Agricultural and
Food Economics

Assessing the Impact of EU Biofuel Support Policies

FAPRI-UK Project

April 2015

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Executive Summary

A range of policies have been used to support the development of the liquid biofuels sector in the EU, including use mandates, budgetary support and trade policies. This study uses the FAPRI-EU partial equilibrium model to simulate the impact of removing these support policies on the biofuel and agricultural sectors. Specifically, four main scenarios are analsysed:

1. elimination of tax credits;

2. elimination of use-mandates;

3a. elimination of import tariffs; and

3b. elimination of import tariffs and relaxation of sustainability criteria.

Within the simulations the elimination of tax credits (Scenario 1) has a limited impact of the EU biofuels market due to the scaling back of tax credits in recent years in favour of mandates.

The elimination of use mandates (Scenario 2) has a more marked impact, with significant declines in consumption of biofuels and hence biofuel prices. Biofuel production also falls and the fall in usage and prices leads to the EU switching from being a net importer of bioethanol to a net exporter. Predicting the reaction of the industry in response to the extreme nature of this scenario is not straightforward and the results need to be treated with care. The removal of mandates may precipitate the dismantling of capacity at a higher rate than shown in this study. In addition, there is considerable uncertainty concerning the response of biofuel consumption to lower prices since biofuels have so far not been competitive relative to fossil fuels in the EU. Thus, sensitivity scenarios with different assumptions concerning biofuels consumption are also considered.

In terms of trade policies, the removal of import tariffs (Scenario 3a) leads to an increased inflow of EU biofuel imports and lower biofuel prices. Biofuel prices fall further when both import tariffs and sustainability criteria are abolished (Scenario 3b) due to the inflow of imports from cheaper markets.

The projected impact on feedstock prices is most marked under the elimination of the of the biofuels use mandate scenario (Scenario 2), with rapeseed experiencing the largest decline as the volume of rapeseed used in biodiesel production is relatively high. The impact on grain prices, however, is more modest due to the limited proportion of grains dedicated to ethanol; also the reduced demand for grain for biofuel is partially offset by increases in feed demand as a result of the reduction in by-product from biofuel production entering the feed market.

Assessing the Impact of EU Biofuel Support Policies: Methodology Paper

1. Introduction

A variety of policies have been used to support the development of the liquid biofuels sector at a Member State and EU level. Underlying these support policies is an EU target for renewable fuels use in the transport sector. The 2003 EU Biofuels Directive encouraged Member States to increase use of biofuels and other renewable fuels in transport to 5.75 per cent by 2010, while the 2009 Renewable Energy Directive (RED) set a binding target of 10 per cent of transport energy from renewable sources by 2020. The support policies implemented by the Member States to achieve these targets can be broadly categorised as follows:

- *Use and blending mandates*: these require liquid biofuel suppliers (refiners and/or retailers) to supply a certain amount of liquid biofuels or a certain percentage of liquid biofuels in total transport fuel use.
- *Budgetary support*: includes price support via tax credits to liquid biofuel producers and/or processors (refiners).
- *Trade policies*: import tariffs are used to protect domestic liquid biofuels producers; imports are increasingly influenced by the sustainability requirements under the RED, which results in the differentiation of biofuels on the basis of their feedstocks and production methods.

While the use and blending mandates and budgetary support policies are implemented at the Member State level, tariffs on imports are implemented for the EU bloc as a whole.

Biodiesel and bioethanol may be used as substitutes for the fossil fuels diesel and petrol respectively in the transport sector. Biofuel policies were motivated by the need to cut GHG emissions, fuel security objectives and the perceived benefits to the EU agricultural and biofuel industries. The greenhouse gas saving credentials of biofuels have, however, increasingly been questioned, with some studies suggesting that reported savings are more limited if different assumptions are used for the life-cycle analysis (Croezen and Kampman, 2008). Furthermore, the savings could be diminished further if the effects of indirect land use changes are taken into account (FAO, 2008). In light of these concerns, the EU has agreed that the use of food crop origin biofuel should not contribute more than 7 per cent to the transport fuel target (Agra-Europe, 2015). In previous baselines produced by FAPRI it has never been assumed that 10 per cent of transport fuels would come from these types of biofuels in anticipation of the types of problems that have arisen. In the current baseline this figure does not exceed 6 per cent and is therefore below the newly agreed ceiling.

This study uses an EU partial equilibrium model, which includes a UK model, to explore how policies that support biofuels impact the agricultural sector[1]. In particular the modelling system is simulated to analyse the impact of the following:

1. elimination of tax credits;
2. elimination of use-mandates;
3a. elimination of import tariffs; and
3b. elimination of import tariffs and relaxation of sustainability criteria.

The paper is organised as follows. The development of policies that support the biofuel sector is described in Section 2. This is followed by a description of the methodology in Section 3.

2. Biofuel Support Policies

Tax Credits

Within the EU, biofuels are not cost competitive compared to fossil fuels due to the high costs associated with producing biofuels, including feedstock, fertilisers and energy consumed in harvesting, transport and manufacture (OECD, 2008). As transport fuels are charged an excise tax on their sale, tax credits provide a simple mechanism to improve the competitiveness of biofuels relative to fossil fuels by creating a tax differential (sometimes referred to as a fuel duty incentive). Tax credits were initially widely used in EU Member States to stimulate growth in the biofuels sector, allowing producers to invest in biofuel production.

The UK introduced an excise tax of 25.8ppl on biodiesel in 2002. This compared to a tax of 51.8 ppl for diesel, yielding a fuel duty incentive of 26ppl (Charles and Wooders, 2012). A bioethanol excise tax of 27ppl was introduced in 2005, 23ppl lower than that for petrol (50ppl). This was simplified in 2008 with the implementation of the same fuel duty incentive for biodiesel and bioethanol of 20ppl. While tax credits provide an incentive to supply biofuel, they come at a budgetary cost in the form of foregone revenue for the government. The fuel duty incentive in the UK was withdrawn in 2010 and replaced with a biofuels mandate, the Renewable Transport Fuel Obligation Order (RTFO); see discussion below.

Similarly, many other EU Member States have scaled back tax credits. For example, prior to 2006, tax exemptions for pure biofuels in Germany led to a rapid growth in biofuel consumption. Taxes were introduced in 2006 but at reduced rates compared to fossil fuels

[1] The UK model (created and maintained by personnel in AFBI) is fully incorporated within the EU grain, oilseed, livestock and dairy (GOLD) run by FAPRI at the University of Missouri.

and the credits for blends were reduced in 2007. However, from 2007 tax credits for pure biofuels have been progressively reduced, apart from E85 (Pires and Schechtman, 2010). In Italy, biodiesel was exempt from tax for a given quota up to 2007. Taxes were applied from 2008 but at a reduced rate compared to diesel and quotas were cut significantly in 2010.

Elsewhere in the EU the tax system continues to be used as an important form of support. France applies a partial tax exemption system in which the tax is reduced as the percentage of biofuel in the fuel increases. The tax is linked to a licensing system, whereby the tax discounts are only possible for given biodiesel and bioethanol production volumes. Production quotas have been progressively increased to increase the share of biofuels in the market, which reached 7 per cent in 2010 (Pelkams *et al.*, 2008). The Swedish government strongly promotes the use of biofuels and continues to grant total tax exemptions for both ethanol and biodiesel.

Blending and Use Mandates

In response to EU directives, many Member States have introduced blending or use mandates, often in tandem with scaling back tax credits. These mandates stipulate that biofuels must account for a minimum percentage or quantity in the transport fuel market. Compared to tax credits, mandates provide a more certain means of ensuring biofuel targets are met. Unlike tax credits they do not lead to budgetary costs for the government. Rather, mandates may lead to higher fuel prices for consumers since biofuels are more expensive to produce than fossil fuels and thus the obligation to supply a certain percentage of biofuels leads to additional costs (Charles and Wooders, 2012).

Within the UK, the RTFO compels large transport fuel suppliers (those supplying more than 450,000 litres of fossil fuels per year) to supply a given percentage of renewable transport fuel each year, rising from 4 per cent by volume in 2011/12 to 5 per cent in 2013/14. Fuel suppliers meet their share of biofuel supplies by redeeming Renewable Transport Fuel Certificates to the Renewable Fuel Agency. Certificates are issued for every litre of biofuel supplied to the market by obligated fossil fuel suppliers and voluntary biofuel producers who participate in the RTFO scheme. Suppliers that do not have sufficient certificates can purchase these from other companies or pay a fine. This fine is known as the buy-out penalty and from April 2010 equalled 30 pence per litre of non-supplied biofuel. The buy-out price is designed to ensure that it is more cost effective to meet the mandate by replacing fossil fuel with biofuel. However, under certain adverse conditions, fuel suppliers may have little incentive to meet the RTFO target if the price difference between biofuel and fossil fuel (taking into account fossil fuel tax, VAT and biofuel tax incentives) is greater than the buy-out penalty.

Most Member States have moved towards a mandatory system. For example, within Germany (the largest consumer of biofuels in the EU), the 2006 Biofuel Quota Act laid down a mandate for fuel suppliers to include a specific percentage of biofuels from 2007. High penalties were imposed for non-compliance. From 2009, the quota for total fuel consumption from biofuels was set at 6.25 per cent based on energy content. This increases progressively, reaching 8 per cent in 2015 (Pelkmans *et al.*, 2008). A different system is applied in France (the second largest consumer of biofuels), wherein fuel suppliers are required to pay a supplementary tax if they supply fuels with a biofuel content less than a specified amount (Doumax, 2010). Starting from 2005 the French government gradually increased the quota to reach a 7 per cent target in 2010. In contrast, a few Member States, such as Sweden, continue to use tax credits rather than mandates to promote the use of biofuels[2].

Import tariffs

At the EU-level, import tariffs protect domestic producers from lower cost foreign suppliers and thereby support the domestic production of biofuels. EU import tariffs vary depending on the types of biofuel. For bioethanol, there are two different rates; €0.102/litre for denatured bioethanol and €0.192/litre for undenatured. Both types are designated for industrial purposes, not necessarily as fuel. These tariff rates are harmonised within the EU. However, the definition of "denaturing" varies across Member States. This implies that if ethanol is denatured before it is imported into the EU, it may have a greater cost advantage due to the lower tariff, but at the same time the market is limited. Both types of ethanol are imported. In *ad valorem* terms these taxes equate to 33.2 per cent and 62.4 per cent for denatured and undenatured respectively, based on 2007 prices and exchange rates (OECD, 2008). In practice the actual average tariff paid on ethanol imports has been below this and has fallen over time (as shown by the difference between the T1 and T2 price, as ethanol imports come in different forms and under a variety of favourable arrangements). In contrast, the import tariff for biodiesel is much lower at 6.5 per cent. Tariffs for some of the biodiesel feedstocks are even lower.

The difference in the import tariffs indicates the different positions of the EU in the world market. For biodiesel, the EU is more of a price maker as it produces over half of the world's production and consumes almost 70 per cent. For bioethanol, the EU is a much smaller player and its products have not been cost-competitive. If the import tariff were lowered or eliminated, it is expected that significant ethanol imports would enter the EU market. This is illustrated clearly by a recent trade loophole. Before April 2012, large amounts of US ethanol mixed with small amounts of petroleum entered the EU under the classification category 'chemical', with an ad valorem tax rate of 6.5 per cent. To close this loophole, the EU specified that from 3 April 2012 onwards all imported ethanol/petrol blends that contain 70 per cent ethanol blended with 30 per cent petrol must be classified

[2] The consumption of biofuels are also promoted within Sweden by the requirement for fuel stations to supply at least one type of biofuel. Green cars are exempt from congestion charges and benefits from free parking (Pelkmans *et al.,* 2008).

by EU customs authorities as denatured ethanol. The biofuel duties are much higher than the former chemical duties.

Import tariffs are exempted for countries covered by different preferential agreements. Except for Norway, most of these are developing countries in the Caribbean, South America, Africa and Asia. These countries enjoy 100 per cent tariff reductions with no quantity restrictions. In this analysis we assume that imports under preferential agreements remain constant.[3]

Sustainability criteria

Unlike import tariffs, sustainability criteria apply uniformly to both domestically produced and imported biofuel. The criteria lead to biofuel of certain types and/or produced in specific regions to be favoured. Sustainability criteria cover two issues, namely greenhouse gas emission savings and land on which feedstock is grown. The former refers to the amount of avoided greenhouse gas emissions when fossil fuel is displaced by biofuel. It is calculated using the life-cycle analysis method. The life-cycle method accounts for direct land use change, e.g. the CO_2 released from grassland or forest land converted for feedstock production is incorporated in the calculation of the saving value. The greenhouse gas savings values set out by the Commission have been the subject of much scrutiny since the life-cycle analysis method can be undertaken in different ways, which leads to different saving values. An even more controversial issue is that the life-cycle analysis calculation does not take indirect land use change into account, which arises dues to the positive price impact of the direct land-use change. Some analysts argue that this indirect effect may offset to a large extent (or even completely under certain circumstances) the emission reduction.

Based on the Commission specification, any type of biofuel needs to have greenhouse gas emission savings of at least 35 per cent to count towards the national renewable energy use target. The threshold is raised to 50 per cent from 2017 onwards, meaning that greenhouse gas savings of the qualified biofuel must be significant. Under the RED the Commission provides the default values and typical values of greenhouse gas emission savings of a set of biofuels. Producers of biofuels with a default value of less than the threshold need to prove on a case-by-case basis that the calculated actual value exceeds the threshold value.

[3] Imports under preferential agreements are difficult to model. They may arise since some areas are competitive in the absence of tariffs, but may be excluded from the exemption list once their exports reach a certain level. Another possibility is that the tariff for major biofuel producing countries (e.g. US and Brazil) is so large that it is economically attractive to first export biofuel to these tariff-free regions and then re-export to the EU. This possibility comes with a price too. To exploit the tariff difference, biofuel exporters need to invest and allocate part of the processing in the re-export regions to qualify for the origin requirement, which sometimes involves substantial extra risks.

Figure 1 shows the default saving values of different types of biofuel set out by the Commission (European Parliament and Council, 2009). There are two key factors determining these values. One is feedstock. Due to their biological characteristics, some crops are more efficient in photosynthesis and tend to have larger greenhouse gas emission savings over others (e.g. sugarcane). Consequently, geographical regions suitable for the plantation of these crops are favoured. Moreover, the saving values are not constant but can be improved through, for example, productivity growth in the agricultural sector (higher crop yield with no greater fertiliser use). Another key factor is processing, in particular how the energy inside the crops is unlocked and the efficiency of the procedure. For example, there are five saving values for wheat ethanol based on different process pathways, ranging from 16 to 69 per cent. Based on the Commission's figures, biodiesel made from soybean oil (default 31 per cent, typical 40 per cent) is the most likely category to be restricted from being counted as a renewable energy use, especially after 2017. However, the specification is not inclusive. Notably, the greenhouse gas emission savings of corn-based ethanol produced in the US is not given. USDA estimates that US produced corn ethanol has a saving value of 34 per cent, disqualifying it from meeting the EU sustainability criteria (Table 1).

The land-use requirement of the sustainability criteria forbids biofuel made from feedstock grown on newly claimed (post 2008) agricultural land from forest, peatland and land of other high nature protection value. Biodiesel made from palmoil is most likely to be restricted by this requirement as the land-use criteria are particularly problematic for Malaysia and Indonesia. Table 1 demonstrates the implications of the sustainability criteria on certain types of biofuel. If the sustainability criteria were to be removed, the import supply curve would shift outwards, probably significantly, as certain types of biofuel would no longer be excluded from the EU market and some of these already play an important role in the world biofuel mix, e.g. the US corn ethanol.

Figure 1 Default GHG Emission Savings Set Out by the Commission

(Red lines show Commission threshold values)

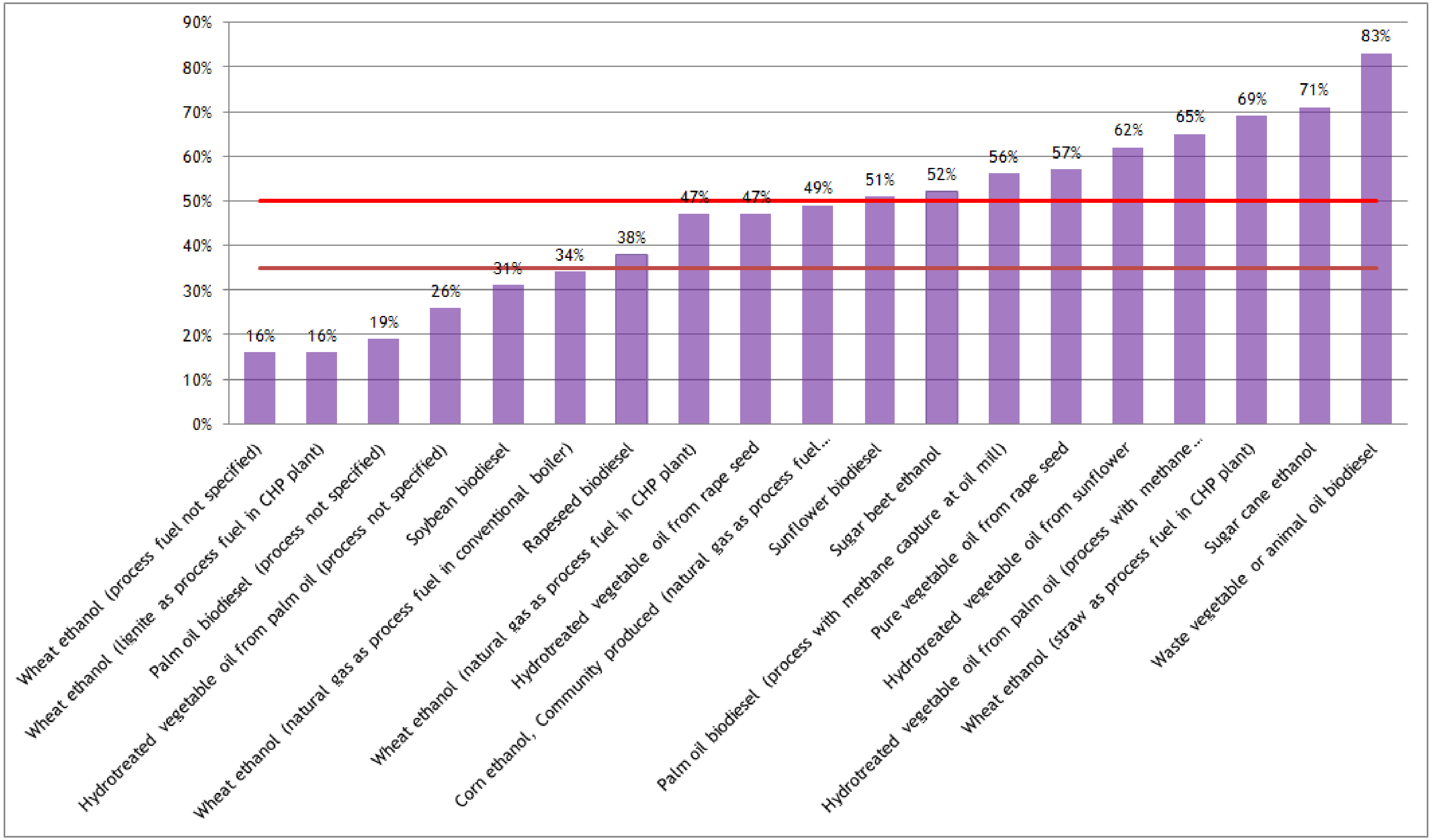


Table 1 Impacts of Eligibility on Biofuels

Type of biofuel	Origin	Emission savings fulfilled? (Theshold: 35%)	Land-use criteria fulfilled?	Eligible?
Rapeseed biodiesel	EU	Yes	Yes	Yes
Palmoil biodiesel	Malaysia	Yes (due to methane extraction)	Yes	Yes
Palmoil biodiesel	Malaysia	No (due to lack of no methane extraction)	Yes	No
Palmoil biodiesel	Indonesia	Yes (due to methane extraction)	No (land was rainforest until 2009)	No
Soybean biodiesel	Brazil	Yes (low transport emissions because low-weight biodiesel is shipped, rather than bulky soybeans)	Yes	Yes
Soybean biodiesel	Processed in EU with soybeans from Brazil	No (emissions are too high due to transport emissions of bulky soybeans)	Yes	No
Soybean biodiesel	Brazil	Yes (low transport emissions because low-weight biodiesel is shipped, rather than soybeans)	No (land that is a designated protection area by the Fed. Govt. and producer cannot provide evidence that planning of soybeans did not interfere with protection purpose)	No
Corn-based ethanol	EU	Yes (default value (49%) used with only applies to EU corn)	Yes	Yes
Corn-based ethanol	USA	No (calculation shows that GHG savings are only 34% and EU default value cannot be applied)	Yes	No

Source: Lendle and Schaus (2010)

3. Methodology

In this study we propose to examine the following scenarios:

1. Elimination of tax credits;
2. Elimination of blending and use mandates;

3a. Elimination of import tariffs; and

3b. Elimination of import tariffs and relaxation of sustainability criteria.

The implementation of these scenarios within the modelling system is described below.

1) Elimination of tax credits

Within the liquid biofuels model, the total biofuels demand equation contains the term 'relative price of weighted biofuel price to weighted fossil fuel price'. The weighted fuel prices include tax rates and therefore tax credits influence the competiveness of biofuels relative to fossil fuels and hence the demand for biofuel. In the scenarios these tax credits will be set at zero and biofuels will pay the same tax as the fossil fuel equivalent.

2) Elimination of use-mandates

As part of the modelling work so far for biofuels care has been taken to construct a demand system for biofuels that can capture fully the impact of policy. In the major countries it is not always the case that the demand for biofuels can be simply determined by the mandate. Some biofuel use would occur regardless of the mandate or the competitiveness of biofuels such as the use of biodiesel in bus fleets if it is assumed that other green public policies are maintained. In the models there is therefore a low minimum level of biofuels use.

Within the UK model the demand schedule is kinked, as shown in Figure 2a. These kinked demand schedules allow for the possibility that the RTFO target may not be met under certain conditions (Patton *et al.*, 2010). This occurs when the price difference between the weighted biofuel price and the weighted fossil fuel price is greater than the buy-out penalty (Section 1). Demand is relatively elastic within this section. When the price difference is between the buy-out penalty (30 pence per litre) and zero, the mandate is binding and demand is relatively inelastic (Section 2). Finally, when the price difference is less than zero (i.e. when biofuel is competitive compared to fossil fuel), demand is very elastic (Section 3). If the RTFO is removed the demand for biofuels would be simpler say as in Figure 2b. The 'Elimination' specification contains just two sections in which biofuels are either competitive (Section B) or not competitive (Section A). Similarly for the EU, there is an inelastic portion of demand for biofuels where a mandate is binding and an elastic portion where biofuel prices fall to a level where they are competitive with fossil fuels (up to a limit).

Under normal circumstances biofuels are not competitive with fossil fuels and so the removal of the RTFO (and similar policies around Europe) would lead to significant drops in biofuel usage. However, at some oil prices biofuels may be competitive without policy intervention. As a result, sensitivity analysis will be undertaken with high and low oil prices (with other world prices also adjusted based on the results of previous analysis).

Figure 2a: Kinked Total Biofuel Demand Schedule

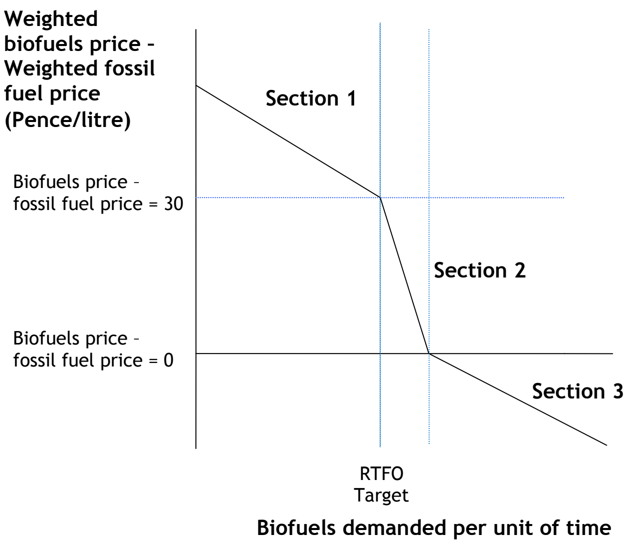
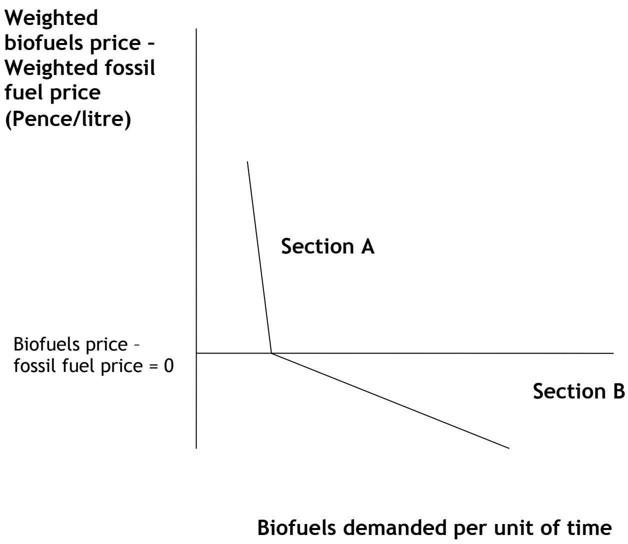


Figure 2b: Re-specified Total Biofuel Demand Schedule for Elimination of use mandates



3) Elimination of import tariffs and sustainability requirements

Modelling trade in biofuels is difficult given the plethora of policy interventions that are in place. At present in the model there is a simple specification that allows trade to fluctuate with changes in the relative EU biodiesel prices and their world counterparts (currently the Brazilian ethanol price and the US biodiesel price) adjusted for tariffs. In order to analyse the impact of liberalization a more complex set of relationships between the various world prices and the EU price is incorporated.

US and EU policy results in a heirachy of biofuel prices. Since sugar based ethanol qualifies for some of the US advanced mandate and corn ethanol does not, sugar ethanol prices should not fall below corn based ethanol. Under Scenario 3a, the import tariffs are set to zero and ethanol imports will continue to be determined by the Brazilian price since the US ethanol will remain excluded under the sustainability criteria. Similarly, with regards to biodiesel, while the palm oil biodiesel price is the lowest, it is excluded to a large extent when the sustainability criteria are in place.

When both the import tariffs and the sustainability criteria are abolished (Scenario 3b), the cheaper US ethanol price will become the relevant price. On the other hand, biodiesel imports in this scenario will largely be determined by the palm oil biodiesel price. In practice this is implemented into the model by building into the world price equations a price wedge equal to the average gap between the respective prices.

Under both scenarios, the changes in the biofuels market will have implications on the crop sector directly and knock-on impacts on the livestock sector through input costs.

4. Results

4.1) Scenario 1: Elimination of tax credits

The elimination of tax credits has a minimal impact on overall EU biodiesel and bioethanol consumption (Table 2). The scaling back of tax credits throughout the EU in recent years in favour of mandates means that the abolition of these has a small impact at the overall EU level. It is however projected that there is some impact at the individual country level where tax credits were in place.

The impact on biofuels consumption is the UK is negligible as the fuel duty incentive no longer applies (Table 4).

4.2) Scenario 2: Elimination of blending and use mandates

Biofuels Sector

EU consumption of biofuels initially collapses in response to the phased abolition of use-mandates (Figure 3). However, in the longer term there is some recovery in consumption (Table 2). EU biodiesel and bioethanol prices both fall in response to the decline in demand, thereby improving the competitiveness of biofuels compared to fossil fuels. By the end of the projection period, biodiesel consumption at the EU-28 level is 57 per cent lower under Scenario 2 compared to the Baseline, while bioethanol consumption is 59 per cent lower. As shown in Figure 3, the impact of the elimination of mandates on biofuel consumption changes over time. This is due to the underlying projection of oil prices that was taken from IHS Global insight. The underlying oil price shows a marked increase over the projection period, rising from a low of $56 per barrel in 2015 to $128 per barrel in 2023. In the early years of the scenario biofuels are not competitive with fossil fuels. In

Table 2: Projected Changes in the EU-27 Biofuels Sector under Scenarios 1, 2, 3a and 3b

		2010	2011	2012	2013	2023								
						Baseline	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b	
							Absolute	% Change	Absolute	% Change	Absolute	% Change	Absolute	% Change
EU Biofuels Sector														
Road Transport Fuel Consumption														
Total	1,000 toe	299,744	297,576	289,303	290,593	303,005	303,005	0.0%	303,041	0.0%	303,016	0.0%	303,021	0.0%
Biofuels	1,000 toe	13,425	13,794	14,236	13,183	16,288	16,274	-0.1%	6,941	-57.4%	16,394	0.6%	16,499	1.3%
Proportion of Biofuels	Percentage	4.48%	4.64%	4.92%	4.54%	5.38%	0.05	-0.1%	0.02	-57.4%	0.05	0.6%	0.05	1.3%
Biodiesel														
Production	1,000 tonne	9,441	9,448	10,194	10,610	13,168	13,160	-0.1%	5,477	-58.4%	11,099	-15.7%	10,314	-21.7%
Capacity	1,000 tonne	19,940	20,450	21,037	20,729	21,274	21,269	0.0%	18,354	-13.7%	20,122	-5.4%	19,616	-7.8%
Utilisation rate	Percentage	47%	46%	48%	51%	62%	62%	0.0%	30%	-51.8%	55%	-10.9%	53%	-15.0%
Consumption	1,000 tonne	11,875	12,150	12,658	11,553	14,144	14,135	-0.1%	6,098	-56.9%	14,210	0.5%	14,239	0.7%
Net exports	1,000 tonne	-2,434	-2,702	-2,464	-943	-976	-975		-621		-3,112		-3,925	
EU biodiesel price	*Euro/1000 litres*	923	1,169	1,132	1,299	1,265	1,264	0.0%	902	-28.6%	1,189	-6.0%	1,160	-8.3%
US biodiesel price	*Euro/1000 litres*	596	984	914	921	720	720	0.0%	696	-3.4%	869	20.7%	926	28.6%
Bioethanol														
Total production	1,000 tonne	3,749	4,033	4,092	4,251	5,252	5,244	-0.1%	4,138	-21.2%	4,681	-10.9%	4,566	-13.1%
Capacity	1,000 tonne	5,361	5,571	5,889	6,149	6,717	6,709	-0.1%	6,151	-8.4%	6,164	-8.2%	6,152	-8.4%
Utilisation rate	Percentage	70%	72%	69%	69%	78%	78%	0.0%	67%	-14.0%	76%	-2.9%	74%	-5.1%
Consumption	1,000 tonne	4,234	4,418	4,401	4,301	5,490	5,481	-0.2%	2,245	-59.1%	5,559	1.3%	5,678	3.4%
Net exports	1,000 tonne	-485	-385	-309	-50	-238	-236		1,893		-878		-1,112	
EU bioethanol price	*Euro/1000 litres*	582	621	639	609	579	579	0.0%	443	-23.5%	546	-5.8%	524	-9.6%
Brazil bioethanol price	*Euro/1000 litres*	451	552	488	457	441	441	0.0%	393	-11.0%	456	3.3%	461	4.5%

Table 3: Projected Changes in the EU-27 Agriculture Sector under Scenarios 1, 2, 3a and 3b

		2010	2011	2012	2013	2023								
						Baseline	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b	
							Absolute	% Change	Absolute	% Change	Absolute	% Change	Absolute	% Change
EU-28 Agriculture Sector														
Crop prices														
Wheat	Euro/tonne	208	195	240	187	171	171	0.0%	167	-2.1%	169	-0.9%	169	-1.1%
Rapeseed	Euro/tonne	489	443	451	380	317	317	0.0%	260	-18.2%	300	-5.4%	294	-7.4%
Rapeseed oil	Euro/tonne	1,032	905	877	719	655	655	0.0%	498	-24.0%	611	-6.7%	595	-9.2%
Crop production														
Wheat	Million tonne	136.7	138.1	133.4	143.5	150.4	150.4	0.0%	151.4	0.6%	150.7	0.2%	150.8	0.3%
Barley	Million tonne	52.9	51.9	54.8	59.6	59.3	59.3	0.0%	59.2	-0.3%	59.2	-0.2%	59.2	-0.2%
Corn	Million tonne	58.7	67.9	57.6	64.4	73.0	73.0	0.0%	72.6	-0.5%	72.8	-0.3%	72.7	-0.4%
Rapeseed	Million tonne	20.6	19.2	19.6	21.1	22.1	22.1	0.0%	20.2	-8.4%	21.6	-2.2%	21.4	-3.1%
Feedstock use														
Wheat	1,000 tonne	4,821	4,448	3,394	3,025	4,131	4,124	-0.2%	2,998	-27.4%	3,527	-14.6%	3,417	-17.3%
Barley	1,000 tonne	489	297	297	240	213	213	-0.2%	162	-23.8%	187	-12.4%	182	-14.7%
Corn	1,000 tonne	3,315	3,845	4,869	5,225	5,566	5,556	-0.2%	4,066	-27.0%	4,770	-14.3%	4,625	-16.9%
Rapeseed oil	1,000 tonne	5,862	5,877	5,702	6,067	7,167	7,162	-0.1%	3,038	-57.6%	6,030	-15.9%	5,605	-21.8%
Livestock production														
Beef	1,000 tonne	8,113	8,052	7,708	7,389	7,593	7,593	0.0%	7,607	0.2%	7,597	0.0%	7,598	0.1%
Pork	1,000 tonne	22,686	22,993	22,518	22,361	22,356	22,356	0.0%	22,397	0.2%	22,371	0.1%	22,373	0.1%
Poultry	1,000 tonne	12,182	12,384	12,638	12,805	14,287	14,288	0.0%	14,321	0.2%	14,301	0.1%	14,303	0.1%
Milk	Million tonne	150	152	152	154	162	162	0.0%	162	0.3%	162	0.1%	162	0.1%
Livestock prices														
Cattle price	*Euro/1000 litres*	320	352	384	382	378	378	0.0%	376	-0.6%	378	-0.2%	377	-0.3%
Pork price	*Euro/1000 litres*	140	153	171	177	147	147	0.0%	146	-1.0%	147	-0.4%	147	-0.5%

Table 4: Projected Changes in the UK Biofuels Sector under Scenarios 1, 2, 3a and 3b

		2010	2011	2012	2013	2023								
						Baseline	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b	
						Abs.	Abs.	% Change	Abs.	% Change	Abs.	% Change	Abs.	% Change
Road Transport Fuel Consumption														
Total	1,000 tonne	36,737	36,130	35,676	36,313	37,610	37,610	0.0%	37,579	-0.1%	37,622	0.0%	37,627	0.0%
Biofuels	1,000 tonne	1,330	1,417	1,080	1,399	1,520	1,520	0.0%	384	-74.8%	1,543	1.6%	1,555	2.3%
Proportion of Biofuels		4%	4%	3%	4%	4%	4%	0.0%	1%	-74.7%	4%	1.5%	4%	2.3%
Proportion of biodiesel in biofuel		39%	41%	60%	49%	46%	46%	0.0%	47%	2.5%	46%	0.3%	46%	0.4%
Biodiesel														
Production	1,000 tonne	256	451	438	334	534	534	0.0%	262	-51.0%	474	-11.2%	451	-15.5%
Consumption	1,000 tonne	847	878	458	745	863	863	0.0%	214	-75.3%	875	1.3%	881	2.0%
Net exports	1,000 tonne	-591	-427	-20	-412	-329	-329		49		-400		-429	
Biodiesel price	£/1000 litres	791	1015	913	879	1012	1011	0.0%	722	-28.6%	951	-6.0%	928	-8.3%
Bioethanol														
Total production	1,000 tonne	169	30	112	164	321	321	0.0%	224	-30.0%	296	-7.8%	279	-13.1%
Consumption	1,000 tonne	483	539	622	654	656	656	0.0%	170	-74.1%	669	1.9%	674	2.7%
Net exports	1,000 tonne	-314	-509	-510	-490	-336	-336		54		-373		-396	
Bioethanol price	£/1000 litres	499	539	518	517	463	463	0.0%	354	-23.5%	436	-5.8%	419	-9.6%

Table 5: Projected Changes in the UK Crop Sector under Scenarios 1, 2, 3a and 3b

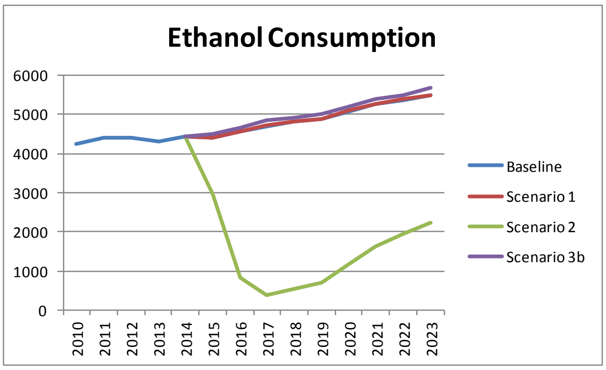
		2010	2011	2012	2013	2023								
						Baseline	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b	
						Abs.	Abs.	% Change	Abs.	% Change	Abs.	% Change	Abs.	% Change
Wheat														
Production	1,000 tonne	14,878	15,257	13,261	11,912	14,264	14,264	0.0%	14,320	0.4%	14,275	0.1%	14,281	0.1%
Domestic use	1,000 tonne	13,885	13,589	14,110	13,356	15,076	15,076	0.0%	14,810	-1.8%	15,009	-0.4%	14,960	-0.8%
Net exports	1,000 tonne	2,224	1,385	-282	-1,279	-816	-816		-495		-738		-684	
Barley														
Production	1,000 tonne	5,252	5,494	5,522	7,138	6,379	6,379	0.0%	6,380	0.0%	6,375	-0.1%	6,375	-0.1%
Domestic use	1,000 tonne	5,366	5,101	4,917	5,431	5,558	5,558	0.0%	5,600	0.7%	5,575	0.3%	5,580	0.4%
Net exports	1,000 tonne	915	671	428	1,392	814	814		773		792		787	
Rapeseed														
Production	1,000 tonne	2,230	2,758	2,557	2,174	2,523	2,523	0.0%	2,410	-4.5%	2,493	-1.2%	2,481	-1.6%
Domestic use	1,000 tonne	2,134	2,164	1,658	1,617	1,962	1,962	0.0%	1,929	-1.7%	1,961	-0.1%	1,960	-0.1%
Net exports	1,000 tonne	96	595	709	300	560	560		481		532		521	
Area														
Total crop	1,000 Hectares	3,626	3,752	3,872	3,720	3,692	3,692	0.0%	3,673	-0.5%	3,686	-0.2%	3,684	-0.2%
Wheat	1,000 Hectares	1,939	1,969	1,992	1,615	1,799	1,799	0.0%	1,808	0.5%	1,801	0.1%	1,802	0.2%
Barley	1,000 Hectares	921	970	1,002	1,213	1,036	1,036	0.0%	1,037	0.1%	1,035	0.0%	1,035	0.0%
Rapeseed	1,000 Hectares	642	705	756	715	680	680	0.0%	650	-4.4%	672	-1.2%	669	-1.7%
Yield														
Wheat	Tonnes/ Hectare	7.7	7.7	6.7	7.4	7.9	7.9	0.0%	7.9	-0.1%	7.9	0.0%	7.9	0.0%
Barley	Tonnes/ Hectare	5.7	5.7	5.5	5.9	6.2	6.2	0.0%	6.2	-0.1%	6.2	0.0%	6.2	0.0%
Rapeseed	Tonnes/ Hectare	3.5	3.9	3.4	3.0	3.7	3.7	0.0%	3.7	-0.1%	3.7	0.0%	3.7	0.0%
Price														
Wheat	£/100kg	13.1	18.3	19.3	19.4	16.3	16.3	0.0%	16.0	-1.8%	16.2	-0.7%	16.1	-0.9%
Barley	£/100kg	10.6	15.5	16.7	15.2	14.1	14.1	0.0%	13.7	-3.0%	13.9	-1.4%	13.8	-1.7%
Rapeseed	£/100kg	22.9	37.7	36.7	32.8	24.9	24.9	0.0%	20.4	-18.2%	23.6	-5.4%	23.1	-7.4%
Oat	£/100kg	10.1	17.3	19.0	17.6	12.8	12.8	0.0%	12.4	-2.9%	12.6	-1.4%	12.6	-1.6%

the latter part of the period their competitiveness increases. The key assumptions here are regarding at what point biofuel consumption will take place in the absence of mandates. The infrastructure to deliver low level fuel blends is in place in the EU, although not to the extent that it is in the U.S. The EU does not have a large flex fuel fleet like that which is available in Brazil, for example, which can use large volumes of biofuels. Here it is assumed that at some point relative biofuel to fossil fuel equivalent profit opportunities would mean that some in the EU would actually use biofuels.

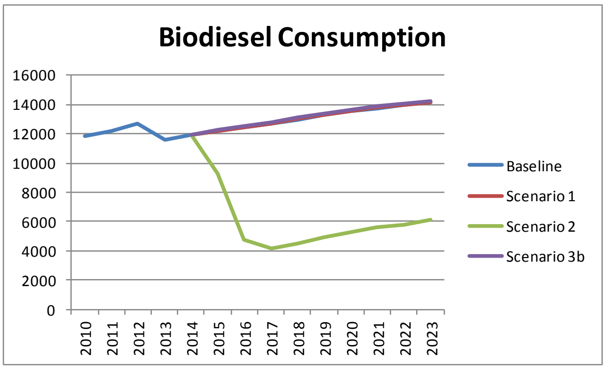
Within the UK, it is projected that biodiesel consumption falls by 75 per cent by the end of the projection period, while bioethanol is by 74 per cent lower (Table 4).

Figure 3: EU Biofuel Consumption under Baseline, Scenarios 1, 2 and 3b

3a: EU Ethanol Consumption



3b: EU Biodiesel Consumption



It is important to note that the consumption projections should be treated with care as there is considerable uncertainty concerning the consumption of biofuels at lower prices since in the EU biofuels have not been competitive relative to fossil fuels. The degree of uncertainty is less in a country such as the US where the blending infrastructure has reached a mature state. Since the blending infrastructure is in place, it is likely that if the mandates were eliminated in the US that changes in biofuel consumption would be minimal. This is reinforced by the fact that in some years consumption of ethanol has exceeded the mandated level. It is likely that if mandates in the US were abolished, biofuels would become competitive with fossil fuels especially in low level blends even where the price of biofuels were above the energy equivalent value with respect of fossil fuel equivalents.

Use of biofuels has not occurred in the EU in excess of mandated levels without tax incentives. Within this scenario, we are implicitly assuming that some cars in the fleet continue to use biofuels and further market emerges when ethanol and biodiesel become competitive relative to fossil fuels. As in the case of the U.S. there is an infrastructure in place (albeit to different degrees in different member states) to supply low level blends to consumers, but the flex fuel fleet is small.

Alternatively, it could be argued that if the EU was to remove any policy incentive for consumption, then consumption levels might collapse, especially given the reluctance to build the scale of low level blend industry that prevails in the U.S. In order to reflect this uncertainty, sensitivity scenarios with different assumptions concerning biofuels consumption are considered in the Appendix. Specifically, we consider a sensitivity scenario in which biofuels consumption collapses and an alternative sensitivity scenario with more elastic consumption functions, which lead to smaller reductions in consumption.

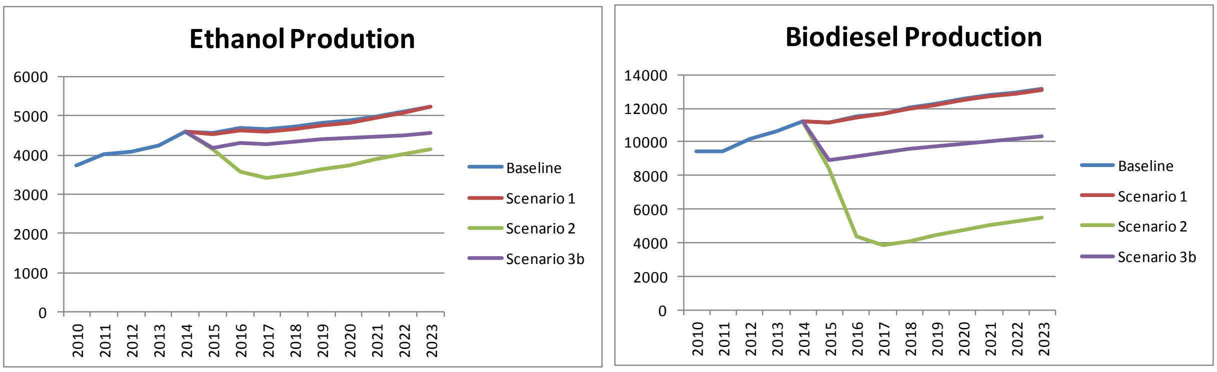
In Scenario 2 the internal bioethanol price converges to the world price, while the price decline is more marked for biodiesel compared to bioethanol relative to the Baseline (-29 and -23 per cent respectively at the end of the projection period) reflecting the fact that in the Baseline the ethanol price is closer to its fossil fuel equivalent than biodisel.

The projected decreases in biofuel prices cause net returns for biofuel plants to fall, leading to declines in production. Note, however, that along with the drop in biodiesel prices, the reduction in demand causes rapeseed oil prices to fall and this keeps returns positive. Given that activity is modelled at an aggregate level this reduction in production could come from a reduction in utilization of facilities, or ending production in a particular location. Although this is important in reality, in terms of modelling this distinction does not matter as long as capacity can be re-activated. Given the way that the model is structured, capacity reacts more slowly than utilization but for both ethanol and biodiesel capacity falls after the end of mandates. It is not straightforward to predict what the industry reaction to the EU abandoning its targets would be. It could be that capacity would be dismantled at a higher pace than that indicated here as it becomes clear that the large market for biodiesel that was envisioned when the capacity was constructed would no longer be a reality.

Overall under Scenario 2 relative to the Baseline in 2023 EU biodiesel production falls from 13,160 thousand tonnes to 5,477 thousand tonnes (58 per cent decrease), while EU bioethanol production falls from 5,244 thousand tonnes to 4,138 thousand tonnes (21 per cent decrease). The more marked decline for biodiesel reflects the relative price impacts; biodiesel has to fall further to reach energy equivalence. The model has a trigger term which spurs consumption where energy equivalence is reached. Although ethanol has a lower relative energy content by volume than biodiesel with respect to diesel, in the baseline biodiesel prices are significantly higher than diesel prices and so prices still have to fall further to reach ethanol equivalent. The dynamics of EU biofuel production are shown in Figure 4. Under Scenario 2, EU biodiesel and bioethanol production increase over time as biofuel prices rise, reflecting the higher oil price. UK biodiesel and bioethanol production also decline under Scenario 2 (51 and 30 per cent respectively in 2023). Note that if mandates were removed, and biofuel producers believed that oil prices would be closer to $50 than $100 in the longer term this could prompt a dismantling of the industry that could preclude the kind of increase in production shown here in the latter years.

Figure 4: EU Biofuel Production under Baseline, Scenarios 1, 2 and 3b

4a: EU Ethanol Production **4b: EU Biodiesel Production**



Under this scenario, with a larger decline in consumption compared to production the EU switches from being a net importer of bioethanol to a net exporter. Recent price reductions for ethanol have seen some exports of ethanol from the EU. In recent years there has been the development of non-mandate driven markets for biofuels (both ethanol and biodiesel) that have been responsive to changes in the relative competitiveness of biofuels and fossil fuels. It is likely that if the collapse in the EU market lead to significant reduction in biofuel prices then these other markets could be a market for EU fuels. At $50/barrel oil these markets would be smaller than at $100 plus oil. There could also be a market for EU biofuels in some of the existing policy driven markets. More likely destinations for exports would be importers like Asian countries, Canada, or other countries that are expected to emerge as ethanol consumers, particularly at prices that are competitive with fossil fuels. The experience of the US with ethanol blended in low levels shows that ethanol might not have to drop to energy equivalence to be competitive. The biodiesel global market is currently smaller than for ethanol. Consumers of biodiesel tend to produce it themselves. Within the UK, the projected changes in consumption and production lead to the UK becoming a net exporter within both the biodiesel and bioethanol markets.

Agricultural Sector

It is projected that there is a decline in the demand for biofuel feedstocks due to the projected fall in biofuels production. For grains, the projected declines in total domestic use of crop commodities are limited for both the EU and the UK. This is not surprising given the limited proportion of grains dedicated to ethanol globally and in the EU and UK. The EU model includes a reduced form of the world models which means that changes in EU trade in grain are reflected in world prices which feed back into the EU system. The declines are partly offset by the increase in animal feed use due to the reduction in production of dried distillers grains and solubles as a co-product of bioethanol. The limited fall in EU domestic use of grain commodities results in modest price falls for wheat and barley. EU wheat and barley prices are 2 and 3 per cent lower respectively under Scenario 2 compared to the Baseline at the end of the projection period (Table 4).

Within the UK net imports of wheat decrease as production increases slightly due to relative price impacts and domestic use declines[4]. In contrast, rapeseed net exports decrease as rapeseed production falls by a greater amount than domestic use due to relative price impacts.

With regards to rapeseed, the price impact is more marked (-18 per cent in 2023). This is consistent with the larger projected decrease in EU biodiesel production compared to ethanol, which is mostly sourced from rapeseed oil, and the fact that the share of rapeseed for biodiesel in total EU rapeseed use is greater than share of grains for bioethanol purposes in total grains use. With the reduced rapeseed price, EU production of rapeseed drops by more than 8 per cent, with more domestic use being filled by imports.

The knock on impact on the livestock sector is negligible in both the EU and UK markets. The decline in grain price prices is too small to lead to significant changes in livestock numbers.

4.3) Scenario 3a: Elimination of import tariffs

In the baseline the tariff on biodiesel is set at 6.5 per cent. For ethanol a variety of different tariff rates are imposed depending on how the fuel enters the EU and which member states it enters through. Here, an indication of the average applied tariff is taken as difference between the T1 and T2 ethanol prices. The difference between these prices varies between years, and in the Baseline an average of historical values is calculated and figure of 60 euros per thousand litres is used. The elimination of these import tariffs leads

[4] Within the Baseline it is projected that the UK is a net importer of wheat at the end of the projection period as the growth in domestic use exceeds the growth in production. This projection is subject to uncertainty concerning the impact of greening restrictions under CAP reform and assumptions regarding yield increases.

to an increased inflow of biofuel imports. Net EU biodiesel imports increase from 976 thousand tonnes to 3,112 thousand tonnes under Scenario 3a compared to the Baseline in 2023, while net EU bioethanol imports increase from 238 thousand tonnes to 878 thousand tonnes (Table 2).

Biofuel prices decline in response to the projected increase in imports. The negative price impact is comparable for each of the fuels (EU bioethanol and biodiesel prices are 6 per cent lower in 2023). The projected decrease in biofuel prices lead to reductions in EU biofuel production, with biodiesel and bioethanol production falling by 16 and 11 per cent respectively.

Within the UK, it is projected that biodiesel and bioethanol production fall by 11 and 8 per cent respectively relative to the Baseline (Table 4). At the same time, UK domestic use for both commodities increase slightly as a result of the lower prices. As a consequence it is projected that UK net imports of both biodiesel and bioethanol increase.

With regards to the agricultural sector, the decline in biofuels production leads to reduced demand for feedstocks (Table 3). This reduced demand exerts a downward impact on the price of crops used for biofuel production. In particular, it is projected that EU wheat, barley and rapeseed prices decline by 1, 1 and 5 per cent respectively. As before, the knock-on impact on the livestock sectors is small.

4.4) Scenario 3b: Elimination of import tariffs and sustainability requirements

Within the Baseline the Brazilian ethanol price is taken as the relevant world price of ethanol imports into the EU given that US ethanol is currently blocked from entering the EU market. The withdrawal of the sustainability criteria within Scenario 3b means that US ethanol is no longer excluded and this is assumed to become the relevant world price rather than the Brazilian ethanol price. In the baseline U.S. corn based ethanol prices are below Brazilian sugar based ones. The cheaper US price exerts a further negative impact on the internal EU price. In recent years the US and Brazilian prices have alternated as to which is cheapest, in the baseline the Brazilian price is higher than the US price (in part because it qualifies as an advanced fuel, but also because it meets EU sustainability requirements) and this price gap is removed in the model in this scenario. This represents a basic means to simulate the impact of ending sustainability requirements, which would no doubt have wide reaching repercussions.

With regards to biodiesel, under the Baseline US biodiesel is taken as the representative price for imported biodiesel. In practice, US biodiesel has been largely excluded from the

EU market recently, but its price is representative of soy based biodiesel to some extent. If sustainability requirements were to be relaxed it would be likely that more of the EUs market would be taken by palm oil biodiesel, since palm oil is currently the cheapest of the major vegetable oils. It is likely that more palm oil would be used inside the EU as well and imports of this commodity would rise. The current model does not have a fully specified palm oil model.

Following the removal of the sustainability criteria on top of the elimination of import tariffs, the internal biofuel prices fall further (Table 2). The internal price decline is more marked for bioethanol (-10 per cent) compared to biodiesel (-8 per cent) since the difference between the internal EU price for bioethanol and its world price is bigger compared to that between that for biodiesel[5]. EU biofuel production decreases in response to the decline in price, while consumption increases. The increase in consumption is greater for bioethanol compared to biodiesel due to relative price effects. The projected changes in production and consumption lead to further increases in EU net imports for both biodiesel and bioethanol.

Similarly, within the UK it is projected that biodiesel and bioethanol production decline, while consumption and net imports increase (Table 3). In terms of the knock-on impact on the agriculture sector, crop prices fall further, with rapeseed experiencing he greatest decline (-7 per cent). However, these changes have little impact on the livestock sector.

[5] Given the limited biodiesel market outside the EU, the EU market plays a large role in determining the world price and thus the price differential is small. In addition, unlike Scenario 2, the mandate supports consumption and as a result, the price of price of biodiesel is sustained at a higher level compared to the conventional diesel price.

5) Conclusions

After a period of strong growth, biofuels use in the EU has plateaued as member states have become reluctant to implement further increases in mandated biofuel incorporation. Further growth could happen, if current sentiments towards biofuels change, technologies are developed that are more palatable to EU citizens, or fossil fuel energy prices increase significantly so this report is in no way an attempt to forecast the future of policy in the sector. Here, several scenarios that were requested are carried out using the FAPRI-UK modelling framework.

The model is a sectoral aggregate model with four regions for biofuels in the EU. The biofuels sector is difficult to model given the widespread linkages between the sector and agriculture and the extensive policy interventions in the sector. There are also a variety of different legal and technical barriers that govern fuel use that may vary across member states. Predicting the reaction of the industry in the face of the extreme scenario undertaken here is difficult. In the US eliminating mandates is thought by many to have little impact on ethanol usage (although for biodiesel a significant reduction would be likely) given that the infrastructure is in place for low level blend use and as long as ethanol prices are comparable to gasoline at a wholesale level blending makes economic sense. It is not clear the same would happen in the EU.

Therefore, three alternative outcomes for biofuel consumption in the EU after the elimination of mandates are undertaken. One where use falls almost to zero, and two where biofuel use continues to differing degrees. In all these scenarios biofuels production falls, but prices fall to such an extent that some biofuels are traded. Here there is also uncertainty as to whether there would in reality be significant markets for EU products (especially biodiesel) at any significant level either within the EU or outside of it. Also, the removal of EU targets might precipitate dismantling of the industry beyond the reduction of capacity envisioned here.

The reduction in the demand for feedstocks would have a knock-on effect on agriculture. Prices of commodities would fall, although decreases in demand for feedstocks would be partially be offset by increases in feed demand as a result in the reduction of by-product from biofuel production processes entering feed.

Appendix: Sensitivity Scenarios around Scenario 2: Elimination of use mandates

As described in the main report, there are uncertainties regarding the biofuel demand elasticity and therefore sensitivity analysis is carried out in this regard.

Sensitivity Scenario 2a

If biofuel demand is inelastic, consumption of biofuel will drop to a greater extent compared to the results shown in the main analysis. Therefore, this scenario examines the case in which the demand is so inelastic that consumption collapses in the absence of the use mandate. This would be the case if there were economic, technical or other (for example public concerns regarding the benefits of biofuels) that meant that all biofuel use ceased.

As shown in Table A1, following the collapse of EU biofuel consumption it is projected that there are marked declines in biofuel prices. By the end of the projection period, the EU biodiesel price is 42 per cent lower compared to the Baseline, while the EU bioethanol price is 29 per cent lower. This exceeds the price falls under the main analysis (Scenario 2). Similarly, EU production of both biodiesel and bioethanol falls further relative to Scenario 2. This results in a further increase in EU bioethanol net exports.

Similarly within the UK, biofuel production falls in response to lower returns (Table A3). However, some production remains and as before the UK switches from being a net importer of biofuels to a net exporter; the extent of the switch is greater compared to the main analysis.

With regards to the agricultural sector, the collapse in EU biofuels consumption results in further declines in crop commodity prices. EU wheat, barley and rapeseed prices are 2, 4 and 23 per cent lower under Sensitivity Scenario 2a relative to the Baseline in 2023 (Table A2). Crop prices fall by similar amounts in the UK (Table A4). As before, these projected changes in crop prices have a negligible impact on livestock numbers.

Sensitivity Scenario 2b

Within recent years low biofuel and high feedstock prices have resulted in slumps in biofuel production in the UK, with some plants ceasing production altogether. In light of the unpredictable nature of biofuel production in the UK it is possible that significant reductions in biofuel prices, such as those experienced in Scenario 2a, may result in the complete shutdown of production. This sensitivity scenario considers a situation in which biofuels consumption collapses, as in Scenario 2a, together with the cessation of biofuels production in the UK.

At the EU level, EU biofuel production falls by a slightly greater amount compared to Scenario 2a, with a larger further decline for bioethanol compared to biodiesel. As a result net bioethanol exports are slightly lower, although still considerable. Within the UK, net trade disappears with the collapse of biofuel consumption and production[6]. The knock-on additional impact on feedstock prices is negligible.

Sensitivity Scenario 2c

In contrast to Sensitivity Scenario 2a, this sensitivity scenario considers the case in which biofuels consumption is more elastic, for example if a low level blend market like that which exists in the U.S. could be developed. Under this scenario EU biofuels consumption falls to a lesser extent compared to the main analysis (Scenario 2). While biofuel prices are lower in this sensitivity scenario relative to the baseline, the price declines are less marked compared to the main analysis (Scenario 2). The biodiesel price (-15 per cent) falls to a greater extent than the bioethanol price (-12 per cent). The projected falls in EU bioethanol and biodiesel production are also less compared to the Scenario 2. In contrast to the main analysis, EU net bioethanol exports are lower and consequently the world price does not fall to the same extent. The world bioethanol price supports the internal EU price.

Since biofuel production falls to a less extent compared to the main analysis, the declines in demand for feedstocks are more modest. Consequently, the resulting reductions in crops prices are less significant compared to Scenario 2.

[6] A small amount of bioethanol production remains from sugar sources.

Table A1: Projected Changes in the EU Biofuels Sector under Sensitivity Scenarios

		2010	2011	2012	2013	2023								
						Baseline	Scenario 2		Scenario 2a		Scenario 2b		Scenario 2c	
							Absolute	% Change	Absolute	% Change	Absolute	% Change	Absolute	% Change
EU Biofuels Sector														
Road Transport Fuel Consumption														
Total	1,000 toe	299,744	297,576	289,303	290,593	303,005	303,041	0.0%	303,037	0.0%	303,037	0.0%	303,037	0.0%
Biofuels	1,000 toe	13,425	13,794	14,236	13,183	16,288	6,941	-57.4%	4,444	-72.7%	4,371	-73.2%	10,696	-34.3%
Proportion of Biofuels	Percentage	4.5%	4.6%	4.9%	4.5%	5.4%	2.3%	-57.4%	1.5%	-72.7%	1.4%	-73.2%	3.5%	-34.3%
Biodiesel														
Production	1,000 tonne	9,441	9,448	10,194	10,610	13,168	5,477	-58.4%	3,469	-73.7%	3,399	-74.2%	8,412	-36.1%
Capacity	1,000 tonne	19,940	20,450	21,037	20,729	21,274	18,354	-13.7%	17,985	-15.5%	18,015	-15.3%	18,877	-11.3%
Utilisation rate	Percentage	47%	46%	48%	51%	62%	30%	-51.8%	19%	-68.8%	19%	-69.5%	45%	-28.0%
Consumption	1,000 tonne	11,875	12,150	12,658	11,553	14,144	6,098	-56.9%	3,774	-73.3%	3,720	-73.7%	9,239	-34.7%
Net exports	1,000 tonne	-2,434	-2,702	-2,464	-943	-976	-621		-305		-321		-826	
EU biodiesel price	*Euro/1000 litres*	923	1,169	1,132	1,299	1,265	902	-28.6%	731	-42.2%	738	-41.7%	1,078	-14.8%
US biodiesel price	*Euro/1000 litres*	596	984	914	921	720	696	-3.4%	674	-6.5%	675	-6.3%	710	-1.4%
Bioethanol														
Total production	1,000 tonne	3,749	4,033	4,092	4,251	5,252	4,138	-21.2%	3,969	-24.4%	3,839	-26.9%	4,503	-14.3%
Capacity	1,000 tonne	5,361	5,571	5,889	6,149	6,717	6,151	-8.4%	6,151	-8.4%	6,151	-8.4%	6,152	-8.4%
Utilisation rate	Percentage	70%	72%	69%	69%	78%	67%	-14.0%	65%	-17.5%	62%	-20.2%	73%	-6.4%
Consumption	1,000 tonne	4,234	4,418	4,401	4,301	5,490	2,245	-59.1%	1,612	-70.6%	1,574	-71.3%	3,671	-33.1%
Net exports	1,000 tonne	-485	-385	-309	-50	-238	1,893		2,357		2,264		832	
EU bioethanol price	*Euro/1000 litres*	582	621	639	609	579	443	-23.5%	414	-28.6%	420	-27.5%	510	-11.9%
Brazil bioethanol price	*Euro/1000 litres*	451	552	488	457	441	393	-11.0%	382	-13.4%	384	-12.9%	417	-5.5%

Table A2: Projected Changes in the EU Agricultural Sector under Sensitivity Scenarios

		2010	2011	2012	2013	2023								
						Baseline	Scenario 2		Scenario 2a		Scenario 2b		Scenario 2c	
							Absolute	% Change	Absolute	% Change	Absolute	% Change	Absolute	% Change
EU-28 Agriculture Sector														
Crop prices														
Wheat	Euro/tonne	208	195	240	187	171	167	-2.1%	167	-2.5%	166	-2.6%	168	-1.4%
Rapeseed	Euro/tonne	489	443	451	380	317	260	-18.2%	244	-23.1%	244	-23.3%	282	-11.1%
Rapeseed oil	Euro/tonne	1,032	905	877	719	655	498	-24.0%	456	-30.4%	454	-30.6%	559	-14.7%
Crop production														
Wheat	Million tonne	136.7	138.1	133.4	143.5	150.4	151.4	0.6%	151.6	0.8%	151.6	0.8%	151.0	0.4%
Barley	Million tonne	52.9	51.9	54.8	59.6	59.3	59.2	-0.3%	59.2	-0.3%	59.1	-0.3%	59.2	-0.2%
Corn	Million tonne	58.7	67.9	57.6	64.4	73.0	72.6	-0.5%	72.6	-0.5%	72.6	-0.6%	72.8	-0.4%
Rapeseed	Million tonne	20.6	19.2	19.6	21.1	22.1	20.2	-8.4%	19.8	-10.6%	19.8	-10.6%	20.9	-5.3%
Feedstock use														
Wheat	1,000 tonne	4,821	4,448	3,394	3,025	4,131	2,998	-27.4%	2,819	-31.8%	2,690	-34.9%	3,347	-19.0%
Barley	1,000 tonne	489	297	297	240	213	162	-23.8%	154	-27.8%	148	-30.7%	179	-16.1%
Corn	1,000 tonne	3,315	3,845	4,869	5,225	5,566	4,066	-27.0%	3,828	-31.2%	3,655	-34.3%	4,532	-18.6%
Rapeseed oil	1,000 tonne	5,862	5,877	5,702	6,067	7,167	3,038	-57.6%	1,905	-73.4%	1,867	-73.9%	4,659	-35.0%
Livestock production														
Beef	1,000 tonne	8,113	8,052	7,708	7,389	7,593	7,607	0.2%	7,609	0.2%	7,609	0.2%	7,602	0.1%
Pork	1,000 tonne	22,686	22,993	22,518	22,361	22,356	22,397	0.2%	22,405	0.2%	22,407	0.2%	22,383	0.1%
Poultry	1,000 tonne	12,182	12,384	12,638	12,805	14,287	14,321	0.2%	14,327	0.3%	14,329	0.3%	14,310	0.2%
Milk	Million tonne	150	152	152	154	162	162	0.3%	162	0.3%	162	0.3%	162	0.2%
Livestock prices														
Cattle price	*Euro/1000 litres*	320	352	384	382	378	376	-0.6%	376	-0.7%	376	-0.7%	377	-0.4%
Pork price	*Euro/1000 litres*	140	153	171	177	147	146	-1.0%	146	-1.2%	145	-1.2%	146	-0.7%

Table A3: Projected Changes in the UK Biofuels Sector under Sensitivity Scenarios

		2010	2011	2012	2013	2023								
						Baseline	Scenario 2		Scenario 2a		Scenario 2b		Scenario 2c	
						Abs.	Abs.	% Change	Abs.	% Change	Abs.	% Change	Abs.	% Change
Road Transport Fuel Consumption														
Total	1,000 tonne	36,737	36,130	35,676	36,313	37,610	37,579	-0.1%	37,552	-0.2%	37,552	-0.2%	37,552	-0.2%
Biofuels	1,000 tonne	1,330	1,417	1,080	1,399	1,520	384	-74.8%	0	-100.0%	0	-100.0%	0	-100.0%
Proportion of Biofuels		4%	4%	3%	4%	4%	1%	-74.7%	0%	-100.0%	0%	-100.0%	0%	-100.0%
Proportion of biodiesel in biofuel		39%	41%	60%	49%	46%	47%	2.5%	48%	4.3%	55%	21.0%	46%	1.0%
Biodiesel														
Production	1,000 tonne	256	451	438	334	534	262	-51.0%	168	-68.7%	0	-100.0%	386	-27.9%
Consumption	1,000 tonne	847	878	458	745	863	214	-75.3%	0	-100.0%	0	-100.0%	0	-100.0%
Net exports	1,000 tonne	-591	-427	-20	-412	-329	49		167		0		385	
Biodiesel price	£/1000 litres	791	1,015	913	879	1,012	722	-28.6%	585	-42.2%	590	-41.7%	862	-14.8%
Bioethanol														
Total production	1,000 tonne	169	30	112	164	321	224	-30.0%	207	-35.4%	41	-87.1%	270	-15.9%
Consumption	1,000 tonne	483	539	622	654	656	170	-74.1%	0	-100.0%	0	-100.0%	0	-100.0%
Net exports	1,000 tonne	-314	-509	-510	-490	-336	54		207		41		270	
Bioethanol price	£/1000 litres	499	539	518	517	463	354	-23.5%	331	-28.6%	336	-27.5%	408	-11.9%

Table A4: Projected Changes in the UK Crops Sector under Sensitivity Scenarios

		2010	2011	2012	2013	2023								
						Baseline	Scenario 2		Scenario 2a		Scenario 2b		Scenario 2c	
						Abs.	Abs.	% Change	Abs.	% Change	Abs.	% Change	Abs.	% Change
Wheat														
Production	1,000 tonne	14,878	15,257	13,261	11,912	14,264	14,320	0.4%	14,338	0.5%	14,336	0.5%	14,297	0.2%
Domestic use	1,000 tonne	13,885	13,589	14,110	13,356	15,076	14,810	-1.8%	14,764	-2.1%	14,368	-4.7%	14,937	-0.9%
Net exports	1,000 tonne	2,224	1,385	-282	-1,279	-816	-495		-431		-37		-645	
Barley														
Production	1,000 tonne	5,252	5,494	5,522	7,138	6,379	6,380	0.0%	6,383	0.1%	6,381	0.0%	6,379	0.0%
Domestic use	1,000 tonne	5,366	5,101	4,917	5,431	5,558	5,600	0.7%	5,607	0.9%	5,628	1.3%	5,585	0.5%
Net exports	1,000 tonne	915	671	428	1,392	814	773		768		744		786	
Rapeseed														
Production	1,000 tonne	2,230	2,758	2,557	2,174	2,523	2,410	-4.5%	2,379	-5.7%	2,378	-5.7%	2,455	-2.7%
Domestic use	1,000 tonne	2,134	2,164	1,658	1,617	1,962	1,929	-1.7%	1,916	-2.4%	1,903	-3.0%	1,944	-0.9%
Net exports	1,000 tonne	96	595	709	300	560	481		463		475		511	
Area														
Total crop	1,000 Hectares	3,626	3,752	3,872	3,720	3,692	3,673	-0.5%	3,668	-0.6%	3,668	-0.7%	3,680	-0.3%
Wheat	1,000 Hectares	1,939	1,969	1,992	1,615	1,799	1,808	0.5%	1,811	0.6%	1,811	0.6%	1,805	0.3%
Barley	1,000 Hectares	921	970	1,002	1,213	1,036	1,037	0.1%	1,037	0.2%	1,037	0.1%	1,036	0.0%
Rapeseed	1,000 Hectares	642	705	756	715	680	650	-4.4%	642	-5.5%	642	-5.6%	662	-2.7%
Yield														
Wheat	Tonnes/ Hectare	7.7	7.7	6.7	7.4	7.9	7.9	-0.1%	7.9	-0.1%	7.9	-0.1%	7.9	-0.1%
Barley	Tonnes/ Hectare	5.7	5.7	5.5	5.9	6.2	6.2	-0.1%	6.2	-0.1%	6.2	-0.1%	6.2	0.0%
Rapeseed	Tonnes/ Hectare	3.5	3.9	3.4	3.0	3.7	3.7	-0.1%	3.7	-0.2%	3.7	-0.2%	3.7	0.0%
Price														
Wheat	£/100kg	13.1	18.3	19.3	19.4	16.3	16.0	-1.8%	15.9	-2.1%	15.9	-2.3%	16.1	-1.2%
Barley	£/100kg	10.6	15.5	16.7	15.2	14.1	13.7	-3.0%	13.6	-3.6%	13.5	-3.8%	13.8	-2.1%
Rapeseed	£/100kg	22.9	37.7	36.7	32.8	24.9	20.4	-18.2%	19.2	-23.1%	19.1	-23.3%	22.1	-11.1%
Oat	£/100kg	10.1	17.3	19.0	17.6	12.8	12.4	-2.9%	12.3	-3.4%	12.3	-3.7%	12.5	-2.0%

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