energy Report 2013.pdf
[3] Holmberg, W. 2013. "Corn-Based Ethanol: A Win for Public Health and the Economy" *Physicians for Social Responsibility*.
[4] Dineen, Bob, (2013, May). Eat This! *Ethanol Producer Magazine*. Retrieved from http://ethanolproducer.com/articles/9864/eat-this

nearly 14 billion gallons in 2011[2]. At the same time, with only a few spikes, annual food inflation has dropped from 9.0% in 1980 to nearly 2.3% in 2012[4], essentially rendering the food and corn argument moot. U.S. Ethanol production accounted for just 3% of the grain supply leaving 97% of all grain produced in the world available for other uses.[5]

Additionally, the U.S. drought in 2012 led to increased corn production worldwide. This was due to the elimination of U.S. corn subsidies because of ethanol's impact on rising corn prices above the subsidy level, thus making world corn plantings profitable by aligning them with free market forces. Consequently, worldwide production of corn in 2012 was similar to 2011, even with a serious drop in U.S, drought ridden corn production[6].

It is also important to recognize that about 95% of the U.S. corn field crop goes into the animal (beef, dairy cows, pork, and poultry) feeding and ethanol industries. In the ethanol conversion process, only the starch is removed to make ethanol. All the protein, oil, fiber and nutrients go into distillers grains, a recognized high quality animal feed. It is noteworthy that the protein from an acre of corn, with the starch removed, is roughly the same amount of protein that comes from an acre of soybeans at comparable costs. The resulting ethanol is an extra dividend. Since most corn farmers rotate their crops with soybeans, they have flexibility in their choice of plantings based on prices, soil and weather conditions.

2) Misconceptions of Corn-Based Agriculture

It is vitally important to identify some of the unique structures and mechanics of corn that makes it the most effective crop to grow for ethanol fuel. Corn is a C4 plant, fixing carbon much more efficiently compared to other cellulosic organisms. Soil organic carbon is fixed by taking carbon dioxide from the atmosphere and turning it into organic (carbon-based) compounds. C4 plants are much more efficient at fixing carbon due to their ability to overcome the waste fixation of oxygen rather than carbon dioxide into the soil. Less than 1% of plant species on the earth are characterized as being C4 plants[7], making corn distinguished and versatile.

Corn cultivation uses less water than a competitor crop such as soybeans, and a good deal less than natural gas operations which require extensive water use to extract non-renewable compounds from deep within in the earth in an unsustainable fashion. An alternative to

[5] Renewable Fuels Association. "Policy Positions: Food vs. Fuel." 2011.http://www.ethanolrfa.org/pages/policy-positions-food-vs-fuel

[6] United States Department of Agriculture, (2013, May). World Agricultural Supply and Demand Estimates. Retrieved from USDA website: http://www.usda.gov/oce/commodity/wasde/latest.pdf

[7] National Renewable Energy Lab Glossary. http://www.nrel.colostate.edu/projects/irc/public/Documents/Science/Glossary.htm

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traditional corn is the planting of dry-land corn for use in areas of depleted water supply because of its even greater efficiency utilizing water[8].

The mature root structure of corn allows its roots to bury deeper into the soil compared to soybeans, permitting corn to draw up more minerals from greater depths, enriching the soil in natural ways, reversing years of actually depleting these mined minerals for agriculture. This is particularly true with phosphorus that is becoming in short supply worldwide. Through corn's superior ability to entrench deeper into the ground, nitrogen and phosphorus are more effectively pulled up for the plants' growth, reducing the risk of the compounds becoming surface and groundwater contaminates. Corn's root systems also act as vast carbon sinks in which excess carbon can be fixed and sent into the soil as opposed to being released back out into the atmosphere as carbon dioxide as plant residues decompose[3].

3) Land Use and No-Till Farming – Future Farming Practices

Corn responds well to no-till farming. This is the practice of minimizing the disruption of soils thereby increasing the organic compounds within the soil from decaying matter.[9] No-till farming decreases the loss of water because water can stay locked in beneath the surface instead of being upturned and evaporated off. South Dakota State University's review of 25 years of soil sample documentation indicates that South Dakota farmer's reduced tillage practices, with no-till and high yielding corn dominant rotations, have increased soil organic matter[10.] No-till practices cut erosion by 98%, and corn's massive deep root systems protect ground water by up taking leached fertilizer nutrients and bringing them back to the surface. No-till includes over one third of US crop acres, and it is trending toward capturing half of US acres within the next ten years[11]. As aquifers continue to be depleted and drought conditions worsen in areas of the Midwest and Southwest United States, conservation of water by good stewardship practices will be increasingly important.

It is assumed by opponents that biofuel production in the U.S. displaces the growth of other crops, which are then grown in other parts of the world; this is known as the Indirect Land Use Concept (ILUC). However, the principles of this concept are shaky. Although corn ethanol production has jumped from 0.4 billion gallons in 1980 to 14 billion gallons in 2011[2], agricultural land use in the United States has decreased from 300 million acres in 1980 to around

[8] Norwood, C. A. (2000). Water use and yield of limited-irrigated and dryland corn. *Soil Science Society of America Journal*, *64*(1), 365-370.
[9] Carpenter-Boggs, L., Stahl, P. D., Lindstrom, M. J., & Schumacher, T. E. (2003). Soil microbial properties under permanent grass, conventional tillage, and no-till management in South Dakota. *Soil and Tillage Research*, *71*(1), 15-23.

240 million acres in 2012[10]. This increase in land productivity is due to better science and technologies for crop production and harvesting, and to the greater understanding of crop rotation and enzymatic breakthroughs leading to larger yields.

It is not a fantasy to envision future corn farming using genetically advanced seeds; no till and water conservation farming practices; modern electronically controlled planting, weed prevention and harvesting practices; constantly improving ethanol production facilities; advanced animal feeding, slaughtering, and total waste recovering capabilities; and, the application of these processed wastes back to the land that grew the corn as fertilizers -- as a scientific and technologically advanced methodology to restore the prairie-type nature of the Midwest.

There is a pending rebirth of industrial hemp that was one of the most important biomass crops during WWII along with the production of synthetic rubber from ethanol (produced over the opposition of Standard Oil of New Jersey).[11] Hemp was critical in the production of ropes used throughout the numerous fleets, parts of military uniforms and other WWII needs.[12] Hemp can produce a wide variety of products including biodiesel, ethanol, cosmetics, auto parts, etc. It can produce three times the amount of biomass per acre than corn and, being an annual crop, can be used in rotation with corn to reduce the use of a large range of pesticides and fertilizers. It also uses less water than other fiber crops.[12] There is considerable support within the Congress to legitimize the production of hemp to take advantage of this important crop with many beneficial uses including the production of ethanol.

4) Ethanol and Natural Gas – A Partnership

There is a natural environmental, energy security, climate change and synergistic relationship between ethanol and natural gas that can be driven by market forces. Natural gas as a transportation fuel is best suited for heavy duty, compression ignition engines (buses, trucks, etc.).[13] While ethanol is a superior fit for light duty spark-ignited engines like in most cars[14]. Furthermore, ethanol and a diesel type fuel can be made from national gas, and methane (CH_4 – is essentially natural gas) made from a large variety of biomass materials. Consequently, there is a strong rationality for a partnering relationship between natural gas and ethanol. As a team,

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[10] Glauber, J. W. (2013, February). Outlook for US Agriculture in 2013. In *Agricultural Outlook Forum 2013* (No. 148043). United States Department of Agriculture.
[11] Hemp for Victory. 1942. United States Dept. of Agriculture.
[12] Department of Energy, Baker et. Al. *Environmental Resources Letters.* Vol. 2.

[13] U.S. Department of Energy. Natural Gas Vehicles. Retrieved from Alternative Fuels Data Center website: http://www.afdc.energy.gov/vehicles/natural_gas.html
[14] U.S. Department of Energy. Flexible Fuel Vehicles. Retrieved from Alternative Fuels Data Center website: http://www.afdc.energy.gov/vehicles/flexible_fuel.html

over time, they can obviate the need for much of the oil in the transportation sector with major benefits for society, the environment and the world at large.

5) Aromatics for Gasoline Octane –An Unaffordable Human Health Cost

Harvard Scientists have estimated the health costs of aromatic compounds in petroleum-based gasoline to be in the range of $13.6 to $34.9 billion dollars in 2006. They also highlight that government modeling is underestimating the amount of secondary organic aerosol compounds (SOA) by a factor by 3-4 times[15]. Some of these health disorders include asthma, premature births, cancer, autism, heart disease, obesity and type II diabetes. Mounting scientific evidence suggests that they share a common linkage: they can be triggered by ubiquitous, nano-sized, particle-borne carcinogens known as PAHs (polycyclic aromatic hydrocarbons), the primary urban source of which is gasoline aromatic compounds used to enhance octane ratings. PAHs are not only carcinogenic and mutagenic, they are genotoxic, and one of the most pervasive and persistent endocrine disruptor compounds found in the urban environment. New research at Columbia University has also shown that exposure to PAHs can lead to several birth defects such as low birth weight, premature delivery, and heart malformations and even lower scores on IQ tests and increased behavioral problems in children.[16] The study also found that exposure to higher levels of PAH was associated with a 24% higher score of anxiety/depression.[16]

Experts worry that as advanced direct-injected, high compression/turbocharged engines are used to meet new fuel efficiency and carbon rules, urban PAH emissions will likely increase unless fuel quality is improved. When the medical costs associated with the PAHs' carcinogenic/mutagenic emissions are considered, higher quality ethanol gasoline blends could save Americans tens of billions per year in reduced health and energy costs, while also substantially reducing the transportation sector's carbon footprint and dramatically improving our quality of life[16], especially for urban youth and those who live near congested roadways.

Since the elimination of lead usage in the 1980s, petroleum refiners have synthesized gasoline aromatics from crude oil via an energy-intensive process. Aromatic compounds are frequently the most expensive components in gasoline, and their costs go up as crude oil prices rise. One piece of goods news: recent research by Ford Motor Co. and other experts has found that partially replacing carcinogenic aromatics with higher blends of ethanol (E-30, which is 30%

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[15] vonStacklelberg, K., Buonocore, J., Brave, P. V., & Schwartz, J. (2013). Public health impacts of secondary particulate formation from aromatic hydrocarbons in gasoline. *Environmental Health,12*(19), doi: 10.1186/1476-069X-12-19 (von Stacklelberg, Buonocore, Brave & Schwartz, 2013)

[16] Perera, F. P., Choi, H., Wang, L., Lin, X., & Spengler, J. D. (2012). Fetal Window of Vulnerability to Airborne Polycyclic Aromatic Hydrocarbons on Proportional Intrauterine Growth Restriction.

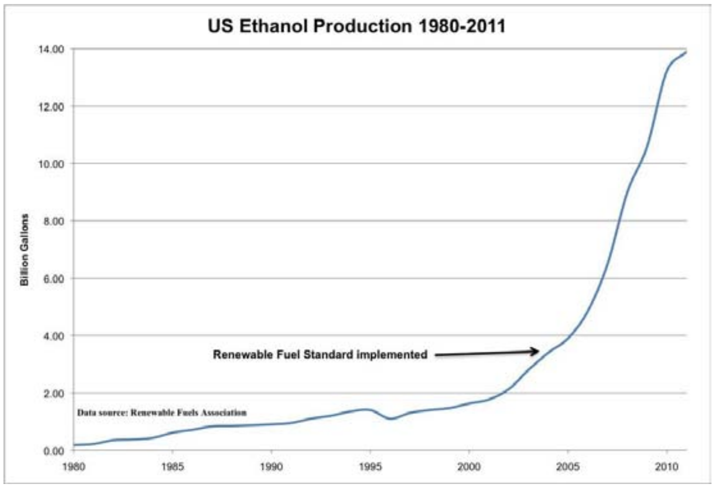
ethanol mixed with 70% gasoline)[17], could reduce particle-borne toxics and black carbon emissions by as much as 45% or more. Motorists would benefit from higher octane (94-plus, compared to 87 with today's 10% ethanol blends), better performance, and cleaner-burning fuels. This would also save money since ethanol is less expensive than aromatics from crude oil[6]. Even more good news: Congress instructed EPA to reduce gasoline aromatic levels to the greatest degree possible in the 1990 Clean Air Act Amendments, so new legislation is not needed. EPA could act to improve gasoline quality standards in the upcoming Tier 3 rulemaking later this year.

See Attached Harvard Study

6) Advanced Biofuels – A Long Road to Fruition

The United States is on the verge of producing 15 billion gallons of corn-based ethanol and launching a dynamic transition into the production of cellulosic and algae based ethanol reinforced by biodiesel and advanced biofuels[2]. As indicated in the following graph, the almost flat level of ethanol production started to move in about 1980, went linier in 1985 and exponential in 2005. There were several reasons for the leap forward: corn production up; increasing efficiencies in the ethanol refining industries and the construction of bigger ethanol plants, and passage of the RFS. Most importantly, the RFS encouraged financial investment in cellulosic and algae technologies and in the broad base of biofuels. In all probability, continuation of the RFS will continue to promote exponential growth of the ethanol production curve, with corn leading the way for a few years and cellulosics, algae, natural gas and others coming on line with minor future modifications to the RFS. EPA is already pursuing this path.

[17] Costagliola, M. A., De Simio, L., Iannaccone, S., & Prati, M. V. (2012). Combustion efficiency and engine out emissions of a SI engine fueled with alcohol/gasoline blends. *Applied Energy*.



Second-generation biofuels can supply a larger proportion of our fuel supply sustainably, affordably, and with greater environmental benefits. The goal of second generation biofuel processes is to increase the amount of these fuels that can be produced sustainably using biomass consisting of the residual non-food parts of current crops, such as stems, leaves and husks that are left behind once the food crop has been extracted, as well as other crops that are not used for food purposes (non-food crops –including "industrial" corn as discussed earlier), such as switchgrass, grass, jatropha, whole crop maize, miscanthus, industrial hemp, and cereals that bear little grain, as well as industry waste such as woodchips, skins and pulp from fruit pressing, municipal wastes, etc.[18] Importantly, algae and ocean-based biomass will be making major contributions to biofuels supplies. The by-products, when using many of these feed stocks, are lignin and other co-products, mostly valuable chemicals. Lignin can be burned as a carbon neutral fuel to produce heat and power for the processing plant and nearby markets as well as profitable byproducts.

Producing second generation biofuels offers greater greenhouse gas emissions savings than those obtained by first generation biofuels. Lignocellulosic and aquatic biomass biofuels can reduce greenhouse gas emissions by around 90% when compared with fossil petroleum; in contrast first generation biofuels offer savings of only 20-70%[19] at this stage in their development. Special interest groups are currently using difficulties facing commercialization of cellulosic production to their advantage by seeking passage of legislation that could cripple the biofuels industry.[20] If ethanol production remains capped at 10% of the total gasoline production

[18] Oliver R. Inderwildi, David A. King (2009). "Quo Vadis Biofuels". Energy & Environmental Science 2: 343.
[19] Concawe Well to Wheels LCA http://ies.jrc.ec.europa.eu/wtw.html.
[20] (2011). Corn harvest strategies for combined starch and cellulosic bioprocessing to ethanol. BCRL PUBLICATIONS, Retrieved from http://www.everythingbiomass.org/publications/93-journal-articles/136-corn-harveststrategies-for-combined-starch-and-cellulosic-bioprocessing-to-ethanol

in the United States, cellulosic ethanol and other biofuels will have little market for their production. If this continues to be the case, even with E-15 trickling into the market, it will be increasingly difficult to gain the finances necessary to meet the potential goals established by the RFS with its many benefits to the U.S. and the planet. With the onset of second generation biofuels , we will also move ahead with higher octane (93+), ethanol-based fuels, flexible fuel vehicles, more blender pumps, higher performance engines, much greater fuel economies and, an approaching end of oil dominance in the transportation market.

The Bipartisan Policy Center has shown that the lack of commercial cellulosic ethanol production was directly correlated to the deepest recession in the last 70 years[2]. This in turn reflected poorly on the impact of the RFS2 as amended in 2107. Now, however, the Energy Information Administration (EIA) has indicated that cellulosic output could grow from 20,000 gallons to more than 5 million gallons in 2013[21], as operations ramp up at several plants. Additionally, several more plants, with a proposed aggregate nameplate capacity of around 250 million, could begin production by 2015. It is in the best interest of the status quo-oriented oil industry to push legislation through Congress, capping the RFS before major production of advanced biofuels can get underway and gain market share.

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From the above conclusions, it is reasonable to infer that the RFS has been wise in its conception and successful in its implementation when considering the impact of the recession and the many difficulties of breaking through into new technological frontiers. The fact that these breakthroughs are occurring, and that we are well on our way to major reductions in oil dependencies with many economic, job creation, national and energy security, greenhouse gas reductions, environmental enhancement and a sustainable future benefits, is a major credit to the American system. These advancements and their continuing exponential gains reflect credit on two Presidents, George W. Bush and Barak Obama, the Congress, creative scientists and engineers, the auto industry and the American people. To turn back now, would be a multifaceted disaster in many ways, not the least of which would be a loss of leadership in one of the biggest industries in the world – the transportation fuels industry that sustains our economy and economic growth in many ways – vehicles, planes, boats, light and heavy equipment, roads, highways, bridges and infrastructures in general. We cannot turn back to oil dominance in all these areas.

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In summary, biofuels in its many forms, combined with natural gas (methane) in its many forms, can provide the United States of America with many advantages and extraordinary benefits in worldwide economic completion, prestige, and greenhouse reduction. We should not be denied these advantages.

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[21] U.S. Energy Information Administration. 26 Feb, 2013. “Today In Energy”. Retrieved from: http://www.eia.gov/todayinenergy/detail.cfm?id=10131

7) Looking to the Future

While there are many unknowns in speculating about the future, with the RFS, there are guidelines in place that will help shape our transportation fuel choices based on economics of the marketplace, preferences, job creation, national security, sustainability, climate change, human health and other environmental factors.

The RFS has proven its merits in setting parameters for these considerations. It must be continued; modifications may prove necessary, but adhering to the principles is vital to the future of the nation. Opponents of ethanol make their case by largely looking backwards, using data that is no longer pertinent to make their case. The Congress can be assured that advancing technologies will rapidly continue to produce ethanol, a never changing molecule that safely and cleanly powers internal combustion engines as well as meeting other energy requirements like stoves and lamps in the developing countries, all while better protecting the land. Further advances in these areas, including the use of starchy crops with residual protein to feed animals, could well be of considerable value in developing countries plagued by oil imports from distant lands

It is critical to recognize that the relatively recent, advances in biofuel productivity have occurred primarily due to passage of the RFS and other supportive legislation that has greatly expanded the market for ethanol in light duty vehicles as well as biodiesel and “drop-in” biofuels for jet engine aircraft. Weakening the RFS could well be a major economic, national security and political loss to the nation, threatening economic investments in the commercialization of biofuels, and allowing health hazards from aromatics to continue to sicken Americans. With a weaker RFS, the U.S. stands to lose its cutting edge advantage to other countries in Europe, Asia and in Brazil. Additionally, The leadership of the Department of Defense, in advancing 2nd generation biofuels to meet drop-in fuels requirement throughout the military services in order to reduce future costs and to ensure supplies throughout the world, has and will continue to be a powerful force in advancing the industry. The RFS is a vital underpinning of that strategy.

William C. Homberg Lt. Col., USMC (Ret.)

Biomass Coordinator

Advisory Council

American Council On Renewable Energy

American Forest & Paper Association

American Forest & Paper Association Comments on

House Energy and Commerce Committee

Renewable Fuel Standard Assessment

White Paper Number 3

Greenhouse Gas Emissions and Other Environmental Impacts

May 24, 2013

The American Forest & Paper Association (AF&PA) appreciates the opportunity to provide its views on Renewable Fuel Standard (RFS) Assessment White Paper Number 3, Greenhouse Gas Emissions and Other Environmental Impacts.

Introduction

The American Forest & Paper Association (AF&PA) serves to advance a sustainable U.S. pulp, paper, packaging, and wood products manufacturing industry through fact-based public policy and marketplace advocacy. AF&PA member companies make products essential for everyday life from renewable and recyclable resources and are committed to continuous improvement through the industry's sustainability initiative - *Better Practices, Better Planet 2020*. The forest products industry accounts for approximately 4.5 percent of the total U.S. manufacturing GDP, manufactures approximately $200 billion in products annually, and employs nearly 900,000 men and women. The industry meets a payroll of approximately $50 billion annually and is among the top 10 manufacturing sector employers in 47 states.

AF&PA member companies are leading the effort to increase our nation's energy supply by combining advanced technology and innovative manufacturing practices with responsible stewardship of our natural resources.

Industry's Responsible and Efficient Biomass Use

The forest products industry is the largest producer and user of bioenergy of any industrial sector and has long-standing operations in the United States, accounting for 62 percent of the renewable biomass energy produced by all manufacturing facilities in all sectors. In fact, on average, approximately 65 percent of the energy used at AF&PA member pulp and paper mills, and 77 percent of the energy from our wood products facilities is generated from carbon-neutral biomass. The creation and use of biomass energy in forest products mills is integral and incidental to the manufacture of products such as pulp, paper, packaging, and wood products. Pulp mills, integrated pulp and paper mills, and wood products mills convert biomass residues to energy while manufacturing bio-based products that are useful to society. The forest products industry has created a highly efficient, market-based system of managed forest use with significant carbon benefits including:

- providing biomass power by utilizing forest and mill residues;
- efficiently using biomass residuals through combined heat and power (CHP) systems
- reducing the industry's and our nation's reliance on fossil fuels, contributing to improved U.S. energy security and reducing GHG emissions while simultaneously meeting society's needs for forest products;
- reducing potential GHG emissions that otherwise would result from residue disposal (e.g., methane from decomposition);
- balancing forest supply and demand through market-based systems for biomass from trees due to forest planting and re-growth, as evidenced by net increases in forest carbon stocks over most of the last 50 years; and
- robustly recycling paper to reuse valuable biomass resources (In 2012, 65.1 percent of all paper consumed in the U.S. was recovered for recycling, nearly doubling our rate of paper recovery since 1990.)

A study performed by RISI and commissioned by AF&PA found that for a given volume of wood consumption, the forest products industry sustains 5 times as many core jobs (i.e., mill jobs) and 9 times as many total jobs (includes logging, paper converting jobs, and downstream wood processing jobs) as the energy sector.

Since 1995, AF&PA members must adhere to sustainable forest management practices if they own land and sustainable procurement practices if they obtain fiber from the forest. Our historic commitment to renewable energy and sustainable forest management demonstrates that a balance between the two is both possible and necessary.

AF&PA Position on Mandates and Incentives

AF&PA believes market forces, not government mandates and incentives, should determine the use of wood and wood residuals for renewable energy. Where state or federal governments institute incentives or mandates for renewable energy, those policies must treat existing industry energy generation from biomass equally with newly created renewable energy generation, promote sustainable forest management, and provide incentives for reliable and affordable regional fiber supplies. These incentives would encourage an increased supply of trees to keep pace with increasing demands on the resource.

This is of particular concern where policies impose mandates or provide subsidies that will have the effect of distorting markets over the long term—making potential adverse impacts even more severe because of their long duration. The RFS is an example of such a mandate, with its requirements for increasing amounts of cellulosic fuel, including a requirement for 16 billion gallons by 2022 and potentially more than that thereafter.

The Committee should recognize that we are in the unique position of relying on biomass to produce both higher value products and renewable energy. Indeed, trees remain the industry's highest production cost. The industry will not be able to competitively manufacture and sell its products in the global marketplace and realize its bioenergy potential if these costs increase significantly due to the increased demand placed on biomass as a result of the RFS mandate or an increased mandate for cellulosic biofuel.

The Forest Products Industry and its Future Contribution to the Nation's Biofuel Supply

While manufacturing the renewable and recyclable products consumers demand, and leading in the generation and use of renewable energy, we also have been active in research and development of biofuels and bio-based chemicals. Several AF&PA members are also members of the Agenda 2020 Technology Alliance, which is actively developing new technologies, some of which can be used to produce biofuels and bio-based chemicals from woody biomass, focusing on integrated biorefineries located at mill sites.

These projects, and the research supporting them, demonstrate that the industry can play a leading role in reducing greenhouse gas emissions, and helping the nation achieve its energy security objectives.

Response to Question #3 on Whether the Definition of Renewable Biomass is Adequate to Protect Against Unintended Environmental Consequence

We believe that the current law definition will lead to unintended economic as well as environmental consequences by intensifying the use of woody biomass for the production of cellulosic biofuel. These consequences would be exacerbated if the mandates for cellulosic biofuel were increased.

First, if woody biomass is used as the feedstock for producing cellulosic biofuel, the mandate for cellulosic biofuel is particularly concerning because it extends over a long term and it is a significant threat to the sustainability of our nation's forests, to jobs in the pulp, paper and wood products industry, and to the global competitiveness of our industry. The supply and demand for trees in this country is currently balanced. However, as indicated in an issue brief by Resources for the Future, if only trees are used to meet the mandate, the increases in cellulosic biofuels mandated by EISA will result in "a 60 percent increase in consumption of raw wood by 2022" or "71 percent of the 2005 harvest of 489 million" cubic meters.[1] Note that this analysis focuses solely on biofuels—not bio-based electricity, and does not factor in the cumulative impact of the other renewable energy or climate change mandates or goals. The thriving forest products industry in this country would be forced to compete with a mandate for its raw material.

Second, trees from federal land are effectively excluded from the definition, meaning all the trees that might be used as a feedstock must come from non-federal land.

Third, for non-federal land, the definition of "renewable biomass" generally covers only planted trees and slash from a tree plantation that was cleared at any time prior to December 19, 2007, and has been actively managed since that date. This definition focuses most biomass energy production in the South where there are viable markets in most areas for woody biomass. Thus, the definition in the RFS program will funnel these distortions onto the defined materials mostly in a limited area, causing undue negative environmental and economic pressures on the forest resource, in an area already using that resource to manufacture forest products and to support thousands of jobs.

While AF&PA generally supports a broad definition of biomass for determining what is considered renewable, we also support recognition that the RFS should not be mandating or incentivizing the diversion of large amounts of woody biomass away from existing use of these materials for wood, paper, and other bio-based products.

Finally, as stated in the White Paper, EPA has the authority to waive RFS requirements for one year if the Administrator finds there will be severe harm to the economy or environment of a state, a region, or the United States. We believe that EPA should make liberal use of this authority when a credible case has been made demonstrating economic or environmental harm, and should not impose unreasonable burdens on petitioners seeking such a waiver.

[1] *The Implications of Increased Use of Wood for Biofuel Production*, Roger A. Sedjo and Brent Sohnegen, Resources for the Future, April 2009). www.rff.org/RFF/Documents/RFF-IB-09-04.pdf

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The Honorable Fred Upton
Chairman
Committee on Energy and Commerce
House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

The Honorable Henry Waxman
Ranking Member
Committee on Energy and Commerce
House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515

Dear Chairman Upton and Ranking Member Waxman,

The American Petroleum Institute (API) appreciates the opportunity to respond to your questions in the House Committee on Energy and Commerce white paper examining the greenhouse gas (GHG) emissions and other environmental impacts associated with the Renewable Fuel Standard (RFS).

For reasons explained below, the RFS failed to deliver the GHG, environmental, and other benefits envisioned by the Energy Independence and Security Act (EISA) of 2007. The RFS has not unfolded as expected, and we agree that several implementation challenges have emerged that received little, if any, consideration prior to passage of EISA. The life-cycle impacts of biofuels on air quality, water, and land were not fully comprehended at the time when the law passed. There is insufficient supply of domestic advanced biofuels, including cellulosic biofuel, and the approaching blendwall could result in severe fuel supply disruptions in the U.S.[1] Meanwhile, the overall energy landscape has changed dramatically. Thanks to technology advances, our nation's energy security is enhanced significantly. According to EIA, U.S. crude and natural gas reserves in year 2022 are projected to be, respectively, 23% and 62% higher than what was projected in 2007. The House Energy and Commerce Committee's review is timely. Congress should repeal the RFS as it has become an infeasible mandate.

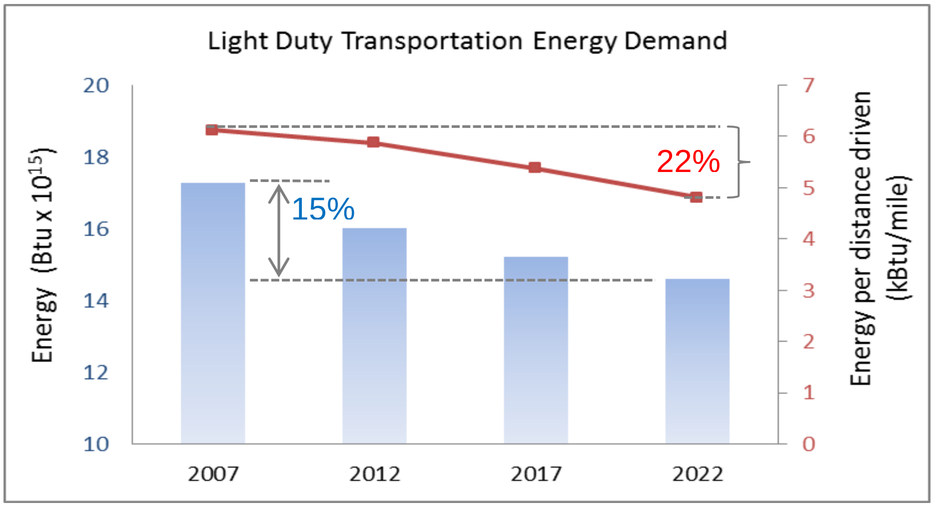
Please find below our responses to the questions for stakeholder input raised in the white paper:

1. **Is the RFS reducing greenhouse gas emissions below that of baseline petroleum-derived fuels? Is the RFS incentivizing the development of a new generation of lower greenhouse gas emitting fuels? Will the RFS produce further greenhouse gas emissions reductions when it is fully implemented?**

   The Renewable Fuel Standard (RFS) is not reducing greenhouse gas emissions (GHG) below that of baseline petroleum-derived fuels.

[1] NERA Economic Consulting, "Economic Impacts Resulting from Implementation of RFS2 Program", October, 2012.

Even though the transportation sector has recently seen a decline in energy demand and associated GHG emissions, these reductions are the result of a decrease in vehicle miles traveled and improvements in vehicle fuel economy, not the RFS. Looking forward, according to EIA data, transportation sector energy demand and associated emissions are projected to decline as a result of vehicle technology improvements, even as vehicle miles driven are projected to increase (see graph below).



The National Academy of Sciences (NAS) study[1] found that "according to EPA's own estimates, corn-grain ethanol produced in 2011, which is almost exclusively made in biorefineries using natural gas as a heat source, is a higher emitter of GHG than gasoline." Based on this statement, one can conclude that in absence of the RFS, it is likely that GHG emissions from the transportation sector would have been lower. Furthermore, NAS concluded that the "RFS may be an ineffective policy for reducing global GHG emissions because the effect of biofuels on GHG emissions depends on how the biofuels are produced and what land-use or land-cover changes occur in the process."[2]

The reason the RFS has not contributed to the reduction GHG emissions to date is that the program has been dominated by corn-grain ethanol. In 2012, according to the EPA, corn-grain ethanol accounted for 85% of the total renewable fuel volume (ethanol energy equivalent basis).[3] As the NAS study notes, "EPA found corn-grain ethanol… to have life-cycle GHG emissions higher than gasoline in 2012 or 2017 unless it is produced in a biorefinery that uses biomass as a heat source (Table 5-4)." The table below from the EPA (Docket number EPA-HQ-OAR-2005-0161-3173) illustrates the fact that greenhouse gas emissions from corn ethanol are almost always higher than those of gasoline.

[2] National Research Council, *Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy*. Washington, DC: The National Academies Press, 2011.
[3] US Environmental Protection Agency, "2012 RFS2 Data: RIN Generation and Renewable Fuel Volume Production by Fuel Type", available at: http://www.epa.gov/otaq/fuels/rfsdata/2012emts.htm#accordProduction

		Percent Reduction Lifecycle GHG Emisisons								
		2022			2017			2012		
	Time Horizon	30	30	30	30	30	30	30	30	30
	Discount Rate	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Range	Low	Mean	High	Low	Mean	High	Low	Mean	High
Dry Mill NG	**Base Plant (dry DDGS)**	-28%	-17%	-3%	-9%	10%	33%	9%	33%	63%
Dry Mill NG	w/ CHP (dry DDGS)	-31%	-20%	-6%	-13%	7%	30%	5%	30%	59%
Dry Mill NG	w/ CHP and Fractionation (dry DDGS)	-33%	-22%	-7%	-14%	5%	28%	4%	28%	57%
Dry Mill NG	w/ CHP, Fractionation and Membrane Seperation (dry DDGS)	-37%	-25%	-11%	-18%	1%	24%	-1%	24%	53%
Dry Mill NG	w/ CHP, Fractionation, Membrane Seperation, and Raw Starch Hydrolysis (dry DDGS)	-41%	-30%	-15%	-23%	-4%	19%	-6%	19%	48%
Dry Mill NG	**Base Plant (wet DGS)**	-39%	-27%	-13%	-21%	-2%	22%	-3%	21%	50%
Dry Mill NG	w/ CHP (wet DGS)	-42%	-30%	-16%	-24%	-5%	18%	-7%	17%	47%
Dry Mill NG	w/ CHP and Fractionation (wet DGS)	-41%	-29%	-15%	-23%	-4%	20%	-5%	19%	48%
Dry Mill NG	w/ CHP, Fractionation and Membrane Seperation (wet DGS)	-44%	-33%	-19%	-27%	-8%	16%	-10%	15%	44%
Dry Mill NG	w/ CHP, Fractionation, Membrane Seperation, and Raw Starch Hydrolysis (wet DGS)	-47%	-36%	-22%	-30%	-10%	13%	-13%	12%	41%
Dry Mill Coal	**Base Plant (dry DDGS)**	1%	12%	26%	22%	41%	64%	42%	66%	96%
Dry Mill Coal	w/ CHP (dry DDGS)	-1%	10%	24%	19%	39%	62%	40%	64%	93%
Dry Mill Coal	w/ CHP and Fractionation (dry DDGS)	-9%	3%	17%	12%	31%	54%	32%	56%	85%
Dry Mill Coal	w/ CHP, Fractionation and Membrane Seperation (dry DDGS)	-16%	-5%	9%	3%	22%	46%	23%	47%	76%
Dry Mill Coal	w/ CHP, Fractionation, Membrane Seperation, and Raw Starch Hydrolysis (dry DDGS)	-25%	-14%	0%	-6%	13%	36%	12%	36%	66%
Dry Mill Coal	**Base Plant (wet DGS)**	-21%	-10%	4%	-2%	17%	41%	17%	41%	71%
Dry Mill Coal	w/ CHP (wet DGS)	-23%	-12%	2%	-4%	15%	38%	15%	39%	68%
Dry Mill Coal	w/ CHP and Fractionation (wet DGS)	-25%	-13%	1%	-6%	14%	37%	13%	37%	67%
Dry Mill Coal	w/ CHP, Fractionation and Membrane Seperation (wet DGS)	-32%	-21%	-7%	-14%	5%	28%	4%	28%	58%
Dry Mill Coal	w/ CHP, Fractionation, Membrane Seperation, and Raw Starch Hydrolysis (wet DGS)	-38%	-26%	-12%	-20%	-1%	23%	-2%	22%	51%
Dry Mill Biomass	Base Plant (dry DDGS)	-51%	-40%	-26%	-34%	-15%	8%	-18%	6%	36%
Dry Mill Biomass	w/ CHP (dry DDGS)	-59%	-47%	-33%	-42%	-23%	0%	-26%	-2%	27%
Dry Mill Biomass	w/ CHP and Fractionation (dry DDGS)	-57%	-45%	-31%	-40%	-21%	2%	-24%	0%	30%
Dry Mill Biomass	w/ CHP, Fractionation and Membrane Seperation (dry DDGS)	-56%	-45%	-31%	-40%	-20%	3%	-23%	1%	30%
Dry Mill Biomass	w/ CHP, Fractionation, Membrane Seperation, and Raw Starch Hydrolysis (dry DDGS)	-57%	-45%	-31%	-40%	-21%	3%	-24%	0%	30%
Dry Mill Biomass	Base Plant (wet DGS)	-52%	-41%	-27%	-35%	-16%	7%	-19%	6%	35%
Dry Mill Biomass	w/ CHP (wet DGS)	-59%	-48%	-34%	-43%	-24%	0%	-27%	-3%	27%
Dry Mill Biomass	w/ CHP and Fractionation (wet DGS)	-57%	-46%	-32%	-41%	-21%	2%	-24%	0%	29%
Dry Mill Biomass	w/ CHP, Fractionation and Membrane Seperation (wet DGS)	-57%	-45%	-31%	-40%	-21%	2%	-24%	0%	30%
Dry Mill Biomass	w/ CHP, Fractionation, Membrane Seperation, and Raw Starch Hydrolysis (wet DGS)	-57%	-46%	-32%	-40%	-21%	2%	-24%	0%	29%
Wet Mill	with NG	-19%	-7%	7%	-3%	17%	40%	13%	37%	67%
Wet Mill	with coal	8%	19%	33%	24%	43%	66%	40%	64%	93%
Wet Mill	with biomass	-59%	-48%	-33%	-43%	-24%	0%	-27%	-3%	27%
	NG Average	-34%	-23%	-9%	-15%	4%	27%	3%	27%	56%

While the data from NAS Table 5-4 suggest that corn-grain ethanol may in 2022 reach a point where it has lower life-cycle GHG emissions than gasoline through investments in advanced fractionation and use of biomass for biorefinery heat, in the near term, the RFS has increased GHG emissions above the baseline gasoline. This suggests that while overall energy consumption in the transportation sector has decreased, associated reductions in GHGs would likely have been higher had the RFS not been in place. Furthermore, it is unclear whether the above-mentioned biorefinery investments in fractionation and energy needed to reduce GHGs may take place in the future.

Cellulosic biofuels may offer GHG benefits, but the reality is that following decades of research and "technology forcing" legislation (i.e., RFS1, RFS2, and California's Low Carbon Fuel Standard), cellulosic biofuels have failed to become available at a commercial scale that is economically competitive in the existing U.S. transportation fuels market. EIA currently projects less than 500 million gallons of cellulosic biofuels in 2022, less than 3% of the RFS's aspirational mandate of 16 billion gallons. Until significant volumes of cellulosic biofuels are commercialized, GHG benefits from the use of biofuels in transportation will not be materialized, and the aspirational GHG targets of RFS2 will not be achieved.

2. Could EPA's methodology for calculating lifecycle greenhouse gas emissions be improved, including its treatment of indirect land use changes? If so, how?

According to the NAS, life-cycle GHG estimates vary, and "some of the key drivers in differences include:

- The geographic range considered;
- Whether direct or indirect land-use changes were included in the estimates;
- Assumptions used in estimating indirect land use changes…;
- Flux values used for N_2O emissions;
- How GHG credits from coproduct production were estimated;
- Technologies and fossil fuel used in the biorefineries;
- The fraction of DDGS that is dried versus fed wet to livestock; and
- Baseline volume of ethanol production."

To this end, EPA should model uncertainty (i.e., run models with variation in key parameters). NAS studies that address uncertainty in their models have revealed plausible scenarios in which biofuel GHG emission are higher than those of comparable fossil fuels.

Additionally, EPA should continue to include indirect land use changes in life-cycle greenhouse gas emissions analyses. In doing so, EPA should ensure that its methodologies are consistent with the most up to date scientific standards for life-cycle analysis in the field, and seek peer review by academics and the National Academy of Sciences, not just the DOE labs.

3. Is the definition of renewable biomass adequate to protect against unintended environmental consequences? If not, how should it be modified?

The current narrow definition of renewable biomass (especially 1st generation biofuels) results in negative environmental impacts, in addition to GHGs.

To avoid unintended consequences, renewable biomass definition should include a systems based, complete lifecycle well-to-wheels assessment that results in societal benefits via cost effectiveness and positive environmental impacts in areas such as GHGs, air quality, water, eutrophication, land, soil, biodiversity, food and others as outlined by NAS.

To illustrate the point, the current definition of biomass in the RFS includes corn stover as a feedstock for cellulosic biofuels. Corn stover is often left on fields as cover between harvest and planting. It can help preserve and add nutrients to the soil. Removal of corn stover in significant quantities could lead to deterioration of the health of the soil and cause increased run off of pesticides and fertilizers. This could contribute to increased water pollution.

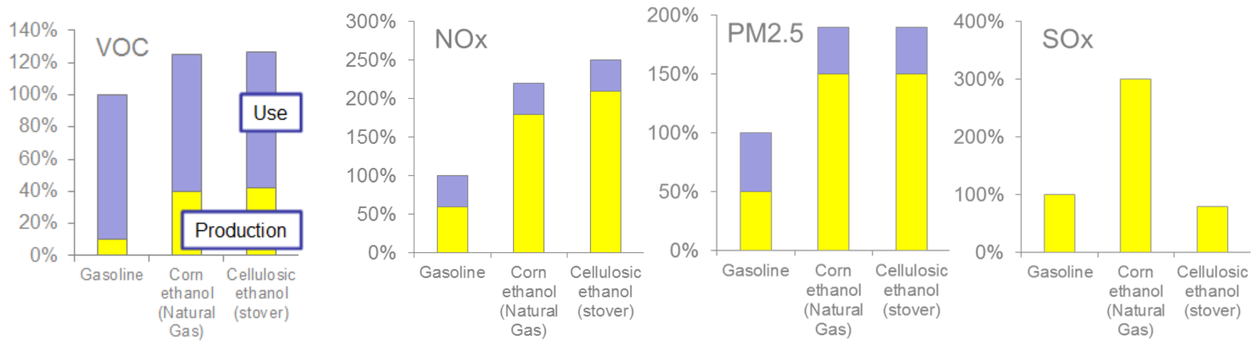
4. What are the non-greenhouse gas impacts of the RFS on the environment relative to a comparable volume of petroleum-derived fuels? Is there evidence of a need for air quality regulations to mitigate any adverse impacts of the RFS?

<u>Air Quality Deterioration</u>
Overall, the expanded use of renewable fuels is generally anticipated to have a variable impact on pollutants. When establishing the expanded RFS2 program in 2010, EPA concluded that pollutants such as hydrocarbons, nitrogen oxides (NOx), acetaldehyde and ethanol would likely increase and others such as carbon monoxide (CO) and benzene were expected to decrease.[4] These emission impacts were anticipated to be highly variable from region to region. The biofuel volumes projected

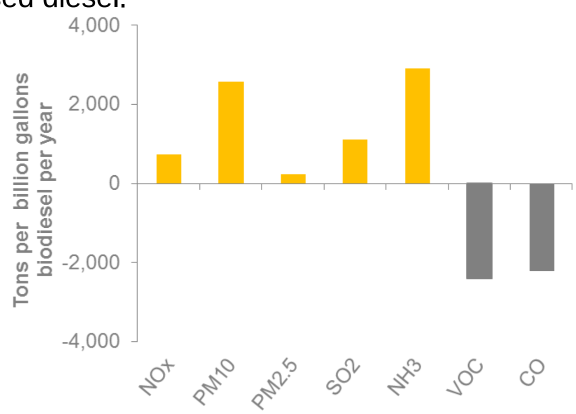
[4] US Environmental Protection Agency, *Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis*, EPA-20-R-10-006, February 2010.

under RFS2 were anticipated to lead to increases in population-weighted annual average ambient PM and ozone concentrations.

According to the NAS, "for corn-grain ethanol, life-cycle emissions of major air pollutant species (for example CO, NO_X, $PM_{2.5}$, VOC, SO_X, and NH_3) are higher than for gasoline. It is clear from the study and the charts below that the non-greenhouse gas impacts of the RFS are at least as severe as the GHG impacts noted above. Across the board, the RFS has the potential to have significant negative air quality impacts; in fact, standard consumption of gasoline is better in this regard. As the NAS study notes, "studies that have considered the ultimate impacts of biofuels have consistently found corn-grain ethanol to have human health damage costs equal to or higher than gasoline." The charts below reflect the fact that biofuel emissions exceed those of gasoline.



There are similar effects for biodiesel as articulated in the EPA 2013 RFS biomass-based diesel standards rule, and reflected in the chart below, which shows higher net emissions from biomass-based diesel.[5]



<u>Unsustainable land use expansion</u>

Largely because of the massive allocation of corn to ethanol production, the acres planted to corn have increased dramatically since the implementation of the RFS. 78.3 million acres were planted to corn in 2006, the year before the RFS2 was passed, and USDA is projecting 97.3 million acres will be planted to corn this year. These kinds of changes are unprecedented in recent decades, and their overall environmental impacts are unknown. Papers published in the journal of the Proceedings of the National Academy of Science (PNAS) indicate that the biodiversity, water quality and carbon sequestration benefits of lands enrolled in the USDA Conservation Reserve Program may be lost, and that grassland conversion to crop production in the western corn belt is expanding

[5] U.S. EPA, "Regulation of Fuels and Additives: 2013 Biomass-Based Diesel Renewable Fuel Volume; Final Rule." September 27, 2013. http://www.gpo.gov/fdsys/pkg/FR-2012-09-27/pdf/2012-23344.pdf

into marginal lands that are more susceptible to erosion and water quality degradation.[6,7] A 2011 USDA report estimates that on about two-thirds of US agricultural land, fertilizer use fails to conform to best management practices.[8] Much of the additional land put into corn production is thought to be more susceptible to environmental degradation such as soil erosion and runoff of fertilizer and pesticides.

It is difficult to predict the future land and water impacts from the harvesting of biomass feedstocks required to produce the projected 16 billion gallons of ethanol equivalent biofuels mandated by the RFS by 2022. The NAS assesses that there will be insufficient feedstock from forest residue and municipal waste alone to produce 16 billion gallons of ethanol equivalent cellulosic biofuels mandated by the RFS by 2022. NAS further states that between 30 and 60 million acres of additional land might be required to produce these volumes of cellulosic biofuels from agricultural feedstocks. This translates to 15 to 30 times the area of Yellowstone National Park or, at the high end, the area of all US national parks combined.

High water consumption and negative impact on water quality

Including agriculture production water use, ethanol requires significantly higher volumes of water than gasoline; this is reflected in the table below from Argonne National Laboratory.[9] (GGE = Gasoline Gallon Equivalent)

Fuel (feedstock)	**Average Net Water Consumed**
Corn ethanol	**17-239 gallon/gallon ethanol (25-358 gallons water per GGE)**
Switchgrass ethanol	**1.9-9.8 gallon/gallon ethanol (2.8-14.7 gallons water per GGE)**
Gasoline (all crudes)	**2.6-6.2 gallon/gallon gasoline**

Similar peer-reviewed data shows that freshwater use in production of gasoline is significantly less than that of corn ethanol.[10]

The environmental dangers of the RFS are not limited to corn-grain ethanol, or its use in small volume blends. A 2012 peer-reviewed paper by the University of Minnesota compared gasoline to E85 for 12 different kinds of environmental impacts and found that, in the aggregate, E85 blends were from 6% to 108% worse than gasoline, and were worse by 23% on average in the overall sustainability metric.[11] A similar independent study by the premier Swiss research institute, EMPA, showed that for most biofuel pathways, only ozone depletion and climate change were more

[6] Ilya Gelfanda, et al., "Carbon debt of Conservation Reserve Program (CRP) grasslands converted to bioenergy production." PNAS 2011, 108 (33): 13864-13869

[7] C.K. Wright and M.C. Wimberly, "Recent land use change in the Western Corn Belt threatens grasslands and wetlands." PNAS 2013, 110 (1): 4134–4139.

[8] Marc Ribaudo, et al., "Nitrogen in Agricultural Systems: Implications for Conservation Policy." USDA Economic Research Report No. ERR-127. September 2011. Available: http://www.ers.usda.gov/Publications/ERR127/

[9] M. Wu and Y. Chiu, "Consumptive Water Use in the Production of Ethanol and Petroleum Gasoline – 2011 Update." Center for Transportation Research, Energy Systems Division, Argonne National Laboratory, July 2011.

[10] Joost Schornagel, et al., "Water accounting for (agro)industrial operations and its application to energy pathways." *Resources, Conservation and Recycling*, April 2012, Vol. 61: 1-15.

[11] Yi Yang, et al., "Replacing Gasoline with Corn Ethanol Results in Significant Environmental Problem-Shifting." *Environmental Science and Technology*, 2012 46(7): 3671-3678.

favorable relative to petroleum. Indicators such as eutrophication, acidification, water depletion, eco-toxicity and land use were consistently higher than petroleum fuels for most biofuel pathways.[12] Corn-grain ethanol was one of the poorest performing biofuels in the comprehensive study.

Overall, as shown by these studies, the RFS2 is a good example of "environmental problem shifting" inherent in EPA's current approach on biofuel production, and of EPA's failure to adequately analyze these impacts relative to petroleum fuel production. These findings continue to show that the expected environmental gains from the RFS have yet to be realized, and likely have contributed to increased degradation of air, water and soil resources due to overwhelming reliance on corn ethanol. Furthermore, they suggest that any benefits the RFS held may not materialize given EIA projections of cellulosic production.

Eutrophication

According to the NAS study, "increased cropping area of corn for ethanol production is assumed to exacerbate eutrophication and hypoxia due to the high inputs of nitrogen, phosphorous, and pesticides required for corn production." NAS assumes that with 10.6 t/ha of soil erosion, 4.8 kg of soil are eroded per liter of ethanol produced. The USDA has published their findings of nitrogen impacts to surface and groundwater quality due to biofuel production by 2015 that shows continued increases in impacts above the baseline.[13] A 2008 paper published in PNAS predicted that meeting the corn ethanol mandates of the RFS2 would prevent EPA from making progress in its goals to reduce water quality impacts (e.g., hypoxia, eutrophication) of nitrogen in the Upper Mississippi River Basin and the Gulf of Mexico.[14]

Contamination of surface and groundwater with fertilizers and pesticides continues to have extensive deleterious effects in most of the Midwestern US in addition to the often-noted Gulf of Mexico hypoxic zone, and soil erosion also continues to degrade these landscapes and associated waterways. Overall, there is insufficient recognition of the huge water quality impacts that are widespread in rivers, streams, lakes and ponds throughout the Midwest. These problems were highlighted in EPA's recent draft "National Rivers and Streams Assessment: 2008-2009".

5. **Has implementation of the RFS revealed any environmental challenges or benefits not fully anticipated in the statute?**

   The environmental effects of the RFS described above may have not been fully comprehended when EISA was enacted. Starting with the grandfathering of existing ethanol plants, ethanol use had higher life-cycle GHG emissions than gasoline in 2011, and likely continued through the present. Additionally, the impacts of ethanol on the water supply, in terms of both quality and use, as well as the atmosphere were not fully comprehended until the NAS report in 2011 highlighted significant concerns as described in previous sections. These greenhouse gas and other environmental issues are exacerbated by the unlikely prospects for any significant commercial cellulosic biofuel production in the near future. The RFS was designed to have payoffs toward the end of the program, as the aspirational GHG benefits were expected to be provided by significant

[12] EMPA, "Harmonisation and extension of the bioenergy inventories assessment." 2012
[13] USDA, "Surface-Water and Groundwater Impacts of Meeting Biofuel Targets Vary by Region." http://www.ers.usda.gov/topics/farm-economy/bioenergy/findings.aspx#impacts
[14] Simon D. Donner and Christopher J. Kucharik, "Corn-based ethanol production compromises goal of reducing nitrogen export by the Mississippi River." PNAS 2008, 105(11):4531-4518.

growth in the volumes of low GHG-emitting cellulosic biofuels that the program was intended to incentivize. Without these fuels, the RFS will continue to be an environmental burden.

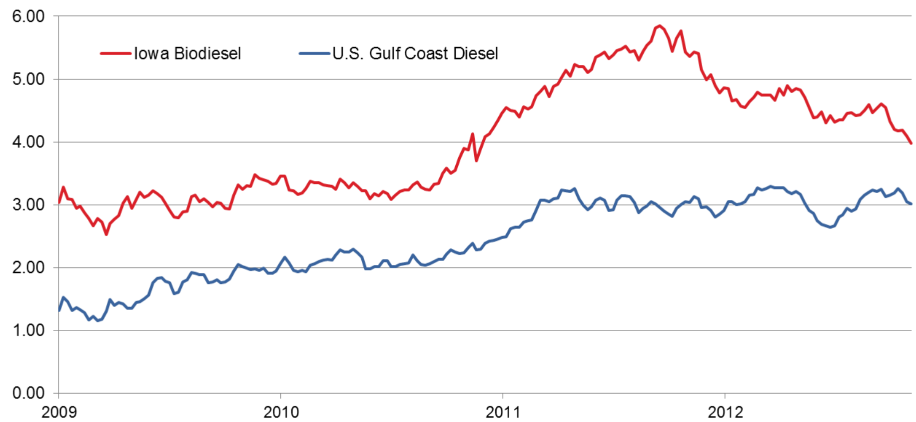
6. What is the optimal percentage of ethanol in gasoline? What is the optimal percentage of biomass-based diesel in diesel fuel?

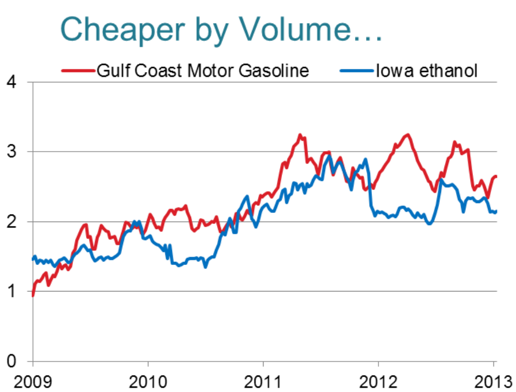
The RFS mandates the use of both ethanol and biodiesel. Currently, nearly all gasoline sold in the U.S. is blended with up to 10% ethanol by volume (E10). The vast majority of gasoline-fueled vehicles on the road, as well as the existing fuel distribution infrastructure (excluding pipelines) has been designed, certified and warranted to function properly using motor gasoline containing no more than 10% ethanol by volume. Fuel suppliers use ethanol at blends of up to 10% in consideration of many factors, including ethanol mandates, government regulatory and industry fuel specification requirements and standards, vehicle technology and fuel delivery infrastructure compatibility constraints, consumer expectations regarding vehicle performance and operating cost, and market price signals.

Fuel suppliers frequently blend biodiesel into petroleum diesel, at volumes of up to 5% for similar reasons. The ASTM International specification for conventional diesel fuel, D975, allows up to 5% biodiesel in conventional diesel fuel. And, most diesel engine/vehicle manufacturers approve the use of B5 and lower blends, as long as the biomass-based diesel portion of the blend meets the ASTM International specification D6751 and/or EN14214. The use of B5+ biodiesel blends is tempered by at least two key ongoing issues: the oxidative stability of the fuel (a fuel storage concern)[15], and low temperature operability impacts (an engine performance concern arising from the increased potential for fuel filter plugging due to wax buildup and/or reduced fuel flow under cold ambient conditions).

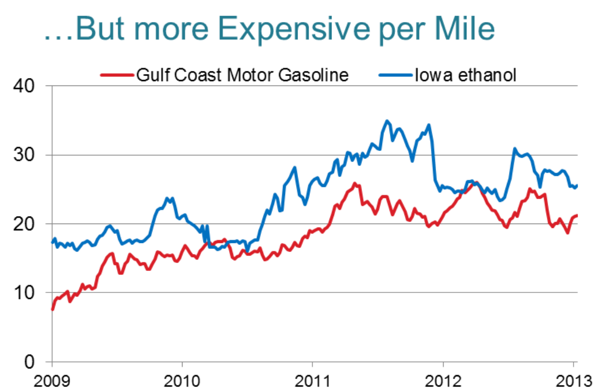
It is clear from the current use of ethanol and biodiesel that fuel suppliers view biofuels as products which have the potential to add value. The perception of having the potential to add value, however, does not suggest that a mandate like the RFS is an appropriate or needed program. Continuing to force consumption of biofuels under the mandate of the RFS could have negative environmental consequences as noted above. Additionally, because biofuels have been more expensive than their petroleum based counterparts, continuing the mandate could have negative economic consequences as can be deduced from the historically higher prices of ethanol and biodiesel reflected in the EIA charts below. Finally, continuing the mandate could result in mechanical problems. For instance, exceeding E10 with the use of gasoline blended with higher levels of ethanol, e.g., 15% ethanol (E15) by volume, not only carries the risk of infrastructure compatibility and long-term engine durability problems, but has more recently been shown to cause vehicle fuel system breakdowns.[16]

[15] Terry, B., McCormick, R., and Natarajan, M., *Impact of Biodiesel Blends on Fuel System Component Durability*, SAE Technical Paper 2006-01-3279, 2006, doi:10.4271/2006-01-3279.
[16] See, for example, the letter from Robert L. Greco III, American Petroleum Institute, to Vice Chairman Chris Stewart and Ranking Member Suzanne Bonamici, House Committee on Science Space and Technology, Subcommittee on Environment, dated February 26, 2013.





Gasoline and ethanol prices and ethanol margins
Dollars per gallon



Gasoline and ethanol prices and ethanol margins
Dollars per million Btu

7. **What are the best options for substantially further reducing greenhouse gas emissions from the transportation sector? Is the RFS an important component of such efforts?**

   Based on projections from the US Energy Information Administration, *2013 Annual Energy Outlook*, Reference Case Scenario, total greenhouse gas emissions from the transportation sector are projected to decline to a low 2030, before recovering by 2040. This trend is driven largely by changes in greenhouse gas emissions from highway vehicles. Key factors underlying this trend for highway vehicles include the recently promulgated CAFE/GHG requirements for model year 2017-2025 light-duty vehicles as well as the recently issued GHG standards for heavy-duty vehicles.

   According to the EPA, there are a number of options for further reducing greenhouse gas emissions from the transportation sector. The "best" option must be determined through careful evaluation of technical feasibility, overall costs and benefits, and relative cost-effectiveness, as well as an assessment of the political will to implement a given approach. The RFS is not an important component of such efforts. To reiterate our answer to question #1 above, the RFS has potentially minimized the contribution to recent reductions in overall GHGs from the transportation sector, and it is not expected to make a meaningful impact in the near future, given the lack of commercial scale production of cellulosic biofuels. The RFS requires blending of ethanol in gasoline at levels much higher than the 10% limit used in the design, certification, and warranties of the vast majority of vehicles and fuel retail infrastructure to date. As we indicated earlier in responding to congressional questions regarding blend wall/fuel compatibility issues with the RFS, API believes that this federal mandate is irretrievably broken, unworkable in practice and should be repealed.[17]

As previously stated, the RFS contains unfulfilled aspirational goals and numerous unintended environmental consequences and other adverse impacts. Again, we appreciate the opportunity to provide these responses. If you have any questions, please don't hesitate to contact us.

Sincerely,

Bob Greco
Group Director: Downstream and Industry Operations

API is a national trade association that represents all segments of America's technology-driven oil and natural gas industry. Its more than 500 members – including large integrated companies, exploration and production, refining, marketing, pipeline, and marine businesses, and service and supply firms – provide most of the nation's energy. The industry also supports 9.2 million U.S. jobs and 7.7 percent of the U.S. economy, delivers $86 million a day in revenue to our government, and, since 2000, has invested over $2 trillion in U.S. capital projects to advance all forms of energy, including alternatives.

[17] American Petroleum Institute, *Responses to the House Energy and Commerce Committee Questions for Stakeholder Comments, White Paper Series on the Renewable Fuels Standard: Blend wall/Fuel Compatibility Issues*, April 5, 2013.