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The Future of the Renewable Fuel Standard

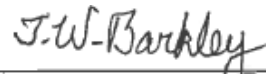
A Capstone Project Submitted in Partial Fulfillment of the
Requirements of the Renée Crown University Honors Program at
Syracuse University

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Honors Capstone Project in Finance

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Abstract

Persistent uncertainty about the future of the Renewable Fuel Standard led to an analysis of the policy's language and the varying degrees of political support for the program in the Senate. Applying probabilities to the various conceived scenarios resulted in a 40% change that the program continues in its current form in perpetuity. The report finds that a Democratic Congress would implement legislation that focuses on the policy's missed environmental goals. Conversely, a Republican Congress would lead to the most uncertainty in the market due to competing views of the RFS within the program. With a narrow Republican majority, legislation that limits ethanol and advances the environmental goals could be achieved as a compromise between the two parties. As a hedge against federal regulatory uncertainty, state and local incentives for biodiesel are considered. Las Vegas, Nevada emerges as a top destination for a biodiesel producer.

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Introduction

The state of Iowa's 3.16 million people may make up less than 1% of the United States of America's total population, but they command an outsized voice in national politicsⁱ. When Iowa speaks, politicians must listen because the rural state is the first to hold caucuses for Presidential electionsⁱⁱ. As it happens, Iowans are the country's largest producers of cornⁱⁱⁱ and second largest producers of soybeans^{iv}, a fact that keeps all Federal agriculture-related policies on the mind of the state's citizens.

This is the context that then-Presidential candidate and Senator Marco Rubio found himself in when he was asked about biofuels on November 24, 2015, in Grinnell, Iowa. In the audience was a farmer who thanked Senator Rubio for stating that he supported the Renewable Fuel Standard until its "expiration" in 2022. Rubio responded by making his opposition to government established portfolios clear, but quickly clarified his view that "People have gone out and made investments based on existing laws. I think it would be unfair to yank it away in the middle. [The RFS] should be allowed to continue until it expires [in 2022]."^v

Nobody in the audience (nor in another audience where he explicitly called 2022 the expiration of RFS) seemed to adversely react to Rubio's choice of words. Since neither an assembly of farmers nor a hopeful Presidential candidate recognized that the policy language dictates a perpetual continuation of the RFS, it should come as no surprise that many in industry seem confused about the program's path after 2022.

Indeed, the Renewable Fuel Standard's future is inherently mired in uncertainty due to the white canvas the policy grants an acting EPA Administrator beginning in 2023. Floating rumors and misguided claims throughout the industry have compounded this uncertainty. Whether it be Senator Marco Rubio's conversations with farmers or my own conversations with

industry leaders, the persistence of political uncertainty made researching the Renewable Fuel Standard an exciting venture. Throughout all of the associated research, three questions kept manifesting themselves: 1.) What is going to happen to this legislation after 2022? 2.) Is the Renewable Fuel Standard sufficient to incentivize the market behavior policymakers seek? and 3.) What are the various conceivable scenarios for an RFS 3.0? Everything that follows is my best attempt at answering each of these questions.

After assessing the world of RFS as it is and the world of RFS as it likely will be, this report aims to offer a better future for the program. The program's goals are both important and urgent. Predictions of what happens if nothing changes are dire, with Harvard's James H. Stock writing that "With an unreformed RFS and projected declines in gasoline demand, the most plausible scenario is one of continued politicization, rising and volatile compliance costs, increasing biodiesel imports, flat or declining domestic ethanol sales, and further stagnation of domestic second generation technologies."^{vi} None of these are desired scenarios for the United States. It is time to consider what reform should look like and how the stain of political uncertainty can be washed away from the Renewable Fuel Standard's future. Putting forth a policy mechanism rooted in the goals of the program that aligns incentives with the desired outcomes will set the program on a better path.

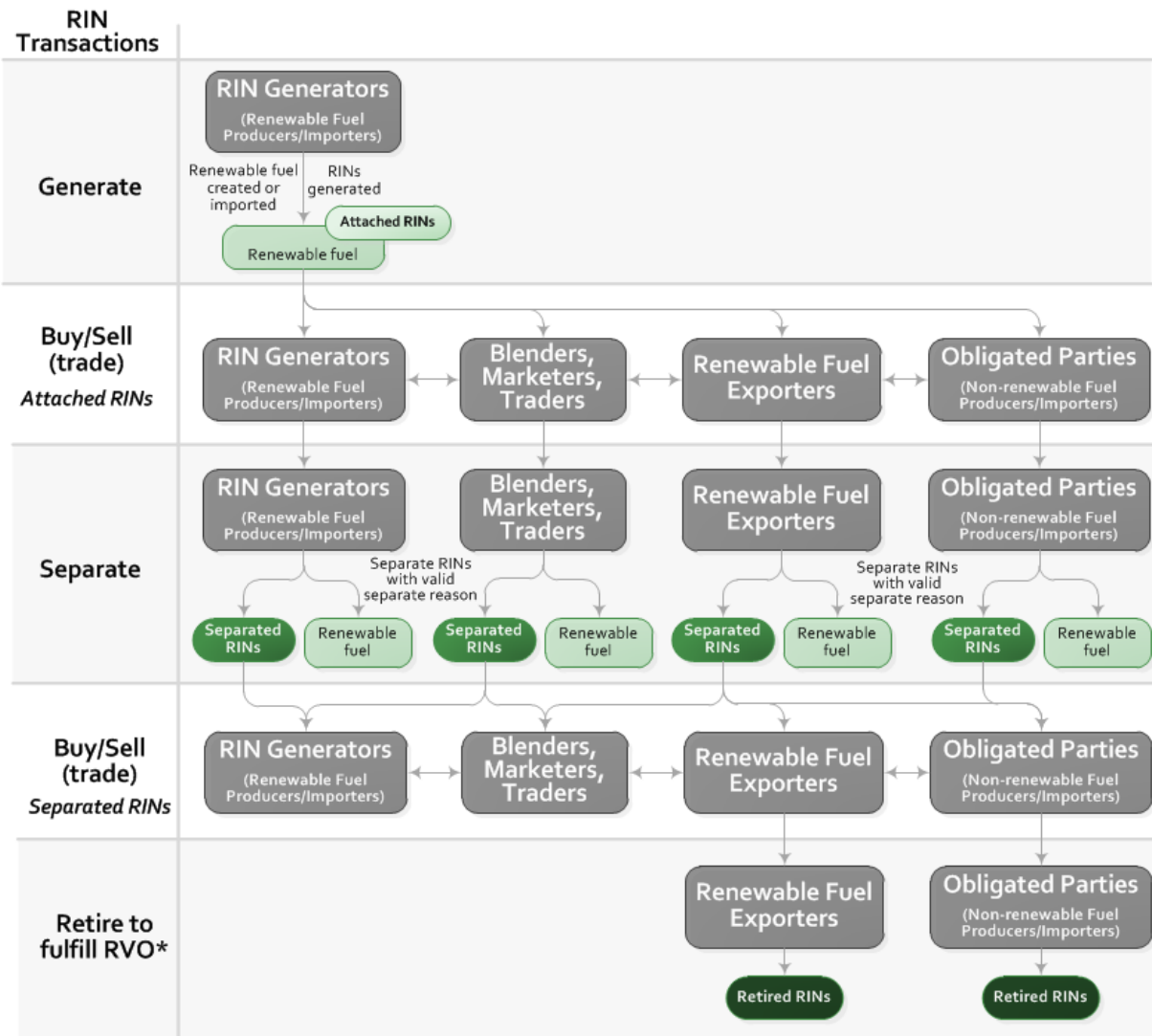
Understanding the Renewable Fuel Standard

Before analyzing the uncertainty around the program's future, the program itself must first be understood. The Renewable Fuel Standard, which dictates that a mandatory minimum volume of biofuels must be blended into the United States' transportation fuel supply each year, was established by the Energy Policy Act of 2005 (EPAAct) and expanded by the Energy Independence and Security Act of 2007 (EISA). At its core, the Renewable Fuel Standard's goals are "to enhance energy security through additional domestic production of biofuels, to support rural economies, and to promote second generation transportation fuels with low life cycle greenhouse gas footprints."^{vii} The policy mechanism through which these goals are meant to be accomplished is the mandated Renewable Volume Obligations that must be blended into the country's transportation fuel supply; these are increasingly ambitious annual volume targets for the blending of biofuels. Refiners and petroleum product importers are required to either blend biofuels into their supplies or purchase Renewable Identification Numbers (RINs) to demonstrate compliance with Renewable Volume Obligations. EPA offers the best explanation for this design structure: "EPA calculates and establishes RVOs every year through rulemaking, based on the CAA volume requirements and projections of gasoline and diesel production for the coming year. The standards are converted into a percentage and obligated parties must demonstrate compliance annually."^{viii}

The program works by attaching a RIN to each produced gallon of renewable fuel. The RIN gets separated from the renewable fuel once the fuel is blended into a petroleum product. For example, corn ethanol that demonstrates at least a 20% reduction in greenhouse gas emissions gets awarded a D6 RIN (there are different RIN codes for different biofuels). The D6 RIN gets separated once the ethanol is blended into gasoline. Refiners must either blend biofuels

into their petroleum products or purchase RINs in the market to meet established Renewable Volume Obligations. This market system functions by allowing the RIN value to float enough to encourage additional production when the market appears to be falling short of blending mandates. At the same time, the market mechanism theoretically allows for the RIN price to collapse when renewable fuel blending exceeds mandates. High volatility and compliance costs in this market are a central part of reform proposals and will be addressed in detail during this report's reform section. The graphic below illustrates how RINs are generated, separated, and purchased.

RIN Transactions in the EPA Moderated Transaction System (EMTS)



*RVO = Renewable Volume Obligation

In order to guide the market towards accomplishing a trio of policy goals, the EISA designates cellulosic biofuel, biomass-based diesel, advanced biofuel, and renewable fuel as four nested fuel categories within the program. Each of these fuels have their own compliance benefits; i.e. some can be counted for RINs for multiple fuel types whereas some, like ethanol, can be classified as a renewable fuel only. Central to the architecture of the nested structure is the understanding that different biofuels fulfill different policy goals. Ethanol could be a boom for the agricultural economy of America without producing much of an environmental benefit.

Cellulosic biofuels can reduce greenhouse gas emissions of our country’s energy portfolio; at the same time, biomass-based diesel could work to solve all three policy goals depending on how indirect land use change is accounted for. Future changes in the policy can be anticipated by understanding which of the policy goals hold equal or greater prevalence than they did in 2007. From here, working backwards can reveal which biofuels will receive the greatest political support in the reform process.

RIN Code	Fuel Type	Qualifies For	GHG Reduction Threshold
D3	Cellulosic Biofuel	Cellulosic Biofuel, Advanced Biofuel, Renewable Fuel	60%
D4	Biomass-based Diesel	Biomass-based Diesel, Advanced Biofuel, Renewable Fuel	50%
D5	Advanced Biofuel	Advanced Biofuel, Renewable Fuel	50%
D6	Renewable Fuel	Renewable Fuel	20%
D7	Cellulosic Diesel	Cellulosic Biofuel, Advanced Biofuel, Renewable Fuel	60%

Here, it could be concluded already that the program aligns the incentives of the RINs market with the extent to which policy goals are achieved. Conventional wisdom suggests that EISA achieves incentive alignment by creating different classes of RINs based on differing greenhouse gas emission reduction thresholds. This becomes a focus later in the report, but it is worth stating here that the program only achieves this to a prohibitively low extent. Although RINs are currently earned by reaching a greenhouse gas reduction threshold, there is no incentive for reducing emissions beyond the threshold. Critics might suggest that awarding renewable diesel 1.6 RINs per gallon is a way of achieving this, but here the award is once again based solely on reaching the stated threshold. Moreover, reviewing the current literature on the environmental impacts of ethanol production suggests the Renewable Fuel Standard may have had no net positive environmental benefit at all.

The Renewable Fuel Standard’s exact policy language in the Energy Independence and Security Act stops dictating specific Renewable Volume Obligations after 2022. This part of the

policy sits at the core of industry’s uncertainty about what the program will look like in 2023 and beyond. In fact, many industry participants even have (or have had) the mistaken belief that the program reaches its sunset in 2022. David Cox, General Counsel for the Renewable Natural Gas Coalition, wrote publicly of the dangers of misinformation in the market about RFS: “Every day, fuel procurement, project financing and infrastructure investment decisions are heavily influenced by misinformation... Harmful reports of a 2022 RFS expiration persist.”^{ix} Conversations with industry participants – those who trade the fuel, those who produce those fuel, and especially those who procure the feedstock – confirmed the pervasiveness of misinformation. This, of course, is easy to clarify: The Renewable Fuel Standard does not sunset in 2022.

What proves much harder to clear up is persistent uncertainty about what a perpetual continuation really looks like. This results from the fact that the policy reads as if it was written by somebody intending to be vague, stating that “the purposes of subparagraph (A), the applicable volumes of each fuel specified in the tables in clause (i) for calendar years after the calendar years specified in the tables shall be determined by the Administrator, in coordination with the Secretary of Energy and the Secretary of Agriculture.”^x These unelected officials (each is an appointed position) are not allowed to pull numbers out of thin air and deem them the Renewable Volume Obligations, however. The Administrator cannot legally remove the program from existence without legitimate cause, even though the EPA’s website mentions that “the statute also contains a general waiver authority that allows the Administrator to waive the RFS volumes, in whole or in part, based on a determination that implementation of the program is causing severe economic or environmental harm.”^{xi} This “waiver authority” compounds market uncertainty for years beyond 2022 and gives the appearance that the political leanings of an

administrator could dictate policy. However, the policy dictates that the EPA Administrator's rulemaking be grounded in a fairly specific process.

The Administrator's RVO rulemaking must be based on "a review of the implementation of the program during calendar years specified in the tables."^{xii} In other words, the previous years with mandated volumes must, by law, be instructive in setting annual volume obligations. The second component of what the EPA Administrator must do in determining annual volume obligations is analyze six different factors: how renewable fuels will impact the environment; how renewable fuels will impact the country's energy security; expected production rates of renewable fuels in the future; how renewable fuels will impact infrastructure in the United States and how compatible infrastructure in the United States is with renewable fuels; how renewable fuels will impact consumers at the pump; and how renewable fuels will effect rural and agricultural economies. The Renewable Fuel Standard's original goals of energy security, environmental protection, and rural economic support are at the core of what the Administrator must consider in setting Renewable Volume Obligations. These three pillars are the goals that will be evaluated to determine what the future must be based on.

There are a few further limitations imposed by the law, such as requiring all biomass-based diesel volumes never slipping below 1 billion gallons (the amount set for 2012, the last year with specific biomass-based diesel mandates). While a floor exists for biomass-based diesel, a ceiling exists for corn ethanol and other conventional biofuels: 15 billion gallons per year (illustrated in the chart below^{xiii}). As for timing, the Administrator is required to announce RVOs at least 14 months in advance of the applicable period for biomass-based diesel. Assuming this rule is followed, this should impose at least some limit on RIN market volatility (addressed later) as transparency in 2021 and 2022 can lead to efficient trading in 2023.

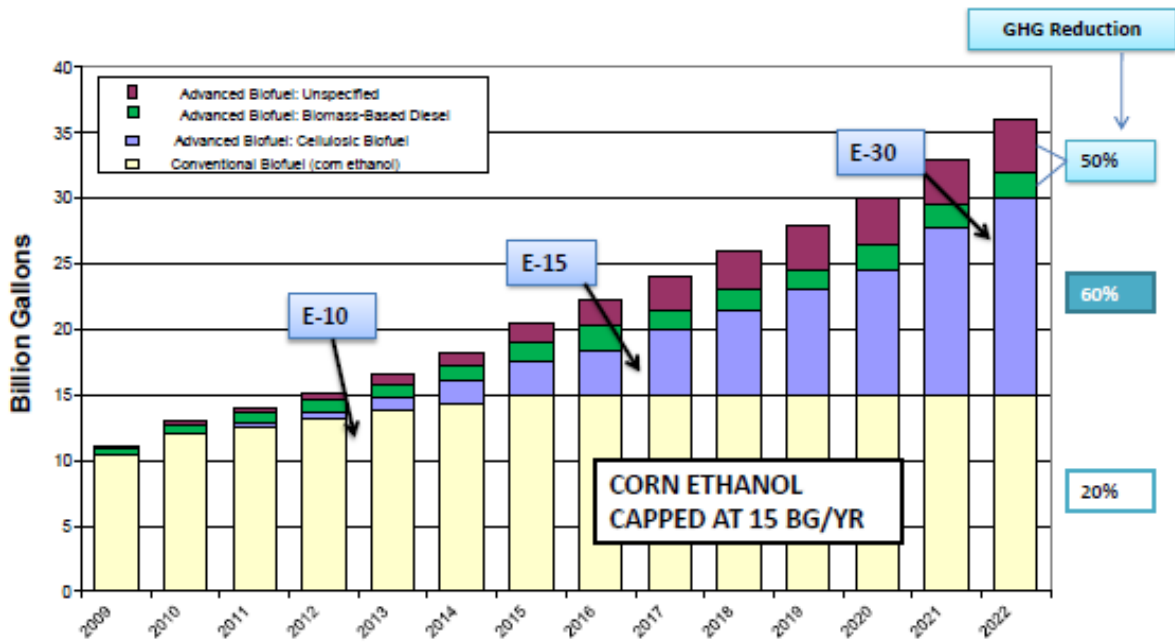


Table 1 Weaver Presentation: How Do RINs Work?

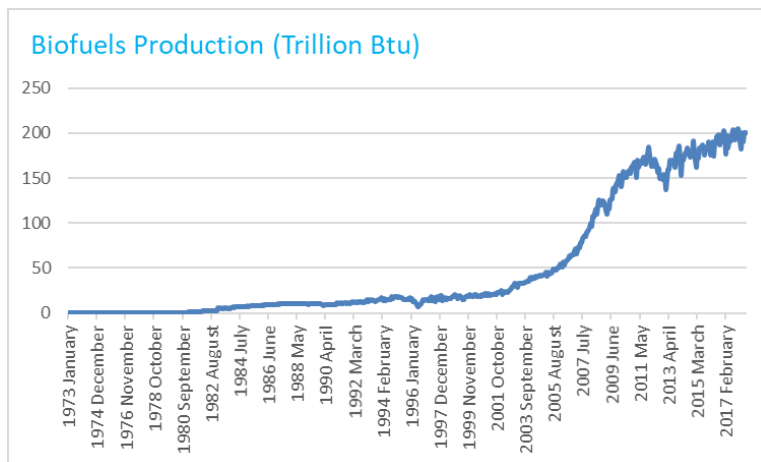
The set-up in its current forms still allows for a fair degree of speculation as to how EPA will approach RFS for years beyond those with specific mandates. In its current form, the Renewable Fuel Standard requires EPA to evaluate the program’s goals and set renewable volume obligations in a manner conducive to achieving those goals in the future, as informed by the understanding of the program’s history. Determining, then, if the RFS achieved its goals (and

whether these goals are still relevant) is of preeminent importance. Any understanding of what Renewable Volume Obligations will look like hinges upon how the Administrator assesses the six analytical pillars outlined in the policy. To emulate this process, the program's success against its three main goals is weighed to consider how an apolitical EPA Administrator would act. Forecasting the policy priorities and political leanings of a specific EPA Administrator fell beyond the scope of this report. This is not to say that the perception of RFS's goal attainment will not vary by who sits at the helm of the EPA. Rather, it is meant to be an apolitical assessment of the RFS's ability to achieve its goals since inception. Adjustments to the analysis can be made after obtaining future clarity about who the future administrator will be.

In addition to allowing entry into the thought process of any acting administrator, such an analysis will also lead to policy recommendations for any RFS re-write. Many industry participants and RFS Stakeholders mentioned that Congress would probably act in 2023 (the optimistic among those interviewed did not assign a timeframe) to rewrite RFS to avoid leaving complete control of the program to the Executive Branch. Understanding what this rewrite could look like requires formulating a view on the program's ability to obtain its goals and on how Congress will act in different scenarios. Analyzing the Senate vote-by-vote, which is taken as a proxy for the Congressional composition as a whole, informs what the complicated politics of RFS indicate is most likely to occur.

The Patina of Success

Many politicians and industry participants are quick to point to the program's successes, even as others look at the program as a "flop." Former Montana Senator Jim Talent is among the advocates, arguing in August 2018 that "The RFS has achieved its objectives; in fact, it may be the one federal energy policy which actually has worked."^{xiv} Irrespective of which goals were or were not satisfied, there can be no denying that the Renewable Fuel Standard dramatically



accelerated the growth of renewable fuels production. The Energy Information Administration (EIA) releases data on the monthly production of biofuels (measured in trillions of British Thermal Units) in the United States. This data

demonstrates that biofuel production only experienced the bulk of its exponential growth *after* the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007, as shown above. As far as the increasing the production of biofuels is concerned, the Renewable Fuel Standard looks like a resounding success.

This growth should not come as a surprise as it is not rooted in magical leaps in technology but in fundamental economic theory. Conventional economic wisdom holds that when price increases supply should also increase. If a good's value jumps, producers of the good will likely be able to produce more of the good. Why should corn ethanol or biomass-based

diesel be any different? The chart to the right illustrates this reality^{xv}.

Adding the value of RINs to a biofuel necessarily makes it more economical to produce, as they dictate a new mandated point on the demand curve. The RIN value should, in theory, bridge the gap between the supply and demand

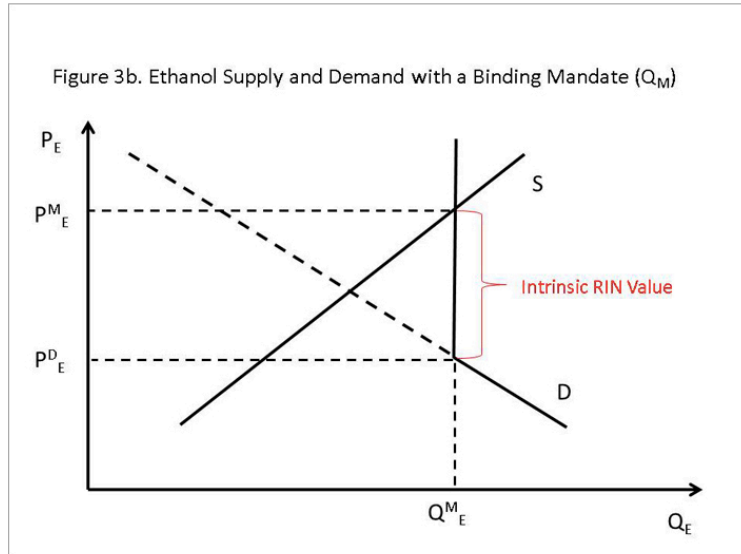


Figure 1 Sourced from Farm Doc Daily: RIN Economics

points resulting from a mandate. Point Q_M^E , where the large gap in price between the forced quantity demanded and quantity supplied is compensated for by the RIN value, illustrates this point. It should come as no shock, then, that biofuels production increased since the program's inception.

Regardless of whether the growth is a result of the added value created by RINs or from an advancement of technology, the scorecard of growth in renewable fuels in the aggregate reads favorably for the Renewable Fuel Standard program. President of the Renewable Fuels Association Bob Dinneen wrote to U.S. News using this exact scorecard as proof that "The RFS has been a resounding success in reducing greenhouse gas emissions, decreasing U.S. dependence on foreign oil and providing consumers with a cleaner, higher-performing alternative at the pump."^{xvi} Of course, increased domestic production of biofuels does reduce foreign oil imports and, depending on which carbon accounting method is used, decrease greenhouse gas emissions. Numerous confounding variables, such as ethanol replacing MTBE as gasoline's primary oxygenate additive^{xvii}, exist that offer an alternative explanation for the remarkable

growth of biofuels production over the last decade. Using growth in biofuels as the sole metric of success is akin to assessing a quarterback's performance solely on the amount of passing yards he throws for in a game.

Critics differ with Dinneen not on the scorecard of aggregate renewable fuels production but with the growth's causation and the lack of growth within portions of the program's nested structure. Examining each of the program's goals to evaluate performance of the Renewable Fuel Standard will paint a better picture of how an acting EPA Administrator might rationally determine RVO in 2023 after evaluating prior years' performance against goals. The nested structure of the program complicates the evaluation process, thereby making an assessment of the performance of policy goals the most efficient means of evaluating the program at large. By choosing to settle on a myopic assessment of the Renewable Fuel Standard's performance, policymakers would misplace incentives and direct the market in a direction that runs counter to the policy's actual goals. This is not a mistake the United States can afford to make; consequently, the performance of the program against each of its goals must be fully examined.

Policy Goal 1: Increase Energy Security

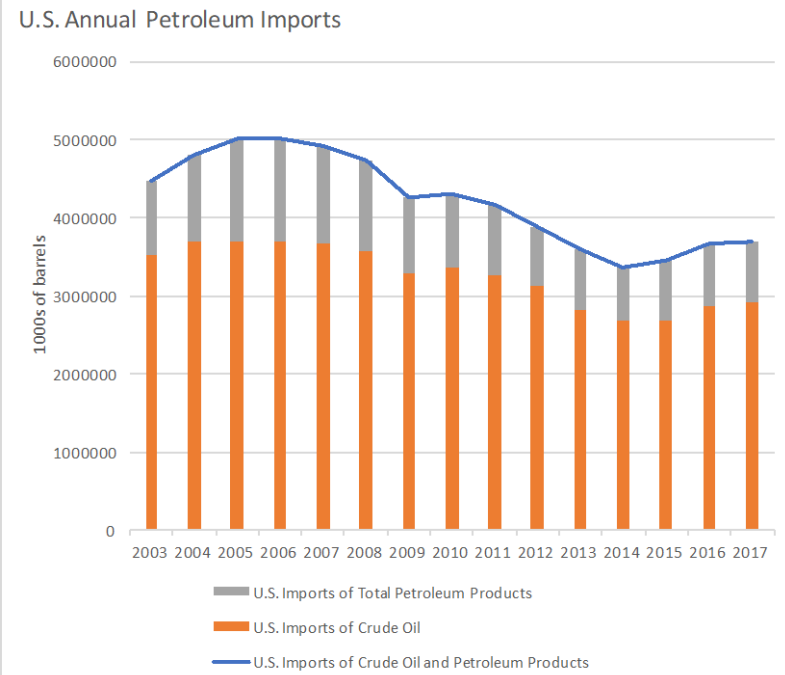
The twin oil price shocks of the 1970's coupled with concerns of Peak Oil Theory imbued fears of energy insecurity into the psyche of American citizens. Long lines and higher prices at the pump coupled with an increased portion of the country's energy supplies coming from nations that are hostile to our own amplified these fears. In line with this mentality, President George W. Bush warned of America's oil addiction in his 2006 State of the Union Address^{xviii}. President Barack Obama, standing on the opposite end of the political spectrum as

security.^{xix}” The parallel in quotes from two ideologically opposed administrations underscores the bipartisan nature of energy security concerns. It logically follows that the Renewable Fuel Standard requires the EPA Administrator to assess impacts on energy security when formulating future Renewable Volume Obligations. This calculus changes if the relevance of energy security as a national issue underwent a paradigmatic shift since the Bush and Obama days.

Defining energy security is itself a difficult task, especially as the world becomes increasingly interconnected. The International Energy Agency attempts to define the term as meaning “the uninterrupted availability of energy sources at an affordable price.^{xx}” Based on this definition, both price and accessibility are variables that must be considered in an assessment of the Renewable Fuel Standard’s aim to increase energy security. Does this mean the program should be judged on how low oil prices have fallen since inception? What is an “affordable” price? For whom must the price be affordable? Entire books are written on the inherent volatility of crude oil prices, a reality of market fundamentals that render price an unfair judge of the program’s success.

The IEA’s usage of the term “uninterrupted availability” better lends itself to quantitatively analyzing energy security. Perhaps the best proxy for assessing energy security, then, is the Energy Information Administration’s petroleum import data. After all, the only way to ensure an uninterrupted supply of energy is sourcing it from within the country’s borders. Comparing the increase in ethanol production since the inception of the Renewable Fuel Standard against the change in petroleum imports over the same time period will reveal to what extent the program increased energy security.

Looking at the data suggests that growth in ethanol production helped bring down total crude oil and petroleum products imports. Shown graphically, right, imports have enjoyed consistent annual declines since the debut of the Renewable Fuel Standard. The relationship between the two holds up mathematically as well: the correlation coefficient between the two data sets comes in at -



.8577. At this point, skepticism should pour in. How could ethanol, whose 2011 to 2012 year-over-year growth is just 16,000 kb, be responsible for a 295,000 kb decline in total oil and products imports? Even though the correlation looks strong, causation does not logically follow due to the order of magnitude difference in annual changes for the two data series. One ethanol barrel cannot displace 10 oil barrels.

As a result of this mismatch in orders of magnitude, the Renewable Fuel Standard cannot be concluded as being responsible for the strengthening of energy security, or at least not for 90% of the decline in

Data Sets Analysis	
Correlation Between Imports, Crude Production	-0.8819
Correlation Between Imports, Ethanol	-0.8578

imports since the program’s inception. Recent breakthroughs in the domestic extraction of hydrocarbons from shale rock through a combination of hydraulic fracturing and horizontal drilling distort any study of how the Renewable Fuel Standard impacted energy security. These

breakthroughs and the associated resurgence in U.S. petroleum extraction are far more responsible for making our energy supply more secure than the Renewable Fuel Standard. This, too, holds up mathematically with a -0.8819 correlation coefficient between crude oil production and petroleum imports. There is also alignment in the respective orders of magnitude.

Of the many consequences of the United States' newfound ability to extract vast quantities of oil and natural gas, the diminishing weight of energy security concerns in policy discussions holds particular importance here. Senators from states indifferent to farming incomes and skeptical of climate change could at least potentially be swayed to cast a vote in favor of the Renewable Fuel Standard due to energy security concerns in the past. The aforementioned former Senator Jim Talent falls into precisely this category, having launched Americans for Energy Security and Innovation, which will “focus its efforts on building support for a stronger RFS to reduce our dependence on foreign oil from unfriendly nations.”^{xxi} Now, however, this policy concern stands largely addressed by a market development that occurred totally independent of the program. Adversarial oil-producing behemoths no longer necessitate the energy security goal of the Renewable Fuel Standard.

The policy goal attainment looking like a resounding success story of the Renewable Fuel Standard to only be uprooted by the analysis of a confounding variable is par for the course with the Renewable Fuel Standard. Later, the reduction in U.S. Greenhouse Gas Emissions will follow this same pattern. Understanding the real drivers of policy goal attainment (or, failure) leads to the final conclusion that an impartial administrator will focus on setting goals that continue to advance rural incomes and decrease greenhouse gas emissions.

Taking a cue from the rhetoric of current Energy Secretary Rick Perry would completely remove the energy security goal from the policy language of the RFS, “An energy dominant

America will export to markets around the world, increasing our global leadership and our influence.”^{xxiii} Indeed, Secretary Perry and the Administration at large are focused on energy dominance, not energy security, manifesting that the energy security policy goal was accomplished almost by accident by something that runs counterintuitively to the RFS. As such, any new version of RFS will have to be focused on the other two main goals, to the extent that they each remain relevant. The diminishing concern about energy security requires that any new RFS be rooted in either advancing rural economies or achieving GHG reductions.

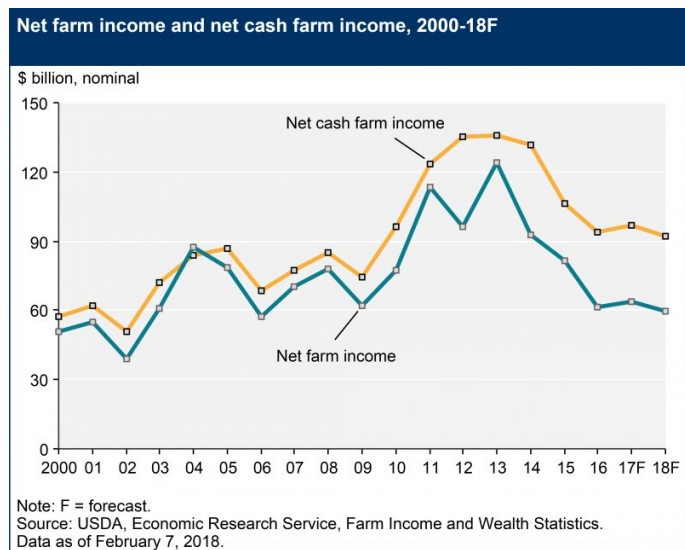
Policy Goal 2: Advance Rural Economies and Farm Incomes

The policy’s goal to assist the nation’s farmers through price support brought on by increased demand can be evaluated in a multitude of ways. For the purposes of this paper, farm incomes are seen as the best evaluative tool as this is the actual amount of income earned by farmers in rural America. To be truly conclusive, using net lift to farm incomes by deploying models that backed out probable crop prices without the Renewable Fuel Standard would be required. As this falls outside the boundaries of what this paper seeks to accomplish, data from the USDA is utilized as a proxy.

Here, net farm incomes are seen as declining ever since 2013, suggesting that the RFS needs to continue in order to achieve the rural income goal. There should still be no denying that the Renewable Fuel Standard assisted farmers since its inception as the core of the program involves increasing demand for corn and soybean oil. Imagine, for a moment, just how steep the decline in incomes would have been *without* the RFS. Conventional economic wisdom dictates that increased demand leads to increased prices. To confirm the value of the RFS to rural America, Iowa State University (ISU) researchers developed tractable multi-market equilibrium models that reached a conclusion that the program does indeed support the agricultural economy.

The study estimates a corn price without RFS and with 2022 mandates of \$2.75/bu and \$3.88/bu, respectively. The study runs the same analysis for soybean oil and arrives at a price of 21.17 cents per pound without RFS and 27.81 cents per pound based on a 2022 mandate estimate^{xxiii}. According to this analysis farmers would receive 23-29% less revenue for their crops without the RFS mandates!

Farmers themselves are among the loudest proponents of the program, as evidenced by the National Corn Growers Association’s comment that states “Rural America supported President Trump last year, now we need the President to support rural America. Supporting policy changes that undermine the RFS will hurt farmers, renewable fuel plant workers, and rural America.”^{xxiv} This quote and ISU study



highlight the importance of the RFS to farmers by showing how much price support the RFS provides to agriculture markets. As such, the policy goal of providing support to rural America and the agriculture industry was certainly achieved by the RFS, as it theoretically should, given the demand mandates. Whether more support is or is not needed to maintain the livelihoods of these groups and communities cannot be inferred from the previously mentioned data. Nonetheless, the agriculture industry – whose voice rings loudly in Washington – certainly claims that continued or greater support is indeed needed to placate farmers in America.

This goal will necessarily be a key focus of the Administrator in 2023. If the Trump Administration still holds power, this goal will be ever-so central to the RFS as the

Administration has had to place major Band-Aids on the trade war wounds of rural America through innovative vehicles such as a \$12 billion aid package^{xxv}. The Administration needs to maintain its political capital with farm states following the trade war's consequences and the RFS is one area that can deliver the relief the agriculture community craves.

In many of my phone calls with former EPA officials and industry participants the future of biomass-based diesel was debated. For example, in an RFS re-write, an olive branch could be extended to big oil where biomass-based diesel targets would be removed (or at least relaxed) from the policy language and ethanol targets remain.

This report holds a view that such a compromise is fundamentally at odds with what will be politically required of any elected officials in 2023 and beyond. Besides from being an egregious move away from the policy's environmental goals, such a compromise would hurt some of the nation's most vulnerable farmers. Soy farmers in America already ailing from the Chinese Trade War would be further damaged by removing biomass-based diesel targets from the Renewable Fuel Standard. Plus, soy cannot be so easily dismissed as it was reported that it would surpass corn in amount of domestic acreage in March 2018 for the first time in 35 years^{xxvi}. Recently, a Bloomberg report deepened the market-forced marriage between politicians and the agriculture community by concluding that "If history is any guide, the trade war with China will have lasting affects for U.S. farmers and their soybean crops that the president won't be boasting about."

Farmers have been vocal in stating their concerns over recent evolutions in the RFS such as the rise in small refinery exemptions under former EPA Administrator Scott Pruitt. Purdue University economist Wallace Tyner summarized rural America's worries by saying that farmers "thought they were voting for an administration that was supportive of rural America."^{xxviii} This

may seem to simply be another manifestation of American's evolved relationship with government, one Michael Lewis covers in The Fifth Risk through a quote from a former NOAA leader who said that "The sense of identity as Citizen has been replaced by Consumer. The idea that government should serve the citizens like a waiter or concierge, rather than in a collective good sense." What makes this case more pressing than just reflecting this evolution is that farmers' perceptions of how the Federal government handled the Renewable Fuel Standard will be crucial in deciding who wins control of the White House in future elections.

States that flipped from voting for the Democratic Presidential Candidate in 2012 to now-President Donald Trump in 2016 are shaded in the darker red with diagonal lines running through it in the map on the right of the below graphic. The fact that these states align neatly with the states who are decidedly pro-RFS in the attached Senate analysis spells trouble for any President trying to win reelection without supporting rural economies. **Analyzing Senate support for the RFS and aligning it with the Electoral College map limits Congress's ability to make meaningful downward revisions to the policy, as any political party seen as being hostile to the interests of the agriculture community could quickly have the Electoral College map flipped against them.**

States that Flipped from Obama to Trump in 2016 Align Neatly with Convincingly Pro-RFS States

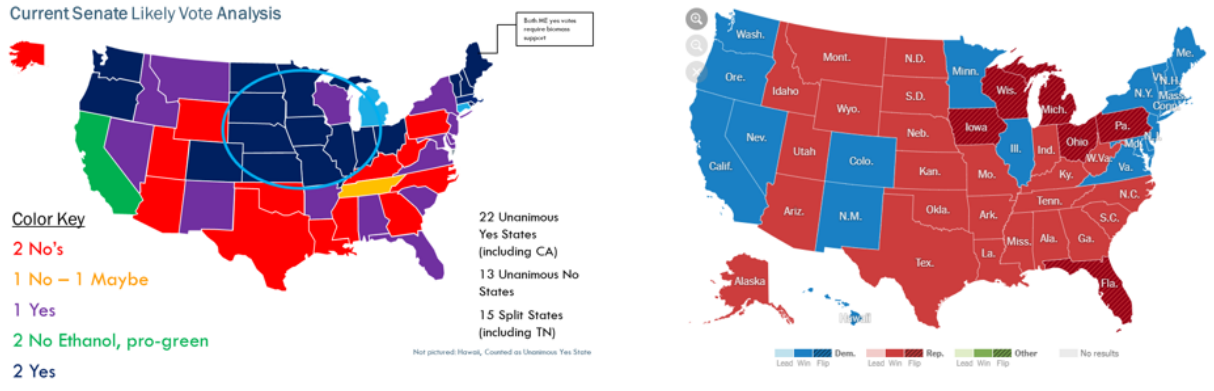


Figure 2 Chart on Left Built from Senate Analysis

All this serves to shed light on the future of RFS: farmers will continue to receive the aid they desire. Outright continuation of the RFS in at least *some form* is almost guaranteed, irrespective of how Congress does or does not act to rewrite the legislation. That is the reality of the politics. Politically important states on the above graphic are the same states that need the Renewable Fuel Standard the most. Consequently, it seems likely that support for ethanol at 15 billion gallons a year will remain, as should the floor for biomass-based diesel of 1 billion gallons. If any major change should come to biomass-based diesel as a result of rural income concerns, it will be an upward revision as opposed to an outright elimination.

Still, ethanol is the most at-risk of being axed from any future Renewable Future Standard as it is widely believed that the fuel’s oxygenate blending properties can shield it from any demand loss in the event of mandates being erased. University of Illinois Economist Scott Erwin echoes this view, arguing that “If the law changed tomorrow and gasoline companies were free to ignore ethanol, they’d almost certainly keep right on blending ethanol into their fuel.”^{xxix} In a compromise between the agriculture and petroleum lobbies, ethanol could be accounted for through some other policy mechanism outside the RFS while biomass-based diesel mandates live on.

As such, any compromise to appease farmers accustomed to the added crop value provided by RINs would have to rely heavily on providing support to the biodiesel market rather than the ethanol market. Farmers might want incentives across the board, but achieving the other goals of the Renewable Fuel Standard requires a transition away from ethanol.

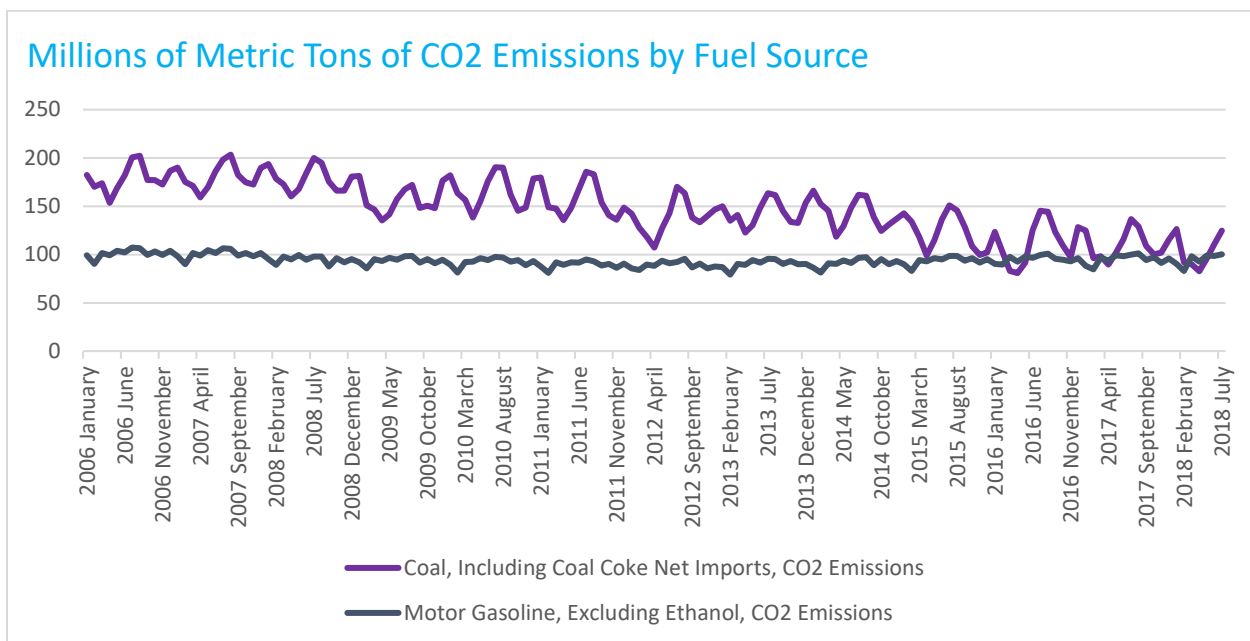
Program Failures and Policy Goal #3

Despite the astronomical growth of biofuels following the implementation of the Renewable Fuel Standard, critics have reason to be skeptical of the Renewable Fuel Standard success narrative put forth by Dinneen and Talent. Among the critiques is the refrain that the outsized majority of the growth comes from corn ethanol, a fuel that satisfies the RFS goal of supporting rural economies but at an uncertain cost to the environment^{xxx}. Any potential claim that the RFS succeeded in reducing greenhouse gas emissions in a meaningful quantity was uprooted by the National Climate Assessment's recent conclusion that "Without substantial and sustained global mitigation and regional adaptation efforts, climate change is expected to cause growing losses to American infrastructure and property and impede the rate of economic growth over this century."^{xxxi}

On top of that, the growth in cellulosic biofuels would not even appear on the same linear scale as ethanol growth in a chart with a single Y-Axis. It was only after the EPA allowed for Renewable Natural Gas from biomass to qualify as an approved pathway that any noticeable cellulosic fuel growth materialized. If the program was created, in part, to transition away from fuels that create GHGs and limit the use of food-competing fuels, critics use the below analysis to call the program a failure.

Even as the United States decreased greenhouse gas emissions in the aggregate, the Renewable Fuel Standard is not currently applauded by environmental groups. This results from

the fact that declines in the power sector are the reason for the recent decline in the country’s GHG reductions. In fact, in late 2017, as the power sector benefited from the displacement of coal generation with cleaner-burning natural gas^{xxxii}, transportation replaced the power sector as being the largest greenhouse gas emitting sector of the economy. This is the complete opposite of what the RFS was designed to achieve. Looking at a chart of greenhouse gas emissions from gasoline consumption versus coal reveals that it is the increasingly declining coal emissions coming down that is largely responsible for the United States reducing its overall carbon footprint since 2006. Gasoline emissions, however, were hardly reduced.



The Renewable Fuel Standard hardly resulted in any tangible benefit to the environment, then, especially when considering that the accounting merits of ethanol lifecycle emissions are still debated and other environmental concerns have been raised. Former California Congressman Henry Waxman tore into the environmental side of the Renewable Fuel Standard, stating that “I supported the admirable environmental goals of the RFS when we created it 10 years ago. Now, it’s clear that the RFS has been a net-negative for the environment. Not only has

the RFS failed to spur significant development of truly advanced fuels, but conventional biofuels like corn ethanol and soy biodiesel are destroying wildlife habitat at home and abroad, polluting waterways, and increasing global warming pollution.”^{xxxiii}

Dispelling the narrative that the Renewable Fuel Standard has been an unflinching success requires looking no further than the actual production of fuels other than ethanol. The original mandate for 2017 advanced cellulosic fuel production was 5.5 billion gallons; yet, just 10 million gallons were produced. The technology that was supposed to come is still stuck in traffic. Fuels that were supposed to deliver the greenhouse gas emission reductions did not come, even as ethanol production took off. Compounding the environmental woes of repeated mandates misses is the fact that “between 2008 and 2012, farmers plowed under more than 7 million acres of habitat, mostly to plant corn and soy. That led to the release of carbon pollution equivalent to the annual emissions of 20 million additional cars on the road,” as written by David DeGennaro of the National Wildlife Federation^{xxxiv}. This speaks to former Congressman Waxman’s view that the RFS not only failed to help the environment, but hurt it in the process of seeking the advancement of rural incomes.

The list of environmental problems associated with the Renewable Fuel Standard runs on, with the Competitive Enterprise Institute recently writing that: “There is considerable evidence (including a recent report from EPA itself) that pristine grasslands, especially in the upper Midwest, have been converted to grow corn used to make ethanol.”^{xxxv} And yet, the program marches on, undisturbed. At the same time as it fails to reduce greenhouse gas emissions in the way the program originally set out to, the Renewable Fuel Standard appears to be causing myriad environmental damages while the other policy goals are pursued with force. Curbing these issues and properly incentivizing reductions in greenhouse gas emissions are

crucial pillars to allow any foundation of a future Renewable Fuel Standard to stand on solid environmental ground. The original environmental goals are both unachieved and still relevant, demanding they be a central consideration in any future change to the program.

Now a cliché, Einstein's original articulation that labeled insanity "doing the same thing over and over and expecting different results" applies to the environmental goal of the Renewable Fuel Standard over time. Hoping the Renewable Fuel Standard will guide the market to a promised land of clean, renewable fuels requires faith -- belief without evidence -- because the facts suggest it simply has not worked. As such, either a greater incentive or completely reimagined RFS will be required to deliver on the environmental goals of the legislation. Rep. Peter Welch and Senator Tom Udall introduced bills into the house and senate in March 2018 that would phase out the ethanol mandate and introduce an incentive to protect land from being used in agriculture production. Though this bill is not seen as likely to pass, the appetite among Congressmen to revise the RFS in order to ensure its environmental goals are reached speaks volumes about the future of the legislation. What, specifically, reform will look like given the lack of environmental improvements created by RFS 2.0 is the focus of the remainder of the report.

What Reform Can and Should Be

There are many competing thoughts on what reform of the Renewable Fuel Standard should look like, and the politics of the legislation are extraordinarily complicated. The analysis of policy goals in this report suggests that reform requires increasing incentives for reducing greenhouse gas emissions from transportation fuels, maintaining some level of support for rural economies, and rethinking the ethanol mandate. In an ideal world, Congress should construct a program that mandates biodiesel, renewable diesel, and advance biofuels blending without any

regard for ethanol blending. Ethanol demand already derives support from its aforementioned benefits as an octane enhancer in gasoline. Mandating its blending is akin to creating a law that rewards humans for consuming calories. If a behavior would happen without the presence of a policy, why subsidize it?

To increase the odds of passing legislation that satisfies enough interested parties, an RFS 3.0 is devised below that features two classes of RINs, one for ethanol (with the caveat that an ethanol phase-out should be instituted so long as the voting structure of Congress allows it to pass) and one for all other biofuels. In the reimagined RIN awarding process, all fuels are assessed based on their greenhouse gas emission reductions and measured against the same metric for ethanol in the RIN awarding process. The greater the lifecycle GHG emissions reduction against ethanol, the greater the reward. Here, the actual desired outcome -- greenhouse gas emission declines -- is properly incentivized. Awarding RINs based on the achieved emissions reduction against ethanol ensures the market will transition to more environmentally-friendly fuels. At the same time, maintaining the incentive for biomass-based diesel will continue to lend support to rural economies.

One of the common arguments from Senators is that the nature of RIN trading needs to be changed due to high compliance costs and unpredictable costs created by the volatility of the RINs market. In some circles, capping the RIN price is synonymous with Renewable Fuel Standard reform. Texas Senator Ted Cruz stands at the center of this circle with a constant request for a 10 cent price cap on RINs^{xxxvi}. It is worth noting, however, that any artificial cap on RINs prices is not viewed as a feasible solution to the challenges the Renewable Fuel Standard faces. Real reform requires moving beyond a price cap and restructuring the program to

more closely align with its policy goals. Doing this satisfies those wanting more predictable compliance costs by removing layers of political uncertainty, as discussed below.

Capping the cost of compliance would distort market signals and impede the policy's abilities to achieve its goals; if compliance is not occurring, prices have to respond accordingly. Though it may be politically popular in petroleum products-producing states, a cap would hurt the very farmers that politicians now have to try desperately to help amid a trade war that has hurt rural America. This is not to say that reform should not include any adjustment to the market's overall structure; any market structure not achieving its policy goals should not be left to its own devices in perpetuity. Rather, it is the actual cause of missed policy goals that must be handled.

The real problem with RIN price volatility is not that prices are allowed to float freely but that the administrative body often sends distorted signals to the market and the price is not indexed to the extent to which any individual RIN achieves policy goals. One day, the administration waives small refineries from needing to comply with the Renewable Fuel Standard; the next, the President will speak on the need to permit year-round sales of E15 (a gasoline blend containing 15% ethanol). This flip-flopping in the political approach to renewable fuels disrupts the market's functioning. To address the former of these issues, maintaining transparency and limiting political threats should be the priority of political leaders once reform passes. Distorting an already complicated market with price controls would only deepen the problems with the program as changes in Washington leadership could cause a reversion to a fully free market, and hence increased volatility around added political uncertainty. Limiting the economic value obtainable from a RIN would also prohibit the program from achieving its own

goals as markets would not be able to adjust to incentivize the marginal gallon of renewable fuel to be produced.

Adding price controls to the market would be akin to fighting fire with fire. Increasing the government's presence in the market would lead to increased potential for volatility over time. Government's role in the RFS should be setting mandates, ensuring compliance, and providing clear signals about what type of market behavior is desired. Obscuring these signals, managing prices, and adding layers of uncertainty hamstringing the Renewable Fuel Standard's potential.

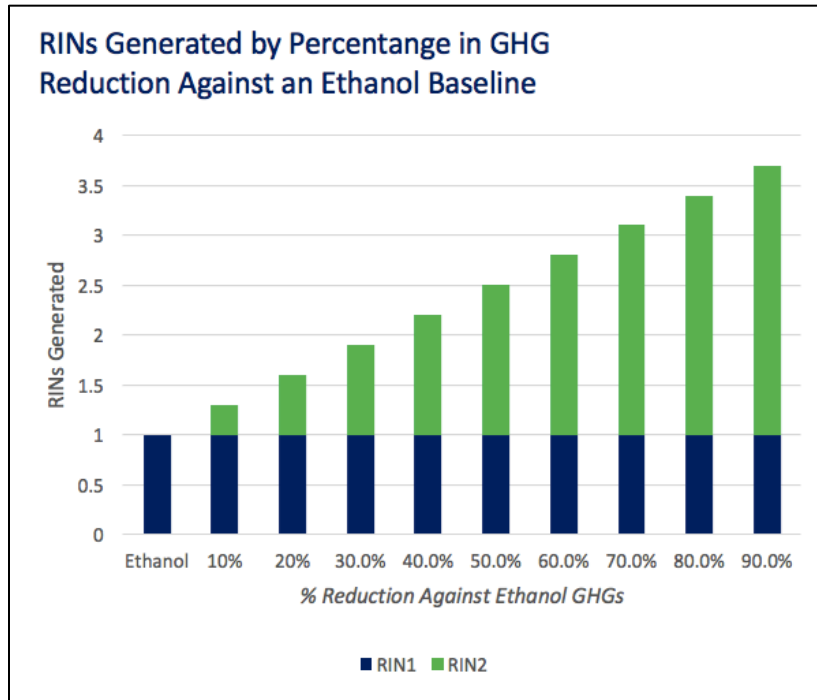
With this in mind, the Renewable Fuel Standard's future is often painted as one that should either be the same as it is today or completely eradicated. If two of the three policy goals have not changed, there should be no reason that the debate need be so binary. Neither a perpetual continuation nor an outright kill bill should be the proposed solution: calculated reform should be the answer. One school of thought for reform was previously mentioned as protecting lands; though important, such an amendment is more of a supplement to full RFS reform than it is constitutive of reform in and of itself. Land protect is a necessary, but not sufficient, condition of an RFS 3.0. Reform requires reimagining how RINs are awarded and aligning the entire RIN generating process with the policy's goals.

In order to generate a RIN in the program's current form, biomass-based diesel must meet a 50% lifecycle GHG reduction, cellulosic biofuel must meet a 60% reduction, advanced biofuel from biomass (other than corn starch) must meet a 50% GHG reduction, and conventional renewable fuel – usually, ethanol – must meet a 20% lifecycle GHG reduction threshold. What's lost in all this is a reward for reductions that exceed the thresholds; currently, producers of renewable fuels have no economic incentive under the Renewable Fuel Standard to

reduce GHG emissions in excess of the stated requirements for each fuel. Fixing this misalignment should take center stage in the reform process, especially given that the environmental goals of the program appear to be the furthest from complete of all the program's policy goals.

After contemplating various reform proposals, I created a high-level organization of the RFS that would align the incentive structure more closely with the program's goals. In this structure, two classes of RINs would exist: one that gets awarded to all "renewable" fuel production and a second from renewable fuels that achieve greenhouse gas emissions (GHGs) reductions in excess of conventional ethanol. RIN1, in this sense, could be limited to 15 billion gallons per year, thereby artificially limiting the price volatility of RIN1 as it would not qualify for RIN2 and therefore not be subject to volatile political changes. RIN2 quantity requirements, however, would be assigned an annual mandate based on the desired reduction in the amount of greenhouse gas emissions of the United States' overall transportation fuel mix. The existence of RIN1 is solely to ensure a relatively high possibility of passing legislation that included these elements.

In order to generate any RIN2's a renewable fuels producer would be required to demonstrate a proven reduction in greenhouse gas emissions against a conventional ethanol baseline in the same way that current greenhouse gas thresholds are evaluated at EPA under RFS 2.0. In this program, the amount of RINs awarded aligns directly with the amount of greenhouse gas reductions achieved by the fuel. Somebody who achieves a 40% reduction in a fuel's GHG reductions would receive twice as many RIN2's as a producer who achieves a 20% reduction.



RIN1 is proposed only to earn the Congressional votes of ethanol-producing states; to fully move the program into the new realities of the market, the ethanol mandate would have to have a sunset provision. Analyzing the Senate make-up suggests that excluding any ethanol

mandate would sacrifice up to 14 Senate votes whose support for RFS was identified as being contingent upon the ethanol mandate. This would send RFS support well below the majority, even when counting all remaining “Maybe” votes as “Yes” votes. The inclusion of ethanol also satisfies the advancing rural economies goal of the original legislation. It will ultimately be the policymakers who decide the fate of the ethanol mandate; the fractured views on the subject could result in the killing of the mandate with a compromise for the introduction of some other policy mechanism to support ethanol demand.

Congress establishing desired national GHGs reduction targets for transportation fuels at the program’s inception would limit volatility induced by the EPA rulemaking process each year. Parties desiring a cap on ethanol RIN prices would be dually satisfied as RINs generated from ethanol production would be capped at the current upper limit of 15 billion gallons per year. With an artificial supply limitation, the volatility associated with RIN1 prices would be suppressed as ethanol is already generated in large quantities to be utilized as a gasoline additive

for performance characteristics. With time, Congress could even wind down this portion of the “ideal” Renewable Fuel Standard to award only the fuels that achieve a clear environmental benefit against ethanol.

The most important distinguishing factor of this “ideal RFS Reform” is that it neatly aligns the market reward with the extent to which a fuel meets a specific policy goal. In former Speaker of the House Paul Ryan’s book The Way Forward, he writes “if you tax something, you get less of it.” The flipside of this relationship is that if the United States demands more of something, it must *pay for it*. Rewarding each additional percentage reduction in greenhouse gas emissions will better incentivize investment in clean, renewable fuels. Assigning annual RIN2 mandates based on percentage reductions in greenhouse gas emissions would also tie the theoretical value of a RIN with its value towards achieving a policy goal. Incentivizing renewable fuels production of any kind mistakes the means for the end. The end goal is not production growth; rather, production growth is a means to the end goals of advancing rural economies and reducing the environmental impacts of the transportation sector.

The first two goals – advancing energy security and supporting rural incomes – are also achieved herein as any gallon of a domestically produced renewable fuel continues to be a gallon of fuel not imported from potential adversaries and the RIN1 price could serve to maintain rural incomes from farming. Additionally, biomass-based diesel must already meet a GHG reduction that is larger than the reduction required of ethanol so the RIN2s generated by soy-based biodiesel would further compensate farmers. Other policy mechanisms would need to be designed should Congress wish to wind down the ethanol mandate with time and still desire some form of market assistance for rural economies. At its core, this version of the Renewable

Fuel Standard would shift the quantity of a good desired from renewable fuels to reduced greenhouse gas emissions from renewable fuels.

RFS 3.0, as described above, is in line with the policy's original goals and informed by evolutions in goal attainment of the policy over time. It also reflects a level-headed assessment of confounding variables that have distorted the extent to which other goals are still needed: ethanol as an oxygenate has firmed demand for the fuel independent of the RFS; rapid increases in domestic production of fossil fuels have transformed energy independence; and the power sector's shift to natural gas has been the real driver of declining U.S. GHG reductions. Transparent, firm, and Congressionally-passed annual GHG reduction mandates will give the market the clarity and incentive needed to encourage long-term investment in "next generation" renewable fuels.

California's LCFS follows a similar structure as the federal program proposed above. "The LCFS requires producers of petroleum-based fuels to reduce the carbon intensity of their products, beginning with a quarter of a percent in 2011 culminating in a 10 percent total reduction in 2020."^{xxxvii} The program administers compliance by requiring carbon producers such as refiners to either develop their own low CI fuels or purchase LCFS credits from those who do. Indexing credit values to the quantity of the reduction in carbon intensity is an idea borrowed from LCFS and one that works with proven success. Even with a few complications along its path, the success of the LCFS is well-documented, with an Executive Vice President of the Renewable Fuels Association recently saying "It seems like there's less risk that something could go wrong with the LCFS, whereas with the RFS, gosh—it seems like every day we've got a new headline coming out about some new clandestine, secret effort to undermine the RFS."^{xxxviii}

In James Stock's "Reforming the Renewable Fuel Standard" paper for Columbia University's SIPA School, he concludes that two of three key legislative reforms of the RFS are to "reduce sharply the compliance costs of blending ethanol into E10. This component builds on the recognition that ethanol has become the cost-effective choice for octane enhancement" and to "transform the second-generation part of the RFS into a technology-pushing program that provides reliable, effective, and long-term support for nascent low-GHG renewable fuels, regardless of feedstock."^{xxxix} Both of these goals are central to the RFS 3.0 designed above: by attaching RIN generation to the value of GHG reductions, advanced technology is properly incentivized by matching the value of the incentive received to every incremental achievement in greenhouse gas reductions.

Compliance costs of blending ethanol also would theoretically come down as the ethanol RIN price should adjust to reflect the needed value based on supply and demand fundamentals of the market. If supply of ethanol overwhelms demand of RIN1s because of ethanol production occurring as a result of octane enhancement demand, the price of RIN1s should drop to a level that matches the needed subsidy. With time (and with a Congress that has the political ability to withdraw it) the RIN1 could be completely phased out and only greenhouse gas emissions in excess of ethanol's reductions would be rewarded.

Stock also pinpoints "the small markets for E15 and E85" as a culprit for why volatility in the RINs market is so high; additionally, he highlights that "RIN prices are sensitive to rumors and market guesses." Both of these principal concerns are removed by reducing the significance of ethanol in the RFS 3.0 and through establish emission reduction goals at the program's inception. All uncertainty associated with the rulemaking process would be eluded through the creation of concrete mandates for annual reductions in greenhouse gas emissions. Even though

the principal aim of RFS 3.0 would be to better satisfy the missed policy goal of reducing greenhouse gas emissions, it also lends support to rural economies and continues to increase the domestic production of renewable fuels.

What Will Actually Occur: Politics, Politics, Politics

The reality of the Senate's current make-up dictates that a reconfiguration of the program in 2023 in line with the ideal version outlined above is impossible absent an ideological shift in the Senate's composition. Analyzing each individual Senator's political comments and voting history on RFS-related matters (where available) as of November 1, 2018 reveals that if the Renewable Fuel Standard went through a vote in the Senate tomorrow, 54 Senators would vote yes, 5 could be made to vote yes if certain compromises are made, and 41 are perceived as voting against the Renewable Fuel Standard. Multiple "yes" votes are hinged on strong support for the rural income portion of the policy that assists farmers through mandated ethanol demand. Enough Senators place a hardline on the ethanol mandate that a pure removal of it from the policy would require serious compromise in other areas.

Looking at each vote in the Senate individually gives a sense of what any "RFS 3.0" would look like; such an analysis was necessary as multiple key contacts stated in phone interviews that the program will continue as written through 2023, after which the Senate will act to wrestle the power to determine mandates away from the EPA Administrator by writing new mandates and perhaps a new program entirely.

Prior to analyzing how the assumed Congressional composition would vote (it is assumed that any RFS that passes through the Senate would duly pass through the House), it is worth stating what will occur to the Renewable Fuel Standard in the event that no legislative change occurs. This scenario is given a 40% probability of occurring as it is assumed 100% likely that a

Democratic-controlled Congress would move to introduce an RFS 3.0, thus no probability is attributed to “No Legislative Change” in a Democratic Congress. The odds of a Democratic Senate are assumed to be 20%, the odds provided by FiveThirtyEight’s analysis of the 2018 Senate election^{x1}. Extrapolating this forward through two elections – 2020 and 2022 – is a rough assumption to make but is the best available probability as of now. In the Republican Senate, just a 1/8 chance of legislative change was originally assigned, which aligned the proportion of Republican with senators who either co-sponsored the RFS Kill-Bill (Heller, Lee, and Barrasso), plus those who have outright proposed legislative action to waive the ethanol mandate (Toomey, Cruz, Hatch, Enzi, and Boozman.). This was amended to a 50% chance following the recent introduction of a bill by Congressmen John Shimkus and Bill Flores; the logic here was to include not only the Republican Senators who voted against the ethanol mandate, but also those who are definitive yes votes but deemed as potentially liable to compromise on ethanol in favor of robust mandates for other fuels. The Shimkus-Flores bill indicates that even those who support the RFS in its current form will want to move to institute reform, which amounts to roughly 50% of the Republican Senators analyzed (those who could be seen as passionate about writing a third version of the Renewable Fuel Standard).

As mentioned above, Electoral College fundamentals require a heightened level of political support for ethanol-producing states. The Republican Party is likely unwilling to risk the support of the four key states that flipped the White House for now-President Donald Trump and 17 Senators within the party are seen as decidedly Pro-RFS. This split between 17 Senators being clearly Pro-RFS and 8 being entirely against the program underpins the assumption that a Republican Congress would create the most uncertainty about the future of the program.

No Legislative Change

The resulting tally suggests a 40% likelihood of the “No Legislative Change Scenario;” here, the Renewable Fuel Standard rests in the power of the EPA Administrator. The Administrator is mandated by the original policy language to consult the history of the program’s success in achieving policy goals when determining Renewable Volume Obligations. To the extent that the Administrator’s analysis mirrors the one above, there should be no downward change to biomass-based diesel blending obligations. At a minimum, biomass-based diesel’s mandated blending must exceed 1 billion gallons annually due to a specific requirement in the “All Other Calendar Years” section of the EISA of 2007. In the future, ethanol’s ability to qualify for total renewable fuels is capped at 15 billion gallons a year^{xli}, as well. Beyond this, the market will have to look at “reset” discussions and annual rulemakings to get a feel for any evolution of the advanced cellulosic portion of the RFS. The bottom line remains clear that the most likely scenario for RFS in 2023 in this scenario is a near-mirror image of the program in 2018. This fact contradicts the echoing pains of political uncertainty I unearthed in many of my conversations with those involved with the industry. Short-term noise in Washington does not translate to structural change in a policy program overnight.

The Renewable Future Standard's Future in a Republican Congress

In the 80% chance that Republicans control Congress, a small likelihood of changing the Renewable Fuel Standard was originally assigned. Now, after a recent draft discussion bill released by two Republican Congressmen that would replace the ethanol mandate with a national octane specification and tie annual biomass-based diesel mandates to actual annual production, a 50% probability is assigned. This remains the single most uncertain future scenario for the program and it would increase volatility in RIN markets as the party has two groups with competing thoughts on what the future of the Renewable Fuel Standard should be. At the risk of simplification, the divide is between those from agriculture-producing states versus those from either refining states or those who adhere strictly to laissez-faire ideology. As Senator Chuck Grassley of Iowa chairs the powerful Judiciary Committee and happens to be perhaps the most vocal advocate of the Renewable Fuel Standard, he could wield outsized influence over the party. At the same time, 32 different Republican Senators appear to be outright “No” votes for any future RFS proposal that holds elements similar to the one passed in the Energy Independence and Security Act of 2007. This underpins the uncertainty that such a set-up would pose if the Senate grows uneasy with the program being in the hands of the Executive Branch in 2023, a possibility repeatedly brought up in my questioning of industry participants.

With a Republican Congress and President, the idea of a compromise between the agriculture and oil lobbies was also a talking point in my conversations with industry participants at the American Fats and Oils Association's annual meeting. This compromise, some believe, would take the view of maintaining the ethanol mandate and phasing out biomass-based diesel and advanced cellulosic fuels. As mentioned above, this is viewed as having a near-zero percent chance of occurring due to the prevalence of soy acreage in the nation's farming mix. It would be

political suicide for Senators from soy producing states to openly abandon their soy farmers after these farmers have already been caught in tariffs associated with the U.S.-China Trade War. Getting rid of the biomass-based diesel mandate in favor of keeping the corn ethanol mandate would be a redundant way of hurting soy farmers while awarding corn farmers because ethanol would likely be blended into gasoline even without the mandate due to its value as an octane enhancer.

The Future of RFS in a Democratic Congress

The views of the Democratic Party towards the Renewable Fuel Standard are much more uniform: use it to advance environmental goals. The Senators in the Democratic Party who have voiced hostility to the RFS have done so almost exclusively to the ethanol portion, with Senator Cardin of Maryland mentioning that “Maryland’s large poultry industry has concerns with the RFS and how the diversion of 40% of our annual domestic corn crop is being turned into fuel.” The resoundingly negative associations with ethanol production from land use change and questionability around the accounting for its lifecycle greenhouse gas emissions could put the fuel at risk in a Democratic Congress as multiple Congressman have voiced hostility to the ethanol mandate’s environmental consequences^{xlii}. As such, it appears that the proposed, ideal scenario for RFS reform has the best chance of having its core elements (namely, limiting ethanol growth and properly incentivizing next generation renewable fuel) adopted in a Democratic Congress. The odds of this scenario occurring are just 20%, however; adding this 20% onto the 40% chance of no major legislative change creates a bright future for biomass-based diesel and renewable diesel. This conclusion is at odds with the conventional wisdom I encountered at the conference that spoke of the high potential for cuts to biodiesel.

Overall, it looks like Renewable Fuels producers, farmers, feedstock aggregators, and everyone else in the industry will have to accept that certainty exists for the biomass-based diesel mandate, but the form the mandate will take remains uncertain. As developments in the ideological composition of Congress unfold, the Renewable Fuel Standard Senate tracking tool included in this report's Appendix can be quickly adjusted to reflect any change in the probabilistic model of the program's future.

The Ideal Spot for a Renewable Fuel Producer: Close to California, Close to Feedstocks

This analysis led to one last question: given the current structure of Congress and the Renewable Fuel Standard, where should a producer of biodiesel from used cooking oil, for example, locate within the United States? The robustness of California's Low Carbon Fuel Standard coupled with the state's Cap and Trade program make it a strong home for renewable fuels. Illinois was also considered as the ultimate home for such a production facility as "Through December 31, 2023, sales and use taxes do not apply to the proceeds from the sale of biodiesel blends containing between 11% and 99% biodiesel (B11-B99) or fuels containing between 70% and 90% ethanol (E70-E90)."^{xliii} It was California that was selected as the ideal location, however, as the LCFS program rewards producers based on the specific Carbon Intensity of the feedstock which incentivizes lower CI Feeds such as used cooking oil. Oregon and Washington were dually considered but the longevity of the California LCFS made it less succumbed to political uncertainty. The recent increase in LCFS Credit prices (shown below) as the state strives to meet increasingly aggressive emissions reductions targets heightens the

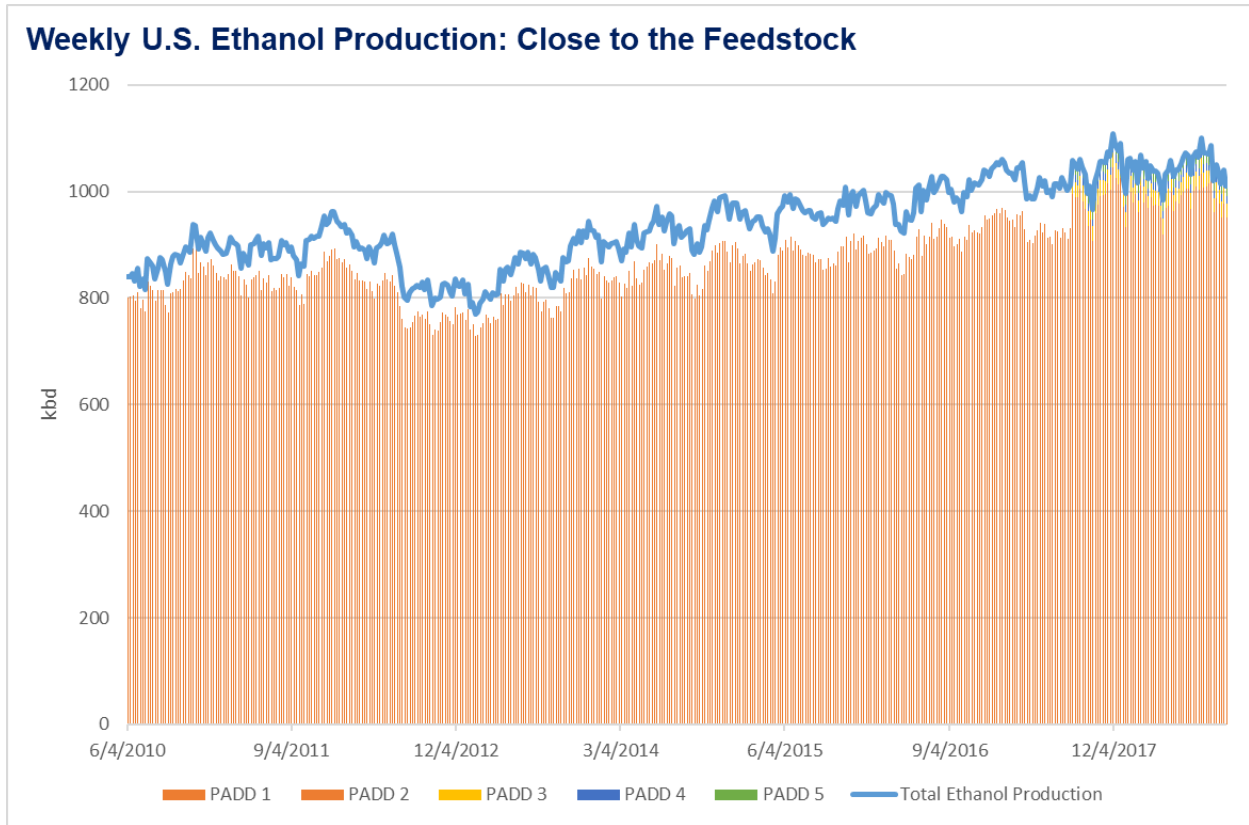
potential of a low carbon intensity feed such as used cooking oil^{xliv}. Since producers are awarded based on the lower CI value of used cooking oil, California’s market makes it a valuable feed.

Demand concerns also led to analyzing specifically California as opposed to Illinois as

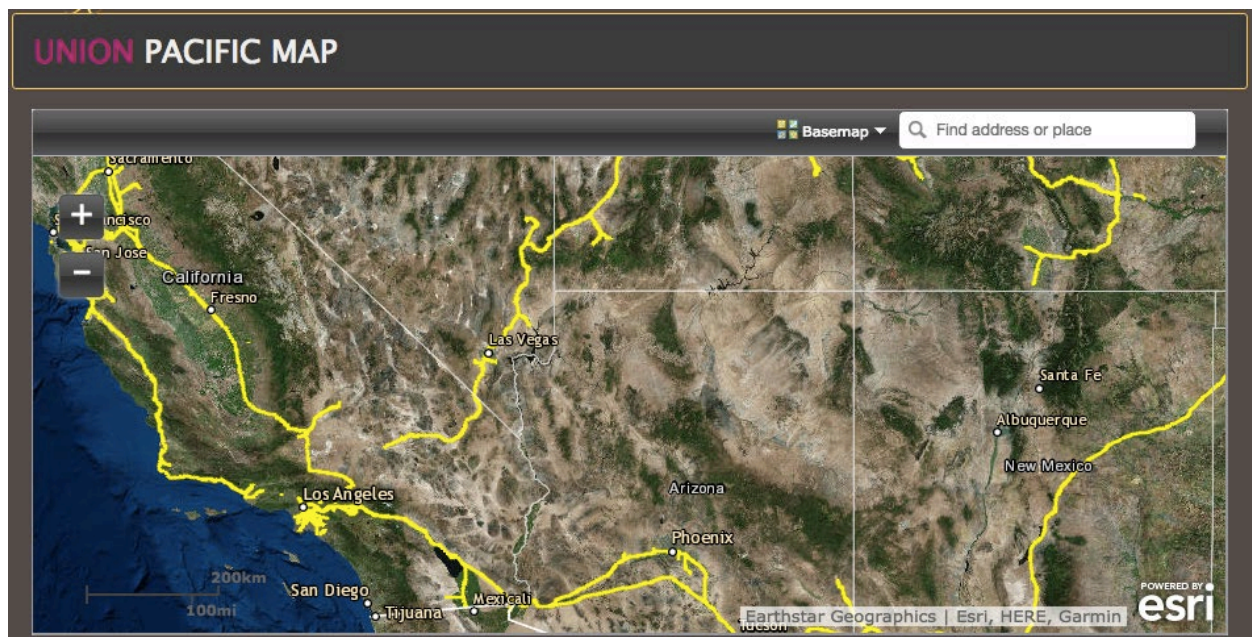


approximately 101 million gallons of biomass-based diesel in the state [of Illinois].”^{xlv} Adding to this concern was the state’s production profile: “The state is a leading producer of both ethanol and biodiesel, with the third-largest production capacity in the nation for ethanol and fourth for biodiesel.”^{xlvi} It seemed more worthwhile, then, to examine the economics of selling biodiesel from used cooking oil into the California market. Industry participants suggested that doing business in the state of California can be both costly and litigious, which led to considering nearby states as alternatives; locating a facility close to the feedstock to minimize transportation

costs is a lesson gleaned from the ethanol industry, which locates nearly all of its plants close to corn production, shown below.



In this process, Nevada jumped out as a state with high potential. Las Vegas, specifically, has the feedstock (used cooking oil) nearby and the rail connectivity needed to service the California market, as shown below. If feed price differentials in Nevada against California and state incentives from the Nevada government outweigh the rail cost, locating the facility in the Las Vegas area demonstrates a higher NPV over nine years than a similar California facility, all else equal. Relative values are used in the NPV calculation as neither feed



prices nor exact rail prices could be obtained on campus. The tool allows for the simplistic insertion of data obtained from price quotes so industry participants can quickly tweak the model to make sure the model's assumptions match their business's reality.

To determine this, all of the variable costs are modeled in a DCF model that allows a user to select a state from a drop-down list, which leads to costs automatically adjusting accordingly. Certain costs, like rail and state-specific incentives are not possible to model specifically without quotes. Here, assumptions are made for differentials between California and Nevada on a percentage basis. This allows for the conclusion that the difference in feedstock costs added onto

state tax incentives must outweigh the rail cost of sending the feedstock into California.

Otherwise, the decline in NPV of doing business in Nevada as brought on by the rail leg must be viewed as compensated for by avoiding the qualitative costs of building a production plant in California (long lead times, highly litigious, etc.).

Relative Performance of a Used Cooking Oil to Biodiesel Plant Assessment Tool

State		California								
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Change based on location	Gallons Sold	1000	1000	1000	1000	1000	1000	1000	1000	1000
Static	Revenue from Fuel Price	3060	3110	3160	3210	3260	3310	3360	3410	3460
	Annual Value of Nevada Tax Incentives	0	0	0	0	0	0	0	0	0
	RIN Value	300	300	300	300	300	300	300	300	300
	LCFS Credit Value	600	600	600	600	600	600	600	600	600
	Blenders Tax Credit Value	1000	1000	1000	1000	1000	1000	1000	1000	1000
	Additional Local Incentives	0	0	0	0	0	0	0	0	0
	Net Revenue	4960	5010	5060	5110	5160	5210	5260	5310	5360
	Feedstock Costs	2400	2400	2400	2400	2400	2400	2400	2400	2400
	Fixed Costs	2448	2488	2528	2568	2608	2648	2688	2728	2768
	Added Freight Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Operating Expenses	4848.00	4888.00	4928.00	4968.00	5008.00	5048.00	5088.00	5128.00	5168.00
	Operating Profit	112.00	122.00	132.00	142.00	152.00	162.00	172.00	182.00	192.00
	Net Present Value	5839.23								

Scenario	10% Feedstock Discount in NV 25 cpg gain in NV due to tax incentive \$10/barrel rail cost	No Feedstock Discount in NV 10 cpg gain in NV due to tax incentive \$10/barrel rail cost	10% Feedstock Discount in NV 35 cpg gain in NV due to tax incentive \$15/barrel rail cost
Nevada NPV	1,712.58	-533.44	2,180.26
California NPV	839.23	839.23	839.23

The tool, illustrated above, concludes that a combination of state tax incentives and qualitative gains of not locating in California must equal roughly ~34 cents per gallon to compensate for the added rail cost and maintain the same NPV of the project in Nevada as in California. Obtaining such a favorable tax package should not be ruled out given that Nevada provided Tesla with \$1.3 billion in tax incentives and other benefits to locate its gigafactory within the state^{xlvii}.

Nevada should be considered as a top destination for Renewable Fuels due to Las Vegas’s abundance of used cooking oil, proximity to sell into the robust California market, appropriate rail connectivity, plus the state’s potential ability to offer a unique set of tax incentives to a biodiesel producer. Although no publicly available data for feedstock costs by region could be obtained, it seems likely that Las Vegas’s used cooking oil could be on sale relative to California’s used cooking oil due to the fact that “Cities with the most fast food restaurants per capita... were spread more evenly throughout the country with Orlando,

Cincinnati, and Las Vegas in the top three spots.”^{xlvi} The current geography of biodiesel plants, shown below, also suggests that any used cooking oil from Las Vegas might be leaving the state to other facilities anyhow. This places a producer located closer to the in-state feeds at a competitive advantage. The second leg of transportation would still have to be on rail, but this criteria is satisfied by the fact that Las Vegas falls on the Union Pacific line into California.

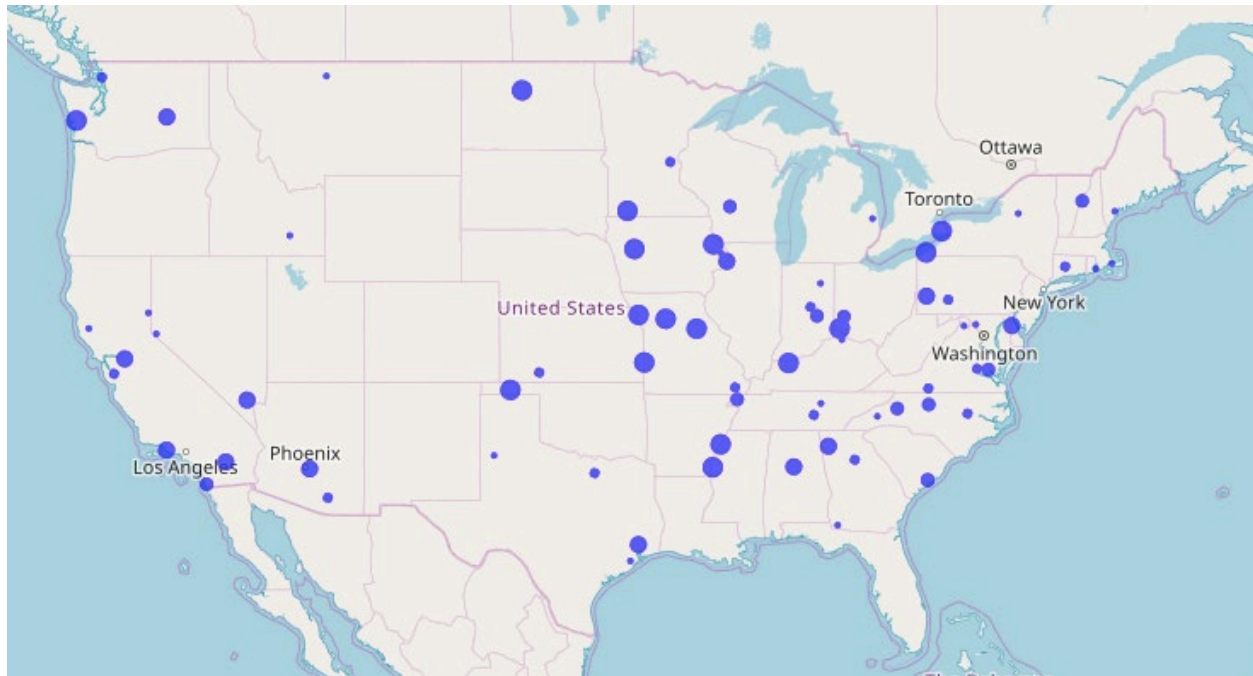


Figure 3 Created using NREL's Biodiesel Atlas

Concluding Thoughts on the Future

Analyzing the composition of the Senate and each Senator's view of the Renewable Future Standard revealed just how fractured the politics around RFS really are. Splits within the Republican Party decrease the ability to forecast the program's future with any certainty, yet one parallel exists outside of the major corn producing states: hostility to ethanol. Republican Senators with no in-state economic incentive to support the ethanol mandate and those with an incentive to vehemently oppose it, such as Texas Senator Ted Cruz, tend to hold a principled view against the Renewable Fuel Standard's ethanol mandate. With some Republican Senators

making the ethanol mandate the whipping boy of their laissez faire rhetoric and a growing environmental concern among Democrats, it is ethanol – not biodiesel – that should be nervous for what it is to come in future policy changes. In fact, this is exactly what happened shortly after I finalized an early draft of this report. The draft discussion bill recently introduced by Congressmen Shimkus and Flores aims to “sunset the conventional biofuel pool under the RFS as of 2023”^{xlix} while simultaneously introducing a new RVO setting process that could lead to increased growth in biodiesel production.

Those bemoaning Renewable Fuel Standard uncertainty have a reason to be exhausted. The drama over small refinery exemptions and E15 sent conflicting signals to a market aching for leadership out of Washington. Is this administration pro-refiners? Pro-ag? What will happen in 2023? These are necessary questions for market participants to ask. But they should not be questions that call for a complete sunset of the Renewable Fuel Standard. Perpetual uncertainty, though exhausting, is a fundamental reality of any legislation that seeks to satisfy a handful of bold policy goals by involving competing parties and technological advancement. In fact, by writing in future growth in advanced cellulosic fuels, the program itself was betting on a wide range of uncertainties. This uncertainty also creates opportunities for companies that invest in understanding the political landscape and specifics of the policy. While nobody at the conference I attended spoke about the removal of ethanol mandates in the future as the probable outcome, my analysis suggests that it can and should happen. Getting caught in the noise can lead to exhaustion whereas analyzing the facts can lead to profit.

The reality of uncertainty does not mean industry participants should entirely ignore all “noise” from the nation’s capital. Understanding which direction policymakers intend to take the Renewable Fuel Standard should underscore the going concern operations of any legitimate

business operating in the renewable fuels industry. When the uncertainty at the Federal level becomes too much to consider a large-scale capital expenditure in the renewable fuels industry, state level legislation can be used as a hedge. The robustness and duration of California's Low Carbon Fuel Standard make its renewable fuels market the ideal home for a producer looking to elude political uncertainty, or at least hedge political risk. For industry participants looking to avoid locating their primary activities in California, the Las Vegas area was shown to be an economical alternative.

Whether it be through California's Low Carbon Fuel Standard, recent moves in Congress to protect biodiesel, or the understanding provided by analyzing the specific policy language, biodiesel's future in the United States is a bright one. Dim forecasts of doom after 2022 were found to be rooted solely in psychological, not political, elements. There are not enough votes in the Senate to sunset the Renewable Fuel Standard; ethanol has a home in gasoline regardless of the Renewable Fuel Standard; and, perhaps most importantly, the environmental goals of the Renewable Fuel Standard are found to have missed their mark by a wide margin. These facts suggest that biodiesel will be well-accounted for in any future of the Renewable Fuel Standard. Around the beginning of forming my thesis question of "What will happen to the Renewable Fuel Standard after 2022?" the industry participants I spoke with asked questions like "will the biodiesel mandate exist beyond 2022?" Based on my analysis, the question is no longer an existential one, but a quantity one: "to what extent will the biodiesel mandate exist" replaces "will it exist?"

Analyzing the policy's goals suggests that a weaker version of the biodiesel mandate is far less probable than a stronger version, a welcomed outcome for anyone involved in the biodiesel industry. We can expect the Renewable Fuel Standard to continue in perpetuity, based

on the policy language, and reasonably expect an upward revision to biodiesel and advanced biofuels in a left-leaning Congress. In a right-leaning Congress, there are too many competing views within the Republican Party to conclude what such a Congress would do to the Renewable Fuel Standard. In both Congressional scenarios, the ethanol mandate is greatly at risk, but biodiesel and advanced biofuels are very likely to maintain their support. Keeping an eye on the dynamic Senate tracking model will be crucial to understand changes in the likely future of the Renewable Fuel Standard.

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