Policy Update

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Implications of blending limits on the US ethanol and biofuels markets

“The bottom line is that ethanol cannot be the only biofuel in the US market given current and possible future blend levels and the low level of penetration of flex-fuel vehicles.”

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In the last issue I discussed the USA and EU approaches to stimulating biofuels [1]. The US approach combines subsidies and mandates for specific volumes of biofuels by type. By 2022, the Renewable Fuel Standard (RFS) calls for 132.5 billion liters of gasoline-type fuels with 56.78 billion liters likely to come from corn ethanol, 60.57 billion from cellulosic feedstocks and 15.14 billion from other advanced biofuels [2]. Up to this point, all the commercial gasoline-type biofuels in the USA have been ethanol. Ethanol in the USA is used in two different blends at present – E10 and E85, meaning 10% ethanol and 85% ethanol, respectively. The actual blend levels may be less than these percentages, but cannot exceed these proportions. The volume of E85 is tiny. About 2000 petrol stations out of 160,000 have the capacity to vend the fuel. There are only about 7 million of the flex-fuel vehicles required to consume E85 (out of over 300 million), and many of those are distant from a fueling station [3]. So, effectively, the RFS mandates must be met with the E10 ethanol blend or some other biofuel.

Total national consumption of gasoline in the US is about 529 billion liters and is expected to fall over time due to increasing fuel economy standards [2]. Thus, at present, if every drop of gasoline were blended at E10, the maximum ethanol that could be absorbed would be 52.9 billion liters. In reality, 10% cannot be blended in all areas and seasons. Most experts consider an average blend of 9% to be the effective maximum, which amounts to about 48 billion liters [4]. US ethanol production capacity already exceeds this level. Thus, we have reached a blending limit known as the blend wall. This physical constraint is the biggest issue facing the US ethanol industry today. If the current blending limit of 10% is maintained, the ethanol industry cannot grow; indeed, it cannot even operate at its existing capacity. That partially explains why 7.5 billion liters of capacity was shut down during much of 2009. It also explains why the ethanol price during much of the year was driven mainly by corn instead of gasoline as it had been previously. The basic economics of the blend wall are depicted in Figure 1. Moving from left to right down the demand curve, once the blend wall is reached, the price plummets from the market equilibrium (with subsidy) at P^* to the intersection of the supply curve and the blend wall P^{BW}. Ethanol becomes priced on a break-even basis with corn. That was the situation in the first three quarters of 2009. Markets picked up in the fourth quarter as more ethanol can be blended in winter months than summer months due to summer evaporative emissions constraints.

At present we have two opposing realities. First, the growing RFS requires more biofuels each year up until 2022, and second, a physical blend wall that does not permit ethanol consumption to grow at all beyond present levels. An ethanol industry support and lobby group called Growth Energy petitioned the US Environmental Protection Agency (EPA) to increase the blending limit from 10 to 15%. On 30 November 2009, the EPA responded to the request indicating it was leaving the blending limit where it is for now but would issue a final ruling once some additional vehicle tests are completed in the summer of 2010. However, even

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if the EPA decides to increase the blending limit, that essentially buys time but does not remove the blending wall limit.

Given this divergence between the RFS and the US blending rules, what options might exist for meeting the RFS given the blending wall reality? Following are six options that will be summarized briefly here:

- The blend limit remains at 10%, and all biofuel is ethanol;
- The blend limit is increased to 15%, and all biofuel is ethanol;
- The blend limit is 10%, and all cellulosic biofuel is thermochemically produced bio-gasoline or equivalent;
- The blend limit is 15% and all cellulosic biofuel is thermochemically produced bio-gasoline or equivalent;
- The blend limit is 10% and cellulosic technology is so expensive that the EPA waives the cellulosic part of the RFS;
- The blend limit is 15% and cellulosic technology is so expensive that EPA waives the cellulosic part of the RFS.

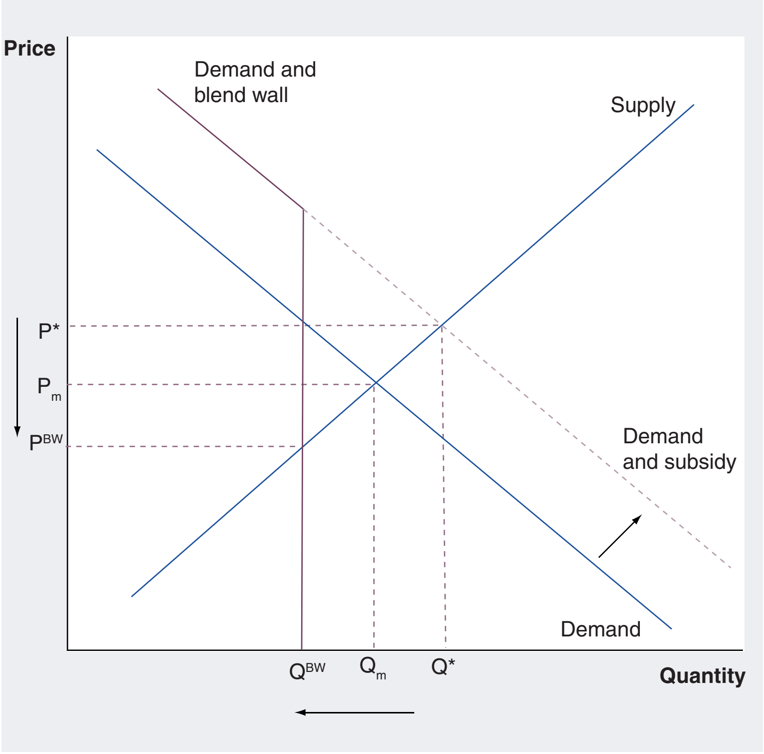

Figure 1. Basic economics of the blending wall.

The first alternative, maintaining the blending limit at 10% and producing only ethanol as a biofuel, is clearly out of the question. It would require massive increases in E85, with accompanying huge increases in flex-fuel vehicles [5]. Annual sales of flex-fuel vehicles would need to be at least 3.7 million per year, about a third of total vehicle sales, compared with a cumulative total of 7 million on the road today. It would also require installation of 2800 E85 fueling stations per year compared with a cumulative total of 2000 operating today. Furthermore, E85 would have to be priced at no more than 70% of gasoline because of the mileage difference. At present ethanol is more expensive than gasoline, so achieving this breakeven price level would be quite difficult. The bottom line is that this scenario is not feasible, and the EPA would be forced to waive the RFS at some point.

The second alternative of a 15% blend limit with only ethanol as a biofuel is less restrictive than the first, but suffers similar problems over the longer term. The higher blend limit essentially buys some time, but does not solve the blend wall problem. Flex-fuel vehicle sales would have to be 2.7 million per year, and 2100 additional E85 fuel stations would be required per year until 2022. These numbers also are not likely to be attained, and at some point, the EPA would have to waive the RFS, but not as soon as with the 10% limit.

In the third and fourth alternatives, we assume that, partly because of the blend wall, cellulosic feedstocks would be converted to hydrocarbons directly, and thus, not be subject to the blend wall. Biogasoline, biodiesel, and biojet fuel would all be products of thermochemical conversion processes for cellulosic feedstocks. If the cellulosic feedstocks were all converted directly to hydrocarbons, then the impact of the blend wall is much less severe. With the E10 blend limit, only 1 million flex-fuel vehicles need be sold each year to absorb all the ethanol in the E85 market. With the E15 blend limit, no additional flex-fuel vehicles would be needed beyond replacement. In other words, these pathways place little dependence on the E85 market as all the cellulosic feedstocks go directly to hydrocarbons.

The fifth and sixth scenarios assume that conversion of cellulosic feedstocks to any form of biofuels turns out to be far more expensive than petroleum-based alternatives. Under this condition, the EPA can waive the RFS for cellulosic biofuels. If that were to happen, it would mean that the total RFS in 2022 would be 71.8 billion liters instead of 132.5 billion liters. For the E10 blend limit, only 0.7 million additional flex-fuel vehicles would be needed per year, and for the E15 blend limit, only flex-fuel vehicle replacements would be needed.

The bottom line is that ethanol cannot be the only biofuel in the US market given current and possible future blend levels and the low level of penetration of flex-fuel vehicles. The blend wall becomes an impenetrable barrier to meeting the RFS. If the thermochemical production processes become viable, then the RFS can be met with a combination of ethanol from corn and sugarcane and hydrocarbons from cellulose.

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