
Renewable Fuel Standard Program (RFS2) – 2010 and Beyond

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Office of Transportation and Air Quality
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Overview

- Key Changes Required by EISA
- Key Highlights of the RFS2 Rule
- The 2010 Standards
- Renewable Biomass Provisions
- Other RFS2 Changes
- Application of Lifecycle Results
- Summary of Impacts
- Questions

Key Changes Required by EISA

- **Energy Independence and Security Act (December 2007) required changes to the RFS program**
 - Significantly increased volumes of renewable fuel – to 36 billion gallons
 - Expanded from onroad gasoline to on and offroad gasoline and diesel
 - Separation of the volume requirements into four separate categories of renewable fuel: cellulosic biofuel, biomass-based diesel, advanced biofuel, total renewable fuel
 - Changes to the definition of renewable fuels to include minimum lifecycle GHG reduction thresholds and grandfathering of volume from certain facilities
 - Restrictions on the types of feedstocks that can be used to make renewable fuel, and the types of land that can be used to grow and harvest feedstocks
 - Inclusion of specific types of waivers and EPA-generated credits for cellulosic biofuel

Highlights of the New RFS2 Program

- Today's rule sets the full 2010 EISA renewable fuels volume.
- The new RFS2 Regulations will go into effect July 1, 2010.
- EPA has developed a path for transitioning from RFS1 to RFS2
- The rule also establishes volume standards for specific categories renewable fuels.
- In order to qualify for these new categories, fuels must demonstrate they meet certain minimum greenhouse gas reduction standards, based on lifecycle assessment, in comparison to the petroleum fuels they displace.
- **2010 Standards:**
 - **Conventional Renewable Standard:** 12 billion gallons of qualifying renewable fuel (grandfathered or fuel meeting the standards)
 - **Biomass-Based Diesel Standard:** 1.15 billion gallons, - combines 2009 and 2010 standards, including special provisions to account for the 2009 biomass-based diesel volume requirements in EISA.
 - **Cellulosic Standard:** 6.5 million gallons.
 - **Total Advanced Standard:** Maintaining full .95bg standard
- **EPA conducted significant work since the proposal and based on data collected during the public comment process and thru the peer review process – including new scientific data and new updated assumptions EPA's current modeling of specific fuel pathways has determined that the following fuels qualify:**
 - Ethanol and Biobutanol from corn complies with the conventional biofuel standard
 - Ethanol produced from sugarcane complies as advanced
 - Biodiesel from soy oil and renewable diesel from waste oils, fats, and greases complies as biomass-based diesel
 - Diesel produced from algal oils complies as advanced
 - Cellulosic ethanol and cellulosic diesel (based on currently modeled pathways) comply with as cellulosic biofuels
- The rule also provides a process to efficiently evaluate and establish new fuels and feedstocks such as sorghum and other crops.
- Rule maintains several key components of RFS1 program, including energy based approach.

What are the Four Categories and Standards?

■ Four Separate Standards

- **Biomass-Based Diesel: 1 Bgal by 2012 and beyond**
 - E.g., Biodiesel, “renewable diesel” if fats and oils not co-processed with petroleum
 - Must meet a 50% lifecycle GHG threshold
- **Cellulosic Biofuel: 16 Bgal by 2022**
 - Renewable fuel produced from cellulose, hemicellulose, or lignin
 - E.g., cellulosic ethanol, BTL diesel, green gasoline, etc.
 - Must meet a 60% lifecycle GHG threshold
- **Advanced Biofuel: Total of 21 Bgal by 2022 (Minimum of 4 billion additional)**
 - Essentially anything but corn starch ethanol
 - Includes cellulosic biofuels and biomass-based diesel
 - Must meet a 50% lifecycle GHG threshold
- **Renewable Biofuel: Total of 36 Bgal by 2022 (Minimum of 15 Bgal additional)**
 - Ethanol derived from corn starch – or any other qualifying renewable fuel
 - Must meet 20% lifecycle GHG threshold - Only applies to fuel produced in new facilities

NOTE: Existing biofuel facilities (domestic and foreign) are not required to meet GHG threshold for conventional biofuel category – facilities are “Grandfathered.”

Volume Standards as Set Forth in EISA

(Reminder: EPA Sets Standards Each November – These are the standards published in the Act)

**Conventional
Renewable
Fuels**

+

**Total
Advanced = Total
Renewable
Fuel**

**Advanced Biomass
Based Diesel + Non Cellulosic
Advanced + Cellulosic
Advanced = Total Advanced**

Year	Conventional Renewable Fuels (Grandfathered Or 20% Reduction)	Advanced Biofuel NESTED STANDARDS				Total Renewable Fuel
		Biomass-Based Diesel (50% Reduction)	Non Cellulosic Advanced (50% Reduction)	Cellulosic Biofuel (60% Reduction)	Total Advanced Biofuel	
2008	9.00					9.0
2009	10.50	0.5	0.1		0.6	11.1
2010	12.00	0.65	0.2	0.1	0.95	12.95
2011	12.60	0.80	0.3	0.25	1.35	13.95
2012	13.20	1.0	0.5	0.5	2.0	15.2
2013	13.80	1.0	0.75	1.0	2.75	16.55
2014	14.50	1.0	1.00	1.75	3.75	18.15
2015	15.00	1.0	1.50	3.0	5.5	20.5
2016	15.00	1.0	2.00	4.25	7.25	22.25
2017	15.00	1.0	2.50	5.5	9.0	24.0
2018	15.00	1.0	3.00	7.0	11.0	26.0
2019	15.00	1.0	3.50	8.5	13.0	28.0
2020	15.00	1.0	3.50	10.5	15.0	30.0
2021	15.00	1.0	3.50	13.5	18.0	33.0
2022	15.00	1.0	4.00	16.0	21.0	36.0

Energy Equivalent Volumes

- **Final rule maintains ethanol equivalent energy-based approach from RFS1**
 - **Except biomass-based diesel standard is biodiesel equivalent energy**
- **Eases the transition from RFS1 to RFS2 by retaining a common metric for RIN generation**
- **Maintains basis for investments based on RFS1, including all the work going on with renewable hydrocarbons and higher alcohols**
- **Values different fuels on the degree to which they displace petroleum use – a primary goal of EISA**
- **Provides a level playing field on which all renewable fuels can compete in the marketplace**
 - **E.g., whether a bushel of corn is used for ethanol or biobutanol, roughly the same number of RINs are generated**
 - Ethanol (denatured) = 1.0
 - Biodiesel (mono-alkyl ester) = 1.5
 - Bio-butanol = 1.3
 - Non-ester renewable diesel with lower heating value of at least 123,500 Btu/gal = 1.7

2010 Standards as Set By EPA

- **Total Renewable Fuel Standard** - Applying EISA full 2010 RFS2 standard – 12.95 billion gallons
 - Most straightforward interpretation of the Act

- **Biomass-based Diesel Standard** - Final rule combines 2009 0.5 bill gal biomass-based diesel requirement with 2010 0.65 Bgal requirement
 - All biodiesel RINs used for compliance in 2009 count towards the standard
 - 2008 and 2009 biodiesel RINs not used for compliance in 2009 can also count towards the standard subject to the rollover cap (8.7% and 20% respectively)

- **Cellulosic Standard** - Based on updated market assessment – EPA is setting a 6.5 million gallon standard for 2010
 - Process: Each November, EPA sets actual standard for the following year
 - Based on EIA's annual production assessment and other market assessments
 - Done by notice and comment

- **Total Advanced Standard** - Maintained at 0.95 billion gallons
 - Met in 2010 with biomass-based diesel compliance ($0.65 \times 1.5 = 0.975$)

RFS2 Volume Standards for 2010

- Presented as Volume and Percentage

Standards for 2010

Fuel Category	Percentage of Fuel Required to be Renewable	Volume of Renewable Fuel (in billion gal)
Cellulosic biofuel	0.004%	0.0065
Biomass-based diesel	*1.10%	*1.15
Total Advanced biofuel	0.61%	0.95
Renewable fuel	8.25%	12.95

**Combined 2009/2010 Biomass-Based Diesel Volumes Applied in 2010*

RFS1 to RFS2 In 2010

- **RFS2 regulatory program will go into effect on July 1, 2010**
 - **New RIN codes, lifecycle thresholds, renewable biomass, facility registration, etc.**
 - **RFS1 regulations will apply January – June**

- **This means there will be both RFS1 and RFS2 Renewable Identification Numbers (RINs) in the distribution system in 2010**
 - **Would have happened even if RFS2 started on Jan 1, since RFS1 RINs are in the marketplace and have a 2 year life**

- **Final Rulemaking provisions provide for this transition**
 - **RFS1 RINs are valid under RFS2, applied toward the separate standards based on codes within the RINs**
 - **RR code of 15 = Biodiesel**
 - **RR code of 17 = Renewable diesel**
 - **D code of 1 = Cellulosic biofuel**

Renewable Biomass Provisions – Approving Feedstocks

- **EISA restricted where feedstocks can grow and be harvested for use in producing renewable fuels for compliance with the RFS2 program**
 - Planted crops/crop residue from ag land cleared/cultivated prior to Dec. 2007
 - Planted trees/tree residue from nonfederal lands and tree plantations cleared/cultivated prior to Dec. 2007

- **Compliance Options for feedstocks from the Non Agricultural land / Forest land**
 - **All renewable fuel producers using feedstocks from this sector can either**
 - 1: Individually verify and qualify their feedstocks following specific recordkeeping and reporting requirements OR
 - 2: Opt to form and participate in a consortium that employs a third party to conduct a verification program that acts to collectively verify and qualify these feedstocks for RFS2 renewable fuel production

- **Compliance Approach for feedstocks from planted crops / agricultural land**
 - For US produced feedstocks, producers can comply under an aggregate compliance approach
 - For Foreign produced ag feedstocks, rule provides future option for other (non-U.S.) sources of feedstocks to use aggregate compliance if source region can provide sufficient data to support aggregate analysis
 - Otherwise, producers must verify using one of the options applied in the non-ag / forest sector

Facility Grandfathering

- **All post-enactment facilities (domestic and foreign) must meet minimum 20% GHG reduction**
- **All pre-enactment facilities (domestic and foreign) are grandfathered for the general renewable fuel category – estimated at ~15 Bgal**
 - Including ethanol facilities that start production in calendar years 2008 and 2009, and are fired with natural gas, biomass, or any combination
- **Basic approach:**
 - Grandfathered indefinitely
 - Only up to a baseline volume
- **Baseline volume based on:**
 - Maximum allowable volume stipulated in air permits
 - Lacking air permits, maximum capacity achieved is used
 - Also allowing a small tolerance of 5% to account for minor changes due to ongoing maintenance
- **Volume increases beyond the baseline must meet the 20% threshold like a new facility**

RFS2 – New RIN Codes

D value	Meaning under RFS1	Meaning under RFS2
1	Cellulosic biomass ethanol	Not applicable
2	Any renewable fuel that is not cellulosic biomass ethanol	Not applicable
3	Not applicable	Cellulosic biofuel
4	Not applicable	Biomass-based diesel
5	Not applicable	Advanced biofuel
6	Not applicable	Renewable fuel
7	Not applicable	Cellulosic diesel

RINs That Can Be Used To Meet Each Standard

Standard	Obligation	Allowable D codes
Cellulosic biofuel	RVO_{CB}	3 and 7*
Biomass-based diesel	RVO_{BBD}	4 and 7*
Advanced biofuel	RVO_{AB}	3, 4, 5, and 7
Renewable fuel	RVO_{RF}	3, 4, 5, 6, and 7*

* Plus certain RFS1 RINs for 2010

Other Program Changes

- RIN Transactions
 - Mostly follows the provisions of RFS1
 - Major enhancement – EMTS
- Expanded Registration, Recordkeeping, Reporting
 - To capture all the new provisions required by EISA

Application of Lifecycle Results

Updates to Lifecycle Modeling

- **Based on peer review results as well as other comments received we have made several updates to our modeling since the NPRM analysis**
 - **Updates to Domestic Agricultural Sector Modeling:**
 - **Updates to International Agricultural Sector Modeling:**
 - **Updates to Biofuel Processing in Both Domestic and International Agricultural Sector Modeling:**
- **Updates to Land Use Change Modeling:**
 - Included more geographic coverage of satellite data
 - Used longer time coverage of satellite data - 2001-2007
 - Used higher resolution satellite data

Addressing Uncertainty In our Analysis

- **For the final rule analysis we are specifically addressing the uncertainty of the lifecycle results in three main ways:**
 1. Getting the best information possible and updating our analysis to narrow the uncertainty
 2. Performing sensitivity analysis around key factors to test the impact on the results
 3. Establishing reasonable ranges of uncertainty and using probability distributions within these ranges in threshold assessment

- **One of the key sensitivity analysis we performed was regarding crop yields**
 - The economic modeling inputs (and specifically crop yield projections) was an area identified by reviewers and public comments – generally that we were underestimating potential yield growth
 - We analyzed a base yield and a high yield scenario to test the impact of this assumption on the overall results

- **For the two key drivers of land use change we performed an uncertainty analysis and developed a range and distribution of results around the land use change emissions**
 - Types of land converted (satellite data)
 - GHG emission factors associated with different types of land conversion

- **For key methodology choices we have selected approaches based on feedback from the comment process and peer review**
 - Where appropriate we will conduct sensitivity analysis around these decisions

Compliance Determination from LCA Results

- **Modeling accounts for the typical feedstock and fuel production pathway from which significant production and contribution to RFS2 volumes are expected (2022)**
- **Modeled fuel pathways meeting compliance (applying 0% discount and 30 Year time horizon):**
 - Ethanol produced from corn starch at a new natural gas, biomass, or biogas fired facility using advanced efficient technologies meets 20% threshold (Coal fired will not)
 - Butanol from corn starch meets 20% threshold
 - Biodiesel (soy, wastes, algae) meets 50% threshold
 - Sugarcane ethanol (multiple pathways) meets 50% threshold
 - Cellulosic ethanol and diesel fuel (Thermal and Biochemical from Stover, Switchgrass) meets 60% threshold
- **Results extended to same fuel type and feedstock as a modeled pathway but with feedstock production sources that were not included in the analysis (e.g., corn ethanol and soybean biodiesel produced in another country)**
 - If agricultural production from a source are significantly different from those modeled and fuel volumes from the source increase, EPA retains the authority to perform a full analysis of the different pathway for compliance determination
- **Results extended to other fuel pathways with low risk of not complying:**
 - Crop residues such as corn stover, wheat straw, rice straw, and citrus residue providing starch or cellulosic feedstock
 - Forest material including eligible forest thinnings and solid residue remaining from forest product production providing cellulosic feedstock
 - Secondary annual crops planted on existing crop land such as winter cover crops and providing cellulosic material, starch, or oil for biofuel production
 - Separated food and yard wastes, including food and beverage wastes from food production and processing
 - Perennial grasses including switchgrass and miscanthus

Approach Going Forward for Qualifying Additional Fuels Based on Lifecycle Modeling

- **Threshold determinations for certain other pathways were not possible at this time because sufficient modeling or data is not yet available.**
- **Based on current/projected commercial trends and status of analysis, EPA anticipates modeling the following fuel pathways and including determinations in a rulemaking within 6 months.**
 - wood pulp ethanol
 - grain sorghum ethanol
 - palm oil biodiesel
- **For other fuel pathways not yet modeled, EPA provides a petition process through which the fuel pathway can be analyzed and provided a compliance determination.**
 - Fuels pathways sufficiently similar to pathways that have been modeled (e.g., energy enhancement to fuel processing technology)
 - Upon determination, allow RIN-generation after next quarterly update of RIN reporting system (EMTS)
 - Formalize in regulations during annual rulemaking process
 - Fuel pathways that require significant new analysis and modeling (e.g., new feedstock or fuel type)
 - EPA would give notice and seek public comment
 - Carried out as part of annual rulemaking process
- **EPA recognizes that the state of scientific knowledge continues to evolve in this area, therefore, the Agency is committing to further reassess these determinations and lifecycle estimates**
 - EPA will request that the National Academy of Sciences over the next two years evaluate the approach taken in this rule, the underlying science of lifecycle assessment, and in particular indirect land use change, and make recommendations for subsequent rulemakings on this subject
 - This new assessment could result in new determinations of threshold compliance compared to those included in this rule that would apply to future production (from plants that are constructed after each subsequent rule)

Overview of Impacts of the RFS2 Program

■ **Petroleum Consumption, Energy Security and Fuel Costs:**

- We estimate this program will replace about 7 percent of expected annual gasoline and diesel consumption in 2022
- Decrease oil imports by \$41.5 billion
- Result in additional energy security benefits of \$2.6 billion.

■ **Greenhouse Gas Emissions:**

- When fully implemented in 2022, renewable fuels are expected to reduce greenhouse gas emissions by 138 million metric tons -- equivalent to the annual emissions of 27 million passenger vehicles.

■ **Agriculture Sector and Related Impacts:**

- In 2022, the increased use of renewable fuels is expected to expand the market for agricultural products such as corn and soybeans and open new markets for advanced biofuels – increasing net farm income by an estimate of \$13 billion dollars – or more than 36 percent – in 2022.

■ **Emissions and Air Quality:**

- Increased use of renewable fuels will also impact emissions.
- Some emissions such as NOx, acetaldehyde, and ethanol are expected to increase and others such as benzene and carbon monoxide are expected to decrease.
- The impacts of these emissions on criteria air pollutants will vary from area to area.
- EISA directs the agency to further evaluate these potential impacts and to mitigate, to the extent possible, any adverse impacts.

Questions?

- For Additional information:
<http://www.epa.gov/otaq/renewablefuels/index.htm>
- Includes Factsheets
- RFS2 Rulemaking Package
 - Preamble
 - Regulations
 - Regulatory Impact Analysis
- Links to Other Information
- Frequently Asked Questions

- Send new questions to: EPAFuelsPrograms@epa.gov