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Biofuels Policy in Limbo

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Federal legislation requires increasing quantities of biofuel to be blended into the fuel supply, but the EPA is vacillating on whether it will enforce this mandate. Biofuel mandates are an expensive way to reduce carbon emissions. The EPA's indecisiveness makes them even more expensive.

Also in this issue

Any game works better when the rules are enforced consistently, whether it is the Superbowl or Monopoly around the kitchen table. If the referee is indecisive, then the players are uncertain about how to play and the game degenerates.

Transportation fuel markets in the United States currently resemble a game with inconsistently enforced rules. The EPA plays the role of the referee. It is charged with implementing federal legislation known as the Renewable Fuel Standard (RFS), which requires ambitious quantities of biofuels such as ethanol and biodiesel to be blended into motor fuels.

Until recently, the fuel industry was able meet the RFS mandate without too much difficulty. However, the mandate now requires more biofuel than the fuel industry can easily absorb, and the EPA has vacillated on whether it will enforce the standard. We are almost at the end of the year, and the EPA still has not told the industry how much biofuel it must use in 2014.

This article explains how we got to this point and outlines the future prospects for biofuels policy.

Background

The transportation sector burns too much fossil fuel because motorists do not pay for their effects on the environment. In particular, fossil fuels generate carbon dioxide emissions that contribute to global climate change. Most economists recommend addressing this problem either by levying a tax on each gallon of motor fuel equal to the marginal emissions damages from using it or by implementing a cap-and-trade system.

Political impediments present an obstacle to a carbon tax or cap-and-trade system in the United States. Instead, the Obama administration has adopted an "All-Of-The-Above" policy, in which it subsidizes or mandates numerous potential low-carbon technologies. The aim of this policy is to reduce carbon emissions without explicitly "picking a winner," which is an admirable goal.

Many economists have argued that the RFS picks an expensive winner. Holland et al. (2014) estimate that renewable-fuel standards are about three times more costly than a cap-and-trade system. Stated simply, it is much cheaper to reduce oil use than to increase biofuel use.

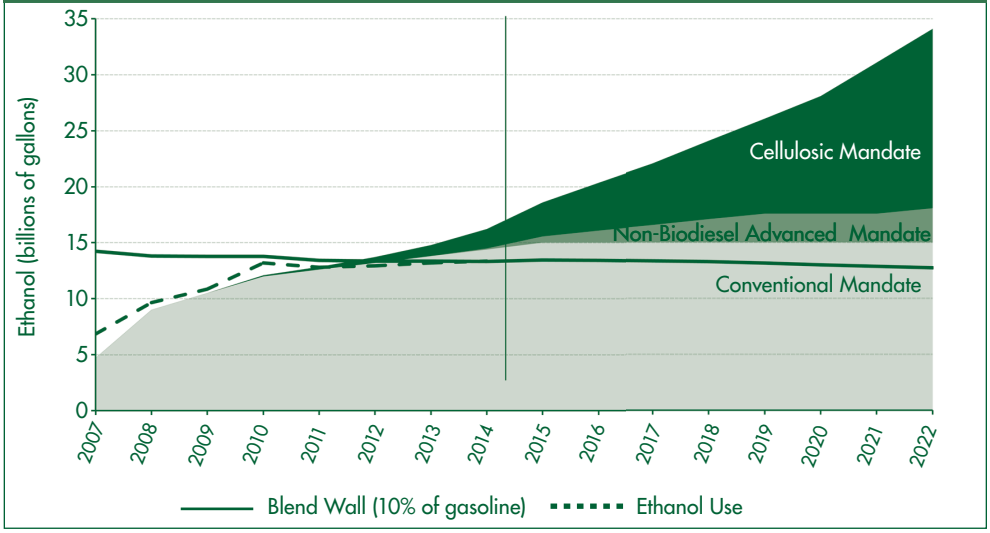
By legislating the RFS rather than a carbon tax, Congress has chosen an inefficient game for the industry to play. The EPA's job is to manage the game in the least costly way.

Current State of the RFS

The RFS requires increasing amounts of three categories of biofuel. The categories are defined by the estimated reduction in lifecycle greenhouse gas (GHG) emissions from using biofuel instead of gasoline. They are:

Cellulosic biofuels. These fuels are produced from the inedible part of

Figure 1. The Ethanol Blend Wall and the RFS Mandate



plants, e.g., corn stover, switchgrass. They are required to generate more than 60% GHG reduction.

Advanced biofuels. These fuels include biodiesel (produced mostly from vegetable oils and animal fats) and ethanol produced from sugarcane. They are required to generate more than a 50% GHG reduction.

Conventional biofuels. Corn ethanol is essentially the only fuel in this category. They are required to generate more than a 20% GHG reduction.

The EPA estimated that, by 2022, the average corn-ethanol gallon would generate a 21% GHG reduction and the average Brazilian sugarcane-ethanol gallon a 61% reduction relative to gasoline. Numerous researchers have challenged these numbers, including some who estimate that corn ethanol has GHG emissions at least as high as gasoline. EPA estimated that the average biodiesel gallon made from soybean oil would generate a 57% reduction relative to diesel. It also estimated that cellulosic ethanol fuels made from switchgrass or corn stover could generate more than a 100% reduction in GHG emissions relative to gasoline.

The mandate is nested, which means that advanced or cellulosic biofuels can be used to satisfy the conventional component of the mandate, and cellulosic biofuel can be used to satisfy the advanced component. Fuel producers are required to blend biofuels with gasoline and diesel at a rate sufficient to get the mandated amount of biofuel into the fuel supply. By 2022, the RFS specifies that about one-quarter of motor fuel should be biofuel.

The RFS faces two significant obstacles in 2014: (i) the blend wall, and (ii) the lack of cellulosic biofuel production.

The blend wall refers to a technical barrier on the amount of ethanol that can be blended into gasoline. The blend cannot exceed 10% ethanol without violating air quality standards and potentially damaging engines. However, the RFS now requires more biofuel than can be consumed by blending ethanol into gasoline up to 10%.

Figure 1 illustrates the blend wall by showing that ethanol use increased rapidly until 2010 when it reached 10% of gasoline consumption. Since that time, ethanol use has remained stagnant in the United States.

Breaching the blend wall will require either expanded consumption of biodiesel, which does not face any relevant blend restrictions, or increasing sales of a high-ethanol blend of gasoline known as E85, which contains up to 85% ethanol and can be used in flex-fuel cars. Although about 6% of registered vehicles in the U.S. have flex-fuel capability, very few gas stations sell E85. Since the mandate exceeded the blend wall in 2013, the market has chosen to comply with the RFS by increasing biodiesel production rather than expanding E85.

Figure 1 also shows the three components of the RFS. It shows the large increase in mandated volumes for cellulosic biofuels in the coming years. The RFS restricts the advanced component of the mandate by specifying a minimum contribution of biomass-based diesel. For the advanced component in Figure 1, I subtracted the required biodiesel quantity so as to show the ethanol quantities that would satisfy the mandate.

Cellulosic biofuel is the only category that entails substantial reductions in GHG emissions, so the level of cellulosic production will determine whether the RFS is ultimately considered to be a successful policy. Although cellulosic biofuel production is technically possible, it is currently very expensive. The statute allows the EPA to waive the cellulosic component of the mandate if there is inadequate domestic supply, and it has exercised this option each year so far. If cellulosic technology remains expensive, then it may be waived each year until 2022. In that case, the cellulosic mandate will not be costly to fuel markets, but nor will we see noticeable GHG benefits from the RFS.

In November 2013, the EPA announced that it also intended to waive the above-blend-wall quantities of the conventional and advanced mandates for 2014. It justified this rule on the grounds that the inadequate domestic supply provision extends to the distribution of fuels. In particular, there currently exists about 15 billion gallons (bgal) of production capacity for corn ethanol, whereas the blend wall binds at about 13.4 bgal. The EPA argued that it could not set the mandate at a level that requires more than 13.4 bgal of ethanol because the surplus would need to be

sold as E85, and there aren't enough flex-fuel cars on the road with access to filling stations that sell E85. This announcement garnered a strong reaction from the biofuel industry and seemed unlikely to survive a court challenge.

Since that preliminary announcement, the EPA has been unable to come to a final rule for 2014. This leaves the industry in flux, not knowing what it is expected to produce this year or what technologies it should be investing in for future years.

Navigating the Blend Wall

I characterize three options for the EPA:

1. Extensive waivers. Set the cellulosic mandate at expected production (essentially zero), the advanced mandate at 2013 biodiesel production (1.5 bgal), and the conventional mandate at the ethanol blend wall. This is essentially the 2014 proposed rule.
2. Cellulosic, advanced and total waiver. Set the cellulosic mandate at expected production and leave the advanced and conventional mandates as in the statute.
3. Cellulosic waiver only. Set the cellulosic mandate at expected production and increase the advanced mandate to compensate for the lost cellulosic quantity. This is the rule the EPA used in 2013 and before.

Option 1 seems untenable under the law. Options 2 and 3 can both be justified using the provision that there is inadequate domestic supply of cellulosic biofuel. The statute gives the EPA Administrator the right to use either of these options. So, which one should it choose?

The open questions are, in the absence of additional policy measures, (i) how much would additional biodiesel demand drive up fuel prices, and (ii) at what price does E85 become cost-effective?

Table 1: EPA Options for Setting Mandate and Compliance Options for the Industry

		RVO				Compliance Possibilities			
						Plan 1		Plan 2	
	Year	Total	Corn Ethanol	Adv. Biofuel	Cell. Biofuel	BBD[1]	E85	BBD	E85[2]
RFS	2014	18.15	14.4	3.75	1.75				
	2015	20.50	15.0	5.50	3.00				
	2016	22.25	15.0	7.25	4.25				
EPA Option 1	2014	15.54	13.3	2.25	0	1.5	0	1.5	0
	2015	15.70	13.4	2.25	0	1.5	0	1.5	0
	2016	15.63	13.4	2.25	0	1.5	0	1.5	0
EPA Option 2	2014	16.40	14.4	2.00	0	2.1	0	1.5	1.3
	2015	17.50	15.0	2.50	0	2.7	0	1.5	2.7
	2016	18.00	15.0	3.00	0	3.1	0	1.5	3.6
EPA Option 3	2014	18.15	14.4	3.75	0	2.5	0	1.5	3.9
	2015	20.50	15.0	5.50	0	3.7	0	1.5	7.2
	2016	22.25	15.0	7.25	0	4.8	0	1.5	10.0

All quantities in billions of gallons. BBD = biomass based diesel. Amount of E10 equivalent gallons sold equals 132.94, 134.46, and 133.75 bgal in 2014, 2015, and 2016 respectively. The "corn ethanol" column would perhaps be better labeled "conventional biofuel" as this component could be met by any biofuel.

1. Billions of wet biodiesel gallons, i.e., (total – corn ethanol)/1.5. For compliance, a gallon of biodiesel counts for 1.5 gal of ethanol because of differences in energy content.

2. Billions of E85 gallons sold, assuming E85 is 74% ethanol and achieves 75% the fuel efficiency of E10.

In Table 1, I outline the compliance possibilities for 2014–16. I set the cellulosic mandate to zero for simplicity. If significant cellulosic production comes online by 2016, then the amounts of biodiesel and/or E85 required to achieve compliance under Option 3 will decrease accordingly. The table also ignores the California low-carbon fuel standard and other state policies. One effect of the California low-carbon fuel standard will be to substitute corn ethanol for sugarcane ethanol. However, this substitution does not affect this analysis as long as the ethanol blend wall binds.

I consider two compliance possibilities that represent possible extremes. In Plan 1, all above-ethanol-blend-wall biofuel comes from biodiesel. For convenience, I set E85 to zero in this scenario. Actual E85 sales are likely around 0.3 bgal this year, but this amount is measurement error around the blend wall, i.e., with this amount of E85, total ethanol use is about 10% of total motor gasoline sales. In Plan 2, biomass-based diesel production is set to the 2013 level of biodiesel production (1.5bgal), and the remainder of the mandate is met with E85.

Consider Option 2. So far, biodiesel production and imports in 2014 have been similar to 2013, so it is reasonable to expect about 1.9 bgal of biodiesel this year. This is close to the required 2014 amount under Option 2. By 2016, Option 2 requires 3.1 bgal of biodiesel production if E85 remains close to zero. To meet the mandate with E85 would require 3.6 bgal of additional E85. The E85 number is higher because (a) each gallon of E85 has about half the energy content of a gallon of biodiesel, so it contributes only half as much towards RFS compliance, and (b) E85 is less fuel-efficient than standard 10% ethanol-blend gasoline (E10), so more

gallons need to be sold to produce the same vehicle miles.

Based on the numbers in Table 1, Option 3 seems infeasible at present. It would require a substantial increase in biodiesel production capacity and/or E85 sales. Next, I explore the implications of Option 2 for agricultural and fuel prices.

The U.S. used 1.8 bgal of biodiesel last year, so Option 2 would require an increase of about 70% by 2016. Some of this increase would come from soybean oil and other oilseeds, some from corn oil, some from animal fat, and some from other sources such as recycled cooking oil. The relative proportions of each depend on the responsiveness of supply from each source; more responsive sources will provide more of the increment.

Soybean oil is the most prominent biodiesel feedstock; it generated about 40% of 2013 biodiesel. About 25% of U.S. soybean oil is used to produce methyl ester, which becomes biodiesel, so a 70% increase in biodiesel demand would imply a $0.7*0.25 = 17.5\%$ increase in demand for U.S. soybean oil. It would require rigorous analysis to generate a precise estimate of the price effect of this demand increase, but 10–20% is the likely magnitude.

If the EPA were to follow Option 2 and if the industry were to comply using biodiesel, which seems likely, then U.S. diesel fuel would still be less than 10% biodiesel. In recent months, biodiesel has been about $0.50 per gallon more expensive than petroleum-based diesel. If the mandate pushed biodiesel prices up another 20%, then we may observe biodiesel prices as much as a dollar more than petroleum-based diesel. However, with biodiesel being only a small ingredient in the final fuel, consumers would see diesel prices rise by less than 10 cents.

Conclusion

As a tool for reducing carbon emissions, the RFS has been ineffective so far. It prompted a huge expansion of corn ethanol use, which offers little reduction in GHG emissions. The only real chance the legislation had to generate significant climate benefits was by spurring substantial production of cellulosic biofuel. When conventional ethanol hit the blend wall, the EPA signaled in November 2013 that it was unwilling to mandate any further expansions in biofuels, so this possibility seemed remote.

The lack of action in the past year suggests that biofuel proponents have swayed the EPA from this position, but these vacillations still bode poorly for future expansion of biofuels. In recent work, Gabriel Lade, Cynthia Lin, and I show how such policy uncertainty undermines the RFS by removing the incentive to develop cellulosic biofuels. Quantity mandates such as the RFS, which require large transfers from petroleum producers to biofuel producers, can easily be undermined if a regulator balks at enforcing the mandate when it gets expensive.

Where should we go from here? The obvious answer is to repeal the RFS and replace it with a carbon tax. Give the industry a better game to play.

Assuming that politics prevents that outcome, it seems likely that the EPA will follow a path like Option 2 in Table 1. This path will raise fuel prices by a negligible amount, raise food commodity prices by a noticeable amount, and benefit biodiesel producers at the expense of petroleum diesel producers. At best, we can hope that it will also signal to cellulosic developers that the EPA is willing to enforce the mandate and thereby inspire more investment in this technology.

The worst outcome would be for policymakers to add new subsidies to the RFS to further distort fuel and agricultural markets. In recent years, diesel blenders have received a $1 per gallon tax credit for blending biodiesel. This tax credit shifts the burden of blending biodiesel from diesel producers and consumers to taxpayers and could be reinstated retroactively for 2014. In addition, several analysts have proposed subsidies for E85 filling stations so as to lower the cost of compliance by expanding the E85 market. This action would expand corn ethanol use, providing little environmental benefit and again shifting the compliance burden from the fuel industry to taxpayers. If these possibilities eventuate, then an already inefficient policy will be made worse.

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For additional information, the author recommends:

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