



## Comparison of the US and EU approaches to stimulating biofuels

“ A technology- and feedstock-neutral policy is clearly preferred to one in which the government weighs in heavily on technology choice. In this case, the EU got it right. ”

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There are some similarities and many differences between the US and EU approaches to stimulating the production and use of biofuels. In the early years, both the USA and EU relied on subsidies. In fact, the same was true for Brazil, the other major biofuel producer. However, over time, as biofuel production increased and, thus, so did the costs of the subsidies, governments tended to rely more on mandates. In the USA, the mandate is called the Renewable Fuel Standard (RFS), and the current version was passed by Congress in 2007 [1]. The current version of the EU biofuels mandate was passed in 2009 [2]. In this article, I will compare the approaches used to stimulate biofuels in the USA and the EU with particular attention to these biofuel mandates.

All of the biofuel incentives in the USA are volumetric. That is, the unit of measurement of success in achieving the mandate is gallons of biofuels produced/consumed, regardless of the type of biofuel being produced. In other words, a liter of ethanol counts the same as a liter of biogasoline or any other biofuel. Ethanol contains two-thirds the energy-per-unit volume as gasoline, but the US subsidy and mandate count them as the same. However, at present, the USA provides a higher subsidy for cellulosic biofuels (US\$0.267/l) than for corn-based ethanol (US\$0.119/l). **Table 1** shows what the subsidies would be for each biofuel if the USA wanted to provide equivalent subsidies based on energy content.

The US biofuel mandate is expressed in volumes, but also partitions the mandate into conventional biofuels (corn ethanol), cellulosic biofuels, other advanced biofuels and biodiesel. **Figure 1** provides the growth of

the US RFS up until 2022, when it reaches 136 billion liters in total. The partition is essentially feedstock-based with conventional biofuels coming from corn, cellulosic biofuels coming from any cellulosic feedstock, other advanced biofuels coming from sugarcane, algae or perhaps cellulosic feedstocks, and biodiesel coming from oilseeds, in the USA mainly soybeans. The US law specifies a threshold of greenhouse gas (GHG) reduction that must be achieved for each category of fuel. For conventional (corn-based) it is 20%, for cellulosic it is 60% and for the other categories it is 50%. The US EPA has authority to reduce each threshold by 10%. The legislation stipulated that direct and indirect GHG emissions must be included. That is, emissions associated with land use change due to the increased biofuel demand must be part of the calculation. Biofuels not meeting the threshold cannot be included in the RFS. However, all corn ethanol plants in operation or under construction as of December 2007 are ‘grandfathered’ and need not meet the GHG standard. This includes essentially all of the US corn ethanol production capacity.

In the EU system, the RFS is expressed in terms of a mandatory target of 20% of renewable energy, including 10% renewable transport fuels by 2020. The targets are in energy units, so that the transport fuel requirement for 2020 is 10% of the energy used in the transport sector. There is no differentiation by feedstock. The EU directive includes sustainability criteria that stipulate that biofuels should not lead to a loss in biodiversity. As in the USA, biofuels must also be shown to reduce GHG emissions. The original threshold is 35%

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**Table 1. Subsidies for various biofuels needed for energy equivalence.**

Biofuel	Energy equivalent subsidy (cents/l)
Ethanol	11.9
Butanol	14.8
Biogasoline	17.6
Biodiesel	19.6

reduction for all biofuels, but that increases to 50% in 2017 and 60% in 2018. Given that corn ethanol in the US is grandfathered, the threshold levels for the other biofuels are essentially the same in the USA and EU. The key difference between the USA and the EU is that the US RFS is volume-based and the EU directive is based on energy content. So, while a liter of ethanol in the USA is equal to a liter of biogasoline, this is not the case in the EU; in the EU, a kilocalorie of ethanol is equal to a kilocalorie of biogasoline.

In the EU system, everything is based on energy units, so the private sector is free to adopt any technology or feedstock that helps them to meet the target. In

other words, the policy is technology and feedstock neutral. On the other hand, the US policy is tilted towards ethanol. This is the case because, while ethanol contains two-thirds the energy of biogasoline, it gets the same RFS credit as biogasoline. If the USA wanted to have a technology-neutral RFS, while keeping a volumetric standard, it would need to credit different biofuels according to their energy content. **Table 2** provides the credits that would be needed to convert the US RFS into a technology-neutral RFS.

The tilt towards ethanol in the US RFS is particularly troublesome for several reasons. First, miles driven is a direct function of energy content of the fuel, so a technology-neutral standard should be keyed to miles driven from renewable fuels and its proxy energy content. Second, there are numerous infrastructure issues with ethanol that limit its use in motor fuels. Ethanol cannot be transported by pipeline, because it is corrosive, absorbs water and also dissolves materials in the pipeline. Ethanol must be transported by rail, truck or barge, making its transport more costly. It must be blended at blending terminals, or even ‘splash blended’

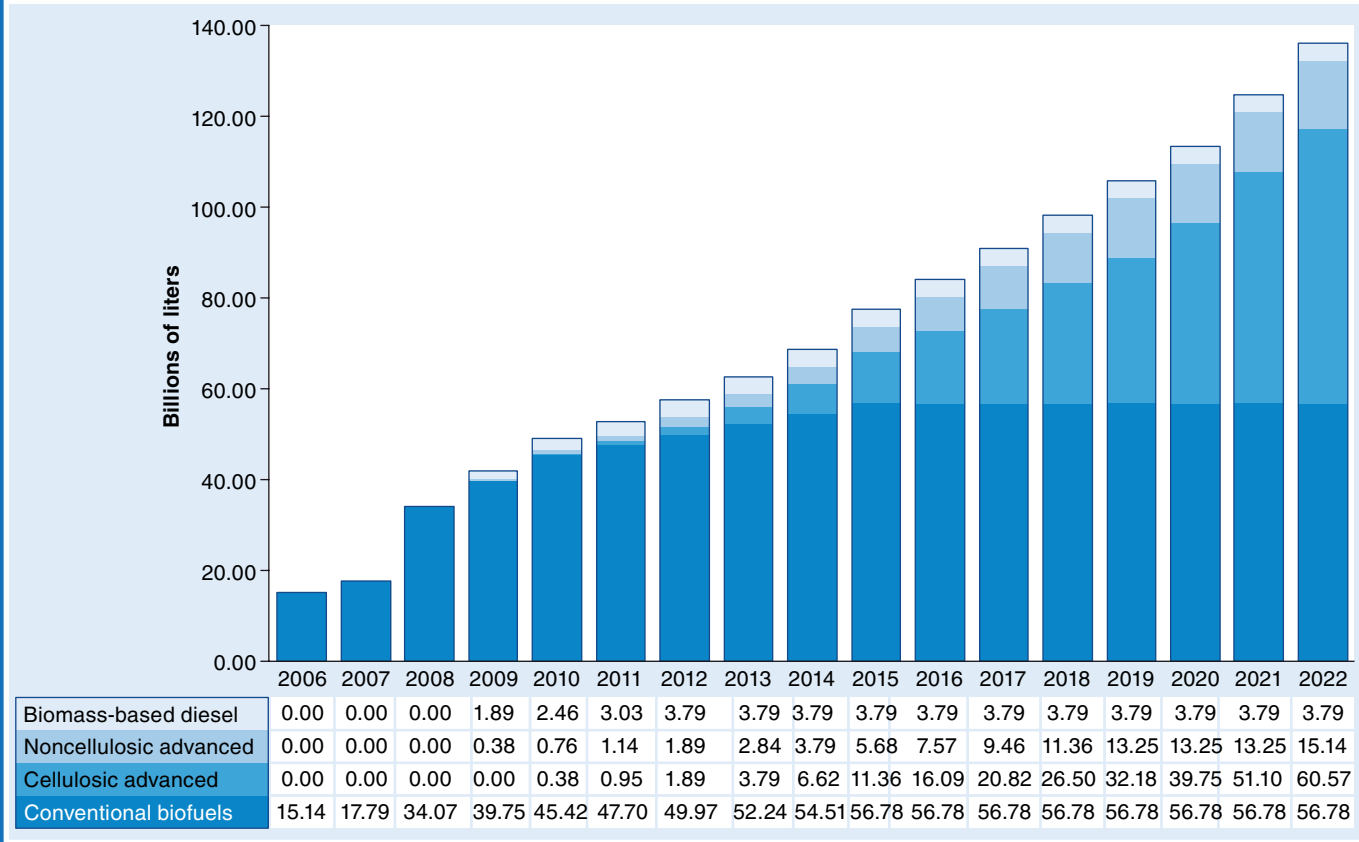


Figure 1. US renewable fuel standard.



**Table 2. Factors needed to convert volumetric renewable fuel standard to energy equivalent.**

Biofuel	Renewable fuel standard (gallons)
Ethanol	1
Butanol	1.25
Biogasoline	1.48
Biodiesel	1.65

at the petrol station. In some parts of the USA, there are no railheads near blending terminals, which again increases distribution cost. Ethanol blends can have higher evaporative emissions than conventional gasoline, which means ethanol cannot be used in some of the warmer southern states in summer. The current US rules permit either an 85% ethanol blend, known as E85, or a 10% blend, known as E10. E85 is a very small percentage of total consumption, so most ethanol must be used in 10% blends. In the next issue, we will focus on the importance of this ethanol blending limit, known as the ‘blend wall’.

The technology neutrality issue is especially important for second-generation biofuels. Cellulosic feedstocks can be converted to ethanol via processes known as biochemical conversion. Essentially, some form of pretreatment is used to isolate the cellulose and hemi-cellulose. Enzymes can then be used to convert these materials on to ethanol. BP and DuPont are developing enzymes that can produce butanol instead of ethanol [3]. The other

major pathway is known as thermochemical conversion. With this pathway (either gasification or pyrolysis), the end product is a mixture of hydrocarbons, including gasoline, diesel and jet fuel. Thus, the US tilt towards ethanol effectively penalizes the thermochemical pathway. Yet, producing hydrocarbons directly avoids the ethanol infrastructure problems described above.

The bottom line is that the EU system leaves the technology and feedstock choices entirely in the hands of the private sector – it is neutral with respect to technology and feedstock, so long as sustainability criteria are met. However, the US system is not technology neutral – it introduces a strong bias in favor of technologies producing ethanol, yet, there are numerous infrastructure problems that suggest direct production of hydrocarbons from cellulose would be a more attractive pathway. A technology- and feedstock-neutral policy is clearly preferred to one in which the government weighs in heavily on technology choice. In this case, the EU got it right.

#### Financial & competing interests disclosure

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