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The Market for Biomass-Based Diesel Fuel in the Renewable Fuel Standard (RFS)

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Summary

The market for biomass-based diesel (BBD) fuel, most notably biodiesel, has expanded rapidly since 2004, largely driven by federal policies, especially tax credits and a mandate for their use under the federal Renewable Fuel Standard (RFS). Most expect that the majority of the BBD fuel quota in the RFS will be met using biodiesel produced from soybean oil. Biodiesel from other feedstocks, and other biomass-based substitutes (e.g., synthetic diesel from cellulosic feedstocks or algae) could play a larger role in the future, although currently these other alternatives are prohibitively expensive to produce in sufficient quantities.

Biodiesel production remains expensive relative to conventional petroleum-based diesel (even with tax credits), largely due to the reliance on soybean oil (a relatively expensive commodity) as a feedstock. Biodiesel and other BBD fuel production remains dependent on both tax incentives and the RFS mandates, as evidenced by a drop in production from 2009 to 2010. The expiration of the BBD tax credits after 2009 more than counteracted the increase in the RFS mandate from 2009 to 2010. Whether enough biodiesel production capacity will come online in 2011 to meet an even larger mandate remains to be seen.

The absence of the tax incentive for most of 2010, along with high soybean oil prices, caused 2010 biodiesel production to drop significantly—to the point that 2010 production may be below that needed to meet the RFS mandate. Any shortfall in supply for the 2010 BBD mandate may be met using credits generated in 2011, leading to even tighter markets going forward. These credits—referred to as RINs (Renewable Identification Numbers)—may be used by fuel suppliers to meet their obligations, banked for the next calendar year, or traded to other entities. In this way, analysis of the financial market for RINs may serve as a useful method for evaluating the overall market for BBD fuels. As BBD RINs become scarce, their price has increased dramatically (by nearly an order of magnitude over the past year). At some point, the value of the RINs may increase enough to bring idled production capacity back online or promote an increase in new capacity development and/or imports, especially if BBD producers expect RIN prices to stay high in the future.

This report discusses the current market for BBD fuels and their corresponding RINs under the RFS. It examines the role that the RIN market may play as an economic incentive for the production of biodiesel and other BBD fuels in the future. Lessons learned from the experience with the BBD quota and the associated RIN market may provide insights into the future RIN markets for other advanced biofuels and perhaps for the RFS as a whole.

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Introduction

Increasing dependence on foreign sources of crude oil, concerns over global climate change, and the desire to promote domestic rural economies have raised interest in renewable biofuels as an alternative to petroleum in the U.S. transportation sector. In response to this interest, U.S. policymakers have enacted an increasing variety of policies to directly support U.S. biofuels production and use.[1] Policy measures include blending and production tax credits to lower the cost of biofuels to end users, research grants to stimulate the development of new biofuels technologies, and loans and loan guarantees to facilitate the development of biofuels production and distribution infrastructure. Perhaps most important, Congress established minimum usage requirements to guarantee a market for biofuels irrespective of their cost.[2]

This guaranteed market—the Renewable Fuel Standard (RFS)—requires refiners and other fuel suppliers to include an increasing amount of biofuels in transportation fuel.[3] By 2022, the RFS requires the use of 36 billion gallons of renewable fuel. Within the larger mandate, there are sub-mandates ("carve-outs") for the use of advanced biofuels (fuels other than corn starch ethanol with at least 50% lower lifecycle greenhouse gas emissions than conventional fuels).[4] Within the advanced biofuel quota, there are additional sub-mandates for cellulosic biofuels and for biomass-based diesel substitutes (BBD).

In the near term, most expect that the majority of the BBD quota (and a significant portion of the larger advanced biofuel quota) will be met using biodiesel produced from soybean oil, although biodiesel from other feedstocks, as well as other biomass-based substitutes (e.g., synthetic diesel from cellulosic feedstocks or algae), could play a larger role in the future.

One of the key incentives, a $1.00-per-gallon tax incentive for the production and/or use of biodiesel and renewable diesel (a related type of BBD), expired at the end of 2009. This tax incentive was eventually extended retroactively for 2010 through 2011 in December 2010. However, the absence of this incentive for most of 2010, along with high soybean oil prices, caused 2010 biodiesel production to drop significantly—to the point that 2010 production is expected to be below that needed to meet the RFS mandate.

Fuel suppliers comply with the RFS by submitting to the Environmental Protection Agency (EPA) sufficient credits (Renewable Identification Numbers, or RINs) to cover their annual obligations. RINs may be used by fuel suppliers to meet their obligations, banked for the next calendar year, or traded to other entities. As BBD RINs have become scarce, their price has increased dramatically (by an order of magnitude over the past year). Analysis of the financial market for RINs may serve as a useful method for evaluating the overall market for BBD fuels. At some point, the value of the RINs may increase enough to bring idled production capacity back online or to spur new capacity development, especially if BBD producers expect RIN prices to stay high

[1] For more information, see CRS Report R41282, *Agriculture-Based Biofuels: Overview and Emerging Issues*, by (name redacted).

[2] For more information on biofuels incentives (both tax and non-tax), see CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by (name redacted).

[3] For more information on the RFS, see CRS Report R40155, *Renewable Fuel Standard (RFS): Overview and Issues*, by (name redacted) and (name redacted).

[4] Advanced biofuels include ethanol from sugarcane, biomass-based diesel fuels, and ethanol and other fuels produced from cellulosic feedstocks.

in the future. Some of the potential 2010 BBD shortfall may be met using RINs generated in 2011, although this added demand for 2011 RINs could push their price even higher.

This report discusses the current market for BBD fuels and their corresponding RINs under the RFS. It examines the role that the RIN market may play as an economic incentive for the production of biodiesel and other BBD fuels in the future. Lessons learned from the BBD quota and the associated RIN market may provide insights into the future RIN markets for other advanced biofuels and perhaps for the RFS as a whole.

What is Biomass-Based Diesel (BBD)?

Biomass-based diesel (BBD) fuel is a term used for any type of biologically derived diesel fuel for compliance with the RFS. BBD is an umbrella term that captures a range of fuels, including biodiesel, renewable diesel, synthetic (Fischer-Tropsch) diesel, algae-based diesel fuel, and cellulosic diesel.

The RFS mandates the use of BBD substitutes. While this is often referred to as a "biodiesel mandate," the term biodiesel refers to a fuel produced through a specific process. The RFS does not distinguish between different BBD fuels or the process by which they are produced, as long as they meet requirements for greenhouse gas emissions reductions.[5] For clarity, when referring to the larger class of fuels, this report uses the term biomass-based diesel, or BBD; the term "biodiesel" is used when referring specifically to fuel that meets the statutory definition of biodiesel.

Different Types of Biomass-Based Diesel

Biodiesel: A diesel fuel substitute (mono-alkyl esters) produced through a chemical conversion process (transesterification). Production feedstocks generally include virgin vegetable/animal oils or recycled restaurant grease and an alcohol (generally methanol). Meets ASTM Standard D6751.

Renewable Diesel: A diesel fuel substitute produced through a thermochemical process and chemically distinct from biodiesel (i.e., non-ester fuel). Feedstocks include animal or vegetable oils but (unlike biodiesel) do not include alcohol inputs. Meets ASTM Standard D975 or D396.

Fischer-Tropsch (FT) Diesel: Often referred to as biomass-to-liquids (BTL), biomass-based FT diesel is produced through a two-step process where the feedstock is converted to a synthesis gas (syngas) and then synthetic diesel fuel is produced through a catalytic process. FT synthesis can also be used to produce natural gas-to-liquids (GTL) or coal-to-liquids (CTL) fuels.

Algae-Based Biofuels: Algae has the potential to produce much higher per-acre yields of oils (lipids) than conventional crops. Algae can potentially be used to produce any of the above diesel fuel substitutes depending on the production process.

Cellulosic Diesel: Instead of using vegetable or other oils as a feedstock, cellulosic material (woody or fibrous plant material) could be used to develop a variety of biofuels, including BBD fuels. Cellulose could be converted to BBD through FT synthesis or through other thermal or chemical pathways.

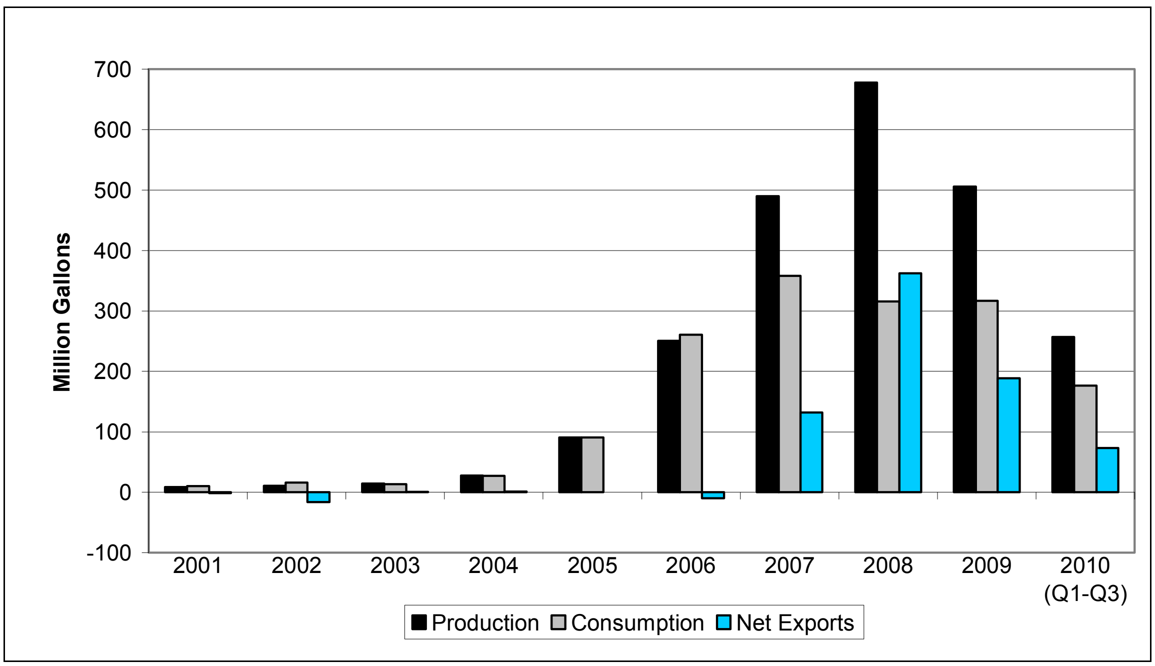
[5] For more information on greenhouse gas reduction requirements under the RFS, see CRS Report R40460, *Calculation of Lifecycle Greenhouse Gas Emissions for the Renewable Fuel Standard (RFS)*, by (name redacted) and (name redacted).

The U.S. Biomass-Based Diesel Industry

Domestic Production

In the United States, BBD production is dominated by biodiesel, mostly from virgin soybean oil, although other feedstocks (e.g., animal fats, canola, recycled grease) play a role, as does non-biodiesel fuel (e.g., renewable diesel). Data on U.S. biodiesel production are limited, especially compared to other energy and agricultural commodities, and data on non-biodiesel BBD are virtually nonexistent. However, despite relatively little detailed data on biodiesel and other BBD markets, one fact is clear: biodiesel production and consumption in the United States have grown dramatically in the last several years, driven mostly by a tax credit for the production/blending of biodiesel and renewable diesel and by mandates in the RFS. (See **Figure 1**.) In 2004, before the biodiesel tax credit was established (2005), production and consumption remained below 30 million gallons annually. By 2008, both production and consumption had increased more than tenfold. Even after the peak in 2008 and subsequent drop, production and consumption levels remain well above pre-2005 levels.

Figure 1. Annual U.S. Biodiesel Production, Consumption, and Exports



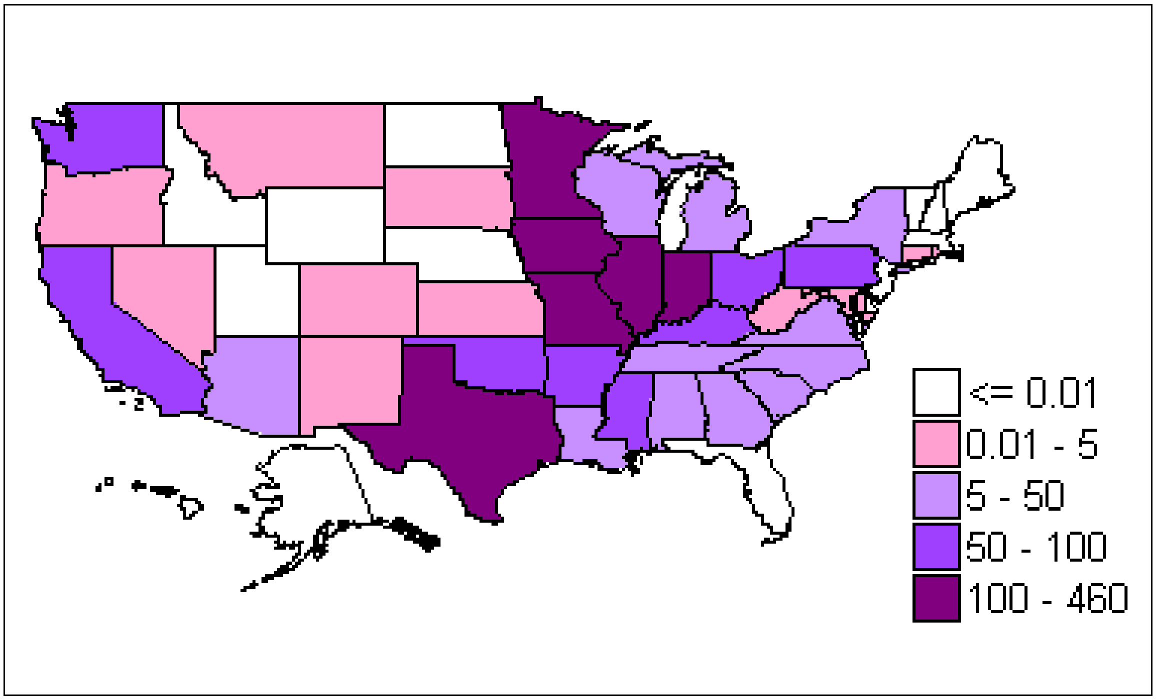
Source: U.S. Department of Energy, Energy Information Administration, October 2010 Monthly Energy Review, Washington, DC, October 28, 2010, Table 10.4, http://www.eia.doe.gov/mer/.

Notes: Domestic production dropped after 2008 partly due to a change in the biodiesel tax credit, as well as the establishment of a European Union biodiesel import tariff. Production further dropped from 2009 to 2010 as the biodiesel tax credit expired after 2009 and was not retroactively extended until late in 2010.

Biodiesel production plants are generally located in the Midwest where soybean and other oilseed production is concentrated, or in Texas close to large supplies of animal fats. (See **Figure 2**.) Six states—Texas, Iowa, Illinois, Indiana, Minnesota, and Missouri—accounted for 60% of production capacity in 2009. In December 2009 the U.S. Department of Energy's Energy Information Administration (EIA) estimated that there was roughly 2 billion gallons in annual biodiesel production capacity.[6] However, plants capable of producing biodiesel may produce a variety of other products as well (or instead), and thus actual biodiesel production tends to be far below theoretical capacity: while most chemical plants operate at 80%-90% nameplate capacity, 2009 biodiesel capacity utilization was around 33%. Even at the peak in 2008, production was well below potential capacity.

Figure 2. 2009 Biodiesel Production Capacity

Million Gallons per Year (mgy), by State



Source: CRS analysis of data from Energy Information Administration, Biodiesel Monthly Report, Washington, DC, October 2010, Table 4, http://www.eia.doe.gov/cneaf/solar.renewables/page/biodiesel/biodiesel.html.

Notes: Biodiesel plant capacity utilization (about 33%) is far below capacity utilization for other chemical plants (generally 80%-90%). Thus, total capacity far exceeds actual biodiesel production.

As noted above, two key domestic incentives—tax credits and the RFS mandate—have driven expansion of domestic production and consumption of BBD. The American Jobs Creation Act of 2004 established a tax credit of $1.00 per gallon for the production and/or blending of biodiesel.[7] Since that time, BBD tax credits have been expanded to include credits for the production of renewable diesel and a Small Agri-Biodiesel[8] Producer Credit.[9] (See **Table 1**.) The RFS mandate for BBD fuels increases to 1.0 billion gallons by 2012, which would lead to production levels nearly 50% higher than the 2008 peak and domestic consumption levels nearly three times higher

[6] U.S. Department of Energy, Energy Information Administration, *Biodiesel Monthly Report*, Washington, DC, October 2010, Table 4, http://www.eia.doe.gov/cneaf/solar.renewables/page/biodiesel/biodiesel.html.

[7] P.L. 108-357, §302.

[8] Biodiesel produced from virgin agricultural products (as opposed to recycled grease).

[9] For more information, see CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by (name red acted).

than the 2007 peak. Total production capacity, capacity utilization at biodiesel plants, and/or imports would need to expand dramatically in the next few years to meet that mandate.

Table 1. Federal Biomass-Based Diesel Tax Incentives

Tax Incentive	Established	Description	Scheduled Termination
Biodiesel Tax Credit	2004 by P.L. 108-357	Producers of biodiesel or diesel/biodiesel blends may claim a tax credit of $1.00 per gallon of biodiesel	End of 2011
Small Agri-Biodiesel Producer Credit	2005 by P.L. 109-58	An agri-biodiesel (biodiesel produced from virgin agricultural products) producer with less than 60 million gallons per year in production capacity may claim a credit of 10 cents per gallon on the first 15 million gallons produced in a year	End of 2011
Renewable Diesel Tax Credit	2005 by P.L. 109-58	Producers of renewable diesel or diesel/renewable diesel blends may claim a credit of $1.00 per gallon of renewable diesel	End of 2011
Cellulosic Biofuel Production Credit	2008 by P.L. 110-246	Producers of cellulosic biofuel (including cellulosic diesel) may claim a credit of $1.01 per gallon	End of 2012

Source: CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by (name redacted).

Biodiesel Markets

Over the past roughly six years (since the enactment of the tax credit), biodiesel prices have generally followed the same trend as conventional diesel prices, but have remained consistently higher despite the tax credit. (See **Figure 3**.) Between September 2005 and July 2010, the spread between biodiesel and conventional diesel prices ranged from $0.26 to $1.11 per gallon. Exacerbating the price spread is that biodiesel has a slightly lower energy content per gallon than diesel fuel. Thus, the per-mile cost difference between biodiesel and conventional diesel is slightly higher than the per-gallon prices would indicate. However, users may see benefits from using biodiesel despite its higher costs, including the potential for lower pollutant emissions and the use of domestically produced fuel.

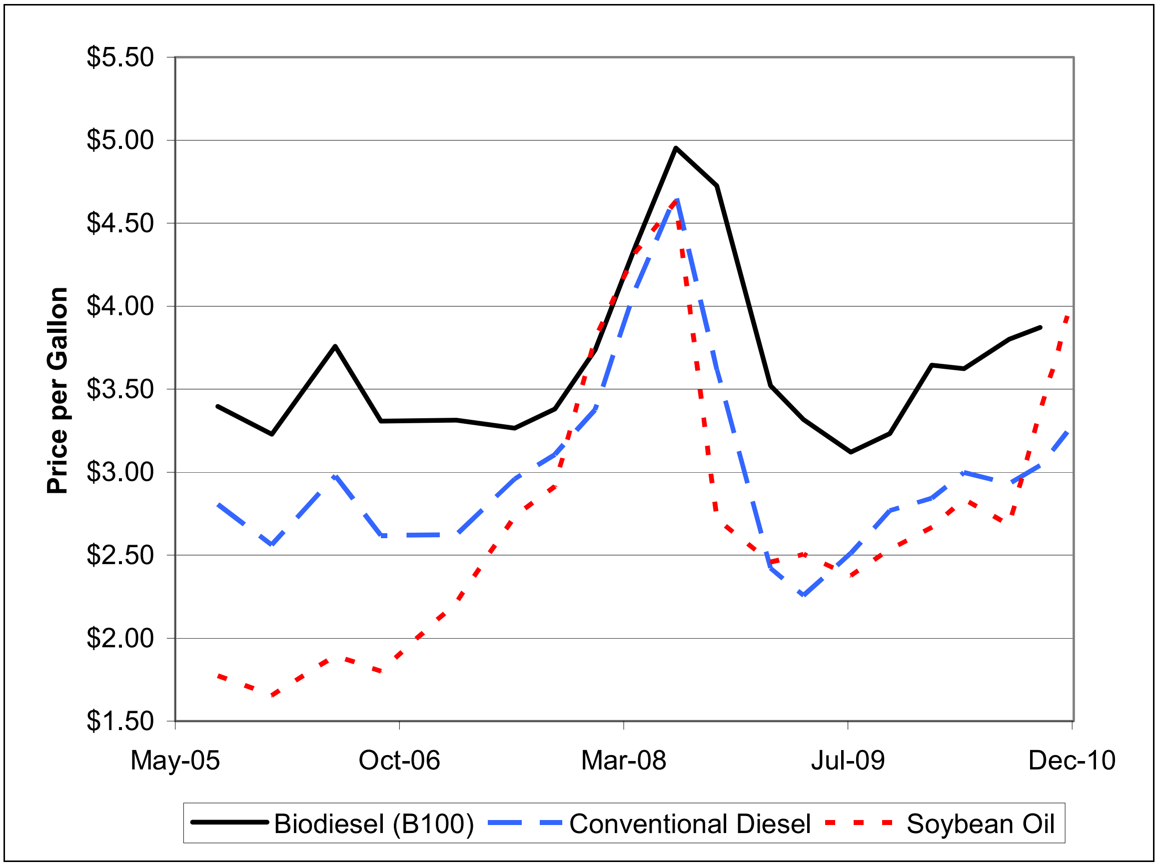
One primary reason for the high price of biodiesel is that the key feedstock—soybean oil—is a relatively expensive commodity that tends to keep pace with petroleum (and conventional diesel) prices. It takes roughly one gallon of soybean oil to produce a gallon of biodiesel (along with other inputs),[10] and per-gallon soybean oil prices have been on par with per-gallon diesel prices in

[10] Energy is needed in the production of soybeans (and in the chemical inputs to soybean production), the transportation and crushing of soybeans into soybean oil, the conversion of soybean oil into biodiesel, and the transportation and distribution of the finished fuel. Various studies have calculated the fossil energy balance (the ratio of energy contained in the fuel to the sum of the fossil energy inputs), with a broad range of results which depend largely on assumptions about the energy value of various inputs and outputs to soy and biodiesel production. Recent analyses by the Department of Energy and EPA have found a large net energy balance, although some other studies have come to different conclusions. See Argonne National Laboratory, *Life-Cycle Assessment of Energy and Greenhouse Gas Effects of Soybean-Derived Biodiesel and Renewable Fuels*, March 12, 2008; U.S. Environmental Protection Agency, *Renewable Fuel Standard (RFS2) Regulatory Impact Analysis*, February 2010; and David Pimentel and Tad W. Patzek, "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower," *Natural Resources Research*, vol. 14, no. 1, 2005, pp. 65-75.

recent years. (See **Figure 3**.) The relationship between conventional diesel prices and soybean oil and biodiesel prices is particularly strong: the correlation between conventional diesel prices on one hand and either soybean oil or biodiesel on the other is 84% and 89%, respectively.[11] Adding production process, transportation, and distribution costs thus raises the price of soy biodiesel above that of conventional diesel, even when the value of the biodiesel tax credit is included.

Figure 3. Comparison of Biodiesel, Conventional Diesel, and Soybean Oil Prices

Retail Prices for Fuels, Wholesale Price for Soybean Oil



Source: Biodiesel and Conventional Diesel prices: Department of Energy, *Clean Cities Alternative Fuel Price Report*, Landover, MD, September 2005 to October 2010, http://www.afdc.energy.gov/afdc/price_report.html. Soybean oil prices: USDA, Foreign Agricultural Service, *Oilseeds: World Markets and Trade Monthly Circular*, January 2011, http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf.

Note: Fuel prices are retail prices, including taxes/tax credits. Soybean oil prices are wholesale (Decatur) prices. Soybean oil prices are converted from $/pound to $/gallon based on 7.5 lbs per gallon. Biodiesel data are through October 2010; soybean oil and diesel data are through December 2010. The dramatic run-up in soybean oil prices (and the less dramatic but still noticeable increase in conventional diesel prices) in late 2010 could lead to similar increases in biodiesel prices.

[11] CRS analysis of data from Department of Energy, *Clean Cities Alternative Fuel Price Report*, Landover, MD, September 2005 to October 2010, http://www.afdc.energy.gov/afdc/price_report.html. USDA, Foreign Agricultural Service, *Oilseeds: World Markets and Trade* Monthly Circular, January 2011, http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf.

The prices for most agricultural commodities, including soybean oil, rose dramatically in late 2010; petroleum and conventional diesel prices have also risen, although not as dramatically. It seems likely that retail biodiesel prices for November and December 2010 (which are not yet available) will reflect these higher input costs.

The development of BBD fuels that are less dependent on traditional commodity feedstocks (e.g., soy) may be necessary to decouple BBD prices from the conventional fuels they are designed to replace. Thus research is continuing in developing processes to make BBD from cellulose and algae. In many cases, cellulose is a waste product with little monetary value, while there is potential to grow algae in non-agricultural areas limiting competition for prime farmland. However, these fuels are currently significantly more expensive to produce than biodiesel from soybean oil.

Renewable Identification Numbers (RINs)

Under the RFS, the mandated volumes that fuel suppliers must meet are administered through a system of credits called Renewable Identification Numbers (RINs), which correspond to actual gallons of biofuel blended or sold. A RIN is a 38-digit number assigned to a batch of renewable fuel when it is produced.[12] RINs can be seen as analogous to retail barcodes. When a fuel supplier (generally a refiner or terminal operator) blends biofuels into conventional fuel or otherwise introduces the biofuels into commerce, the RIN is "detached." Once RINs are detached, the owner of the RINs may use them to meet the current-year obligation, save them for use in the coming year (with certain limits), or trade them to another party.

Use of RINs

After each calendar year, fuel suppliers must submit to EPA sufficient RINs to cover that year's mandate. For example, if a refiner had an obligation under the mandate of 1 million gallons for 2010, by February 28, 2011, that refiner would need to submit 1 million RINs to EPA. In general, up to 20% of a given year's obligation may be met using RINs from the previous year ("RIN rollover"), while no RINs may be used from two or more years earlier.[13] Thus, RINs effectively have a one-year "shelf life." If an obligated party falls short of its obligation in a given year, it may carry that deficit forward for one year, but then may not carry any deficit forward in the following year. In that way, fuel suppliers have a limited ability to borrow RINs from the future.

Under the RFS, fuel suppliers actually face four distinct but linked RIN requirements. These requirements correspond to the four fuel types required by the RFS: (1) cellulosic biofuel; (2) biomass-based diesel (BBD) fuel; (3) advanced biofuel; and (4) overall renewable fuel. Some fuels may be used to meet different obligations simultaneously. For example, a cellulosic biofuel or BBD RIN may be used to meet the cellulosic/BBD requirement (no. 1 and/or no. 2),[14] the

[12] Within each batch, individual gallons of fuel are numbered sequentially. Thus, the last 16 digits of the 38-digit number indicate the total volume (and number of RINs) in that batch. For a more detailed discussion of RINs, see CRS Report R40155, *Renewable Fuel Standard (RFS): Overview and Issues*, by (name redacted) and (name redacted).

[13] The exception to this is that, because the 2009 program was established after the end of 2009, 2008 BBD RINs may be used to meet the 2009/2010 combined mandate.

[14] A cellulose-based BBD fuel could potentially be used to meet all four mandated categories.

advanced biofuel requirement (no. 3), and the overall RFS (no. 4), while a corn-based ethanol RIN can only be applied to the overall mandate (no. 4).[15] Thus, RIN markets will likely develop separately for various classes of fuels.[16] As the cellulosic biofuel and BBD requirements are more specialized, and the fuels are generally more expensive to produce, those RINs can be expected to be more expensive most of the time, especially if there is any expected shortage in the market.

Biodiesel RIN Market

The RFS was significantly expanded by the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140), including the establishment of the BBD mandate. However, while EISA mandated the use of 0.5 billion gallons of BBD in 2009, EPA did not finalize rules for the expanded RFS (often referred to as "RFS2") until February 2010.[17] Therefore, EPA combined the 0.5-billion-gallon 2009 mandate with the 0.65-billion-gallon mandate in 2010 for a combined 2009/2010 mandate of 1.15 billion gallons. EPA estimates that, counting 2008 and 2009 RINs that have been registered with the agency, an additional 345 million gallons of biodiesel in 2010 will be needed to meet the combined requirement.[18]

The Energy Information Administration (EIA) estimates that roughly 320 million gallons of biodiesel was consumed in 2009. (See **Figure 1**.) If EIA consumption estimates for the first three quarters of 2010 are accurate, then total 2010 consumption will likely fall below that in 2009.[19] Thus, supply for 2010 biodiesel RINs will almost certainly be tight, and demand may actually exceed supply.

For 2011, EISA mandates the use of 800 million gallons of biomass-based diesel. Therefore, as 2010 demand may very well exceed supply, 2011 supply will need to increase dramatically to meet the anticipated demand, and the value of any 2010 rollover RINs could increase as well.[20]

This tight RIN supply appears evident in RIN markets. Since the start of 2010, biodiesel RINs produced in 2010 have steadily increased in price, from roughly $0.10 per gallon in January 2010 to nearly $0.90 in January 2011; RINs produced in 2011 were trading at comparable prices. (See **Figure 4**.) Current 2010 and 2011 RIN prices are an order of magnitude higher than 2008 and 2009 biodiesel RINs (or ethanol RINs). Unless domestic production increases dramatically or there is a large increase in imports, RIN prices will likely continue to increase through 2011

[15] RINs are generally given an equivalency rating based on their energy content relative to ethanol. As the BBD mandate is for a given number of gallons of BBD specifically, the equivalency is one-to-one. But a biodiesel RIN is equivalent to 1.5 RINs of ethanol in meeting the advanced biofuel or overall RFS mandates.

[16] *Ethanol Monitor* and other publications currently track prices for conventional (corn-based) ethanol RINs and biodiesel RINs.

[17] EPA, "Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program," 75 *Federal Register* 14669-14904, March 26, 2010.

[18] EPA, *Questions and Answers on Changes to the Renewable Fuel Standard Program (RFS2)*, Washington, DC, October 13, 2010, http://www.epa.gov/otaq/fuels/renewablefuels/compliancehelp/rfs2-aq.htm.

[19] EIA estimates that 176 million gallons of biodiesel was consumed from January through September 2010, leading to a monthly average of 19.6 million gallons. If that average continues through the fourth quarter of 2010, total consumption would be roughly 235 million gallons. EIA, *October 2010 Monthly Energy Review*, Washington, DC, October 28, 2010, Table 10.4, http://www.eia.doe.gov/mer/.

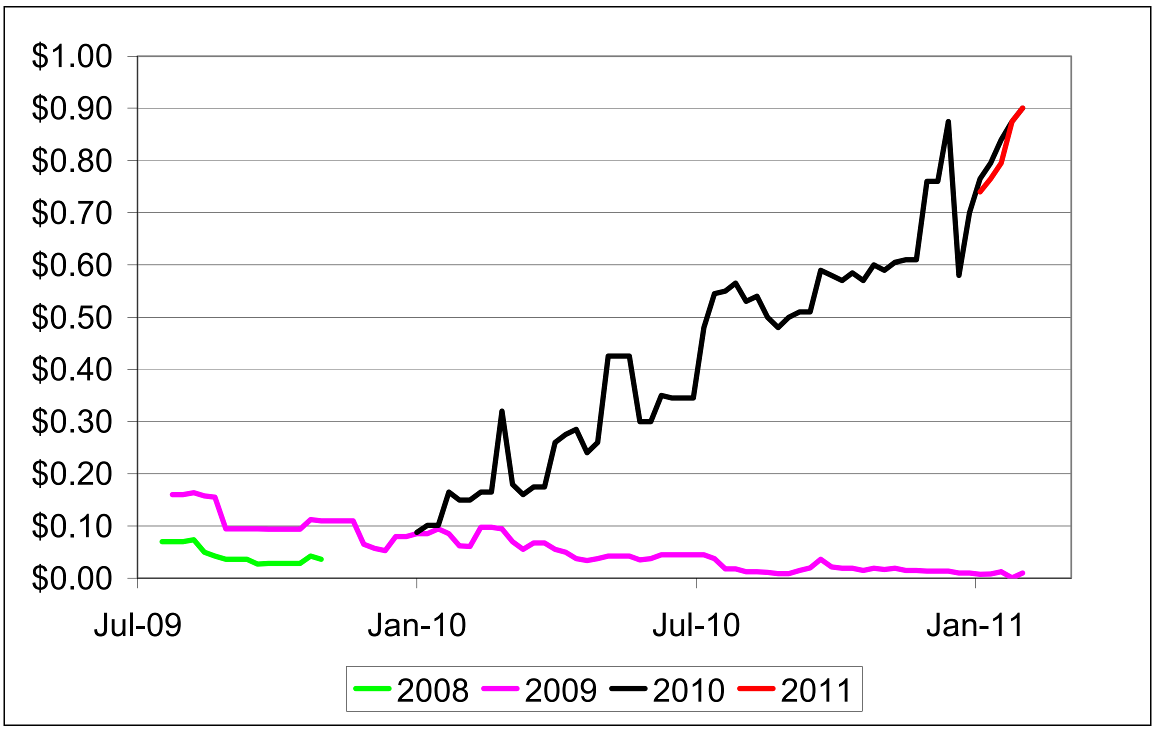
[20] This may be especially evident if fuel suppliers are expecting a shortfall in 2011 in the number of RINs available to meet the BBD mandate. As suppliers may not carry year-on-year deficits, suppliers may be less willing to register a deficit for the 2009/2010 mandate if they expect to need to carry a deficit from 2011 into 2012.

unless EPA grants a waiver from the 2011 BBD mandate, which the agency argues may be unnecessary:

> In addition to current production rates, the biodiesel industry's production potential also supports a finding that it can more than satisfy the applicable volume of biomass based diesel specified in the statute for 2011. In July of 2010, over 1.8 billion gallons of production capacity had been registered under the RFS2 program. As of September 2010, the aggregate production capacity of biodiesel plants in the U.S. was estimated at 2.6 billion gallons per year across approximately 170 facilities. Indications from the biodiesel industry are that idled facilities can be brought back into production with a relatively short leadtime. Imports of biodiesel from foreign countries also has the potential to increase the volume available for consumption in the U.S.[21]

Figure 4. Biodiesel RIN Prices, by Vintage Year

$ per Gallon



Source: "RIN Quotes," *The Ethanol Monitor*, July 20, 2009 to February 7, 2011.

Notes: RINs may be used in the year they were generated (vintage Year) or one year afterward. However, only 20% of an obligated party's requirement may be met using the prior year's RINs. After the settlement period (February 28), RINs from two years prior are unusable and should have no market value.

To avoid a major shortfall in 2011 RIN supply, idled or new capacity will likely need to be brought online relatively quickly, capacity utilization at operating plants will need to increase dramatically, and/or imports will need to increase. The 800-million-gallon 2011 mandate exceeds U.S. production at its 2008 peak (roughly 700 million gallons). The potential effects of such a rapid increase in biodiesel production on soybean oil demand and soybean prices are unclear—

[21] EPA, "Regulation of Fuels and Fuel Additives: 2011 Renewable Fuel Standards," 75 *Federal Register* 76802, December 9, 2010.

doubling biodiesel production in the short run would likely lead to a doubling of soybean oil use for biodiesel production. In 2009, roughly 2 billion pounds of soybean oil were used for biodiesel production,[22] representing roughly 10% of U.S. soybean oil supply.[23] Increasing soybean oil use for biodiesel from 10% to 20% of supply in one year could have dramatic effects on soybean oil prices for biodiesel and for other uses.

Tax Credit Effects

The tax credit for the production and use of BBD fuels has been a major factor in their growth over the past few years. While the RFS mandates could potentially provide a larger incentive—in the form of a guaranteed and growing market—biodiesel production has remained largely dependent on the $1.00-per-gallon tax credit. Despite a growing RFS mandate, the expiration of the tax incentives at the end of 2009 led to a drop in production from 2009 to 2010. The mandate was not sufficient to overcome the expiration of the tax credit, along with tight credit markets and an overall poor economy. The National Biodiesel Board maintains that the extension of the tax credit that was enacted in December 2010 will "help kick-start the domestic biofuel industry," and that the credits make biodiesel competitive with conventional diesel at the pump.[24]

While the tax incentives improve the competitiveness of BBD fuels, some stakeholders question whether they are warranted in the presence of a mandate to use the fuel. They argue that if the mandate is binding, the incentives will not promote the use of additional fuel beyond the mandate, and that overall fuel prices are lowered, creating an incentive to use more conventional fuel.[25] A counterargument is that this perverse incentive is only likely if the mandate is binding and credible. As seen in **Figure 1**, after the expiration of the tax credit, production declined from 2009 to 2010. If producers do not see the mandate as binding and certain, the presence of the tax credit may lower their perceived risk. Alternately, producers could be gambling on the likelihood that EPA will waive the BBD mandate in the face of limited production, or they could be hedging their bets into 2011 based on the deficit carryover contingency while they wait to see what the EPA will do with the BBD mandate. BBD producers have already seen the EPA waive the cellulosic RFS2 mandate in successive years due to lack of production. Meanwhile, BBD RIN prices have risen steadily to about $0.90 per gallon.

If BBD RIN prices remain high, producers may perceive less need for the tax credit, especially if RIN prices ultimately exceed the per-gallon value of the tax credit.

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22 EIA, *Biodiesel Monthly Report*, Washington, DC, October 2010, Table 3, http://www.eia.doe.gov/cneaf/solar.renewables/page/biodiesel/biodiesel.html.

23 According to the U.S. Department of Agriculture (USDA), U.S. production of soybean oil in 2009/2010 was 19.6 billion pounds. Mark Ash, *Oil Crops Outlook*, USDA, Economic Research Service, OCS-11a, Washington, DC, January 13, 2011, Table 3, http://usda.mannlib.cornell.edu/usda/current/OCS/OCS-01-13-2011.pdf.

24 National Biodiesel Board, *Biodiesel Tax Incentive*, Jefferson City, MO, December 16, 2010, http://www.biodiesel.org/news/taxcredit/default.shtm.

25 Harry de Gorter and David R. Just, *The Law of Unintended Consequences: How the U.S. Biofuel Tax Credit with a Mandate Subsidizes Oil Consumption and Has No Impact on Ethanol Consumption*, Cornell University, Charles H. Dyson School of Applied Economics and Management, Cornell University Working Paper No. 2007-20, Ithaca, NY, February 1, 2008, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1024525.

Implications for the Future

Going forward, the settlement of the 2009/2010 combined BBD mandate,[26] as well as the trajectory of domestic production/consumption and BBD RIN prices in 2011, could provide insights for the future of other biofuel/RIN markets. For the BBD RIN market to function effectively, EPA most likely will need to hold firm to its 2011 RFS2 BBD mandate. Because of shortfalls in cellulosic biofuel production capacity, EPA has waived the vast majority of the 2010 and 2011 cellulosic biofuel mandates.[27] EPA lowered the 2010 and 2011 mandates from 100 million gallons to 6.5 million gallons, and from 250 million gallons to 6.6 million gallons, respectively. In 2012, the scheduled mandate is 500 million gallons, and it remains unclear whether there will be sufficient production capacity to meet that level.

If cellulosic biofuel production capacity does eventually catch up with the RFS schedule, long-run cellulosic RIN prices may provide a significant financial incentive for cellulosic biofuel production, if the mandates are perceived as binding and credible. However, if EPA consistently provides waivers from the cellulosic biofuel mandate, and producers question the credibility of the mandate, cellulosic biofuel production—and cellulosic RIN prices—could stay low.

Potential Policy Options

The markets for biomass-based diesel fuel and for RINs under the RFS raise many issues. Depending on one's perspective, there are a variety of policy options to address these issues. On the tax policy side, these options fall into three categories: (1) maintain the existing incentive structure and extend it into the future; (2) eliminate some or all of the incentives; (3) modify the incentives to more directly address certain policy goals.

In the first category—maintaining existing incentives—efforts to extend tax incentives have been proposed and enacted. Most recently, the "tax extenders" bill that was enacted in December 2010[28] extended through the end of 2011 various biofuels tax incentives, including the biodiesel and renewable diesel tax credits.[29] A key question for Congress is whether to extend these incentives past 2011 at their current levels, to modify them, or to let them expire.[30] Proponents of the tax incentives argue that they spur domestic production of non-fossil fuels, reducing U.S. reliance on imported petroleum, promoting rural development, and raising farm incomes.

As noted above, some critics argue that layering tax incentives on top of mandates is a redundancy, provides unintended incentives for conventional fuel supply, and may add little further incentive for production/consumption (beyond the mandate). Further, some stakeholders are concerned that as the RFS mandates grow, the liability for Treasury revenues will continue to

[26] February 28, 2011.

[27] See CRS Report R41106, *Meeting the Renewable Fuel Standard (RFS) Mandate for Cellulosic Biofuels: Questions and Answers*, by (name redacted).

[28] The Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312)

[29] P.L. 111-312, §701. As the credit had expired at the end of 2009, the law made the extension retroactive to cover all 2010 production, as well.

[30] See CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by (name redacted).

increase if the tax incentives are maintained. Thus some stakeholders have argued for an elimination or phaseout of the tax incentives.

Other proposals have included modifying the existing tax incentives to base their value of performance measures, as opposed to simple per-gallon incentives. Possible performance measures could be based on various goals. For example, the value of the tax credit could be based on the expected amount of petroleum displaced by the fuel, or by its environmental performance (e.g., greenhouse gas emissions reduction). Further, one of the key rationales for the tax incentives is to make biofuels more competitive with petroleum. Thus, the tax incentives could be keyed to the price of oil: as oil prices rise above a certain level, the incentives could phase out.

One potential concern for BBD is that supply may not keep pace with mandates set in the RFS, regardless of the tax incentives. Therefore, some stakeholders may look for ways to make it easier to meet the BBD mandate, either through additional economic incentives or through a lowering of the mandate. The former would help spur production, while the latter would likely limit investment in new production.

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