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Renewable Identification Number Markets: Draft Baseline Table

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Quick overview of Renewable Identification Numbers (RINs)

The Energy Policy Act of 2005 required at least a mandated volume of biofuel use in the United States, called the Renewable Fuel Standard (RFS). The Energy Independence and Security Act of 2007 increased the overall RFS and created nested sub-mandates for advanced biofuels, biomass-based diesel, and certain cellulosic biofuels. A more generally accessible article outlining the nature of RINs and their relationship to the RFS is available elsewhere.[1]

The obligation to meet the mandates falls on fuel blenders, firms that buy input fuels to mix into final fuels that they sell to retailers. Renewable Identification Numbers (RINs) are the mechanism used to make sure each of these firms meets its share of all the mandates. Domestically produced and imported biofuels sold to fuel blenders in the U.S. can have RINs. Each fuel blender must acquire enough RINs to cover its share of the mandate.

The RINs are tradable. They are bought and sold so that the mandates will be binding or non-binding nation-wide. It is not necessary for every blender to use at least their share of the mandated amount of biofuels, but each blender is obliged to acquire RINs to meet their mandate either by buying the biofuels themselves or by buying RINs from other fuel blenders who use extra biofuels and sell extra RINs.

RIN prices are affected by
   1) the gap between the price that fuel blenders pay to buy biofuels and the prices of biofuels implicit in blended fuels,
   2) the transaction costs of trading RINs, and
   3) speculation about whether or not the mandates will be binding in the near future, as well as whether or not there will be a waiver.
The FAPRI-MU model represents the first component and part of the third component.

The price gap component is positive if a mandate is binding. A binding mandate is one that forces blenders to use more biofuels than they would otherwise. In that case, each additional gallon of biofuel blended is at a loss. Blenders have the option to blend biofuels at a loss or buy extra RINs from their peers. Blenders will bid the price of RINs up until it is at least as large as the loss on the marginal gallon. A high RIN price indicates that the mandate is binding.

If the mandate is non-binding then the price gap is not positive. There would still be a transaction cost element because the price of the RIN must cover the costs of making a deal or else blenders with extra RINs will not bother selling them to blenders who want to buy the RIN. A RIN price is likely to rise if blenders expect that the mandate will become binding because

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[1] Thompson, Meyers, and Westhoff. "Renewable Identification Numbers Are the Tracking Instrument and Bellwether of US Biofuel Mandates." *Eurochoices*. www3.interscience.wiley.com/journal/122457318/issue. 2009.

they have some ability to store RINs for later use. Consequently, observed RIN prices are very unlikely to be zero even if all of the mandates are non-binding.

Introduction to the FAPRI-MU RIN Baseline Table

FAPRI-MU 2009 baseline projections include markets for RINs that meet the overall, advanced, and biodiesel mandates.[2] The economic models of these markets consist of equations that represent biofuel supplies (tied to the broader FAPRI-MU agricultural markets models), fuel blenders' decisions, and final fuel demand. These equations are slightly revised relative to documentation available elsewhere.[3] Key revisions relate to rollover and defining implicit RIN variables. FAPRI-MU uses this model to generate its baseline and policy analysis.[4]

These projections are generated in the FAPRI baseline, but they have not been reported before. The August 2009 baseline projects markets forward to the 2014/15 marketing year, but was extended in part to illustrate how the RIN markets evolve through 2019/20.

Highlights of RIN supply and use tables

Nested mandates cause a RIN price hierarchy. Biodiesel and cellulosic RINs also count towards advanced and overall mandates. Advanced RINs automatically count towards the overall mandate. The reverse is not true: RINs that count towards the overall mandate do not automatically count towards any submandate; and an advanced RIN does not automatically meet either biodiesel or cellulosic mandates.

This nesting means that the price of a sub-mandate RIN can never be less than the price of a broader RIN. For example, an advanced RIN can meet either the advanced or the overall mandate but a RIN that counts against the overall mandate might not count as advanced, so the advanced RIN price cannot be less than the overall RIN price. In the table, advanced and conventional RIN prices are the same from 2009/10 to 2013/14.

Equivalence values, the means to put all RINs on par with corn-based ethanol, are assumed to be one except for biodiesel, which was assumed to be 1.5 when the baseline was developed. If true, then a biodiesel RIN counts as 1.5 ethanol RINs when adding them up to compare to the

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[2] The cellulosic mandate is assumed to be waived in the 2009 baseline.

[3] "Model of the U.S. Ethanol Market." FAPRI-MU Report #07-08. July 2008.

[4] "Impacts of Selected US Ethanol Policy Options" FAPRI-MU #04-09, May, 2009; "Biofuels: Impact of Selected Farm Bill Provisions and other Biofuel Policy Options" FAPRI-MU #06-08, June, 2008; Thompson, Meyer, and Westhoff, "How Does Petroleum Price and Corn Yield Volatility Affect Ethanol Markets with and without an Ethanol Use Mandate?" *Energy Policy*, February, 2009; and Thompson, Meyer, and Westhoff, "Mandate Economics Applied to US Biofuel Policies," presented at the annual meeting of the IATRC, December 2008. For others, see http://www.fapri.missouri.edu.

advanced and overall mandates. Taking into account both the equivalence value and the RIN hierarchy, the biodiesel RIN price must be at least 1.5 times more than the price of an ethanol RIN that meets the advanced mandate. In these projections, the biodiesel RIN price is more than 1.5 times the advanced RIN price through 2013/14, then biodiesel RIN prices are set by their value as an advanced biofuel.

The cellulosic mandate is assumed to be *waived.* Cellulosic biofuels are a component of two broader mandates, and both are reduced by the same amount as the cellulosic biofuels given the waiver. We assume the cellulosic RIN price equals its effective limit, or *allowance value*, imposed by legislation in the event of a waiver.

One or more of the mandates are *binding* in most years of the simulations, particularly as they grow over time, but not all. If a mandate is *not binding*, then the price of RINs that meet that mandate fall towards zero, as in the case of the conventional RIN at the end of the period. (There would still be a price to cover transaction costs that we do not include here.) If a mandate is binding, then the value of RINs that meet that mandate will rise.

Rollover provisions are expected to allow up to 20% of one year's mandate to be met by RINs issued in the previous year. Blenders have an incentive to overshoot the mandates in any year in order to have a buffer for the next one – behavior analogous to *carry out* of a commodity. We expect RIN rollover will depend on the RIN price and future increases in the mandated volume.

RINs not submitted to meet their own mandate at the end of one year can go to any of two or three other uses. First, they can be used for rollover up to the regulatory limit. Second, they can *expire* after at least one year without ever being used for compliance. The third option for all but overall RINs is that they can be used to meet a broader mandate. Submandate RINs used to help satisfy a broader mandate are *demoted*. The nested mandates means that biodiesel mandates automatically meet advanced or total mandates, as well as their own. The reverse is not true: overall RINs cannot be used to meet any submandate and advanced RINs cannot be used to meet biodiesel or cellulosic mandates.

Some advanced RINs are demoted in the early years to help meet the overall RFS and biodiesel RINs are demoted to help with the increasingly challenging advanced RFS by the end of the period. From 2018/19, the amount of conventional RIN carry out for the overall mandate hits the rollover limit, so the rest of these RINs above that limit expire. At that point, the conventional RIN price (ignoring transaction costs) falls to zero.

We requested historical data, but none are yet available so *all RIN data are estimated*. Data are averaged over crop years, even though the mandates operate on a calendar year basis, to coordinate with feedstock market models.

Biofuel RIN Supply and Utilization: Crop Year

	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
					(Million gallons)						
Renewable Fuel Standard	12,277	13,440	14,431	15,404	16,362	17,524	18,409	19,137	19,913	20,737	21,279
Advanced biofuels	777	1,040	1,431	1,804	2,162	2,724	3,409	4,137	4,913	5,737	6,279
Cellulosic ethanol (waived)	11	24	64	137	245	391	576	804	1,079	1,404	1,779
Biodiesel	600	750	933	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Biodiesel RFS RINs					(Million RIN-gallons)						
Production	617	765	925	1,002	1,011	1,007	1,063	1,143	1,216	1,282	1,332
Carry In	55	73	87	79	82	92	99	88	81	75	70
Use for biodiesel compliance	600	750	933	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Unused for this mandate	73	87	79	82	92	99	163	230	297	358	402
of which, carry out	73	87	79	82	92	99	88	81	75	70	71
of which, demoted	0	0	0	0	0	0	75	149	221	288	331
Advanced RFS RINs											
Production	1,212	1,527	1,847	2,051	2,217	2,610	3,383	4,129	4,899	5,698	6,301
Biodiesel (in ethanol gallons)	927	1,147	1,387	1,504	1,516	1,511	1,595	1,714	1,823	1,923	1,998
Cellulosic	11	24	64	137	245	391	576	804	1,079	1,404	1,779
Other Advanced	276	356	395	411	456	709	1,212	1,611	1,996	2,371	2,524
Carry In	130	184	267	343	380	429	315	289	281	267	228
Use for advanced compliance	777	1,040	1,431	1,804	2,162	2,724	3,409	4,137	4,913	5,737	6,279
Unused for this mandate	567	671	683	590	435	315	289	281	267	228	250
of which, carry out	184	267	343	380	429	315	289	281	267	228	250
of which, demoted	383	404	340	210	6	0	0	0	0	0	0
Total RFS RINs											
Production	12,658	13,897	14,764	15,233	16,021	17,091	18,413	19,661	20,837	21,769	22,964
Biodiesel (in ethanol gallons)	927	1,147	1,387	1,504	1,516	1,511	1,595	1,714	1,823	1,923	1,998
Cellulosic	11	24	64	137	245	391	576	804	1,079	1,404	1,779
Other Advanced	276	356	395	411	456	709	1,212	1,611	1,996	2,371	2,524
Conventional	11,446	12,370	12,917	13,182	13,804	14,481	15,030	15,532	15,938	16,070	16,663
Carry In	1,840	2,223	2,680	3,013	2,842	2,501	2,069	2,073	2,597	3,521	4,181
Use for total compliance	12,277	13,440	14,431	15,404	16,362	17,524	18,409	19,137	19,913	20,737	21,279
Unused for this mandate	2,223	2,680	3,013	2,842	2,501	2,069	2,073	2,597	3,521	4,552	5,866
of which, carry out	2,223	2,680	3,013	2,842	2,501	2,069	2,073	2,597	3,521	4,181	4,256
of which, expired	0	0	0	0	0	0	0	0	0	372	1,610
RIN value					(Dollars per RIN-gallon)						
Biodiesel RIN	0.53	0.57	0.72	0.69	0.58	0.51	0.63	0.70	0.75	0.81	0.80
Cellulosic RIN allowance val.	0.74	1.03	0.92	0.84	0.79	0.75	0.70	0.66	0.62	0.58	0.53
Other Adv. RIN	0.07	0.03	0.01	0.05	0.11	0.34	0.42	0.47	0.50	0.54	0.53
Conventional RIN	0.07	0.03	0.01	0.05	0.11	0.17	0.18	0.14	0.06	0.00	0.00
RIN compliance expend.					(Million Dollars)						
Total	1,145	809	814	1,492	2,383	3,519	4,150	4,005	3,269	2,903	3,134

Notes. Qualifying carry out RINs are those RINs not used for compliance with their designated mandate, not used for a broader mandate, and within the 20% rollover limit. RIN values reflect estimates of the core RIN value (price gap) and RIN rollover speculation , but do not include estimates of transaction costs or speculation about possible waiver for any of biodiesel, advanced, or overall mandates. The mandate for biofuels made from cellulosic and agricultural feedstocks (cellulosic) is assumed to be waived, so the number here reflects a lower level that is assumed to be used in this event, and the allowance value is used as the relevant RIN price.