Cost Benefit Analysis

Problem under consideration

A.1 The Renewable Transport Fuel Obligation (RTFO) is the UK's mechanism for incentivising the supply of biofuels in the road transport sector, and meeting the transport target in the Renewable Energy Directive (RED). The RED requires the UK to source 10% of energy used in transport, from renewable sources by 2020.

A.2 The RTFO obligates suppliers of fuel used in road vehicles, non-road mobile machinery (including inland waterway vessels when not at sea, agricultural and forestry tractors, and recreational craft when not at sea) to ensure a certain amount of renewable fuel is supplied for each litre of fossil fuel supplied. The obligation does not apply to fossil gaseous fuels. Based on feedback from stakeholders and technological developments in the industry, we are proposing to make some amendments to the RTFO.

A.3 Since the RED target for the UK to source 10% of its transport energy from renewable sources is for 2020 and the UK Government is currently working with stakeholders on how to reach the target, we do not make any assumptions regarding what may happen to the RTFO post-2020 and this cost benefit analysis therefore covers only five years, 2015 to 2020 inclusive, not the recommended ten years.

Policy objective

A.4 The objectives of the policy changes in the cost benefit analysis are to align the treatment of a particular type of biofuel, provide greater incentives for the supply of gaseous fuels and also to clarify the RTFO Administrator's power to require information from any transport fuel supplier.

There is only one policy option, which includes four legislative amendments. A summary of the four amendments is shown below. This cost benefit analysis focusses on just one of the four proposed legislative changes to the RTFO, that is, the increased incentives for renewable gaseous fuels, since we do not expect the other changes to affect the amount or the mix of fuels supplied under the RTFO.

Policy option A:

- Change incentives for renewable gaseous fuels so that they are awarded renewable transport fuel certificates (RTFCs) based on their higher energy content relative to renewable liquid fuels.

- Align the treatment of 'hydrotreated vegetable oil' (HVO) with that of the most common form of biodiesel (FAME), so both receive the same level of support (i.e. one RTFC per litre).
- Rationalise the powers of the Administrator of the RTFO to request information from transport fuel suppliers. This rationalisation will meet one of the Red Tape Challenge commitments.
- Provide that the RTFO Administrator can apply rounding when RTFCs are awarded.

1. Renewable gaseous fuels

1.1 Rationale for intervention

A.5 Currently the RTFO incentivises renewable gaseous fuels with one RTFC per kilogram for crop-derived gaseous fuels and two RTFCs per kilogram for waste-derived gaseous fuels[1]. This means that the potential financial benefit for supplying one kilogram of gaseous fuel is equivalent to that of one litre of liquid biofuel[2]. Biomethane is the only gaseous fuel currently reported under the RTFO. No biopropane or biobutane is currently reported - small volumes may enter the market from late 2016 at the earliest.

A.6 However, the energy content of gaseous fuels is typically significantly higher per kilogram than that of liquid biofuels per litre. For example biomethane has almost twice the energy content per kilogram than bioethanol per litre. Therefore, on an energy adjusted basis, the financial incentive to supply gaseous biofuels is significantly lower than the financial incentive to supply liquid biofuels. Increasing incentives for gaseous fuels so that they are awarded RTFCs to reflect their energy content rather than their weight would provide more of a level playing field for suppliers of these fuels.

1.2 Policy options cost benefit analysis

- **Do nothing**: gaseous fuels continue to be issued with 1 RTFC per kg.
- **Option A**: gaseous fuels are issued a number of RTFCs proportional to their energy content (e.g. biomethane is issued 1.9 RTFCs per kg, and 1.75 RTFCs per kg for biomethane and biopropane.

[1] Under the RTFO, biofuel derived from wastes, residues, non-food cellulosic material, and ligno-cellulosic material receive double the number of RTFCs as biofuels derived from crops and other non-waste materials.
[2] RTFCs can be freely traded and have a market value. In this sense the award of RTFCs is equivalent to financial support for the supply of biofuel, albeit a variable one.[why is it equivalent to a subsidy?]

1.2.1 Benefits

Non-monetised benefits

A.7 The joint Government / Industry Task Force on low carbon HGV technologies has identified that gaseous fuels could play a significant role in decarbonising the HGV sector. For example, waste-derived biomethane can offer carbon savings of around 80% compared to fossil fuels. Encouraging the use of biomethane in heavy goods vehicles is also consistent with the 2012 Bioenergy Strategy. We consider the main benefit of increased support for renewable gaseous fuels to be the development of an associated industry and infrastructure, which will help meet the total demand for renewable fuels in the long run.

A.8 In the short run, changing the number of RTFCs awarded per kilogram of renewable gaseous fuel means that for the same amount of gaseous fuel supplied more RTFCs would be awarded. As a fixed number of RTFCs are required to meet a fuel supplier's obligation under the RTFO, increasing the supply of RTFCs that are awarded for the use of gaseous fuels will likely reduce the demand for liquid biofuels as suppliers may choose to meet their obligation by redeeming certificates issued for the supply of renewable gaseous fuels.

A.9 As the RTFO is a market-based instrument under which suppliers are incentivised to minimise costs, we would expect this reduction in the use of liquid biofuels to impact on the most expensive 'marginal' biofuels supplied under the RTFO and to marginally reduce the overall cost of meeting the RTFO.

A.10 Gaseous fuels (e.g. biomethane from municipal waste) typically have good greenhouse gas (GHG) saving characteristics. In the short run, it is expected that the reduced demand for liquid biofuel would have either small negative impacts (if waste-derived biodiesel is displaced by the supply of gaseous fuels) or high positive impacts (if crop-derived biodiesel is displaced and indirect land use change[3] is taken into account). We think it is more likely that gaseous biofuels would replace crop-derived biodiesel, which has a high indirect land use change impact and is therefore considered unsustainable. This would be a benefit, but there is significant uncertainty around which liquid biofuels would be replaced by gaseous fuels.

A.11 In the long run, if the RTFO obligation level is increased to meet the 2020 RED target, we would expect that the reduced demand for liquid biofuels would have significant positive GHG impacts (when taking indirect land-use

[3] Indirect land use change occurs where biofuel feedstock is grown on existing crop land and additional land is then cleared to grow the crops which have been displaced to grow the biofuel feedstock. These means that for some biofuel feedstocks, when indirect emissions are taken into account, emissions can be higher than that of fossil fuels. The ILUC factors used here are taken from International Food Policy Research Institute modelling for the European Commission.

change into account). This is because crop-derived biodiesel is expected to become the marginal biofuel supplied under the RTFO as the obligation increases, even though it currently accounts for just 2% of renewable fuels supplied. Crop biodiesel is estimated to cause increased GHG emissions relative to fossil fuel when indirect effects are taken into account.

A.12 The extent to which these impacts will materialise depends on the extent to which gaseous renewable fuels will be used in road transport. Biomethane currently makes up around 0.004% of total road transport fuel by volume. In the short run, the potential to increase the supply of biomethane is tightly limited by 'demand constraints' (i.e. there are relatively few vehicles currently on the road which can use this fuel). In contrast to this, Bio-LPG is limited by supply constraints (while LPG vehicles are reasonably widespread, bio-LPG is not currently sold in the UK). We therefore assume here that biomethane will continue to be the main gaseous renewable fuel supplied under the RTFO between now and 2020, other gaseous fuels may be supplied going forward but we have not attempted to quantify these

Monetised benefits

Modelling assumptions:

A.13 Given the uncertainty around assumptions made about HGV uptake of gaseous fuel (taken from DfT forecasts) and marginal fuel displacement to assess the scale of the impact, to highlight sensitivities to our assumptions, we have used different uptake and fuel displacement scenarios, which are described in more detail below. We expect that the main users of biomethane supplied under the RTFO will be HGVs, that the fuel will be mainly waste-derived, where the fuel is taken directly from a production site, and that the main source of waste-derived biomethane will be landfill sites. Other kinds of natural gas vehicles, such as buses and municipal vehicles, are more likely to use methane taken from the natural gas grid. Where possible, carbon impacts are quantified, including and excluding estimates of emissions from indirect land-use change (ILUC).

A.14 Approximately 500 HGVs are using gas today. For comparison, 23,000 new HGVs over 18t were registered in 2012, so only a very small percentage of all HGVs are currently equipped to use gaseous fuels instead of liquid fuels. Since April 2014, gaseous transport fuels benefit from a guarantee that the current fuel duty differential will continue until 2024. We expect that this will contribute to a higher future uptake of dual-fuel or gas-powered vehicles, which would in turn increase the potential for biomethane to be used.

A.15 The process of displacement is assumed to be indirect. Whilst biomethane displaces natural gas and not diesel or biodiesel in a practical sense, the RTFCs that are awarded to biomethane would displace RTFCs which would otherwise be awarded for liquid biofuels. However, it should be noted that as the RTFO is a market based system the marginal liquid biofuel which may be

displaced is not fixed and may change if relative prices shift or if targets are increased in the future.

Monetised benefits – Central Scenario

A.16 In the central scenario, we assume that the biodiesel indirectly displaced by biomethane is made up of 50% used cooking oil (CO) and 50% crop biodiesel. This is to reflect the considerable uncertainty around which one will be the marginal fuel between 2015 and 2020.

Table 1.1: carbon intensity - for biodiesel and biomethane gCO_2/MJ are based on values reported under the RTFO in years 4b, 5 and 6

GHG saving from displacement is calculated using the following formula:

(Counterfactual compressed natural gas (CNG) emissions – biomethane emissions) – (counterfactual diesel emissions – displaced biodiesel emissions) = GHG savings from displacement

GHG savings are based on an average carbon intensity factor for biodiesel in gCO_2/MJ, assuming 50% crop biodiesel and 50% UCO:

(Crop biodiesel carbon intensity (48.9g plus ILUC factor 55g) + UCO carbon intensity (14.9g))/2

= (103.9+14.9)/2

= 59.4 gCO_2/MJ.

The following carbon intensity factors are also used:

Diesel = 83.8 gCO_2/MJ

CNG = 76.7 gCO_2/MJ

Biomethane = 21 gCO_2/MJ

A.17 The guarantee of the existing fuel duty differential drives the assumptions underlying our central scenario for biomethane uptake. If 5% of new HGVs (1150 per year) from 2015 onwards were gas vehicles (including dual fuel) and new vehicle registrations remain constant, then there would be approximately 7400 gas HGVs by 2020. This also assumes vehicles reaching their end-life are replaced and additional re-fuelling infrastructure is put in place.

A.18 Given a long-term duty differential commitment, we estimate that 12.5% of the fuel used by this fleet will be biomethane. Based on the fact that so far, gas-

powered vehicles are almost exclusively dual-fuel, we then make the following assumptions:

- that dual fuel vehicles run on diesel half of the time and gas half of the time;
- that half of dual-fuel vehicles in 2020 will use 100% fossil gas;
- that the other half of these vehicles in 2020 will use a mix of 50% fossil gas and 50% biomethane.

A.19 Therefore, of all the energy used by these dual-fuel vehicles, in our central scenario, 12.5% is assumed to come from biomethane.

A.20 At present, the marginal biofuel supplied under the RTFO is thought to be FAME biodiesel (either waste-derived or crop-derived). Given the uncertainty over which marginal biodiesel would be displaced, our central modelling assumes a 50/50 mix of UCO and crop-biodiesel being displaced by biomethane. This is a modelling scenario and does not represent today's mix of biofuels as reported under the RTFO, where crop biodiesel only accounted for 2% of renewable fuels supplied under the RTFO in years 5 and 6 (to date).

Table 1.2 Central scenario – HGV biomethane uptake

Central gas HGVs	2014	2015	2016	2017	2018	2019	2020
No. of gas HGVs in fleet, 12.5% of fuel is biomethane	500	1650	2800	3950	5100	6250	7400
Energy from biomethane, TWh	0.02	0.05	0.09	0.13	0.17	0.21	0.24

A.21 Based on an average fuel use of 264 MWh/year per[4] gas-powered HGV, an overall total of 0.9 TWh would be supplied from biomethane in the RTFO in the period 2015-2020.

A.22 Our scenario estimates that UCO and crop-derived biodiesel displacement will lead to overall GHG savings of 0.04 $MtCO_2$ in the period 2015-20 including ILUC. The monetised discounted GHG benefits would be £2.65m in the period 2015-20, based on non-traded carbon prices from DECC's valuation of energy use and greenhouse gas emissions for appraisal toolkit.

A.23 Therefore, central scenario benefits estimates:

[3] DfT estimate

Table 1.3 Central scenario – benefits from biomethane use.

Using carbon intensity as reported under the RTFO for Years 4b to 6 plus ILUC factors:

	2015	2016	2017	2018	2019	2020	Total	Total present value
$MtCO_2$ Saved	0.003	0.005	0.007	0.009	0.011	0.013	0.05	
£m, based on DECC's non-traded carbon prices (2014)	0.18	0.31	0.44	0.57	0.71	0.86	3.06	2.65

Table 1.4 Using carbon intensity as reported under the RTFO but excluding ILUC:

	2015	2016	2017	2018	2019	2020	Total	Total present value
$MtCO_2$ Saved	-0.006	-0.010	-0.015	-0.019	-0.023	-0.027	-0.10	
£m, based on DECC's non-traded carbon prices (2014)	-0.38	-0.65	-0.93	-1.22	-1.52	-1.82	-6.51	-5.63

A.24 These estimates are very sensitive to the inclusion of ILUC factors but less sensitive to the assumption of biodiesel being displaced with a mix of 50% crop biodiesel and 50% UCO, since UCO is currently double counted and we take this into account when estimating displacement. For 100% UCO displacement the estimated impacts are monetised discounted carbon increases of £5.56million

A.25 For 100% crop biodiesel displacement the estimated impacts are monetised discounted carbon savings of +£18.66million including ILUC and -£6.17million excluding ILUC

Monetised benefits – low scenario

A.26 In the case of demand constraints, there will be no additional take-up of gas HGVs. Gas HGVs will remain constant at 500 vehicles and only a 5% share of their fuel will be from biomethane. There will be no additional increase in the uptake of biomethane. Awarding additional certificates to current amounts of biomethane use would have no significant effects.

Monetised benefits – high scenario

A.27 The high scenario assumes new gas HGV uptake will stay at 5% of new vehicles between 2015 and 2017 (as in the central scenario). But from 2018 onwards, we expect increasing uptake. This is based on a maximum uptake scenario where by 2030 all newly registered HGVs are gas-powered and their share of new vehicles increases gradually between 2018 and 2030. This would result in approximately 13,950 gas HGVs in 2020. To achieve annual increases above 5% of new registrations, we assume there will be significant new nationwide refuelling infrastructure and a well-established second-hand market for HGVs.

We assume that the fleet will still be dual-fuel, so that 50% of their fuel comes from diesel. We also assume that all the gas used by the fleet is a 50/50 mix of fossil and biomethane, so that the biomethane share of fuel goes up to 25% (from 12.5% in the central scenario). Biomethane use in 2020 would be just under 1TWh, which is well within expected supply volumes. Approximately 25TWh of biomethane (from various sources) was used in 2012 across transport, heating and electricity generation.

Table 1.5 High Scenario – HGV biomethane uptake

High gas HGVs	2014	2015	2016	2017	2018	2019	2020
No. of gas HGVs in fleet, 25% of fuel is biomethane	500	1650	2800	3950	5950	8950	13950
Energy from biomethane, TWh	0.03	0.11	0.18	0.26	0.39	0.59	0.92

A.28 In the high uptake scenario we can illustrate the best case and the worst case outcome in terms of carbon impacts and fuel being displaced. If we assume that 100% UCO is displaced, we see a significant increase in carbon emissions (including or excluding ILUC makes no difference here.) If we assume that 100% crop biodiesel is displaced and ILUC factors are taken into account, we see significant carbon savings.

Table 1.6 - High uptake scenario - monetised carbon savings

	2015	2016	2017	2018	2019	2020	Total	Total present value
100% UCO displaced	-0.74	-1.28	-1.84	-2.81	-4.29	-6.78	-17.74	-15.15
50% UCO, 50% crop biodiesel displaced, **incl.** ILUC	0.35	0.61	0.87	1.34	2.04	3.23	8.45	7.21
50% UCO, 50% crop biodiesel displaced, **excl.** ILUC	-0.75	-1.30	-1.86	-2.84	-4.34	-6.87	-17.96	-15.33
100% crop biodiesel displaced, **incl**. ILUC	2.55	4.40	6.30	9.63	14.70	23.25	60.82	51.93
100% crop biodiesel displaced, **excl**. ILUC	-0.77	-1.33	-1.90	-2.91	-4.45	-7.03	-18.40	-15.71

1.2.2 Costs

Non-monetised costs

A.29 Since the biofuel industry is competitive and the RTFO mechanism is cost minimising, we do not expect suppliers to use the fuels incentivised by the proposed legislative changes unless the cost of doing so is equal to or lower than the cost of supplying the biofuels which they would replace. Therefore we do not expect any of the proposed changes to increase the cost imposed on motorists by the RTFO.

A.30 The amendment is expected to reduce demand for marginal fuels from waste and crop biodiesel in the short term. These fuel suppliers may experience lower turnover and profitability. Due to the limited number of gas-powered vehicles capping the possible demand for biomethane, we do not expect the impact on these suppliers to be significant. Given the inherent uncertainty over the type and quantity of marginal fuels, the cost to firms described above have not been quantified in the cost benefit analysis. The worst case scenario illustrates that the more UCO is displaced in the RTFO the greater the increase in GHG emissions, which would present a cost to society.

A.31 To the extent that double counted gaseous fuel replaces single counted liquid renewable fuel, the overall transport energy supplied under the RTFO may decrease. This shortfall may result in additional sales of other liquid biofuels or of fossil fuels and an associated change in carbon emissions. We have not attempted to quantify this secondary effect, since its impact depends on which liquid biofuel is the marginal fuel at the time, the comparative costs of fossil and biofuels and the RTFO obligation level.

Summary

A.32 The primary non-monetised long-term benefit we expect to see from the proposed amendments is a small step towards the decarbonisation of road transport through the increased use of gaseous fuels.

A.33 In terms of monetised short-term impacts, we expect to see a change in carbon emissions from the primary impact of gaseous fuels displacing liquid biofuels. The range of impacts could vary as follows:

Low uptake scenario: no impact

Central uptake scenario: carbon reduction benefits ranging from -£6.17 million to +£18.66 million over the period 2015 to 2020 with a central estimate of savings worth £2.65 million in net present value

High uptake scenario: carbon reduction benefits ranging from -£16 million to +£52 million over the period 2015-2020