THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

BRIEFING

FEBRUARY 2014

How the Renewable Fuel Standard works

In late 2013, EPA issued a controversial proposal to reduce the volume of biofuel that must be blended into gasoline and diesel in 2014. Political pressure to increase the mandate (from the biofuel industry) and to decrease it (from the oil industry) has pushed the Renewable Fuel Standard (RFS) into the spotlight.

This briefing provides a broad overview of the RFS, including its history and how it is currently implemented. We explain how and why EPA proposed to reduce the 2014 RFS volumes, as well as how different types of biofuels are categorized under the RFS, how the credit trading system works, and how new biofuel pathways can qualify for credits.

ORIGINS OF THE RFS

Policy support for ethanol began over a decade before the Renewable Fuel Standard, with the reformulated gasoline program. In 1990, amendments to the Clean Air Act required gasoline in cities with high smog levels to be reformulated to reduce emissions of volatile organic compounds, which act as ozone precursors, and toxic compounds. Until 2006, the Clean Air Act required reformulated gasoline to contain at least 2% oxygen by weight in the summer and 2.7% in the winter to enable more complete combustion of the fuel in older (pre-2001) cars. To boost the oxygen content of fuel, methyl tertiary butyl ether (MTBE) was widely blended into gasoline, as it was the least expensive oxygenate at the time.

But in the early 2000s, local governments across the U.S. became concerned as evidence mounted that MTBE was contaminating groundwater. EPA did not ban the use of MTBE as an oxygenate but many states did, and as a result refiners began to substitute ethanol for MTBE. At the same time, ethanol use was also promoted through the blender's tax credit for alcohol fuel, biodiesel, and alternative fuel mixtures. The combined effect of the state bans on MTBE and the tax incentive was

Prepared by Stephanie Searle (stephanie@theicct.org) and Adam Christensen (adam.christensen@jhu.edu).

to create an estimated 545-million-gallon ethanol market worth approximately $700 million in 2005.[1]

RENEWABLE FUEL STANDARD 1

The Energy Policy Act of 2005 removed the oxygen requirement from the reformulated gasoline program because it was unnecessary in newer cars, but at the same time created the first Renewable Fuels Standard (RFS1) to promote the consumption of fuels made from plants, animal products or wastes. The RFS1 required refiners to blend biofuel with gasoline supplied to consumers in the U.S., and specified the volumes of biofuels to be blended each year from 2006 to 2012: 4 billion gallons total of renewable fuel in 2006, rising to 7.5 billion gallons in 2012, at which point biofuels would constitute approximately 6% of the total volume of finished gasoline sold in the U.S.[2] This mandate was primarily met with corn ethanol, and the guarantee of a market helped a sizeable domestic corn ethanol industry to develop.

RENEWABLE FUEL STANDARD 2

In 2007, Congress passed the Energy Independence and Security Act (EISA)[3], which required the U.S. Environmental Protection Agency (EPA) to make certain changes to the RFS program. The EPA released the final rule for the revised Renewable Fuels Standard Program (the revised version now known as RFS2) on February 3, 2010.

The transition from RFS1 to RFS2 took place on July 1, 2010, and the RFS2 is in effect through 2022. Major changes that EISA made to the RFS program included:

- Creating sub-mandates for specific categories of qualifying biofuel
- Requiring that biofuel be blended into diesel fuel as well as gasoline
- Establishing greenhouse-gas reduction thresholds

THE BASICS OF THE RFS2

The revised Renewable Fuels Standard (RFS2) requires that a specified volume of renewable fuel be blended with gasoline and diesel intended for use in the U.S. each year from 2010 to 2022[4]. This volume schedule is spelled out in EISA. In 2013, fuel refiners and blenders were required to blend 16.55 billion gallons of renewable fuel in motor gasoline and diesel. In 2022, the requirement will rise to 36 billion gallons.

These annual requirements are divided among different categories of biofuel, defined by greenhouse gas intensity and feedstock. “Renewable fuel” must have a lifecycle

1 In 2007, ethanol averaged approximately $1.80/gallon “at the rack” (i.e. at the terminal where ethanol is finally blended with a gasoline blendstock before being moved by truck to a retail station); this price does not consider the blenders credit. Ethanol prices, net the $0.51/gallon blenders tax credit (26 USC 6426), averaged $1.29/gallon.

2 EPA’s Office of Transportation and Air Quality, (2011) “EPA Finalizes Regulations for a Renewable Fuel Standard (RFS) Program for 2007 and Beyond”. Available at: http://www.epa.gov/otaq/renewablefuels/420f07019.pdf

3 The Energy Independence and Security Act of 2007. Available at: http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf. Changes to RFS detailed in Title II, Section 202.

4 All information in this section is from: EPA, (2010), Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program, Available at: http://www.epa.gov/oms/fuels/renewablefuels/regulations.htm

greenhouse gas (GHG) intensity at least 20% lower than the fossil fuel baseline on an energy basis. "Advanced biofuel," a subset of renewable fuel, must meet a lower threshold: no more than 50% of the fossil-fuel baseline GHG intensity. Within the category of advanced biofuels two subcategories are defined: biomass-based diesel (at least 50% GHG savings) and cellulosic biofuel (at least 60% GHG savings), which must be produced from cellulose, hemicellulose, or lignin. Some advanced biofuels, such as sugarcane ethanol, don't fit into either of the subcategories. Figure 1 shows these nested categories.

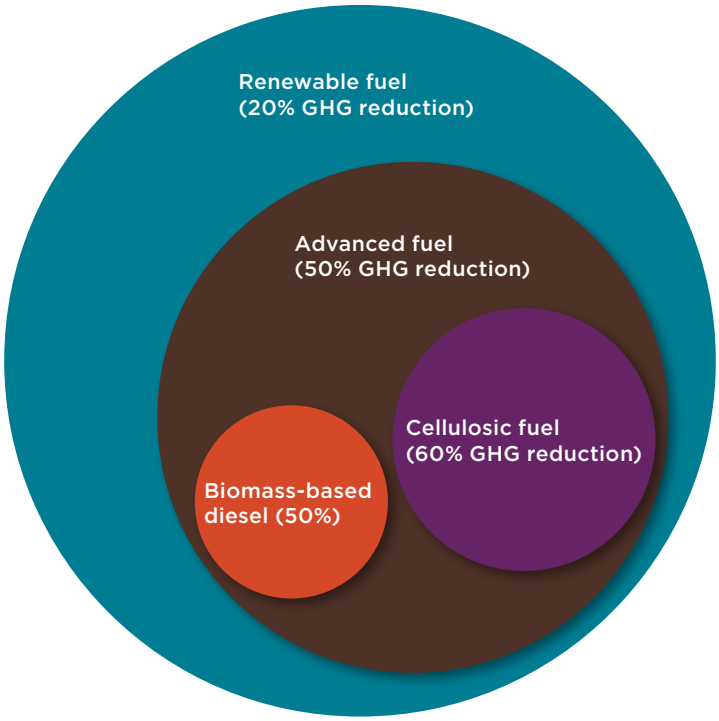

Figure 1: Categories of biofuel required in the Renewable Fuels Standard 2, with the greenhouse gas reduction requirement pertaining to each category. Categories are nested, e.g.: cellulosic fuel counts towards the advanced fuel requirement, which counts towards the total renewable fuels requirement.

The amount of each category of biofuel mandated by the RFS2 increases over time, as shown in Figure 2.

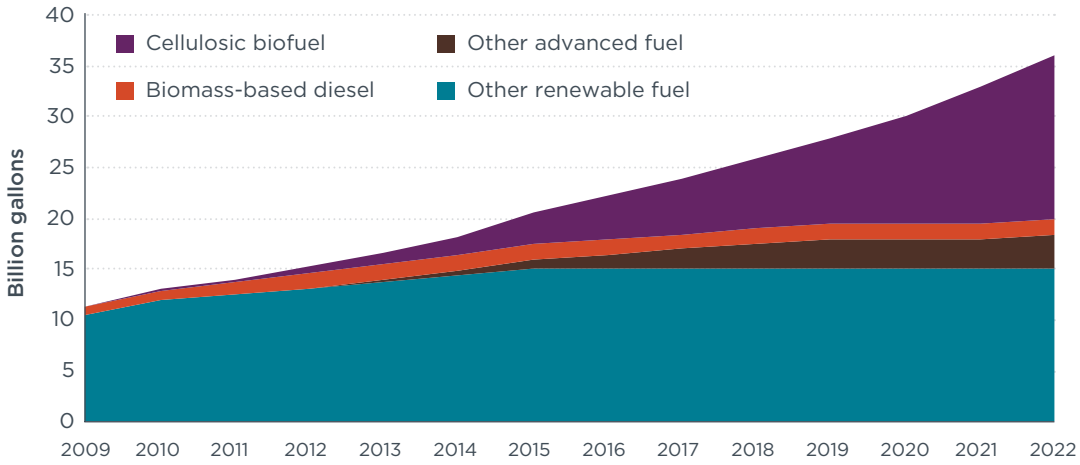

Figure 2: The amounts of each category of biofuel required under the RFS2 over time.

Any U.S. fuel refiner that produces gasoline or diesel fuel, or any importer that imports gasoline or diesel fuel, must demonstrate compliance with the RFS2 by retiring "Renewable Identification Numbers" (RINs), credits representing the supply of volumes of biofuel, at the end of the year. Alaska, Hawaii and non-contiguous U.S. territories are exempted from the program unless they opt in (Hawaii has done so), and small refineries were exempted until 2010. Failure of an obligated party to meet its obligation can result in fines up to $37,500 per day of violation, plus the amount of economic benefit or savings resulting from each violation. Blenders that simply blend renewable fuel into gasoline or diesel are not considered obligated parties under the RFS.

MODIFYING THE RFS VOLUME REQUIREMENTS

The EPA has some discretion to change the required volumes specified by EISA. EPA may reduce the cellulosic volume in any year due to insufficient supply, and in fact has done so in every year to date (Table 1). EPA also has discretion to set the biomass-based diesel standard for all years after 2012, but these annual volumes must be at least 1 billion gallons each year. Lastly, EPA has a "general waiver authority" that allows the agency to reduce or waive any or all of these mandates if there is insufficient supply or under extreme circumstances.

Table 1. Original and revised required volumes for cellulosic biofuel under the RFS, in million ethanol equivalent gallons per year.

	Original RFS2 requirement for cellulosic biofuel (mga)	Revised RFS2 requirement for cellulosic biofuel (mga)	Actual production of cellulosic biofuel (mga)
2010	100	5	0
2011	250	6	0
2012	500	8.65	0.02
2013	1000	6	

EPA has proposed to use its general waiver authority for the first time in 2014, reducing the total renewable fuel volume below that specified in EISA due to the so-called blend wall of 10% ethanol in gasoline, the maximum ethanol blend that can be consumed without significant changes in the U.S. vehicle fleet and fueling infrastructure (Table 2). Cars older than 2001, motorcycles, and all gasoline-powered equipment and boats cannot be safely operated using ethanol blends above 10%, and gasoline storage tanks, fuel lines, and fuel dispensers would have to be retrofitted to supply gasoline with 15% or higher ethanol content. But the amount of renewable fuel, which is mostly ethanol, mandated for 2014 under EISA exceeds this blend limit. EISA permits EPA to waive some or all of the RFS2 volume requirements under the condition of "insufficient supply", which EPA has interpreted to include the current situation where the volume of biofuel required under EISA cannot be consumed without adverse consequences.

Table 2. Original and proposed RFS volumes for 2014, in billion gallons per year, and proposed standards for the percentage of gasoline and diesel that must be biofuel

Category	2014 original volumes under EISA (billion gallons)	2014 volumes proposed by EPA (billion gallons)	Proposed percentage standards
Cellulosic fuel	1.75	0.017	0.010%
Biomass-based diesel	≥1.28	1.28	1.16%
Advanced biofuel	3.75	2.20	1.33%
Renewable fuel	18.15	15.21	9.20%

RIN TRADING SYSTEM

For every gallon of biofuel that is created, the producer earns one credit, or Renewable Identification Number (RIN) that is specific to the biofuel category—i.e., there are separate RINs for advanced biofuels, cellulosic biofuels, and so on.[5] That RIN remains attached to the biofuel as it is sold to a refiner or blender. Once the biofuel is blended with gasoline or diesel, the RIN becomes detached. It can then be used by that refiner or blender to demonstrate compliance at the end of the year, or can be sold or traded. Obligated parties can thus achieve compliance by either supplying fuels themselves, or buying RINs from third parties (or some combination of the two).

The EPA must estimate in advance how much cellulosic biofuel will be produced each year. If this estimate is lower than the amount required under RFS2, the agency releases a Notice of Proposed Rulemaking (NPRM) with a reduced requirement. Following a comment period, the EPA issues a final rule with the revised cellulosic requirement. For example, in 2013 EPA reduced the cellulosic requirement from 1 billion gallons to 6 million gallons.

If it reduces the cellulosic requirement, the EPA is also required to issue cellulosic biofuel waiver credits equivalent to the revised volume mandate. Obligated parties may fulfill their revised cellulosic obligation either by obtaining cellulosic RINs or

5 RINs are awarded on an energy basis, relative to ethanol, so that, for example, the production of one gallon of biodiesel would earn more than one RIN.

by purchasing waiver credits from the EPA, but must use these waivers specifically for the year they are bought. For example, suppose in a given year a fuel blender is obligated to retire 5 million advanced RINs, 1 million of which should be cellulosic RINs. If there are cellulosic waiver credits available in that year, the fuel blender can meet its obligation by retiring 5 million advanced RINs and buying 1 million cellulosic waiver credits, rather than retiring 4 million advanced RINs and 1 million cellulosic RINs.

ASSESSMENT OF GREENHOUSE GAS REDUCTION OF BIOFUELS

EISA specifies that, by definition, all renewable fuel must provide a greenhouse gas savings of at least 20% relative to gasoline or diesel (whichever is being replaced). To qualify as "advanced," a renewable fuel must have a GHG reduction of at least 50%; biomass-based diesel falls under this category. Cellulosic biofuel has an even more stringent requirement of at least a 60% GHG reduction.

To estimate the GHG emissions for the production of biofuel, EPA uses a largely *consequential* accounting approach. This is as opposed to the *attributional* approach that has more typically been used in the past. The attributional approach accounts for the emissions that can be "attributed" to the production of a given volume of fuel, for example adding up the emissions from running farm equipment, fertilizing fields and processing the feedstock into biofuel. The consequential approach on the other hand looks at the agricultural and fuel processing system as a whole and aims to calculate the difference in emissions between a scenario in which a given volume of biofuel is used, and a counterfactual scenario where that volume of biofuel is not used. In this consequential approach the question is not how much fertilizer is applied to a single field growing biofuel feedstock, but rather how much more fertilizer is used in a world where that feedstock is used for biofuel than in a world where it is not. This approach requires complex modeling of the entire agricultural sector, the food market, and the fuel sector, but it allows the EPA to determine indirect effects of biofuel production as required under EISA. Importantly, the consequential approach includes a consideration of the global land use change implications of biofuel.

For example, increased production of corn in the U.S. could raise the price of corn globally, incentivizing farmers to cultivate additional cropland in other countries to grow more corn. This effect is called *indirect land use change* (ILUC), and the emissions from the extra land conversion (cutting down trees, digging up soil, etc.) worsen the GHG profile of U.S. biofuels. EPA conducts a land-use change analysis for most cultivated feedstocks (e.g. corn, switchgrass), but not crop residues, wastes, or cover crops, as these are assumed to have no significant impact on land use.

The main categories of emissions accounted for in EPA's modeling include:

- Domestic and international agriculture (modeled separately)
- Domestic and international land use change
- Fuel production (i.e,. processing the feedstock into fuel at the biofuel plant)
- Fuel and feedstock transport
- Tailpipe emissions

For fuel production and fuel and feedstock transport and tailpipe emissions a consequential approach coincides with a conventional attributional approach, on the assumption that each additional gallon of biofuel supplied requires an additional gallon of processing capacity. EPA adds the emissions from feedstock production to emissions from biofuel plants and transportation and compares this total with the total emissions from producing and combusting the equivalent amount of gasoline or diesel. The resulting GHG balance, expressed as a percentage saving or increase, is used to confirm whether the fuel qualifies as a renewable fuel (20% GHG savings), advanced fuel (50% GHG savings), and so on.

In the RFS final rule there are some exceptions to the GHG requirements, with older facilities being grandfathered into the RFS2. Renewable fuel from facilities that existed or had commenced construction on or before December 19, 2007, and ethanol plants that use natural gas or biodiesel for process heat that existed or had commenced construction on or before December 31, 2009, do not have to demonstrate GHG savings to qualify as renewable fuel.

In addition to the GHG savings requirements, there are basic sustainability requirements for biofuel feedstock production qualifying under the RFS2. Renewable biomass must be from one of the following sources: crops grown on agricultural land cleared earlier than December 19, 2007 and actively managed or fallow on that date; farmed trees on land with the same requirements; slash and precommercial thinnings on nonfederal forestlands that are not listed as old-growth or critically imperiled rare by a State Natural Heritage program; biomass cleared from the vicinity of buildings; separated yard and food waste. These additional requirements are in place to prevent direct environmental damage from occurring as a result of the Renewable Fuels Standard.

APPROVED PATHWAYS

The RFS2 final rule of 2010 approved several pathways to qualify towards the mandate. These pathways are listed below, leaving out the required processing technologies (which can be found in the final rule on the RFS website[6]):

- Corn ethanol (renewable fuel; 20% GHG savings)
- Biobutanol from corn starch (renewable fuel; 20% GHG savings)
- Soybean biodiesel (biomass-based diesel; 50% GHG savings)
- Biodiesel and renewable diesel from algal oil, waste fats, and grease (biomass-based diesel; 50% GHG savings)
- Sugarcane ethanol (advanced fuel; 50% GHG savings)
- Cellulosic ethanol from corn stover, switchgrass, and forestry thinnings (cellulosic fuel; 60% GHG savings)

Pathways similar to these that were not explicitly analyzed in the RFS2 final rule (such as wheat straw, similar to corn stover) are assumed to have the same GHG impacts and thus qualify under the same categories. This includes feedstocks produced in countries other than the ones analyzed. For example, U.S. corn ethanol was analyzed in the RFS2 final rule, and so if corn ethanol from Europe were imported to the U.S., it would qualify

6 http://www.epa.gov/otaq/fuels/renewablefuels/index.htm

as well. The five categories of feedstocks that can be grouped together and qualify based on existing modeling are:

1. Crop residues such as corn stover, wheat straw, rice straw, citrus residue
2. Forest material including forest thinnings and residue from wood products
3. Annual cover crops planted on existing crop land
4. Separated food and yard waste
5. Perennial grasses such as Miscanthus

Since the RFS2 final rule was published, a number of additional pathways have been approved in separate rules:

- Canola oil biodiesel (biomass-based diesel, 50% GHG savings), September 2010
- Sorghum grain ethanol (renewable fuel, 20% GHG savings; under certain conditions advanced fuel, 50% GHG savings), November 2012
- Camelina biodiesel (biomass-based diesel, 50% GHG savings), December 2012
- Energy Cane biofuel (cellulosic biofuel, 60% GHG savings), December 2012
- Renewable gasoline from wastes such as crop residues or yard waste (cellulosic fuel, 60% GHG savings), December 2012
- Cellulosic ethanol from Napier grass and Giant Reed (cellulosic fuel, 60% GHG savings), June 2013

A few other pathways are currently under consideration by the EPA for addition to the RFS2:

- Palm oil biodiesel (as a renewable fuel; 20% GHG savings)
- Barley ethanol (renewable fuel, 20% savings, under certain conditions advanced biofuel, 50% savings)
- Compressed natural gas from landfill biogas (cellulosic fuel, 60% GHG savings)
- Corn butanol (renewable fuel, 20%, under certain conditions advanced biofuel, 50% savings)

It is always possible for a stakeholder to petition the EPA to consider additional pathways.

PROCESS OF APPROVING A PATHWAY

EPA typically proposes a new rule, invites comments for a period of time, and then releases a final rule that addresses any significant adverse comments.

EPA typically performs a full analysis, including lifecycle greenhouse gas accounting, for new pathways. In some cases when the pathway under consideration is very similar to one already approved, or is expected to have minimal indirect effects, the EPA does not do an indirect land use change analysis. In cases where the EPA expects the pathway to be noncontroversial, it may issue a final rule directly, without the normal preliminary period for public comment.