Title: Fuel Quality Directive **IA No:** DFT00048 **Lead department or agency:** Department for Transport **Other departments or agencies:**	**Impact Assessment (IA)**
	Date: 28/11/2011
	Stage: Final
	Source of intervention: EU
	Type of measure: Primary legislation
	Contact for enquiries: Stephen Howe Stephen.Howe@dft.gsi.gov.uk (020 7944 4895)

Summary: Intervention and Options

RPC: AMBER

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB on 2009 prices)	**In scope of One-In, One-Out?**	**Measure qualifies as**
-£1.8 to -£1.3bn	-£8 to -£6bn	£0.5bn to £0.6bn	No	NA

What is the problem under consideration? Why is government intervention necessary?

Transport greenhouse gas (GHG) emissions impose a significant external cost that is not reflected in the market price of transport fuel. In particular, fuel suppliers have little incentive to deliver GHG savings through lower emission renewable fuels such as biofuels, at least in the near term, due to their relatively higher costs compared to fossil fuels. Cost differentials are driven primarily by the relative maturity and costs in the different fuels markets, infrastructure requirements etc. Government intervention will therefore be required to meet the Fuel Quality Directive target which requires at least a 6% reduction in lifecycle GHG emissions from the inland surface transport sector by 2020.

What are the policy objectives and the intended effects?

The objective of the policy is for fuel suppliers to deliver a minimum of 6% lifecycle GHG savings in the transport sector. This can be achieved through the supply of biofuel, a change in the fossil fuel mix to less polluting fossil fuels, improvements to fossil fuel extraction/refining processes or increased use of electricity in the transport sector. Given the competitive nature of the fuel market, the cost of delivering these measures is expected to be passed through to final consumers of fossil transport fuel. We do not intend to implement this Directive beyond the minimum requirements.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

3 potential approaches have been considered for implementation of the Fuel Quality Directive:

A) Do nothing (baseline)

B) Put in place a 6% 2020 GHG savings target with a trajectory of annual targets leading up to 2020 (various targets and trajectories have been considered - options 1 to 5).

C) Put in place a 6% 2020 GHG savings target but delay determining what future steps to take until further evidence on sustainability and deployment issues can be gathered (option 6).

Approach C (option 6) is preferred given the substantial risks (i.e. large scale investment in unsustainable technologies) associated with committing to increase the deployment of 1st generation crop-derived biofuels before sustainability issues are addressed and resolved (see paragraph 147 for further explanation).
Please note that details of the Government's final policy position are given in Annex 20 (12/2012).

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 04/2014

Does implementation go beyond minimum EU requirements?			No		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** No	**< 20** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:** 14 to 16	**Non-traded:** -102 to -120	

I have read the Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) that the benefits justify the costs.

Signed by the responsible Minister: Norman Baker Date: 05/12/2012

Summary: Analysis & Evidence — Policy Option 1

Description: Put in place a 2020 6% GHG reduction target with a linear trajectory of annual targets from 2017 to 2020

FULL ECONOMIC ASSESSMENT

Price Base Year 2010	PV Base Year 2010	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: -8,369	**High:** 4,939	**Best Estimate:** -1,272

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	315	8	-110	**-884**
High	315		1,289	**15,305**
Best Estimate	315		489	**6,051**

Description and scale of key monetised costs by 'main affected groups'

Monetised costs capture the cost of delivering GHG savings (primarily through the supply of biofuel), infrastructure costs and administrative costs. These costs are incurred by obligated suppliers (e.g. suppliers of inland surface transport fuel), representing the net cost to business, and are assumed to be passed through 100% to final consumers of inland surface transport fuel given the competitive nature of the fuel market.

Other key non-monetised costs by 'main affected groups'

Costs related to the introduction of biofuel "high blend" fuel streams - e.g. supply infrastructure, changes to the vehicle fleet and overcoming consumer preference barriers - have not been quantified due to the lack of available evidence. These costs would be borne primarily by the final consumers of transport fuel. The economy-wide cost of potential increased food prices as a result of increased demand for agricultural feedstocks has not been quantified due to a lack of robust data.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			344	**4,055**
High			596	**6,936**
Best Estimate			435	**4,779**

Description and scale of key monetised benefits by 'main affected groups'

Monetised benefits include CO2 savings, air quality impacts, noise impacts, congestion impacts and road traffic accident impacts. These benefits are likely to benefit the wider society which includes a general benefit from reduced GHG emissions and improved air quality, but also road users due to improved travel conditions.

Other key non-monetised benefits by 'main affected groups'

Non-monetised benefits include GDP effects of potential growth in UK biofuel industry; innovation spillovers from the development of different sectors of the fuel market and associated technologies; and potential benefits to the country from energy security owing to the wider diversity in fuel sources

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5

Uncertainties include: future costs; future GHG savings; and future energy demand .These uncertainties have been addressed using sensitivity tests where possible. There are substantial risks associated with committing to increase the deployment of 1st generation crop-derived biofuels before sustainability issues (in particular Indirect Land Use Change) are resolved and addressed. Such an approach could incentivise investment in unsustainable technologies, hence option 6 is preferred.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**In scope of OIOO?**	**Measure qualifies as**
Costs: 507	**Benefits:** 0	**Net:** -507	No	NA

Summary: Analysis & Evidence

Policy Option 2

Description: Put in place a 2020 6% GHG reduction target with a linear trajectory of annual targets from 2014 to 2020

FULL ECONOMIC ASSESSMENT

Price Base Year 2010	PV Base Year 2010	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: -9,603	**High:** 5,530	**Best Estimate:** -1,532

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	315	5	-105	**-800**
High	315		1,436	**17,529**
Best Estimate	315		556	**7,069**

Description and scale of key monetised costs by 'main affected groups'

Monetised costs capture the cost of delivering GHG savings (primarily through the supply of biofuel), infrastructure costs and administrative costs. These costs are incurred by obligated suppliers (e.g. suppliers of inland surface transport fuel), representing the net cost to business, and are assumed to be passed through 100% to final consumers of inland surface transport fuel given the competitive nature of the fuel market.

Other key non-monetised costs by 'main affected groups'

Costs related to the introduction of biofuel "high blend" fuel streams - e.g. supply infrastructure, changes to the vehicle fleet and overcoming consumer preference barriers - have not been quantified due to the lack of available evidence. These costs would be borne primarily by the final consumers of transport fuel. The economy-wide cost of potential increased food prices as a result of increased demand for agricultural feedstocks has not been quantified due to a lack of robust data.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low			388	**4,730**
High			659	**7,926**
Best Estimate			487	**5,546**

Description and scale of key monetised benefits by 'main affected groups'

Monetised benefits include CO2 savings, air quality impacts, noise impacts, congestion impacts and road traffic accident impacts. These benefits are likely to benefit the wider society which includes a general benefit from reduced GHG emissions and improved air quality, but also road users due to improved travel conditions.

Other key non-monetised benefits by 'main affected groups'

Non-monetised benefits include GDP effects of potential growth in UK biofuel industry; innovation spillovers from the development of different sectors of the fuel market and associated technologies; and potential benefits to the country from energy security owing to the wider diversity in fuel sources

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5

Uncertainties include: future costs; future GHG savings; and future energy demand .These uncertainties have been addressed using sensitivity tests where possible. There are substantial risks associated with committing to increase the deployment of 1st generation crop-derived biofuels before sustainability issues (in particular Indirect Land Use Change) are resolved and addressed. Such an approach could incentivise investment in unsustainable technologies, hence option 6 is preferred.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 574	**Benefits:** 0	**Net:** -574	No	NA

Summary: Analysis & Evidence — Policy Option 3

Description: Put in place a 2020 6% GHG reduction target with a stretching trajectory of annual targets from 2014 to 2020

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2010	2010	18	**Low:** -10,355	**High:** 5,638	**Best Estimate:** -1,801

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	315	8	-95	**-652**
High	315		1,509	**18,627**
Best Estimate	315		593	**7,629**

Description and scale of key monetised costs by 'main affected groups'

Monetised costs capture the cost of delivering GHG savings (primarily through the supply of biofuel), infrastructure costs and administrative costs. These costs are incurred by obligated suppliers (e.g. suppliers of inland surface transport fuel), representing the net cost to business, and are assumed to be passed through 100% to final consumers of inland surface transport fuel given the competitive nature of the fuel market.

Other key non-monetised costs by 'main affected groups'

Costs related to the introduction of biofuel "high blend" fuel streams - e.g. supply infrastructure, changes to the vehicle fleet and overcoming consumer preference barriers - have not been quantified due to the lack of available evidence. These costs would be borne primarily by the final consumers of transport fuel. The economy-wide cost of potential increased food prices as a result of increased demand for agricultural feedstocks has not been quantified due to a lack of robust data.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low			405	**4,986**
High			684	**8,272**
Best Estimate			508	**5,828**

Description and scale of key monetised benefits by 'main affected groups'

Monetised benefits include CO2 savings, air quality impacts, noise impacts, congestion impacts and road traffic accident impacts. These benefits are likely to benefit the wider society which includes a general benefit from reduced GHG emissions and improved air quality, but also road users due to improved travel conditions.

Other key non-monetised benefits by 'main affected groups'

Non-monetised benefits include GDP effects of potential growth in UK biofuel industry; innovation spillovers from the development of different sectors of the fuel market and associated technologies; and potential benefits to the country from energy security owing to the wider diversity in fuel sources

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5

Uncertainties include: future costs; future GHG savings; and future energy demand .These uncertainties have been addressed using sensitivity tests where possible. There are substantial risks associated with committing to increase the deployment of 1st generation crop-derived biofuels before sustainability issues (in particular Indirect Land Use Change) are resolved and addressed. Such an approach could incentivise investment in unsustainable technologies, hence option 6 is preferred.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 611	**Benefits:** 0	**Net:** -611	No	NA

Summary: Analysis & Evidence — Policy Option 4

Description: Put in place a 2020 6% GHG reduction target with a linear trajectory of annual targets from 2012 to 2020

FULL ECONOMIC ASSESSMENT

Price Base Year 2010	PV Base Year 2010	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: -10,424	**High:** 5,810	**Best Estimate:** -1,719

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	315	8	-99	**-702**
High	315		1,518	**18,828**
Best Estimate	315		595	**7,693**

Description and scale of key monetised costs by 'main affected groups'

Monetised costs capture the cost of delivering GHG savings (primarily through the supply of biofuel), infrastructure costs and administrative costs. These costs are incurred by obligated suppliers (e.g. suppliers of inland surface transport fuel), representing the net cost to business, and are assumed to be passed through 100% to final consumers of inland surface transport fuel given the competitive nature of the fuel market.

Other key non-monetised costs by 'main affected groups'

Costs related to the introduction of biofuel "high blend" fuel streams - e.g. supply infrastructure, changes to the vehicle fleet and overcoming consumer preference barriers - have not been quantified due to the lack of available evidence. These costs would be borne primarily by the final consumers of transport fuel. The economy-wide cost of potential increased food prices as a result of increased demand for agricultural feedstocks has not been quantified due to a lack of robust data.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			691	**5,973**
High			411	**8,405**
Best Estimate			514	**5,109**

Description and scale of key monetised benefits by 'main affected groups'

Monetised benefits include CO2 savings, air quality impacts, noise impacts, congestion impacts and road traffic accident impacts. These benefits are likely to benefit the wider society which includes a general benefit from reduced GHG emissions and improved air quality, but also road users due to improved travel conditions.

Other key non-monetised benefits by 'main affected groups'

Non-monetised benefits include GDP effects of potential growth in UK biofuel industry; innovation spillovers from the development of different sectors of the fuel market and associated technologies; and potential benefits to the country from energy security owing to the wider diversity in fuel sources

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5

Uncertainties include: future costs; future GHG savings; and future energy demand .These uncertainties have been addressed using sensitivity tests where possible. There are substantial risks associated with committing to increase the deployment of 1st generation crop-derived biofuels before sustainability issues (in particular Indirect Land Use Change) are resolved and addressed. Such an approach could incentivise investment in unsustainable technologies, hence option 6 is preferred.

BUSINESS ASSESSMENT (Option 4)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 613	**Benefits:** 0	**Net:** -613	No	NA

Summary: Analysis & Evidence — Policy Option 5

Description: Put in place a 2020 7% GHG reduction target with a linear trajectory of annual targets from 2012 to 2020

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2010	2010	18	**Low:** -14,541	**High:** 6,042	**Best Estimate:** -3,722

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	315	8	10	**425**
High	315		2,041	**25,270**
Best Estimate	315		871	**11,107**

Description and scale of key monetised costs by 'main affected groups'

Monetised costs capture the cost of delivering GHG savings (primarily through the supply of biofuel), infrastructure costs and administrative costs. These costs are incurred by obligated suppliers (e.g. suppliers of inland surface transport fuel), representing the net cost to business, and are assumed to be passed through 100% to fuel consumers. This option exceeds minimum EU requirements and would therefore require compensatory deregulation under 'one in one out'.

Other key non-monetised costs by 'main affected groups'

Costs related to the introduction of biofuel "high blend" fuel streams - e.g. supply infrastructure, changes to the vehicle fleet and overcoming consumer preference barriers - have not been quantified due to the lack of available evidence. These costs would be borne primarily by the final consumers of transport fuel. The economy-wide cost of potential increased food prices as a result of increased demand for agricultural feedstocks has not been quantified due to a lack of robust data.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			520	**6,467**
High			881	**10,729**
Best Estimate			576	**7,385**

Description and scale of key monetised benefits by 'main affected groups'

Monetised benefits include CO2 savings, air quality impacts, noise impacts, congestion impacts and road traffic accident impacts. These benefits are likely to benefit the wider society which includes a general benefit from reduced GHG emissions and improved air quality, but also road users due to improved travel conditions.

Other key non-monetised benefits by 'main affected groups'

Non-monetised benefits include GDP effects of potential growth in UK biofuel industry; innovation spillovers from the development of different sectors of the fuel market and associated technologies; and potential benefits to the country from energy security owing to the wider diversity in fuel sources

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5

Uncertainties include: future costs; future GHG savings; and future energy demand .These uncertainties have been addressed using sensitivity tests where possible. There are substantial risks associated with committing to increase the deployment of 1st generation crop-derived biofuels before sustainability issues (in particular Indirect Land Use Change) are resolved and addressed. Such an approach could incentivise investment in unsustainable technologies, hence option 6 is preferred.

BUSINESS ASSESSMENT (Option 5)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 889	**Benefits:** 0	**Net:** -889	Yes	IN

Summary: Analysis & Evidence

Policy Option 6

Description: Put in place a 2020 6% GHG reduction target but delay setting a trajectory of annual targets until further evidence on sustainability and deployment options can be fully researched.

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2010	2010	18	**Low:** -10,355	**High:** 5,638	**Best Estimate:** N/A

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	315	8	-110	**-854**
High	315		1,509	**18,627**
Best Estimate	315			

Description and scale of key monetised costs by 'main affected groups'

There is no best estimate since there are a range of trajectories that could fit this option (see options 1 to 3 for examples). Monetised costs capture the cost of delivering GHG savings, administartive costs and infrastructure costs. These costs are incurred by obligated suppliers (e.g. suppliers of inland surface transport fuel), representing the net cost to business, and are assumed to be passed through 100% to final consumers of inland surface transport fuel given the competitive nature of the fuel market.

Other key non-monetised costs by 'main affected groups'

Costs related to the introduction of biofuel "high blend" fuel streams - e.g. supply infrastructure, changes to the vehicle fleet and overcoming consumer preference barriers - have not been quantified due to the lack of available evidence. These costs would be borne primarily by the final consumers of transport fuel. The economy-wide cost of potential increased food prices as a result of increased demand for agricultural feedstocks has not been quantified due to a lack of robust data.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			-110	**4,986**
High			1,509	**8,272**
Best Estimate				

Description and scale of key monetised benefits by 'main affected groups'

There is no best estimate since there are a range of trajectories that could fit this option. Monetised benefits include CO2 savings, air quality impacts, noise impacts, congestion impacts and road traffic accident impacts. These benefits are likely to benefit the wider society which includes a general benefit from reduced GHG emissions and improved air quality, but also road users due to improved travel conditions.

Other key non-monetised benefits by 'main affected groups'

Non-monetised benefits include GDP effects of potential growth in UK biofuel industry; innovation spillovers from the development of new technologies; and potential benefits to the country from energy security owing to the wider diversity in fuel sources This option allows for more time to address sustainability issues before putting in place a final trajectory of GHG saving targets, thus mitigating the risk of investment in unsustainable technologies.

Key assumptions/sensitivities/risks — **Discount rate (%)** 3.5

Uncertainties include: future costs; future GHG savings; future energy demand. These sensitivities have been addressed using sensitivity tests where possible. There is a risk that sustainability issues may not have been resolved by 2014 and the additional investor certainty and sustainability benefits of pursuing option 6 (relative to options 1 to 5) may not materialise.

BUSINESS ASSESSMENT (Option 6)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 507 - 611	**Benefits:** 0	**Net:** 507 - 611	No	NA

Evidence Base (for summary sheets)

Contents

Executive Summary

1 This impact assessment presents cost benefit analysis underlying 3 high-level approaches for implementation of Article 7a of the EU Fuel Quality Directive. This requires EU inland surface transport fuel suppliers (principally those providing fuel and energy for land-based transport, and other non-road mobile machinery (including inland waterway vessels) and recreational craft when not at sea) to reduce greenhouse gas (GHG) emissions by a minimum of 6% by 2020, relative to fossil fuel. The 3 approaches (which are set out in the accompanying government response document) are:

Approach A: Do nothing (impact assessment baseline)

Approach B: Put in place a 2020 GHG savings target with a trajectory of interim GHG savings targets leading up to 2020 (impact assessment options 1 to 5)

Approach C: Put in place a 6% 2020 GHG savings target but delay setting a trajectory of interim GHG savings targets (whilst using the current RTFO to deliver GHG savings towards the FQD until 2014) until further analysis on sustainability and deployment issues has taken place (impact assessment option 6). Delaying setting a trajectory is intended to avoid investment in unsustainable technologies which could potentially be rendered unviable by future policy aimed at addressing and resolving biofuel sustainability issues. This approach is considered to represent the best outcome for future market stability and investor certainty.

2 The impact assessment presents cost benefit analyses of a number of options for implementation of the identified approaches. In addition to quantifying the costs and benefits; underlying assumptions, uncertainties and evidence gaps have also been set out.

3 The analysis identifies option 6 (approach C) as the preferred option. Option 6 involves putting in place a 6% 2020 GHG savings target but delaying determining what further steps to take to implement the GHG saving obligation (whilst using the current RTFO to deliver GHG savings towards the FQD) until sustainability issues (in particular indirect land use change, “ILUC”) have been addressed. Putting in place a trajectory prior to resolving sustainability issues risks incentivising investment in unsustainable technologies which could potentially be rendered unviable by future policy aimed at addressing and resolving sustainability issues. The EU is currently assessing policy options for mitigating the effects of ILUC. In the meantime, the Renewable Transport Fuel Obligation will be used to deliver the gradual decarbonisation of the transport fuel supply required by the Fuel Quality Directive.

4 Option 6 (approach C) is considered to mitigate infraction risk relative to doing nothing baseline scenario (approach A). However, option 6 does not completely mitigate all infraction risk as the absence of a trajectory of annual GHG savings targets in the short term (as would be delivered under approach B) could be viewed as non-compliance with the directive.

5 The infraction risk for this option has not been explicitly quantified in the Impact Assessment. This is because it is unclear at this stage what the relative likelihood of infraction would be, as well as the exact scale of any fines. However, these risks are considered to be limited in the short term, at least until provisions are in force as a matter of EU law setting out how the GHG lifecycle emissions referable to fossil fuels and energy are to be calculated. Such provisions are unlikely to come into force until at least early 2013. In order to reduce the risk of infraction in the meantime, under this option a legal obligation will be imposed on the Secretary of State for Transport to keep ongoing compliance with the directive’s requirements under review and, in particular, to consider what additional measures will be required to

ensure that the UK delivers the GHG emission savings in the period 2014 to 2020. This is the period for which there are currently no increases in the biofuel supply trajectory required under the RTFO set out in law.

6 Options 1,2 and 3 would all still be available under option 6.

SECTION 1 - Introduction

7 This Impact Assessment considers the estimated costs, benefits and wider issues arising from a range of options for implementation of Article 7a of the Fuel Quality Directive (FQD), which requires suppliers to reduce lifecycle[1] GHG emissions per unit energy from fuel supplied for road transport, non-road mobile machinery (NRMM) (including inland waterway vessels when not at sea), agricultural and forestry tractors, and recreational craft when not at sea[2] by a minimum of 6% by 2020. Costs and benefits are measured as additional to the costs and benefits attributable to the Renewable Transport Fuel Obligation (RTFO) which is the policy currently in place to support renewable energy in the road transport sector.

8 The analysis presented is intended to provide the order of magnitude of expected effects though of course there are considerable uncertainties in several areas. The analysis has been described in as transparent a way as possible, noting that there are limitations to what is possible given current available evidence.

9 Six options have been considered in this Impact Assessment for the implementation of the FQD. The options presented in the analysis are as follows:

1) Put in place a 2020 6% GHG reduction target with a linear trajectory of annual targets from 2017 to 2020 **(approach B)**
2) Put in place a 2020 6% GHG reduction target with a linear trajectory of annual targets from 2014 to 2020 **(approach B)**
3) Put in place a 2020 6% GHG reduction target with a stretching trajectory of annual targets from 2014 to 2020 **(approach B)**
4) Put in place a 2020 6% GHG reduction target with a linear trajectory of annual targets from 2012 to 2020 **(approach B)**
5) Put in place a 2020 7% GHG reduction target with a linear trajectory of annual targets from 2012 to 2020 **(approach B).** Option five exceeds the requirements of the Directive and would therefore require removal of regulation under ‘one in one out’ regulatory rules.
6) Put in place a 2020 6% GHG reduction target but delay determining what further steps to take to implement the GHG saving obligation until further evidence on some fundamental issues (e.g. sustainability and deployment options) has been developed and examined **(approach A).**

10 All options have been evaluated against a baseline of “doing nothing” which, in this case, means leaving an unamended RTFO in place as the incentive mechanism for delivering GHG savings from transport fuel.

11 This analysis will consider:

- The options available for fuel suppliers to meet their GHG obligations, and the costs and benefits of doing so, including administrative costs
- The key uncertainties in the analysis and how these can be assessed through sensitivity tests

[1] Lifecycle GHG savings refer to the difference in total GHG emissions from using biofuel (or alternative GHG saving measures) in place of fossil fuel. This includes emissions from the production of fossil fuels and biofuels.
[2] For ease of reading, these applications are collectively termed “road transport and NRMM” for the remainder of this document.

- The estimated GHG savings potentially achievable from the FQD obligations over the period to 2030
- The expected impact on fuel prices as a result of suppliers passing the costs of meeting their obligations through to consumers
- The wider costs and benefits to society of delivering lifecycle GHG reductions in fuel for road transport and NRMM.

12 The analysis is arranged as follows: Section 2 looks at the costs, benefits and wider implications associated with doing nothing (baseline); Section 3 looks at the costs and benefits associated with various options for implementation of an obligation setting mandatory targets for fuel suppliers to reduce lifecycle GHG emissions in line with the requirements of the Directive (options 1 to 5); Section 4 looks at putting in place a 6% GHG savings target for 2020 but delaying determining what further steps to take to implement the GHG saving obligation (option 6). Section 5 summarises the preferred option.

Changes from consultation stage impact assessment

13 This final stage impact assessment follows a public consultation exercise carried out by the Department for Transport. Interested parties were invited to comment on the policy options and underlying analysis either at public meetings (2 of which were held) or through written responses. The main points (and actions taken) which came out of stakeholder responses to the consultation are set out below.

Biofuel Price Projections

14 A number of stakeholders suggested that the biofuel price projections used in this analysis are too high and therefore lead to overestimates of the cost of expanding the UK biofuel supply. International Energy Agency biofuel price projections were suggested as an alternative.

15 The Government acknowledges that future biofuel (and fossil fuel) prices are highly uncertain, as is demonstrated by the considerable volatility seen in markets in recent years. The biofuel prices used in this impact assessment have been developed using the OECD-FAO Aglink-Cosimo model and are intended to be consistent with underlying DECC oil price projections. However, these projections are significantly different to the IEA price projections. In order to address stakeholders concerns, an additional sensitivity using IEA price projections has been modelled and the results are presented in annex 17.

Biofuel GHG Saving Assumptions

16 Some responses to the consultation have suggested that the average GHG savings used in the FQD analysis are conservative and that it is possible that GHG savings from crop-derived biofuel could be high enough to deliver both the Renewable Energy Directive target (10% renewable energy by 2020) and the FQD target (6% reduction in GHG emissions by 2020) to be met by the same set of biofuel.

17 In order for this to happen, the average lifecycle GHG saving delivered by biofuel would have to be in excess of 60%. In the high GHG saving scenario, average GHG savings from bioethanol are assumed to be 74% from 2020 onwards and average GHG savings from bioethanol are assumed to be 62% from 2020 onwards. Therefore a scenario where both the Renewable Energy Directive and the Fuel Quality Directive can be met using the same mix of

biofuel has already been captured within the range of average GHG saving sensitivities covered in the analysis.

Non-biofuel GHG Saving Pathways

18 Some responses to the consultation highlighted that there are alternative 'non-biofuel' abatement options which can be used to deliver the GHG savings required by the FQD. Whilst the consultation stage impact assessment acknowledge the potential for non-biofuel GHG savings, it was not possible to robustly quantify the role which these pathways might play in delivering FQD GHG saving targets. This remains the case and no further evidence which could be used to model these options was submitted in response to the consultation.

19 The fact that more evidence is required on 'deployment options' is explicitly recognised in the rationale underlying the preferred policy option (i.e. to delay setting GHG savings targets until issues around deployment options and sustainability can be resolved). It is the Government's intention to further analyse alternative abatement options before targets are put in place.

GDP contribution of UK biofuel industry

20 It was suggested that the impact assessment did not capture the economic 'added value' of having increased domestic biofuel production which could result from increased biofuel supply. Whilst (due to a lack of robust data) it has not been possible to quantitatively estimate the additional GDP impacts of UK biofuel industry growth under the scenarios modelled in this impact assessment, a more detailed qualitative analysis has been added in the evidence base.

Bacterial Contamination of Biodiesel in Marine Engines

21 It was also suggested that the impact assessment did not adequately capture the potential costs associated with microbial infection of biodiesel in marine engines. This issue will be addressed in more detail in a separate impact assessment looking specifically at the inclusion of Non Road Mobile Machinery (NRMM) fuel in the Renewable Transport Fuel Obligation.

Updated modelling assumptions

22 In this version of the impact assessment the analysis includes a number of assumptions which have been updated in the intervening period between drafting of the consultation stage impact assessment and the final stage impact assessment.

Oil price assumptions

23 Department of Energy and Climate Change (DECC) oil price projections were updated in October 2011. The latest price projections are considerably higher than previous estimates. As the cost of biofuel policy is determined by the additional cost of biofuel (over and above the cost of fossil fuel), the impact of higher oil price assumptions is to lower the estimated cost of biofuel policy. This effect can be seen by comparing the policy cost estimates in this (final stage) impact assessment with the policy cost estimates in the cost in the consultation stage impact assessment which were calculated using lower oil price assumptions.

High blend costs

24 FAME biodiesel and bioethanol (the two biofuels covered in this impact assessment) can be blended into the regular fuel supply (and used in all petrol and diesel vehicles) at low concentrations. At higher concentrations, modified vehicles and dedicated fuel streams are required. This (final stage) version of the impact assessment contains estimates of 'high blend' vehicle capital and operating costs which were not in previous versions of the impact assessment.

Problem under consideration

25 The UK is committed, through legally binding "carbon budgets", to reducing greenhouse gas (GHG) emissions by 34% below 1990 levels in 2020 and by at least 80% below 1990 levels in 2050. As transport sector emissions account for around 21% of total UK emissions, reducing GHG emissions from transport fuel has a key role to play in meeting these targets.

26 The FQD requires fuel suppliers to reduce the lifecycle GHG emissions per unit energy of road transport and non-road mobile machinery fuel they supply fuel by a minimum of 6% by 2020, relative to fossil fuel. This can be achieved through a number of measures including biofuels, electric vehicles, improvements to fossil fuel extraction/refining processes, and switching to alternative fossil fuels (e.g. methane, LPG). Within a timeframe to 2020, biofuels are expected to be the dominant contributor to reducing transport fuel GHG emissions.

27 In order to comply with this directive additional intervention over and above policy measures currently in place will be required.

Rationale for intervention

28 The costs of climate change are not directly reflected in transport fuel production costs and suppliers therefore lack the incentive to reflect these costs in their supply decisions. In the absence of intervention, the transport fuel market is unlikely to decarbonise in line with targets set in the FQD or carbon budgets due to the additional costs required to make GHG savings.

Policy objective

29 The objective of the policy options set out in the following analysis is to reduce lifecycle GHG emissions from transport fuel, as required by the FQD and UK carbon budgets, in a cost effective manner.

SECTION 2 – Do nothing (baseline)

30 Doing nothing implies leaving support for renewable transport fuel unchanged from the currently legislated levels. This option sets out the baseline against which all other options are assessed. Therefore, there are no additional GHG savings (benefits) or costs. It reflects a continuation of the current RTFO with no additional stringency. However, this option may lead to infraction proceedings being taken against the UK by the European Commission. If infracted, additional costs may be incurred in the form of fines for non-compliance with the FQD.

The Renewable Transport Fuel Obligation (RTFO)

31 The RTFO requires relevant (i.e. obligated) road transport fuel suppliers to supply biofuel in increasing volumes as a percentage of total fuel supplied. The RTFO sets obligation levels which peak at 5% by volume in 2013/14, as set out in the table below.

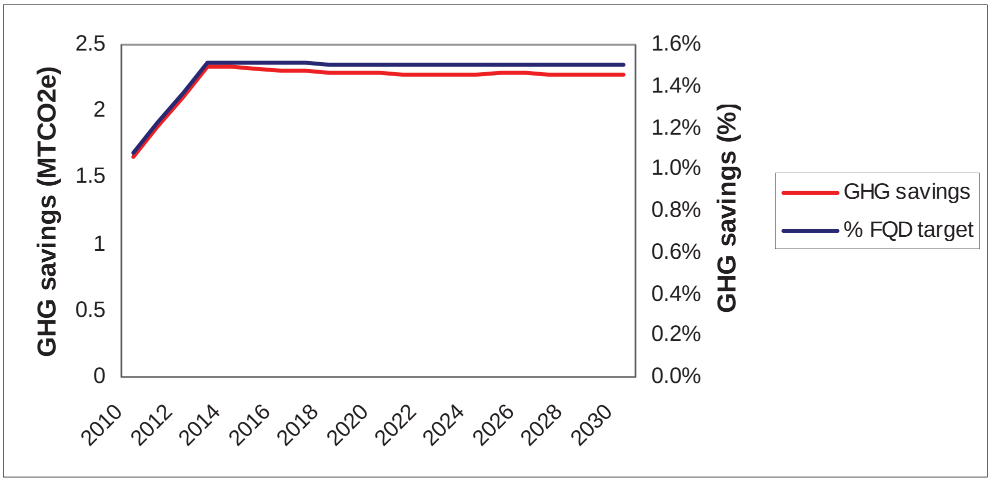
Figure 1: RTFO biofuel supply target as % of total transport fossil fuel supplied to 2013/2014

Year	% Obligated
2008 / 2009	2.50%
2009 / 2010	3.25%
2010 / 2011	3.50%
2011 / 2012	4.00%
2012 / 2013	4.50%
2013 / 2014 & onwards	5.00%

32 Average lifecycle GHG savings of 56% from bioethanol and 44% from biodiesel (note that this figure includes biodiesel produced from used cooking oil and tallow feedstocks which typically have a relatively higher GHG saving) have been projected for biofuel delivered under the RTFO (for further detail see annex 16). Lifecycle GHG savings from displaced fossil fuel net of GHG emissions from the production of biofuel of around 1.5% (2.35 $MTCO_2e$[3]) are projected for 2013/14 onwards when the RTFO obligation level peaks at 5% road transport fuel (by volume) This falls far short of the 6% GHG savings in 2020 required under the FQD.

[3] GHG savings are measured as CO_2e which means tonnes of CO_2 equivalent and captures other green house gases such as methane in relative terms.

Figure 2: Projected GHG savings from the RTFO, relative to the case if it were not in operation



Source: DfT modelling

Infraction risk

33 Infraction can result in very substantial fines. For example in 2005, following a particularly serious and long-running case, the European Court of Justice fined France a figure of nearly €58 million for each 6-months of delay in complying with a judgment of the court concerning fisheries on top of a lump sum of €20 million.

34 While the size of fines in any given case will continue to depend on the European Court of Justice’s (ECJ) assessment of the seriousness of the breach, its duration and the ability of the Member State to pay, Member States have recently signalled their willingness to accept a more punitive regime. This is reflected in the fact that the infraction process in non-notification cases has just been streamlined under the Lisbon Treaty so that the ECJ can move to fine a Member State significantly more swiftly than has to date been possible.

35 This information is intended to give an indication of the possible scale of the costs of infraction. It should be noted that the UK would of course seek to avoid infraction through the appropriate transposition of the Directive.

RTFO baseline

36 In the following analysis, which looks at options for implementing the FQD, cost and benefit estimates are presented as additional to (i.e. net of) the projected costs and benefits attributable to the current RTFO trajectory.

SECTION 3 – Wider context

Introduction

37 This section describes the relevant context for the implementation of the Directive in terms of summarising the requirements of the FQD; describing how it could be implemented; providing a high-level overview of the potential impact of the FQD on the market for biofuels; and explaining the relevance of the Renewable Energy Directive (Directive 2009/28/EC).

38 Although the Directive will be implemented at the EU level, this Impact Assessment considers the costs and benefits to the UK only.

The Fuel Quality Directive

39 Article 7a of the FQD requires fuel suppliers (i.e. not Member States) to reduce the lifecycle GHG emissions per unit energy of road transport and non-road mobile machinery fuel they supply by a minimum of 6% by 2020, relative to fossil fuel. It also requires Member States to ensure that these reductions are delivered as gradually as possible (e.g. by setting of a trajectory of GHG reduction targets out to 2020). GHG emission reductions could be delivered in a range of ways. These include, the deployment of biofuel, switching to less polluting fossil fuels (e.g. fossil methane, LPG) a reduction in the GHG intensity of fossil fuels through changes to the extraction/refining processes or through the deployment of electric vehicles (provided that the electricity can be appropriately accounted for). GHG savings are measured relative to the EU average lifecycle GHG emissions from fossil fuels in 2010.The European Commission recently came forward with a proposal for adoption through the EU's committee system for approving delegated legislation ('comitology') related to the accounting of GHG emissions from fuels/energy other than biofuels and other measures necessary to implement Article 7a; this proposal is now being considered by Member States and while the comitology process is underway, the exact implementing measures remain uncertain.

40 In practice, it is anticipated that a large majority of the GHG savings will be delivered through increased use of biofuels. Use of biofuels is currently mandated in the UK through the RTFO. Implementing the FQD will therefore require making changes to the RTFO or introducing parallel obligations, so that fuel suppliers are required to meet GHG intensity targets in a cost-effective manner.

41 Relative to the RTFO, the FQD applies to a wider section of the fuel supply covering non-road mobile machinery — which includes railway engines, inland waterway vessels when not at sea, construction machinery, as well as agricultural and forestry tractors, and recreational craft when not at sea — in addition to road transport fuel. In addition, the current RTFO is a volume based obligation requiring suppliers to supply a particular volume of biofuel irrespective of source or inherent GHG savings; in contrast the FQD specifically targets GHG savings.

42 The FQD also covers a wider range of potential GHG reduction pathways including electricity used in transport applications and changes to fossil fuel extraction/processing.

The Renewable Energy Directive

43 The Renewable Energy Directive (Directive 2009/28/EC, the “RED”) requires Member States to ensure that 10 % of the energy used in transport is from renewable sources in 2020, sets out an indicative trajectory, and requires the introduction of mandatory sustainability criteria for biofuels contributing to these targets.

44 It should be noted that the requirements of the RED and associated trajectory have not been explicitly and separately considered in relation to the baseline for the purposes of this impact assessment. This is because it is expected that for the UK to meet the requirements of both the RED and FQD, it is most cost effective to consider one trajectory only i.e. one that satisfies both Directives. In this case, as the FQD requirements are more stringent, meeting this would also satisfy the RED.

Implementing a GHG savings obligation

45 In the following analysis, the policy instrument used to deliver GHG savings required by the FQD is referred to as a “GHG saving obligation”. In practice this means placing a legal requirement on the relevant transport fuel suppliers to demonstrate that they have delivered GHG savings required by the target. As such, the method which suppliers use to decarbonise the fuel supply is left to their discretion allowing them flexibility to deliver GHG savings at least cost.

Potential impact of a GHG savings obligation on the market for biofuels

46 At present, the UK biofuels market is primarily driven by volume (or energy content) and not GHG savings. This is because the financial incentive currently in place (the RTFO) effectively provides a subsidy on a volume basis because fuel suppliers are able to pass the costs of meeting the obligation through to the pump price of fuel. Biofuels supplied to the UK, as reported to the RFA, currently deliver a very wide range of GHG savings, from a low of –35% to a high of +93% GHG savings relative to the displaced fossil fuel (see annex 16 for a breakdown of GHG savings reported to the RTFO administrator).

47 Moving from a volume obligation (the current RTFO) to a GHG saving obligation would be expected to have significant implications for the biofuel supply market. Given the expected increase in demand for fuels that are able to offer higher GHG savings relative to others, it is likely that the structure of biofuels market would change so that biofuels delivering high GHG savings would command higher prices than biofuels with low GHG savings (for a given supply). In effect, transport sector GHG savings would become commoditised. At present biofuels pricing is not driven significantly by GHG savings so there is no incentive for higher GHG savings to be achieved.

48 Implementation of the FQD and the RED in other EU Member States is expected to impact on the biofuels market across the EU. The introduction of GHG mandates in Europe (i.e. the planned introduction of a GHG mandate in Germany in 2015) is likely to mean that biofuel producers would have a strong incentive to optimise their products and processes to deliver higher GHG savings.

49 There are many potential pathways that can be used to deliver higher GHG savings biofuel. These include lowering the carbon intensity of the underlying feedstock, which can be achieved through increasing yields; switching feedstocks; and decreasing the use of

fertilisers. GHG savings can also be made through process improvements in biofuel production. Process improvements can take many forms. Some of the most significant savings can be made by increasing the energy efficiency of the production process or generating production energy from renewable sources. An example of how process improvements can be made is British Sugar's Wissington bioethanol refinery which uses a combined heat and power boiler to produce process heat. This process delivers an estimated 81% lifecycle GHG saving[4], which is significantly higher than the RED's 52% default value for lifecycle GHG savings for sugar beet bioethanol.

50 In general, a move to a GHG driven biofuels market is thought likely to benefit EU biofuel producers and farmers. This is because farming practices tend to be relatively more efficient and yields tend to be relatively higher.

Constraints on blending biofuels with petrol and diesel – "the Blend Wall"

51 At present, the vast majority of biofuel delivered under the RTFO is supplied in low concentrations as part of a biofuel/fossil fuel blend (i.e. the blend of fuel which is currently supplied at a typical garage forecourt). The amount of biofuel that can be blended in fossil petrol and diesel is currently limited by a combination of EU legislation and industry fuel standards. The current limit is 5% by volume for bioethanol[5] in petrol and 7 % by volume for biodiesel in diesel[6]; however, the bioethanol limits will be raised to 10 % by 2011[7]. These limits exist because current vehicles are not compatible with, or warranted for use with, higher percentages of biofuel than these levels. The effect of these limits results in a "blend wall", which is the point at which the vehicle fleet cannot take higher levels of biofuel without encountering warranty or performance issues. Only a very small proportion of overall biofuel supply is delivered to final fuel consumers as a "high blend", which is only suitable for a small subset of the vehicle fleet.

52 Under the current RTFO biofuel deployment trajectory (which rises to 5% by volume in 2013/14), it is not necessary for biofuel to be supplied in excess of the blend wall for the obligation to be met. However, the introduction of a significantly more demanding 6% GHG reduction target will be likely to require that biofuel is supplied in excess of the blend wall by 2020. It should also be noted that, in the absence of the FQD, biofuel in excess of the blend wall would be expected to be required to meet the RED 10% renewable energy in transport target in 2020 (see paragraph 37).

53 There is considerable uncertainty over how the FQD targets may be met in practice. Options include the introduction of high blend fuel streams, increased uptake of biomethane/electric vehicles, introduction of biofuel which can be blended at higher concentrations (e.g. biobutanol and partially renewable fuels such as co-processed Hydrogenated Vegetable Oil) and the development of 2nd generation "drop in" biofuels that are chemically identical to fossil fuels and therefore do not have any blending limits. Some of these options may require significant additional investment in new infrastructure and vehicle technology. Further analysis and research is required for these impacts to be robustly quantified. In the following cost-benefit analysis, in order to capture the potential scale of these costs, it is assumed that the blend wall has been overcome using a combination of E85 (85% ethanol, 15% petrol) cars and B100 HGVs (100% biodiesel).

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[4] Sugar beet GHG savings taken from the latest RFA carbon and sustainability reporting http://www.renewablefuelsagency.gov.uk/carbon-and-sustainability/rtfo-reports .

[5] Annex III of Directive 98/70/EC as amended by 2003/17/EC, and industry standard EN 228:2008

[6] Industry standard EN 590:2009

[7] Annex I of Directive 98/70/EC as amended by 2009/30/EC

54 In practice, under current market conditions, there are infrastructure barriers to the deployment of high blend fuel streams. These include the likely requirement for new fuel supply infrastructure, availability of vehicles capable of accepting high blends, the tax system, and the consumer incentive to purchase high blend biofuels when there are alternatives available.

SECTION 4 – Analytical Approach

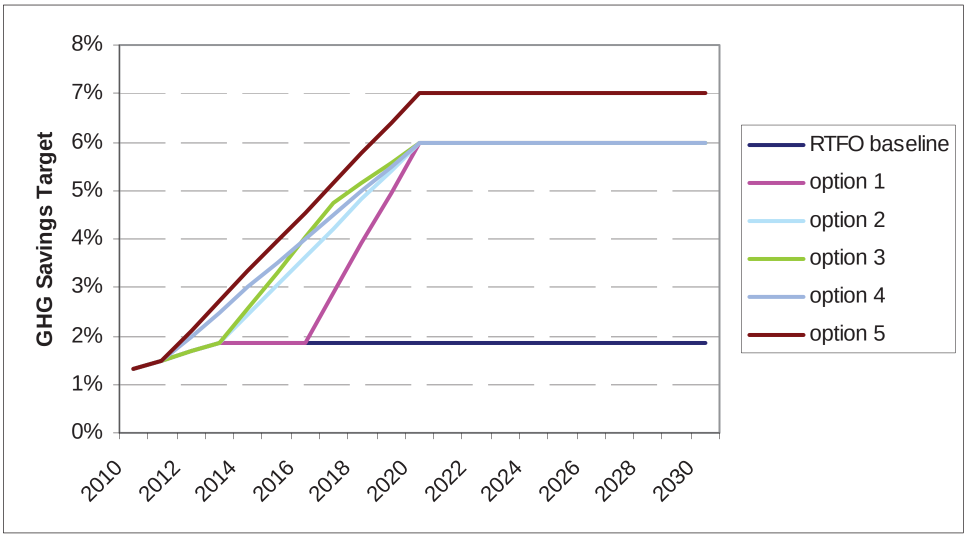
Options for setting GHG saving obligation targets and trajectories

55 The FQD requires that GHG savings are delivered "as gradually as possible". This may imply putting in place a trajectory of annual GHG savings targets leading up to 2020.

56 Given the significant uncertainty and evidence gaps surrounding the costs, benefits, feasibility and distributional impacts of delivering future GHG savings, relative to fossil fuels, a scenario based approach has been used on the basis of a range of potential trajectories. The scenarios presented should be regarded as illustrative and any numbers should be considered as part of a (necessarily wide) range, rather than point estimates. The analysis is intended only to provide a sense of the relative magnitude of expected effects and to present an assessment of the uncertainties, underlying assumptions and limitations of the analysis.

57 Figure 3 presents the range of annual target trajectory options that have been explored. These trajectories have been chosen to represent the range of potential options available for implementation of the FQD GHG savings target in the UK. Further discussion around the feasibility of the individual trajectories is included in Section 5.

Figure 3: GHG savings target trajectory options



58 **RTFO baseline:** The RTFO continues along its current trajectory delivering 5% biofuel by volume or estimated GHG savings of around 1.8% from 2013/14 onwards. The 2020 FQD 6% GHG savings target is therefore not met.

59 **Option 1:** The RTFO continues to 2017, at which point a GHG savings obligation is introduced which increases linearly with annual targets leading up to a 6% GHG savings target in 2020.

60 **Option 2:** The RTFO continues to 2014, at which point a GHG savings obligation is introduced which increases linearly with annual targets leading up to a 6% GHG savings target in 2020.

61 **Option 3:** The RTFO continues to 2014, at which point a GHG savings obligation is introduced which increases linearly (initially at a faster rate) with annual targets leading up to 4.8% in 2017 and then more slowly to 6% in 2020. **(stretching trajectory)**

62 **Option 4:** A GHG savings obligation is introduced in 2012 which increases linearly with annual targets leading up to a 6% GHG savings target in 2020.

63 **Option 5:** A GHG savings obligation is introduced in 2012 which increases linearly with annual targets leading up to a 7% GHG savings target in 2020. **(stretching target).**

Overview of analytical approach

64 Recognising the significant uncertainties around the implementation of the FQD, including the responses of fuel suppliers to any long term obligation, the costs of compliance and the trajectory illustrated to meet the 2020 6% obligation, the analytical approach used for modelling FQD target trajectory impacts is indicative but based on the best available evidence. Sensitivity tests have been taken forward to reflect the considerable uncertainties around several key assumptions, as will be explained.

65 The following analysis seeks to compare the costs and benefits of meeting a variety of FQD GHG saving trajectories under the options described above. In particular it will highlight the estimated GHG impacts, the administrative costs on suppliers and the potential impacts on fuel prices.

66 To estimate the costs, benefits and impacts of meeting the FQD obligation by 2020, it is important to make assumptions about:

i) The options for suppliers to meet the FQD targets and therefore the potential GHG savings from deploying biofuels as part of the transport fuel mix over the period to 2020;

ii) Estimated costs incurred by suppliers to meet FQD obligations; and

iii) The trajectory of GHG savings required in order to meet the 2020 FQD target.

67 The assessment relies on a model built specifically for this analysis, which draws on available evidence to explore how GHG savings could be achieved to meet the FQD 2020 obligations for each trajectory covered.

68 GHG abatement options included in the modelling reflect a combination of: uptake of 1st generation crop-derived biofuel; uptake of non-1st generation biofuel (i.e. biofuel derived from waste and advanced biofuels[8]); and, fossil fuel extraction/refining improvements. However, given the uncertainty over the cost and feasible potential for GHG savings from non-1st generation biofuel GHG saving options in the period to 2020, a simplifying assumption has been made when calculating costs. Petrol is assumed to be de-carbonised in line with the target trajectory using only crop-derived bioethanol and diesel is assumed to be de-carbonised in line with the target trajectory using only crop derived biodiesel. This is not to say that this is Government's preferred way in which the targets should be met, nor is it the case that all suppliers would only explore these options because lower cost alternatives may

8 Advanced biofuels also known as 2nd or 3rd Generation biofuels, are made from non-food feedstocks such as wood or algae.

be feasible, but it is an assumption made for the purposes of this analysis given available evidence.

Costs of delivering GHG savings required under the FQD

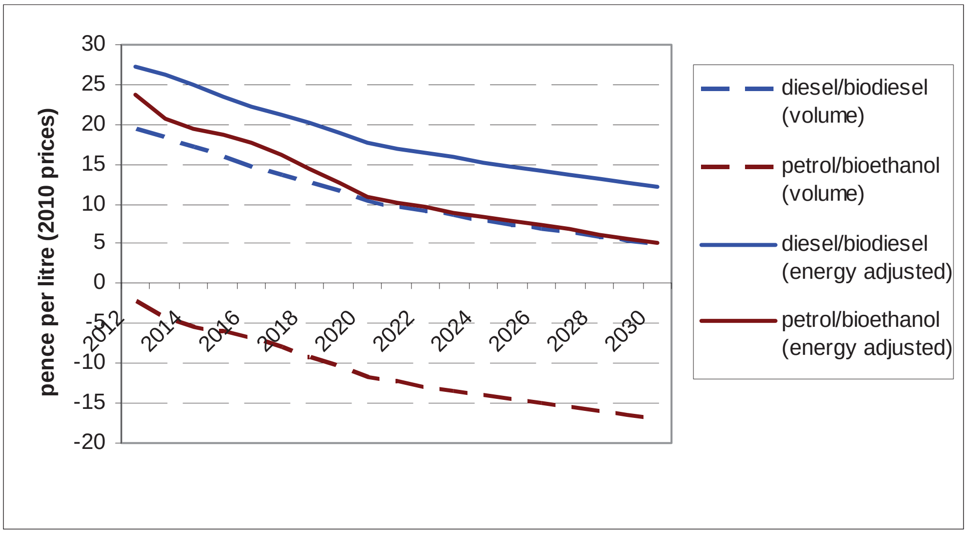
69 In the absence of a GHG savings obligation to 2020, transport fuel suppliers are assumed to maximise profits and minimise costs. The implementation of a GHG savings obligation is expected to impose additional costs on transport fuel suppliers relative to the status quo (i.e. the additional cost of supplying biofuel relative to fossil fuel, the additional cost of using electric vehicles relative to conventional vehicles and the additional cost of reducing GHG emissions from fossil fuel extraction/refining).

70 Given that biofuels are expected to be the only feasible option for delivering the majority of the GHG savings required to meet the 6% GHG savings target in 2020, the primary focus of this cost benefit analysis is to look at the additional cost associated with delivering GHG savings through the deployment of biofuel. This is not to say that other options are not possible, but it has not been possible to include them in the analysis at this stage given the lack of available evidence. Alternative options have therefore been addressed qualitatively.

The additional cost of supplying biofuel

71 In general, biofuel prices are higher than fossil fuel prices because, at present, the cost of producing biofuels is higher than the price of supplying the equivalent fossil fuel. The difference in cost between supplying biofuel and supplying fossil fuel is referred to as the “spread” between biofuel and fossil fuel prices. Using petrol and diesel price projections consistent with oil price projections produced by the Department of Energy and Climate Change (DECC) and crop price projections produced by the OECD FAO Aglink-Cosimo model (see Annex 14 for a description of the model) it is possible to estimate the cost differential between supplying fossil fuel and biofuel. The following charts show central estimates of the spread, both in volume terms and energy adjusted terms (energy density data can be found in Annex 11). When considering GHG savings the relevant measure is the energy adjusted spread because this allows the GHG savings to be compared with the fuel purchased by consumers to travel their given distances (i.e. we take the underlying projected baseline level of travel demand as a given); as such, the percentage GHG savings used in this analysis are presented on an energy adjusted basis.

Figure 4: Central estimates of spreads for biodiesel and bioethanol



Source: DfT analysis based on OECD Aglink-Cosimo biofuel price projections and DECC oil price projections

72 As can be seen from the Figure 4, in 2012 bioethanol is currently estimated to be slightly less expensive than petrol on a volume basis. However, as the energy density of bioethanol is only around two-thirds that of petrol, the energy adjusted spread between petrol and bioethanol prices is considerably higher, with bioethanol being more expensive than petrol on an energy-adjusted basis (shown by the solid line). As the price of petrol increases (driven by rising oil prices) and the price of bioethanol decreases over time (as crop prices are estimated to fall from their current highs). A similar pattern can be seen for biodiesel although the difference between volume and energy adjusted prices is smaller as biodiesel has a higher energy density. Over the period from 2012 to 2030 biodiesel is estimated to be more expensive than bioethanol on an energy adjusted basis. The full datasets used to calculate these spreads can be found in Annex 8.

73 The additional cost of supplying biofuel is highly sensitive to oil prices and crop prices. Holding biofuel prices constant, higher fossil fuel prices will decrease the spread between biofuel and fossil fuel prices. Lower oil prices will increase the spread making biofuels less cost effective. Holding oil prices constant, higher crop prices will increase the spread between biofuel and fossil fuel prices. Lower crop prices will decrease the spread making biofuels more cost effective. In reality, there is thought to be some correlation between oil prices and crop prices which dampens this effect. Uncertainties in the spread should be recognised, particularly given the timeframe for analysis is out to 2030. Therefore, sensitivity tests on oil prices and crop prices have been modelled in the following cost benefit analysis.

Abatement of GHGs through the supply of biofuel

74 When estimating the cost of implementing a GHG saving obligation, it is necessary to consider the £/tCO_2e abatement costs along with the additional cost associated with supplying a given volume of biofuel (though of course they are linked to some extent). As lifecycle GHG savings from biofuel vary widely and are contingent upon a number of factors, not least the options chosen by the supplier to meet their obligations. In turn, this leads to variations in feedstock type, region of origin, crop yields, fertiliser use, transport emissions and process energy used we need to project average GHG savings going forward which can be used to inform calculations of £/tCO_2e abatement costs.

75 Following the introduction of a GHG savings obligation, because of the impact on the demand and supply across different fuel sources, it is expected that pricing in the UK (and also within the EU when other Member States adopt the FQD) biofuels market will change to reflect GHG

savings. It is also expected that an explicit economic incentive to deliver GHG savings and competitive pressures will drive down the production costs associated with delivering GHG savings over time as the market matures, relative to levels seen in the current volume/energy driven market. In order to estimate the cost of delivering a GHG reduction target, it is necessary to make projections of likely abatement costs going forward in a GHG driven market, given the implicit assumptions about the action taken by suppliers to meet their obligations. Given uncertainty over the evolution of the biofuels market and potential for GHG reduction, alongside considerable uncertainty over future oil prices and feedstock prices, these abatement cost estimates should be interpreted as illustrative and as part of a necessarily wide range.

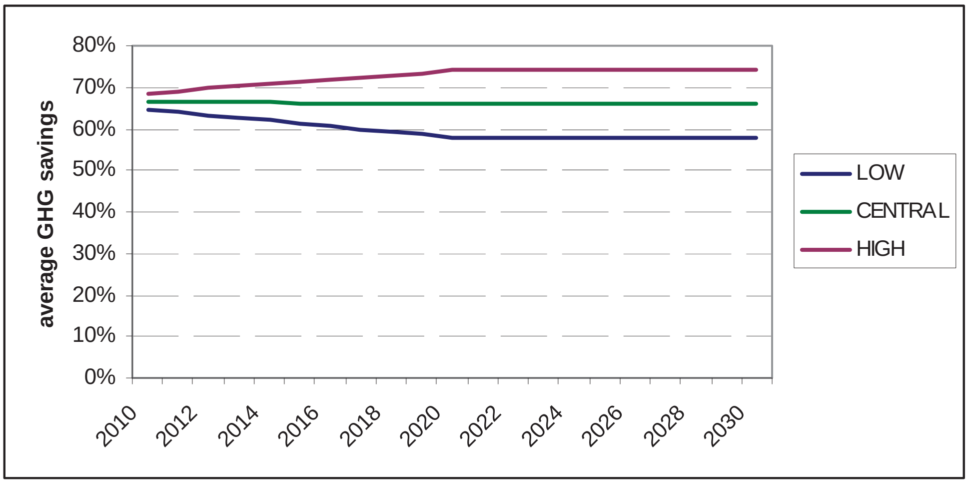
Bioethanol – average GHG savings trajectory and abatement costs

76 GHG savings from crop-derived bioethanol vary widely. Typical GHG savings values, taken from Annex V of the RED, show a range from 32% for wheat derived ethanol (which uses coal for process energy) to 71% for Brazilian sugar cane ethanol. Using the energy adjusted spread for bioethanol (i.e. reflecting the additional cost of supplying a unit of energy from bioethanol relative to petrol) we can estimate the implied abatement costs for carbon savings attributed to bioethanol across a range of differently sourced bioethanol and therefore different sources of GHG savings. Using the central values for bioethanol and petrol prices in 2012, the implied estimated abatement cost for bioethanol delivering 32% GHG savings is some £270/tCO_2e. For bioethanol delivering 71% GHG savings, the implied abatement cost is around £122/tCO_2e.

77 Looking forward, for the purposes of this analysis it is necessary to make estimates of average abatement costs that could be delivered under a GHG driven biofuels mandate by estimating an average GHG savings profile for bioethanol going forward over time, assuming a proportion of bioethanol is supplied to meet the FQD objectives.

78 Average GHG savings from bioethanol are projected to remain constant at around 66%/67% over the period from 2010 to 2030. These projected savings are based upon an assessment of current data and possible GHG saving options available from bioethanol production technologies and feedstocks. However, it is important to recognise that the projections are inherently uncertain and thus should be considered to be purely illustrative. In order to account for this uncertainty, a “low” and “high” sensitivity are also taken (for further details on the analysis behind the average GHG savings trajectories see annex 15). The "low" and "high" scenarios are illustrated to vary 10% either side of the central scenario; this sensitivity range reflects the expected focus on the market of those fuels offering greater GHG savings hence very low average GHG savings would not be considered likely. The high scenario exceeds the GHG savings of the highest GHG-saving bioethanol currently on the market, as referred to above.

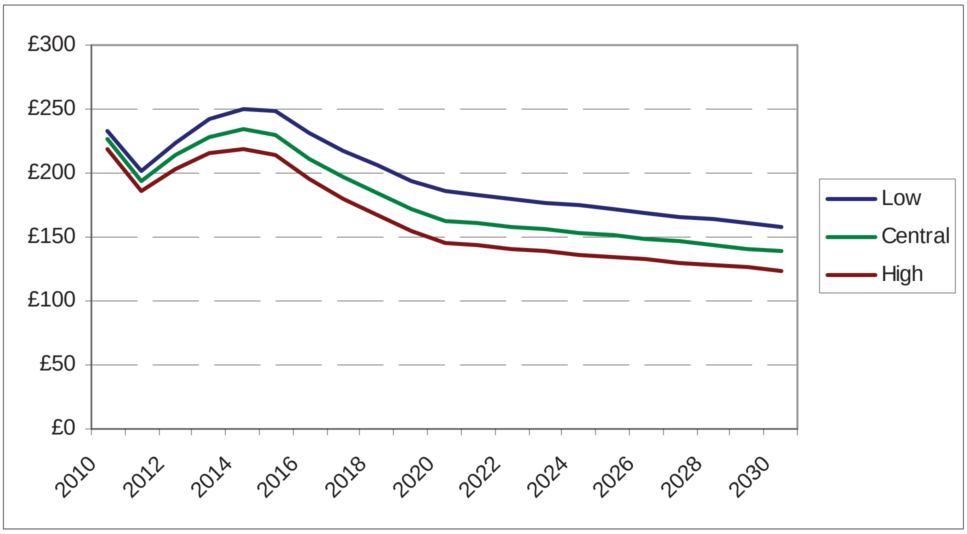
Figure 5: Average GHG savings projections for bioethanol (under a GHG savings obligation)



Source: DfT analysis

79 Across all three GHG savings scenarios abatement costs are projected to fall over time. This is due to a declining spread between projected bioethanol and petrol prices, as oil prices rise and bioethanol prices fall over time. Under the central GHG savings scenario for GHG savings abatement costs are estimated to fall from £130/tCO_2e to £28/tCO_2e over the period from 2012 to 2030.

Figure 6: Projected GHG abatement costs for bioethanol across average GHG savings scenarios



Source: DfT analysis based on OECD Aglink-Cosimo biofuel price projections, DECC oil price projections and average GHG savings projections.

80 The projected abatement costs (i.e. abating one tonne of CO2 e through the provision of biofuel to displace fossil fuel) are very sensitive to underlying assumptions, in particular the spread between petrol and bioethanol prices and average GHG saving assumptions. Sensitivity tests around oil prices, crop prices and average GHG saving assumptions have been undertaken in the following cost-benefit analysis.

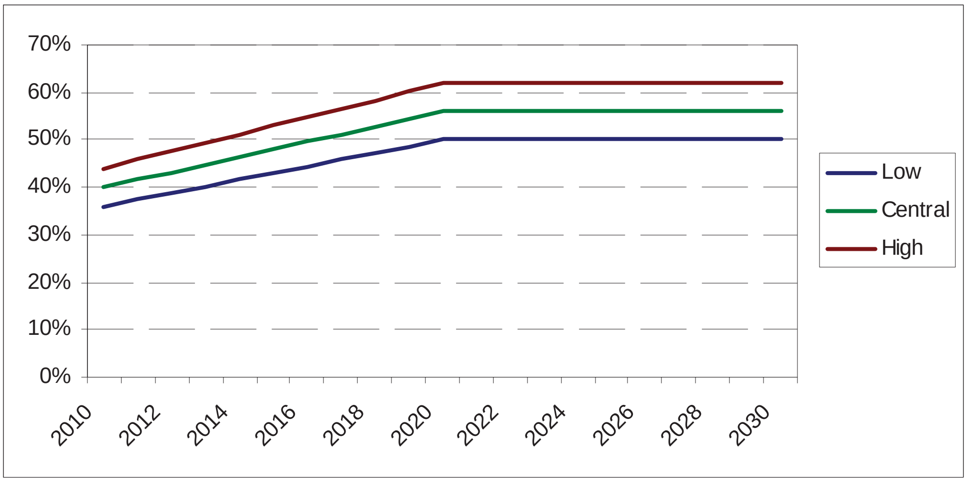
Biodiesel – average GHG savings trajectory and abatement costs

81 As with bioethanol, GHG savings from crop-derived biodiesel vary widely but to a lesser degree than bioethanol. Typical values presented in Annex V of the RED range from 36% for

palm oil (process unspecified) to 68% for HVO[9] palm oil with methane capture at the oil mill. Using the energy adjusted spread for biodiesel (i.e. the additional cost of supplying a unit of energy from biodiesel relative to fossil diesel) we can estimate the implied abatement costs for different forms of biofuel and therefore the different GHG savings. Using the central values for biodiesel and fossil diesel prices in 2012, the implied abatement cost for biodiesel delivering 36% GHG savings is £248/tCO_2e. For biodiesel delivering 68% GHG savings, the implied abatement cost is £131/tCO_2e.

82 Average GHG savings from biodiesel are projected to rise gradually from 40% to 56% over the period from 2010 to 2030 (incidentally, rising to 50% by 2017 under the central scenario, which would be consistent with the mandatory sustainability criteria proposed by the RED). Again, it is important to recognise that these projections are highly uncertain; therefore, a “low” and “high” sensitivity are also taken, again varying by 10% either side of the central case (for further details on the analysis behind the average GHG savings trajectories see annex 16). As with bioethanol, the range illustrated is intended to reflect the market being driven by GHG savings, hence the demand for lower GHG savings referred to in paragraph 72 is likely to fall.

Figure 7: Projected average GHG savings projections for biodiesel (under a GHG savings obligation)

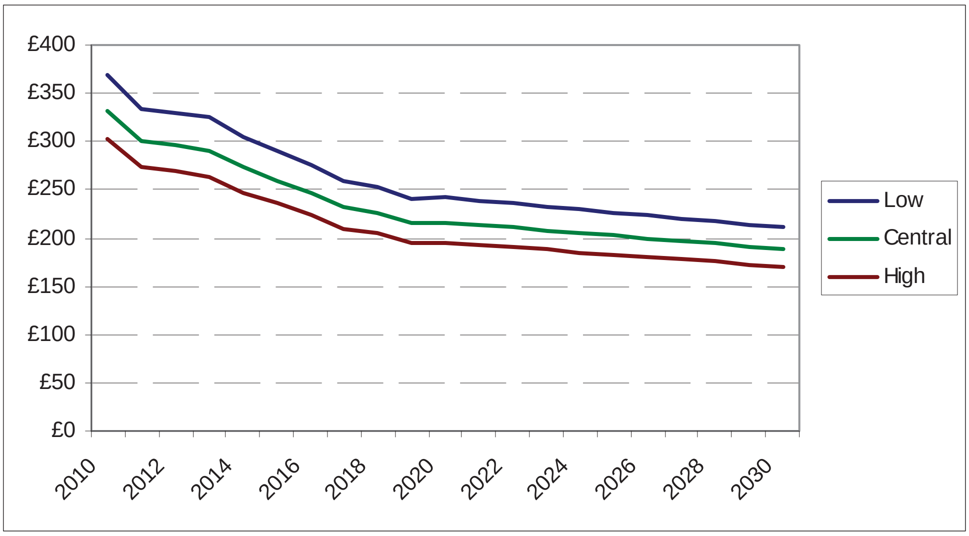


Source: DfT analysis

83 Across all three GHG savings scenarios abatement costs are projected to fall over time. This is due to a combination of rising average GHG savings and a declining spread between biodiesel and fossil diesel prices. Under the central GHG savings scenario abatement costs are illustrated to fall from £206/tCO_2e to £70/tCO_2e over the period from 2012 to 2030.

[9] Hydrogenated Vegetable Oil

Figure 8: Projected GHG abatement costs for biodiesel



Source: DfT analysis based on OECD Aglink-Cosimo biofuel price projections, DECC oil price projections and average GHG savings projections.

84 As is the case with our analysis concerning bioethanol, the projected abatement costs through the use of biodiesel are very sensitive to the underlying assumptions. Sensitivity tests around oil prices, crop prices and average GHG saving assumptions have been undertaken in the following cost-benefit analysis.

Additional costs associated with the supply of biofuel

85 Over and above the cost of purchasing biofuel, additional costs will also be incurred through investment required to upgrade the existing refining and distribution infrastructure to handle increased volumes of biofuel. The additional infrastructure cost required to deliver higher volumes of biofuel was estimated following consultation with industry as part of previous analysis looking at meeting the 10% renewable energy transport target required by the RED. As a similar volume of biofuel is likely to be required to meet the FQD GHG savings target the same figure has been used. It is estimated that the additional costs required to upgrade the UK refinery infrastructure for the industry is £315m in 2010 prices. This has been captured in the modelling as a one-off cost incurred in 2014.

Estimated abatement costs — other abatement options

86 Given the current levels of maturity (and immaturity) of the various biofuels technologies, crop-derived bioethanol and biodiesel are expected to provide the majority of effort required to deliver GHG savings required to meet the FQD GHG savings target in the period to 2020. However, there are other abatement options available to obligated suppliers including waste-derived biofuel such as tallow, used cooking oil and biomethane. GHG savings can also be delivered through the adoption of advanced biofuels, alternative fossil fuels with lower carbon intensities (e.g. fossil methane and LPG), electric vehicles and improvements to fossil fuel extraction/refining processes.

87 It has not been possible to robustly model the potential penetration of these alternative (non 1st generation biofuel) GHG saving options and costs over the period to 2030 owing to the lack of available evidence. At present, increased supply of waste-derived biofuel looks the

most likely to make an impact as it is currently supplied in significant quantities (see Annex 12) and delivers high GHG savings which would potentially be more attractive, and therefore stimulate a greater market, under a GHG obligation than at present.

88 Rather than model them separately, for the purposes of the Cost Benefit Analysis modelling, non crop-derived biofuel abatement options have been captured as a subset of the projected biodiesel supply. This is because obligated suppliers are assumed to substitute biodiesel for alternative GHG saving options. As the supply of alternative GHG saving options is constrained (i.e. they cannot be sourced in infinite quantities), it is assumed that suppliers' willingness to pay for these alternative options is determined by the cost of GHG savings from biodiesel (i.e. the price of tallow and used cooking oil could be driven up by suppliers who increase their demand for these higher GHG saving fuels in order to avoid the cost of delivering GHG savings through crop-derived biodiesel). This is a conservative assumption and the cost estimates should be thought of as representing an upper bound. In reality, obligated suppliers may be able to source alternative GHG savings at a lower cost than GHG savings from biodiesel.

'High Blend' Costs

89 FAME biodiesel and bioethanol (the two biofuel types explicitly modelled in this impact assessment) can be blended into the regular fuel supply (and used in all petrol and diesel vehicles) at low concentrations. A regulatory 'blend wall' limits the concentration at which biofuel can be blended into the regular ('protection grade') fuel stream as higher concentrations of biofuel can cause engine damage in certain vehicles.

90 For FAME biodiesel and bioethanol to be blended with diesel and petrol at higher concentrations (i.e. greater than the blend wall), modified vehicles and dedicated fuel streams are required. This (final stage) version of the impact assessment contains estimates of these additional 'high blend' vehicle capital (i.e. corrosion resistant seals and valves, improved engine management systems) and operating costs (i.e. increased servicing costs) which were not captured in previous versions of the impact assessment. The additional costs associated with the purchase of high-blend capable vehicles and the additional operating costs incurred from using these vehicles have been taken from the "Modes" research which has been carried out on behalf of the Department for Transport by AEA technology. These results are summarised in Annex 18. The analysis assumes that all high-blend biodiesel will be used in B100 (100% biodiesel) fuel streams and all high-blend ethanol is used in E85 (85% ethanol, 15% petrol). This is a simplifying assumption as there are a number of potential routes for supplying biofuel in excess of the "blend wall" and it is not clear which options suppliers would choose to implement in reality.

Administrative/Enforcement Costs

91 The additional administrative cost (over and above those already incurred under the RTFO) of complying with a GHG driven obligation (i.e. reporting requirements) is estimated to be between an additional £4,000 and £17,500 per year, per supplier. For the purposes of this impact assessment a central estimate of £10,750 has been taken. Taking the conservative assumption that all 53 firms registered under the current RTFO will bear these additional costs to the full extent[10], plus five additional NRMM and fossil fuel gas fuel suppliers who will need to open new accounts, will bear these additional costs to the full extent, the industry-wide increase in administrative burden is estimated at around £623,500 annually, starting

[10] In reality this is unlikely as some biofuel supply operations are significantly less complex than others. Administrative cost estimates were produced in conjunction with large obligated suppliers and therefore may be overestimates of potential costs faced by smaller operators.

from the point at which the GHG reporting obligation is introduced. Obviously, in practice there will be significant variations in the administrative costs faced by suppliers but for the purposes of this analysis, an illustrative average has been considered. No additional on-going government-funded administration/enforcement costs are expected (over and above what would have been incurred under the RTFO). Transitional administrative costs (i.e. changing systems from a volume to a GHG savings obligation) in the region of £50,000 to £200,000[11] have been estimated. The analysis of administrative costs assumes that the current minimum threshold (at which fuel suppliers become obligated under the RTFO) of 450,000 litres per annum remains in place.

Cost Pass-through

92 Given the (assumed) competitive nature of the fuel supply market, the additional costs of delivering GHG savings required by the FQD are assumed to be passed through 100% to the final consumer of the underlying transport fuel. This assumption has been made due to the highly competitive nature of the fuel supply market and the inherent substitutability of refined fuels from different producers (i.e. petrol from all refineries is identical). Therefore refinery operators cannot exert significant market power and are assumed to be unable to unilaterally influence the market price. The cost of de-carbonising petrol using bioethanol is modelled as being passed through to petrol prices and biodiesel costs are modelled as being passed through to diesel pump prices.

93 It is recognised that the degree of cost pass-through may vary, at least in the short term, across the industry depending on the particular fuel markets served and the nature of demand, and the particular market conditions such as the degree of competitiveness. Generally however, full cost pass-through would be expected in the longer term.

Unquantified Costs

94 Implementing a GHG saving obligation will create a number of additional costs that have not been quantified in the following analysis due to a lack of available evidence. These include:

- Increased demand for biofuel may lead to higher feedstock prices, which would be felt more widely across the economy (e.g. increased demand for wheat may lead to an increase in bread prices).
- There may be potential balance of payment/exchange rate impacts from the increased value of imports due to the imported biofuel being more expensive than imported fossil fuel. (This will depend on the level of domestic biofuel production and could potentially be a benefit).
- Potential costs of modifications to vehicles and machinery required to cope with higher volumes of biofuel being blended into the fuel supply.
- The wider GDP impacts associated with any rises in transport costs resulting from the supply of biofuels.

[11] Estimate provided by the RTFO administrator.

Benefits of delivering GHG savings required under the FQD

GHG Savings

95 The primary benefit of implementing a GHG saving obligation for transport fuel is the avoided GHG emissions. Total GHG emissions from transport fuel have been estimated using Department of Energy and Climate Change estimates of transport sector energy demand, internal analysis of NRMM energy demand and lifecycle GHG emissions for petrol and diesel. These projections suggest that lifecycle GHG emissions from transport fuel could be around 144 $MTCO_2e$ in 2020 (in the absence of RTFO/FQD decarbonisation measures). These estimates and underlying data can be found in annex 11. DECC projections have been used in order to be consistent with projections of petrol and diesel use made by DECC in wider climate change policy analysis[12].

96 GHG savings target values (expressed in CO_2e terms) are calculated by multiplying total lifecycle (including production emissions) carbon emissions by the obligation level in any given year. For example, a 6% GHG savings obligation in 2020 would deliver savings equivalent to 6% × total transport emissions ($MTCO_2e$) in 2020, which is 0.06 × 144 = 8.7 $MTCO_2e$.

97 Lifecycle GHG savings have been monetised using DECC's carbon saving values for the traded and non-traded sectors. GHG savings/emissions have been split into various sectors, including UK traded sector, UK non-traded sector, EU and rest of the world. A more detailed description of the carbon accounting methodology used is outlined in Annex 15.

Ancillary Benefits

98 Other benefits attributed to delivering GHG savings required by the FQD include reduced congestion, reduced accidents, reduced noise pollution and improved air quality. These result from a reduced level of road transport mileage that would be expected as a consequence of higher pump prices resulting from the additional cost of delivering GHG savings required under the FQD. Improvements in air quality are also estimated to result from a reduction in demand for transport fuel.

99 The elasticity used to calculate the change in transport fuel demand and conversion factors for converting reduced mileage to monetised benefits can be found in Annex 9.

GDP benefits of UK biofuel industry

100 Increasing the UK biofuel supply through implementation of FQD GHG saving targets may lead to growth in the UK biofuel production industry. Increased UK biofuel production may bring a number of economic benefits. Displacement of imported oil or biofuel with domestically produced biofuel is likely to improve the balance of trade and national output.

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[12] Although the DECC projections of energy demand are based on the assumption that the Renewable Energy Directive targets for biofuel are met, because we are using only the overall energy demand and not fuel volumes, any potential risk of double counting in this context is minimal.

Increased UK biofuel production will also create additional UK jobs in the biofuel industry. Increased demand for biofuel feedstocks may increase agricultural production with employment and GDP benefits. It has not been possible to quantify these impacts in a robust manner.

Other (unquantified) Benefits

101 Implementing a GHG saving obligation will create a number of additional benefits which have not been quantified in the following analysis. These include:

- Potential improved profitability for UK biofuel producers and farmers
- Potential exchequer impacts from a potential increase in fuel duty revenue (due to an increase in the volume of road transport fuel supplied, but this may be at least partially off-set by any fiscal incentives provided to incentivise renewable fuels)
- Innovation benefits from the incentive to provide renewable fuels in order to meet the GHG obligation
- Wider economic benefits resulting from any increase in the UK biofuel-related agricultural markets

Assumptions, uncertainty and evidence gaps

102 Underpinning the analysis are several assumptions which are inherently uncertain. There are also a number of significant evidence gaps. The following describes the key assumptions and uncertainties.

Emissions from Indirect Land Use Change (ILUC)

103 CO_2e savings are based on direct emissions (i.e. agricultural and refining emissions) and do not include the potential effects of indirect land use change (ILUC). In absence of mitigating measures, CO_2e emissions attributable to ILUC could potentially be very significant for some biofuel feedstocks and could reduce the estimated GHG benefits delivered by biofuels policy. However, work is on-going at the EU level to assess the effects of ILUC and to consider whether these effects should be accounted for under the RED and FQD.

Fossil fuel and biofuel price projections

104 Fossil fuel and biofuel projections are fundamental to estimating the future costs of biofuel support policy. However, these are inherently uncertain. The projections used for this analysis (including sensitivities) can be found in Annex 8.

Bioethanol/biodiesel split

105 The modelling implicitly assumes that both the diesel and petrol supply are decarbonised (symmetrically) by the level of the FQD target using biodiesel and bioethanol respectively. In reality, more biodiesel may be supplied than bioethanol (or vice versa). GHG savings from other sources may also have a role to play.

Dieselisation of fossil fuel demand

106 Assumptions have been made around the trend towards dieselisation of the UK vehicle fleet and are implicit in the transport energy demand projections which underpin the modelling. These projections can be found in Annex 9.

Maximum rate of deployment/barriers to deployment

107 The following cost benefit analysis implicitly assumes that transport fuel suppliers will be able to meet a given GHG savings target in a given year. In reality there will be barriers to deployment which may prevent targets from being achieved (e.g. infrastructure, consumer demand). These have not been specifically modelled.

Potential for non-biofuel GHG savings

108 Currently, there is limited knowledge concerning the potential for GHG savings from non-biofuel options (e.g. electric vehicle, fuel switching, refining/extraction improvements).More detail on alternative GHG saving options can be found in annex 12.

SECTION 5 - Cost Benefit Analysis (options 1 to 5)

Summary

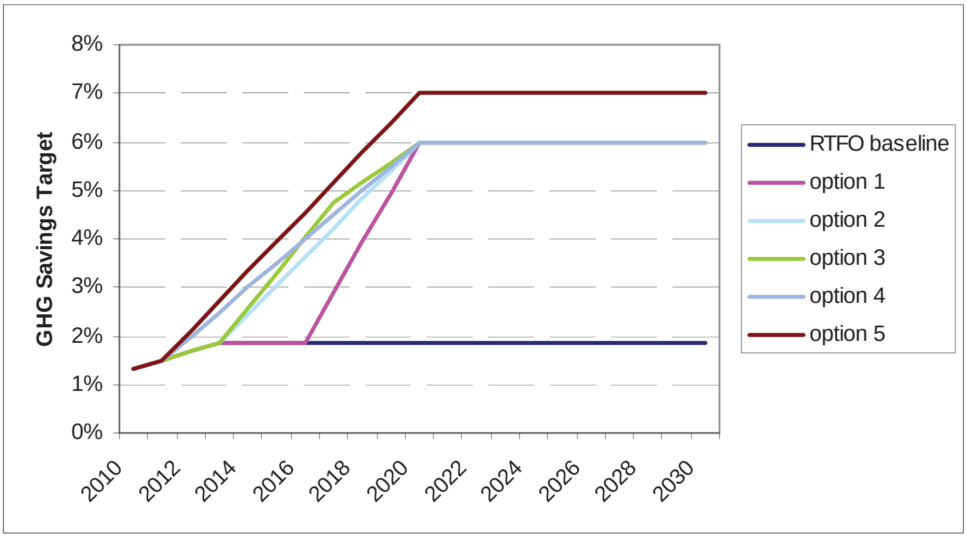
109 All monetised costs and benefits are presented in 2010 prices. Future costs and benefits have been discounted into 2010 terms using the government standard Treasury "Green Book" discounting methodology.

110 All costs and benefits presented for FQD options are estimated as additional to those projected under the current Renewable Transport Fuel Obligation (RTFO) baseline (i.e. the costs and benefits of delivering FQD GHG savings target are presented net of costs and benefits which would have occurred under the current RTFO trajectory).

Options analysis

111 The following chart shows the GHG savings trajectories presented in the following cost benefit analysis. This selection of trajectories has been chosen to represent the range of possible target trajectories which could be used to deliver the GHG savings required under the FQD.

Figure 9: GHG savings target trajectory options



Monetised Costs and Benefits

112 The following table sets out quantified costs and benefits associated with the various trajectory options under central assumptions.

Figure 10: Projected costs and benefits of FQD trajectory options

Cost Benefit summary		option 1	option 2	option 3	option 4	option 5
additional compliance cost to 2030 (£m)	£m	-3,510	-4,384	-4,723	-4,933	-6,181
additional administrative costs to 2030 (£m)	£m	-5	-6	-6	-7	-7
high-blend vehicle costs to 2030 (£m)	£m	-2,251	-2,394	-2,614	-2,468	-4,634
additional infrastructure costs (£m)	£m	-285	-285	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	3,766	4,368	4,577	4,703	5,771
ancillary benefits to 2030 (£m)	£m	1,013	1,178	1,251	1,271	1,614
NPV to 2030 (£m)	£m	-1,272	-1,523	-1,801	-1,719	-3,722

113 As can be seen from the "net benefit" row of the table, de-carbonising the transport fuel supply is estimated to be a net cost measure (i.e. it delivers a negative overall benefit to society). That is to say, the monetised costs outweigh the monetised benefits. Option 5, which delivers the most additional GHG savings to 2030, is estimated to create the lowest net benefit to society. Option 1, which delivers least additional GHG savings, is estimated to create the highest net benefit.

114 Compliance costs (i.e. the costs of supplying the GHG savings needed to meet the obligation) are higher for trajectories which deliver greater volumes of carbon savings over the period to 2030 because more effort is required by the supplier. Benefits also increase with the obligation level as the GHG savings increase. Monetised GHG savings increase as a higher obligation level requires more GHG savings. Ancillary benefits (e.g. reduced congestion and accidents, improved air quality etc) which result from lower levels of driving – a consequence of higher fuel prices – also rise in tandem with the obligation level. However, the absolute increase in compliance costs is greater than the absolute increase in benefits which means that the overall net benefit decreases as carbon savings increase. In general, more stretching trajectories have higher net costs.

115 As biofuel abatement costs are projected to fall over time, trajectories which are more heavily weighted towards the future are less expensive relative to trajectories which are weighted towards the present. Option 1 which delivers the least GHG savings and is most weighted towards the future (i.e a trajectory of GHG reduction targets kicks in from 2017 onwards) is the least cost option. Option 4 which delivers the most GHG savings (of the trajectories which peak at a 6% GHG savings target) and is weighted towards the present (i.e. a trajectory of GHG reduction targets begins in 2011) is the most expensive option. This effect is also due to the fact that future costs and benefits are more highly discounted than costs and benefits closer to the present. However, there is significant risk that, due to the steep incline of the target trajectory, option 1 may not be deliverable in practice, given the considerable barriers associated with increasing biofuel supply beyond the blend wall, particularly in the near-term.

GHG Savings

Figure 11: Projected GHG savings and carbon cost-effectiveness of FQD trajectory options

Life-cycle GHG savings		option 1	option 2	option 3	option 4	option 5
additional CO2 savings in 2020 (MTCO2)	MTCO2e	6.5	6.5	6.5	6.5	7.9
additional CO2 savings to 2030 (MTCO2)	MTCO2e	79.2	89.1	92.6	94.1	115.4
£/tCO2 (to 2030)	£/tCO2e	11.9	13.2	15.4	14.5	26.5

116 Figure 11 shows that options 1,2,3 and 4 which all have a 6% GHG savings target in 2020 are estimated to deliver 6.5 megatonnes CO_2e GHG savings over and above what would otherwise have been delivered in an RTFO baseline in 2020. Option 5, which has a 7% 2020 GHG savings target, is estimated to deliver and additional 7.9 megatonnes CO_2e GHG savings in 2020.

117 Trajectory options with higher average target levels (i.e. options with more gradual trajectories which start earlier in the lead up to the 2020 target or, in the case of option 5, have a higher 2020 target) deliver higher total volumes of GHG savings over the period to 2030. Option 1 which has a steep trajectory starting in 2017 delivers the lowest volume of overall GHG savings. Option 5 which starts in 2011 and has a 7% 2020 GHG savings target delivers the largest volume of overall GHG savings. The £/tCO_2e metric (which is presented net of monetised benefits) are negatively correlated with delivery of higher overall GHG savings and the extent to which the trajectory of targets is front loaded.

Pump price Impacts

118 The additional impact of the FQD on pump prices has been estimated and presented for the year 2020, which is when compliance costs are projected to peak. Pump price impacts have been presented in 3 different forms:

1) Pence per litre (ppl) impacts which show how the cost of a litre of road transport fuel (at the retail point of purchase) is estimated to change in 2020. This figure implicitly assumes that biofuel can be blended with fossil fuel at concentrations required to meet the target. This may be unrepresentative of reality due to the blend wall (see paragraphs 48 to 51).
2) Energy cost (p/GJ) impacts which show the additional cost of supplying transport fuel (in energy terms) net of tax (i.e. increased VAT and fuel duty) impacts.
3) Driving cost impacts (% increase) which show the increase in cost of supplying transport fuel (in energy terms) inclusive of tax.

119 **When considering overall costs to society, the "energy cost" is the key metric as it captures the additional cost (excluding monetised benefits) to society of meeting its energy needs under the FQD.** The **"**pump price" metric is distorted by changes in the energy density of fuel and the "consumer cost" metric is distorted by tax transfers from consumers to government.

Figure 12: Projected pump price impacts of FQD trajectory options

2020 PUMP PRICE IMPACTS						
Petrol		option 1	option 2	option 3	option 4	option 5
pump price	ppl	-0.5	-0.5	-0.5	-0.5	-0.2
	%	-0.8%	-0.8%	-0.8%	-0.8%	-0.6%
energy cost	£/GJ	£0.40	£0.40	£0.40	£0.40	£0.59
	%	2.4%	2.4%	2.4%	2.4%	3.6%
consumer cost	£/GJ	£1.24	£1.24	£1.24	£1.24	£1.68
	%	2.8%	2.8%	2.8%	2.8%	3.8%
road diesel						
pump price	ppl	1.7	1.7	1.7	1.7	2.6
	%	1.1%	1.1%	1.1%	1.1%	1.7%
energy cost	£/GJ	£0.54	£0.54	£0.54	£0.54	£0.78
	%	3.3%	3.3%	3.3%	3.3%	4.7%
consumer cost	£/GJ	0.80	0.80	0.80	0.80	1.12
	%	1.9%	1.9%	1.9%	1.9%	2.7%
NRMM diesel						
pump price	Ppl	2.3	2.3	2.3	2.3	3.2
	%	2.6%	2.6%	2.6%	2.6%	3.6%

energy cost	£/GJ	£0.71	£0.71	£0.71	£0.71	£0.95
	%	4.4%	4.4%	4.4%	4.4%	5.8%
consumer cost	£/GJ	£0.92	£0.92	£0.92	£0.92	£1.22
	%	3.9%	3.9%	3.9%	3.9%	5.1%

Petrol

120 The estimated 2020 pump price impact of blending bioethanol into petrol is negative (-0.5ppl [0.8% less than the baseline pump price] for a 6% target), as bioethanol is not much more expensive than petrol on a volume basis. However, as bioethanol is significantly less energy dense there are significant costs associated with buying additional volumes of fuel required to bridge this energy gap. This is reflected in the increase in energy costs (£0.40/GJ [4.3%]) which are significantly higher. The consumer costs are higher again (£1.24/GJ [3.5%]), as an increase in volume of fuel demanded means that more duty (which is levied on a per litre basis) is paid.

Road diesel

121 Road diesel pump price impacts are higher than petrol (1.7ppl [1.1% additional cost above baseline pump price] for a 6% target). This is because biodiesel is more expensive than bioethanol on a volume basis. Road diesel energy costs are also higher than petrol (£0.54/GJ [3.3%]) because GHG savings from biodiesel are estimated to be more expensive than GHG savings from bioethanol. Consumer cost impacts for road diesel (£0.80/GJ [1.9%]) are lower than for petrol because biodiesel is more energy dense than bioethanol. This means that a lower additional volume of fuel need to be supplied (to offset the lower energy density of biofuel) incurring less additional taxation.

NRMM diesel

122 Although the absolute cost of delivering GHG savings for NRMM diesel is identical to that of road diesel, the additional cost (relative to an RTFO baseline) is higher as NRMM fuel is not currently obligated under the RTFO. NRMM diesel pump price impacts are estimated to be 2.3ppl (2.6%) for a 6% target. Energy cost impacts are £0.71/GJ (4.4%). Consumer cost impacts are £0.92 (3.2%). The percentage increase in consumer costs is significantly higher than for road diesel due to the fact that duty is levied on NRMM fuel at a lower rate and a given increase in input costs will result in a higher proportional impact on the final price paid by consumers.

Carbon Accounting

Figure 13: Change in sectoral GHG emissions (carbon accounting)

Carbon Accounting		option 1	option 2	option 3	option 4	option 5
Change in traded valued emissions	MTCO2e	-13.6	-15.6	-16.3	-16.5	-20.2
Change in non-traded valued emissions	MTCO2e	101.8	115.3	120.0	122.4	150.2

123 When calculating the monetised value of GHG savings, lifecycle GHG emissions savings related to biofuels production are allocated into traded and non-traded sectors and valued using the relevant carbon price (for more details on the GHG accounting methodology see annex 15).

Feasibility

124 In general, a steeper trajectory will make a given option harder to achieve. There is some risk that, due to the steep incline of the target trajectory, option 1 may not be achievable in practice. This is due to the considerable barriers associated with increasing biofuel supply beyond the blend wall (i.e. consumer uptake of E85 vehicles and roll-out of a new fuel stream), particularly in the near-term. Option 1 is estimated to require an average of around 416,000 E85 (high-blend ethanol) cars to enter the fleet between 2019 and 2020. Given that over 2 million new cars enter the fleet each year this is technically possible but would require a great deal of effort from industry to deliver. The estimated average annual number of E85 vehicles required under the preferred approach (approach C which leaves open options 1 to 3) varies from 208,000 to 416,000 E85 vehicles per annum which is thought to be feasible (particularly at the lower end of the range) given overall fleet turnover.

Policy Stability (sustainability) Risk

125 Putting in place a GHG savings trajectory prior to resolving sustainability issues (in particular Indirect Land Use Change) runs a significant risk of incentivising investment in unsustainable technologies which could potentially be rendered unviable by future policy aimed at addressing sustainability issues. Such a change in policy direction risks creating private sector losses (a modern large-scale biorefinery can cost up to £250m. Meeting FQD targets would be likely to require construction of many such facilities). Investors may also have recourse to legal action which could transfer losses onto the public sector. At present, negotiations amongst EU member states (aimed at identifying policy options to address indirect land use change) are underway and are expected to be concluded in 2012.

126 Committing to one trajectory before the direction of future policy around sustainability is clearer has significant risks, hence option 6 (delaying setting a trajectory) is explored.

Sensitivity Analysis: exploring the impacts of alternative assumptions

127 This section explores the effect of flexing three modelling assumptions on cost-benefit and pump price impact projections. Theses are: oil prices, crop prices and average GHG savings assumptions. Low crop prices and high oil prices reduce the cost of delivering the policy as the additional cost of supplying biofuel falls under either of these scenarios. High crop prices and low oil prices have the opposite effect (i.e. incentivising biofuel supply becomes more expensive). Higher average GHG savings reduce the cost of delivering the policy as a lower overall volume of biofuel will be required to meet the GHG saving target.

128 High and low overall cost scenarios have also been modelled to give a range of cost and benefits around central estimates (see figures 24 to 30).

Oil Price Scenarios

129 Central, high and low oil price scenarios are set out in annex 8.

Figure 14: Projected costs and benefits of FQD trajectory options under oil price sensitivities

Cost Benefit summary		low	central	High
additional compliance cost to 2030 (£m)	£m	-8,651	-4,384	-1,738
additional administrative costs to 2030 (£m)	£m	-6	-6	-6
high-blend vehicle costs to 2030 (£m)	£m	-2701	-2394	-2223
additional infrastructure costs (£m)	£m	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	4,474	4,368	4,309
ancillary benefits to 2030 (£m)	£m	2,509	1,526	1,045
NPV to 2030 (£m)	£m	-4,660	-1,175	1,102

130 Figure 14 shows cost-benefit analysis results for option 2 (which is taken as an illustrative central option scenario) across a range of oil price scenarios. In general, a lower oil price implies higher costs of delivering GHG savings through biofuels. This is because the spread (difference) between the cost of supplying biofuel and the cost of supplying fossil fuel is estimated to be greater under a low oil price. GHG savings are slightly lower in the high oil price scenario as a higher oil price decreases overall demand for fuel (and therefore also the GHG savings implied by a 6% GHG reduction target). Ancillary benefits fall as the oil price rises because the decrease in fuel demand (which creates indirect benefits such as reduced congestion and accidents) attributed to the additional cost of supplying biofuel falls as the oil price rises (i.e. the more expensive oil is, the lower is the difference in cost between biofuels and fossil fuels, hence there is a lower fuel price effect causing changes to behaviour). Costs to fuel suppliers – the 'additional cost of compliance' – range from £1,738m (high oil price) to £8,651m (low oil price) over the period to 2030. Overall, the net benefit increases as the oil price rises from -£4.7bn (i.e. a net cost to society) to £1.1bn (i.e. a net benefit to society) as the oil price scenario changes from "low" to "high".

Figure 15: Projected GHG savings and carbon cost-effectiveness of FQD trajectory options under oil price sensitivities

Life-cycle GHG savings		low	central	High
additional CO2 savings in 2020 (MTCO2)	MTCO2e	6.6	6.5	6.4
additional CO2 savings to 2030 (MTCO2)	MTCO2e	91.3	89.1	87.8
£/tCO2 (to 2030)	£/tCO2e	51.1	13.2	-12.5

131 The £/tCO_2e cost effectiveness metric is shown in figure 15 and falls as the oil price rises (i.e. the net cost to society is lower when oil is more expensive) due to the fall in the spread between biofuel prices and fossil fuel prices and therefore overall compliance costs.

Figure 16: Projected pump price impacts of FQD trajectory options under oil price sensitivities

2020 PUMP PRICE IMPACTS				
petrol		low	central	high
pump price	ppl	0.7	-0.5	-1.2
	%	0.5%	-0.8%	-1.5%
energy cost	£/GJ	£0.61	£0.40	£0.27
	%	4.6%	2.4%	1.5%
consumer cost	£/GJ	£1.49	£1.24	£1.09
	%	3.7%	2.8%	2.4%
road diesel				
pump price	ppl	2.8	1.7	1.1
	%	2.1%	1.1%	0.7%
energy cost	£/GJ	£0.77	£0.54	£0.41
	%	5.8%	3.3%	2.3%
consumer cost	£/GJ	1.06	0.80	0.64
	%	2.8%	1.9%	1.5%
NRMM diesel				
pump price	ppl	4.1	2.3	1.2

	%	5.6%	2.6%	1.3%
energy cost	£/GJ	£1.09	£0.71	£0.49
	%	8.5%	4.4%	2.7%
consumer cost	£/GJ	£1.38	£0.92	£0.66
	%	6.9%	3.9%	2.5%

132 Figure 16 shows that pump price impacts fall as the oil price rises due to the fall in the spread between biofuel prices and fossil fuel prices and therefore overall compliance costs.

Crop Price Scenarios

Figure 17: Projected costs and benefits of FQD trajectory options under crop price sensitivities

Cost Benefit summary		low	central	high
additional compliance cost to 2030 (£m)	£m	733	-4,384	-10,138
additional administrative costs to 2030 (£m)	£m	-6	-6	-6
high-blend vehicle costs to 2030 (£m)	£m	-2394	-2394	-2394
additional infrastructure costs (£m)	£m	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	4,368	4,368	4,368
ancillary benefits to 2030 (£m)	£m	842	1,526	2,293
NPV to 2030 (£m)	£m	3,257	-1,175	-6,162

133 Figure 17 shows cost-benefit analysis results for option 2 (which is taken as an illustrative central option scenario) across a range of crop price scenarios (see annex 8 for the related biofuel prices). In general, higher crop prices imply higher costs of delivering GHG savings through biofuels. This is because the spread (difference) between the costs of supplying biofuel instead of fossil fuel is estimated to be greater under a high crop price scenario. GHG saving benefits remain constant across scenarios as carbon prices and GHG savings targets do not vary with the oil price. Over the period to 2030, costs to fuel suppliers – the 'additional cost of compliance' – range from -£733m (i.e. a cost saving) in the low crop price scenario to £10,138m in the high crop price scenario. Overall, the net benefit falls as the oil price rises from £3.2bn (i.e. a net benefit to society) to -£6.2bn as the oil price scenario changes from "low" to "high".

Figure 18: Projected GHG savings and carbon cost-effectiveness of FQD trajectory options under oil price sensitivities

Life-cycle GHG savings		low	central	high
additional CO2 savings in 2020 (MTCO2)	MTCO2e	6.5	6.5	6.5
additional CO2 savings to 2030 (MTCO2)	MTCO2e	89.1	89.1	89.1
£/tCO2 (to 2030)	£/tCO2e	-36.6	13.2	69.2

134 Additional GHG savings across the scenarios are constant across the crop price scenarios as crop prices are assumed to be independent of biofuel GHG savings. Increasing crop prices also increases the £/tCO2 estimates associated with the policy (i.e. cost-effectiveness deteriorates as crop prices rise).

Figure 19: Projected pump price impacts of FQD trajectory options under oil price sensitivities

2020 PUMP PRICE IMPACTS				
petrol		low	central	high
pump price	ppl	-1.4	-0.5	0.8
	%	-1.9%	-0.8%	0.6%
energy cost	£/GJ	£0.13	£0.40	£0.74
	%	0.8%	2.4%	4.5%
consumer cost	£/GJ	£0.93	£1.24	£1.65
	%	2.1%	2.8%	3.7%
road diesel				
pump price	ppl	0.2	1.7	3.3
	%	0.1%	1.1%	2.2%
energy cost	£/GJ	£0.19	£0.54	£0.92
	%	1.2%	3.3%	5.5%
consumer cost	£/GJ	0.37	0.80	1.25

	%	0.9%	1.9%	3.0%
NRMM diesel				
pump price	ppl	-0.3	2.3	5.0
	%	-0.3%	2.6%	5.7%
energy cost	£/GJ	£0.12	£0.71	£1.34
	%	0.7%	4.4%	8.2%
consumer cost	£/GJ	£0.21	£0.92	£1.68
	%	0.9%	3.9%	7.0%

135 Figure 19 shows that pump price impacts increase as crop prices rise due to the increase in the spread between biofuel prices and fossil fuel prices and therefore overall compliance costs.

High and Low GHG savings assumptions

136 The following sensitivity analysis looks at the costs and benefits under three different "average GHG savings" scenarios (annex 15) i.e. the GHG saving per unit of biofuel supplied is altered. Under the "high" scenario suppliers are assumed to source biofuels delivering higher GHG savings than under the central scenario. Under the "low" scenario suppliers are assumed to source biofuels delivering lower GHG savings than under the central scenario.

Figure 20: Projected costs and benefits of FQD trajectory options under average GHG savings sensitivities

Cost Benefit summary		low	central	high
additional compliance cost to 2030 (£m)	£m	-5,231	-4,384	-3,698
additional administrative costs to 2030 (£m)	£m	-6	-6	-6
high-blend vehicle costs to 2030 (£m)	£m	-2394	-2394	-2394
additional infrastructure costs (£m)	£m	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	4,711	4,368	4,059
ancillary benefits to 2030 (£m)	£m	1,770	1,526	1,329
NPV to 2030 (£m)	£m	-1,436	-1,175	-994

137 As figure 20 shows, assuming constant biofuel prices (by volume) across scenarios, abatement costs are higher under scenarios where average GHG savings are lower because more needs to be supplied for a given GHG saving. Therefore compliance costs are highest under the "low" average GHG savings scenario and lowest under the "high" scenario. Ancillary benefits, which result from higher fuel costs leading to lower transport energy demand, are directly influenced by compliance costs and fall as average GHG savings rise because the costs to suppliers are lower hence there is a lower pump price increase.

138 The overall net benefit to society decreases as average GHG savings fall (and costs rise). This pattern is reflected in policy carbon cost effectiveness (£/tCO_2e): biofuels are more cost effective (i.e. lower £/tCO2e) with higher average GHG savings[13], as shown in figure 22. Pump price impacts also follow this pattern due to lower compliance costs under scenarios with higher average GHG savings, this is shown in figure 23.

Figure 21: Projected GHG savings and carbon cost-effectiveness of FQD trajectory options under average GHG savings sensitivities

[13] This relation does not hold for the difference between £/ tCO_2e in the low and central scenario as baseline GHG savings in the "low" scenario fall significantly more relative to estimated GHG savings modelled for the "low" FQD scenario (see annex 15 for more detail).

Life-cycle GHG savings		low	central	high
additional CO2 savings in 2020 (MTCO2)	MTCO2e	6.5	6.5	6.5
additional CO2 savings to 2030 (MTCO2)	MTCO2e	89.1	89.1	89.1
£/tCO2 (to 2030)	£/tCO2e	16.1	13.2	11.2

Figure 22: Projected pump price impacts of FQD trajectory options under average GHG savings sensitivities

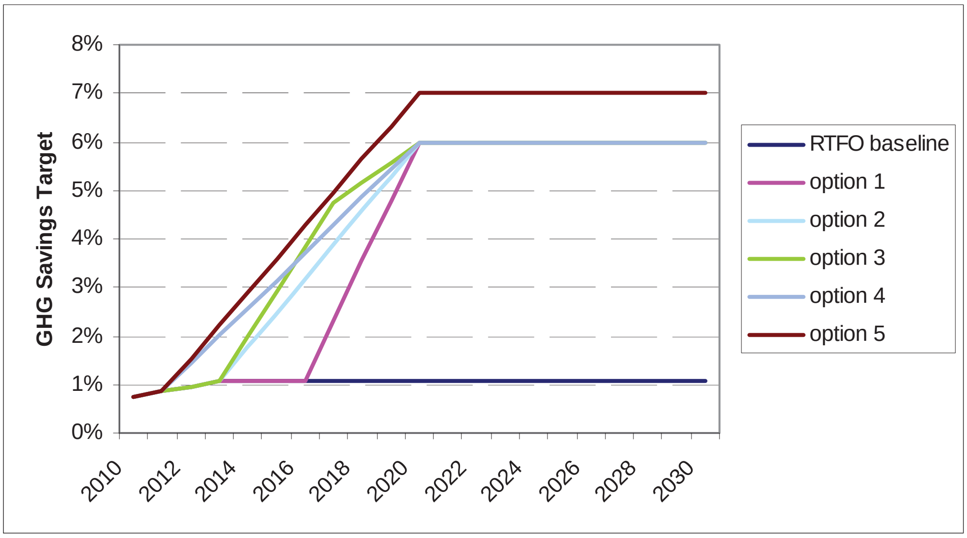
2020 PUMP PRICE IMPACTS				
petrol		low	central	high
pump price	ppl	-0.7	-0.5	-0.3
	%	-1.0%	-0.8%	-0.7%
energy cost	£/GJ	£0.44	£0.40	£0.36
	%	2.7%	2.4%	2.2%
consumer cost	£/GJ	£1.45	£1.24	£1.08
	%	3.3%	2.8%	2.5%
road diesel				
pump price	ppl	1.9	1.7	1.6
	%	1.3%	1.1%	1.0%
energy cost	£/GJ	£0.61	£0.54	£0.49
	%	3.7%	3.3%	3.0%
consumer cost	£/GJ	0.90	0.80	0.71
	%	2.2%	1.9%	1.7%
NRMM diesel				
pump price	ppl	2.5	2.3	2.2
	%	2.8%	2.6%	2.5%
energy cost	£/GJ	£0.78	£0.71	£0.66
	%	4.8%	4.4%	4.1%
consumer cost	£/GJ	£1.01	£0.92	£0.86
	%	4.2%	3.9%	3.6%

High and low overall cost assumptions

139 High and low overall cost scenarios have been developed to form the upper and lower cost bounds of the cost ranges presented in the impact assessment options summary sheets. The high overall cost scenario combines “low” oil price, “high” crop prices and “low” carbon price. The “low” overall cost scenario is composed of the assumptions reversed.

High overall cost scenario

Figure 23: FQD trajectories under high overall cost scenarios



140 Under the high overall cost scenario as shown in figure 24 average GHG savings in the (RTFO) baseline are lower. Therefore each of the trajectories requires more additional GHG savings to meet a 6% or 7% 2020 GHG savings target.

Figure 24: Costs and benefits under high overall cost scenario

Cost Benefit summary		option 1	option 2	option 3	option 4	option 5
additional compliance cost to 2030 (£m)	£m	-12,474	-14,537	-15,397	-15,747	-19,957
additional administrative costs to 2030 (£m)	£m	-5	-6	-6	-7	-7
high-blend vehicle costs to 2030 (£m)	£m	-2541	-2701	-2939	-2790	-5021
additional infrastructure costs (£m)	£m	-285	-285	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	3,864	4,474	4,686	4,811	5,904
ancillary benefits to 2030 (£m)	£m	3,072	3,452	3,586	3,593	4,825
NPV to 2030 (£m)	£m	-8,369	-9,603	-10,355	-10,424	-14,541

141 Under the high overall cost scenario, compliance costs are higher due to lower average GHG savings in the baseline (meaning more additional GHG savings will be required to meet a given GHG savings target). Lower assumed average GHG savings under the FQD mean that a greater volume of biofuel will be required to deliver GHG savings, further increasing costs. Monetised benefits from GHG savings (relative to the central cost scenario) are higher due to the larger overall volume of GHG savings required for a given option. Ancillary benefits (i.e. congestion, accidents, noise) are also higher due to increased pump price impacts leading to lower overall fuel demand. Costs to business and overall net benefit (to society) values are lower (i.e. more negative) under the high overall cost scenario than under the central cost scenario.

Figure 25: Lifecycle GHG savings under high overall cost scenario

Life-cycle GHG savings		option 1	option 2	option 3	option 4	option 5
additional CO2 savings in 2020 (MTCO2)	MTCO2e	6.6	6.6	6.6	6.6	8.1
additional CO2 savings to 2030 (MTCO2)	MTCO2e	81.3	91.3	94.8	96.4	118.2
£/tCO2 (to 2030)	£/tCO2e	103.0	105.2	109.2	108.2	123.0

142 Relative to the central scenario, figure 25 shows additional GHG savings under the high overall cost scenario are higher due to lower GHG savings in the baseline (resulting from assumed lower average RTFO GHG savings). The £/tCO_2e cost effectiveness metric is higher (i.e. more expensive per tonne of CO_2 saved) due to the lower overall net benefit (which is driven by higher compliance costs e.g. the cost of supplying GHG savings rises).

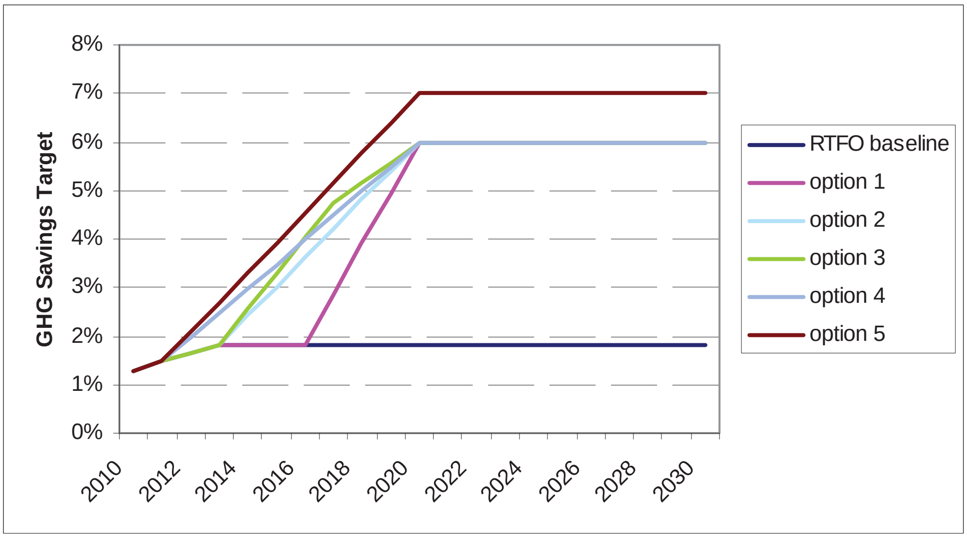
Figure 26: Pump price impacts under high overall cost scenario

2020 PUMP PRICE IMPACTS							
petrol		option 1	option 2	option 3	option 4	option 5
pump price	ppl	2.0	2.0	2.0	2.0	2.8
	%	2.0%	2.0%	2.0%	2.0%	2.7%
energy cost	£/GJ	£0.95	£0.95	£0.95	£0.95	£1.28
	%	7.1%	7.1%	7.1%	7.1%	9.6%
consumer cost	£/GJ	£1.90	£1.90	£1.90	£1.90	£2.50
	%	4.7%	4.7%	4.7%	4.7%	6.2%
road diesel						
pump price	ppl	4.4	4.4	4.4	4.4	6.0
	%	3.2%	3.2%	3.2%	3.2%	4.4%
energy cost	£/GJ	£1.14	£1.14	£1.14	£1.14	£1.54
	%	8.5%	8.5%	8.5%	8.5%	11.4%
consumer cost	£/GJ	1.51	1.51	1.51	1.51	2.03
	%	4.0%	4.0%	4.0%	4.0%	5.4%
NRMM diesel						
pump price	ppl	6.8	6.8	6.8	6.8	8.4
	%	9.4%	9.4%	9.4%	9.4%	11.6%
energy cost	£/GJ	£1.72	£1.72	£1.72	£1.72	£2.12
	%	13.3%	13.3%	13.3%	13.3%	16.4%
consumer cost	£/GJ	£2.13	£2.13	£2.13	£2.13	£2.62
	%	10.7%	10.7%	10.7%	10.7%	13.2%

143 As shown in figure 26, pump price impacts are higher under the high overall cost scenario due to higher compliance costs resulting from lower projected average GHG savings.

Low overall cost scenario

Figure 27: FQD trajectories under low overall cost scenarios



144 Under the low overall cost scenario average GHG savings in the (RTFO) baseline are higher than under the central cost scenario due to higher assumed average baseline GHG savings. Therefore each of the trajectories requires less additional GHG savings to meet a 6% or 7% 2020 GHG savings target.

Figure 28: Costs and benefits under low overall cost scenario

Cost Benefit summary		option 1	option 2	option 3	option 4	option 5
additional compliance cost to 2030 (£m)	£m	3,263	3,314	3,377	3,287	4,285
additional administrative costs to 2030 (£m)	£m	-5	-6	-6	-7	-7
high-blend vehicle costs to 2030 (£m)	£m	-2089	-2223	-2434	-2293	-4418
additional infrastructure costs (£m)	£m	-285	-285	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	3,711	4,309	4,517	4,642	5,697
ancillary benefits to 2030 (£m)	£m	344	421	470	466	771
NPV to 2030 (£m)	£m	4,939	5,530	5,638	5,810	6,042

145 Due to low crop prices and high oil prices, it is cheaper to supply biofuel than fossil fuel in the low overall cost scenario. This leads to a net saving to fuel suppliers ranging between £3.3bn and £4.3bn over the period to 2030. Monetised GHG benefits are also lower as less additional (to the RTFO baseline) GHG savings are required to meet the targets. Ancillary benefits (i.e. congestion, accidents, noise) are also lower due to a lower increase in pump price impacts (which correspond to a lower fall in demand for road transport energy). Under the low overall cost scenario, the estimated net benefit ranges from £4.9bn to £6.0bn over the period to 2030.

Figure 29: Lifecycle GHG savings under low overall cost scenario

Life-cycle GHG savings		option 1	option 2	option 3	option 4	option 5
additional CO2 savings in 2020 (MTCO2)	MTCO2e	6.4	6.4	6.4	6.4	7.8
additional CO2 savings to 2030 (MTCO2)	MTCO2e	78.0	87.8	91.3	92.9	113.9
£/tCO2 (to 2030)	£/tCO2e	-63.3	-63.0	-61.7	-62.6	-53.1

146 Overall GHG savings (additional to the RTFO baseline) are lower under the low overall cost scenario due to higher projected baseline GHG savings, as shown in figure 29. The £/tCO_2e cost effectiveness metric is lower due to higher overall net benefit (which is driven by lower compliance costs e.g. the cost of supplying GHG savings falls).

Figure 30: Pump price impacts under low overall cost scenario

2020 PUMP PRICE IMPACTS						
Petrol		option 1	option 2	option 3	option 4	option 5
pump price	Ppl	-2.1	-2.1	-2.1	-2.1	-2.3
	%	-2.5%	-2.5%	-2.5%	-2.5%	-2.6%
energy cost	£/GJ	£0.01	£0.01	£0.01	£0.01	£0.11
	%	0.0%	0.0%	0.0%	0.0%	0.6%
consumer cost	£/GJ	£0.78	£0.78	£0.78	£0.78	£1.10
	%	1.7%	1.7%	1.7%	1.7%	2.4%
road diesel						
pump price	Ppl	-0.5	-0.5	-0.5	-0.5	-0.2
	%	-0.3%	-0.3%	-0.3%	-0.3%	-0.1%
energy cost	£/GJ	£0.06	£0.06	£0.06	£0.06	£0.16
	%	0.3%	0.3%	0.3%	0.3%	0.9%
consumer cost	£/GJ	0.21	0.21	0.21	0.21	0.37
	%	0.5%	0.5%	0.5%	0.5%	0.9%

NRMM diesel						
pump price	Ppl	-1.3	-1.3	-1.3	-1.3	-1.0
	%	-1.4%	-1.4%	-1.4%	-1.4%	-1.1%
energy cost	£/GJ	-£0.10	-£0.10	-£0.10	-£0.10	£0.00
	%	-0.6%	-0.6%	-0.6%	-0.6%	0.0%
consumer cost	£/GJ	-£0.05	-£0.05	-£0.05	-£0.05	£0.08
	%	-0.2%	-0.2%	-0.2%	-0.2%	0.3%

147 As figure 30 shows, pump price impacts are higher under the high overall cost scenario due to higher compliance costs resulting from lower projected average GHG savings. Under the low overall cost scenario pump prices fall relative to the baseline as biofuel is cheaper than fossil fuel in this scenario.

SECTION 6 - Put in place a 6% 2020 GHG savings obligation but delaying determining what further steps to take to implement the GHG saving obligation (approach C / Option 6)

Rationale

148 Option 6 proposes to put in place a 6% GHG saving target in 2020 but to delay setting a GHG saving trajectory until the EU will have developed a policy response aimed at mitigating the impacts of GHG emissions from Indirect Land Use Change and other biofuel sustainability issues are resolved. However, under this option a legal obligation will be imposed on the Secretary of State for Transport to keep ongoing compliance with the Directive's requirements under review and, in particular, to consider what additional measures will be required to ensure that the UK delivers the GHG emission savings in the period 2014 to 2020. This approach is also thought to represent the best balance between the risk of putting in place a GHG savings trajectory before sustainability issues have been resolved (which may lead to wasted investment in unsustainable technologies) and the risk of infraction for failure to transpose fully the requirements of the FQD.

Cost Benefit Analysis

149 The quantified costs and benefits associated with this option will fall within the range of those presented for options 1, 2 and 3 in the previous analysis in section 3. In addition, option 6 also delivers the additional benefit of increased long-term investor certainty and mitigates the risk of investment in unsustainable technologies (which could potentially run into billions of pounds). These trajectories represent a range of scenarios showing how a 6% 2020 target - with a trajectory starting in 2014 onwards - could be achieved, with option 1 forming the lower end of the range (in terms of costs) and option 3 forming upper end of the range. More detailed qualitative and quantitative analysis of these options can be found in section 3 (paras 102 – 133). Analysis, sensitivities and caveats apply as per the previous analysis in section 3.

Figure 31: Subset of GHG savings target trajectory options for Approach C

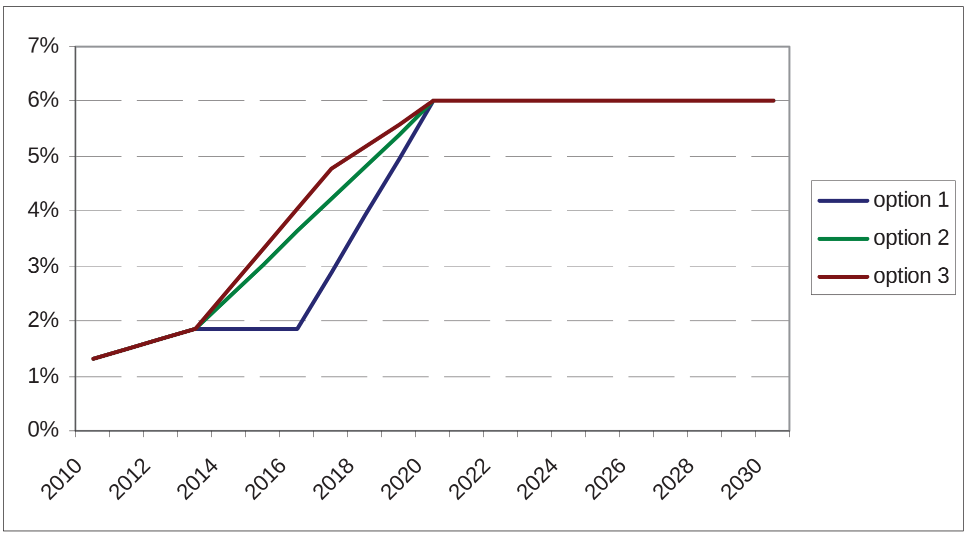


Figure 32: Range of potential costs and benefits under Approach C

Cost Benefit summary		option 1	option 2	option 3
additional compliance cost to 2030 (£m)	£m	-3,510	-4,384	-4,723
additional administrative costs to 2030 (£m)	£m	-5	-6	-6
high-blend vehicle costs to 2030 (£m)	£m	-2,251	-2,394	-2,614
additional infrastructure costs (£m)	£m	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	3,766	4,368	4,577
ancillary benefits to 2030 (£m)	£m	1,013	1,178	1,251
NPV to 2030 (£m)	£m	-1,272	-1,523	-1,801

150 Figure 32 shows the range of potential costs and benefits associated with approach C. Costs and benefits depend upon the profile of the trajectory chosen to reach the 6% target in 2020. Trajectories which are weighted towards 2010 will lead to greater costs and benefits and a higher overall net cost. Option 3 leads to the highest net cost to society and option 1 leads to the lowest. This is because a greater overall volume of biofuel (which is estimated to be more expensive than the fossil fuel which it displaces) will be supplied under these trajectories. However, trajectories weighted towards the present are more likely to deliver the 2020 6% GHG savings target as the industry will have more time to adapt to the changes required to deliver the target.

Policy Certainty (sustainability) Benefits

151 Putting in place a GHG savings trajectory immediately (prior to resolving sustainability issues - in particular Indirect Land Use Change) runs a significant risk of incentivising investment in unsustainable technologies which could potentially be rendered unviable by future policy aimed at addressing sustainability issues.

152 Choosing to delay setting a trajectory until 2014 (whilst using the current RTFO to deliver GHG savings towards the FQD) creates time for the EU to develop a policy response to address outstanding sustainability issues. Having a clearly defined policy framework in place is expected to increase investor confidence and also reduces the risk of investment in unsustainable technologies. Putting in place a GHG savings trajectory prior to resolving sustainability issues (in particular Indirect Land Use Change) runs a significant risk of incentivising investment in unsustainable technologies which could potentially be rendered unviable by future policy aimed at addressing sustainability issues. Such a change in policy direction risks creating private sector losses (a modern large-scale biorefinery can cost up to £250m. Meeting FQD targets would be likely to require construction of many such facilities). Investors may also have recourse to legal action which could transfer losses onto the public sector. At present, negotiations amongst EU member states (aimed at identifying policy options to address indirect land use change) are underway and are expected to be concluded in late 2011/early 2011

Infraction risk

153 Option 6 (approach C) is considered to mitigate infraction risk relative to doing nothing baseline scenario (approach A). However, option 6 does not completely mitigate all infraction risk as the absence of a trajectory of annual GHG savings targets in the short term (as would be delivered under approach B) could be viewed as non-compliance with the directive.

154 The infraction risk for this option has not been explicitly quantified in the Impact Assessment. This is because it is unclear at this stage what the relative likelihood of infraction would be, as

well as the exact scale of any fines. However, these risks are considered to be limited in the short term, at least until provisions are in force as a matter of EU law setting out how the GHG lifecycle emissions referable to fossil fuels and energy are to be calculated. Such provisions are unlikely to come into force until at least early 2013. In order to reduce the risk of infraction in the meantime, under this option a legal obligation will be imposed on the Secretary of State for Transport to keep ongoing compliance with the directive's requirements under review and, in particular, to consider what additional measures will be required to ensure that the UK delivers the GHG emission savings in the period 2014 to 2020. This is the period for which there are currently no increases in the biofuel supply trajectory required under the RTFO set out in law.

SECTION 7 - Summary and Preferred Option

155 Given the risks around implementing a GHG savings trajectory before sustainability issues have been resolved (i.e. the potential for investment in unsustainable technologies which could potentially be rendered unviable by future policy aimed at addressing sustainability issues), option 6 (approach C) is recommended as the preferred option. This allows time for EU Member States to come to an agreed policy response aimed at mitigating GHG emissions from Indirect Land Use Change (which is expected to be finalised in late 2011/early 2012). To set the trajectory in advance of having this information raises potential risks of imposing obligations on business which may need to be changed significantly in the future creating the potential for wasted investment and damaged investor confidence. The increase in the infraction risk associated with this option is considered to be limited and to be outweighed by the substantial risks inherent in setting targets which subsequently need to be changed.

156 Putting in place a 6% GHG 2020 savings target whilst delaying determining what further steps to take to implement the GHG saving obligation will allow us to demonstrate substantial compliance with the Fuel Quality Directive whilst maintaining flexibility to conduct further research into sustainability and deployment options in advance of setting a final target trajectory. It also allows a better understanding to be built of associated issues regarding the risks and costs to business before committing to a particular trajectory; and therefore increases the ability to set a trajectory at an appropriate time which allows the FQD targets to be met cost effectively.

Annex 1 — References

EU Fuel Quality Directive:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0030:EN:NOT

Renewable Transport Fuel Obligations (Amendment) Order (2009):
http://www.legislation.gov.uk/uksi/2009/843/contents/made

ECJ v. France - Case C-304/02:
http://curia.europa.eu/jurisp/cgi-bin/form.pl?lang=en

Renewable Fuels Agency carbon and sustainability data (archived)
http://webarchive.nationalarchives.gov.uk/20110410141814/http://renewablefuelsagency.gov.uk/carbon-and-sustainability/rtfo-reports

DfT biofuels statistics webpage
http://www2.dft.gov.uk/pgr/statistics/datatablespublications/biofuels/

Annex 2 — Competition Assessment

157 Along with GHG savings, the main economic impact of implementing the FQD 6% GHG savings target is expected to be an increase in transport fuel costs in the UK. Increases would be expected to be felt particularly keenly by consumers of fuel for NRMM (which is not currently covered under the RTFO), as the increase in fuel costs would be proportionally larger in this sector (as it is not currently obligated under the RTFO).

158 In general — within the UK/EU economy — impacts of cost increases attributable the FQD are expected to be felt in proportion to the reliance on such fuels. However the cost base of those who rely on such fuels disproportionately, for example due to the physical location of their agricultural activities, may be expected to be disproportionately affected. EU global competitiveness may suffer as a result of increased input costs relative to international competitors, and this may also be the case more widely for export industries which rely on transport fuel as a significant input may be put at a competitive disadvantage relative to international competitors.

159 The Directive is to be implemented across the EU as a whole in order to ensure as far as possible, a level playing field, though it is recognised that some fuel suppliers are global and therefore may need to adapt their EU operations specifically.

160 The preferred option signals the direction of policy by setting the 2020 target but allows time for the essential evidence to be gathered before committing to a detailed trajectory over that timeframe. No impacts are therefore expected before 2014.

Annex 3 — Small Firms Assessment

161 Along with GHG savings, the main economic impact of implementing the FQD 6% GHG savings target is expected to be an increase in transport fuel costs across the economy. It is assumed that, in general, small firms and large firms will use same relative volume of fuel for a given economic activity and will be affected equally by any increase in fuel costs though the proportion of business costs accounted for by transport costs is likely to vary. The impact will therefore vary by supplier.

162 As mentioned in the Competition Assessment, the Directive's requirement that all fuel suppliers are obligated will impose some fixed administrative costs on all transport fuel suppliers (These are covered in more detail in paragraph 82). As smaller suppliers have a smaller revenue base than larger suppliers they will be affected disproportionately by the imposition of any fixed costs. Options around extending the obligation to cover all fuel suppliers, irrespective of size, have not been monetised at this stage of the policy process.

163 Under the preferred option, no additional impacts would be expected before 2014 (though there may be some industry preparatory costs)

Annex 4 — Sustainable Development

164 An increase in biofuel demand would increase the potential for sustainable biofuels to contribute to sustainable development through the decarbonisation of the UK's transport system and contribute towards meeting the Department's transport sector carbon budgets.

165 However, increased biofuel deployment can potentially have adverse impacts on sustainability such as biodiversity impacts and GHG emissions associated with agriculture and refining.

166 In order for biofuel to count towards the FQD GHG savings target, it must be compliant with the mandatory sustainability criteria (which sets minimum standards for lifecycle GHG savings and biodiversity impacts).

167 GHG emissions from the indirect effects of feedstock crop cultivation (this is often referred to as indirect land use change, ILUC, which is for example, the displacement of cultivation onto land which leads to GHG emissions) are not currently addressed by the mandatory sustainability criteria. The Department for Transport is currently conducting research into this issue.

Annex 5 — Racial and Disability Equality

168 Along with GHG savings, the main economic impact of implementing the FQD 6% GHG savings target will be an increase in transport fuel costs across the economy. For this to have a negative impact across racial groups, the amount of fuel consumed and the type of fuel consumed would need to be greater for people of a specific racial groups relative to the whole population. The Department for Transport is not aware of any evidence that disaggregates fuel consumption between racial groups on a quantitative or qualitative basis.

169 Likewise, for the policy to have a negative impact upon disabled people, the amount of fuel consumed and the type of fuel consumed would need to be greater for disabled people relative to the whole population. The Department for Transport is not aware of any evidence that disaggregates fuel consumption between groups on a quantitative or qualitative basis. However, to the extent that some disabled people are reliant on personal road transport, any increase in fuel prices, as set out in this analysis, would affect their travel costs adversely.

Annex 6 — Gender Equality

170 Along with GHG savings, the main economic impact of implementing the FQD 6% GHG savings target will be an increase in transport fuel costs across the economy. For this to have a negative impact between genders, the amount of fuel consumed and the type of fuel

consumed would need to be greater for people of a specific gender relative to the whole population. As stated above, The Department for Transport is not aware of any evidence that disaggregates fuel consumption between gender groups on a quantitative or qualitative basis.

Annex 7 — Rural Proofing Assessment

171 An increase in NRMM fuel prices could pose an additional cost burden on rural businesses, as many of these will be in the agricultural sector, which is one of the main users of non-road mobile machinery. The estimated impact on NRMM fuel prices has been set out in this analysis.

172 An increase in road transport fuel costs may also have a disproportionate impact on rural communities and businesses which have higher fuel demand than their urban counterparts. But the UK agriculture sector may benefit if there are opportunities for the UK to supply sustainable biofuels and contribute to the UK meeting its obligations.

173 An increase in biofuel demand could reduce opportunities for UK biofuel refiners and feedstock suppliers if they have previously specialised in the supply of biofuels which offer relatively lower GHG savings, which may have impacts on rural incomes through either higher employment in biofuel production facilities or through increased business opportunities for UK biofuel supply chains. These impacts have not been directly quantified.

174 Increased biofuel deployment may be an issue for particularly remote rural areas that are serviced by marine tankers. The chemical properties of hydrocarbon petrol and ethanol are such that they do not mix particularly well at the molecular level, and can easily be encouraged to separate with the addition of water. This is known as phase separation and is problematic because standard marine tankers do not keep moisture from coming into contact with the fuel adequately. Thus in remote areas of the country that are supplied primarily by these means, such as the “Highlands and Islands” in Scotland, may not be able to take the same biofuel blend as the rest of the country.

Annex 8 — Fossil fuel and biofuel price projections

175 Biofuel price projections were developed using the OECD FAO Aglink-Cosimo model and have been modelled to correspond with the four different DECC oil price scenarios – “low”, “central”, “high” and “high–high”.

Figure A1: biodiesel/bioethanol price projections (2010 prices)

	bioethanol			Biodiesel		
	low	central	high	low	central	high
2012	38	48	61	53	75	101
2013	36	46	59	53	75	100
2014	36	46	59	53	74	98
2015	36	45	58	52	73	96
2016	35	45	58	52	72	95
2017	35	44	57	52	72	93
2018	34	43	56	52	71	92
2019	33	43	55	52	71	91
2020	32	42	54	51	70	89
2021	32	42	54	51	70	89
2022	32	41	54	51	70	89
2023	32	41	53	51	70	89
2024	32	41	53	51	69	89

2025	32	41	53	51	69	89
2026	32	41	53	51	69	89
2027	32	41	53	51	69	89
2028	32	41	53	51	69	89
2029	32	41	53	51	69	89
2030	31	41	53	51	69	89

Source: OECD FAO Aglink-Cosimo modelling / Poyry production cost model

176 Projections of future oil prices are produced by the Department of Energy and Climate Change.

Figure A2: DECC oil price scenarios (2011 prices)

	Low	Central	High
2012	108	111	113
2013	106	112	115
2014	104	113	118
2015	101	114	121
2016	99	115	123
2017	97	116	126
2018	96	117	129
2019	94	118	132
2020	92	119	135
2021	90	120	138
2022	88	121	142
2023	86	122	145
2024	85	123	148
2025	83	124	152
2026	81	126	155
2027	80	127	159
2028	78	128	162
2029	77	129	166
2030	75	130	170

Source: DECC

177 Projections of pre-tax petrol/diesel prices based on underlying DECC oil price scenarios are presented in table A2.

Figure A3: fossil diesel/petrol price projections (pre-tax price) (2010 prices)

	petrol			Diesel		
	low	central	high	low	central	high
2012	49	50	51	54	56	57
2013	48	50	52	53	56	58
2014	47	51	53	53	57	59
2015	46	51	54	52	57	60
2016	46	52	55	51	58	61
2017	45	52	56	50	58	63
2018	44	53	57	49	59	64
2019	43	53	59	48	59	65
2020	43	53	60	47	60	67
2021	42	54	61	46	60	68
2022	41	54	62	46	60	70
2023	41	55	64	45	61	71
2024	40	55	65	44	61	73
2025	39	56	66	43	62	74
2026	39	56	68	42	62	76
2027	38	56	69	42	63	78

2028	37	57	71	41	63	79
2029	37	57	72	40	64	81
2030	36	58	74	40	64	83

Source: DfT road transport fuel price model (based on DECC oil prices)

Annex 9 — road transport fuel demand elasticity and ancillary benefit coefficients

178 Table A3 shows projections of the elasticity of demand for road transport fuel which shows the reduction in road transport fuel demand estimated for a 1% increase in pump prices (e.g. a 1% increase in pump prices in 2012 will lead to a 0.2% decrease in demand for road transport fuel.

Figure A4: price elasticity of demand for road transport fuel

	Elasticity (%)
2012	-0.20
2013	-0.20
2014	-0.20
2015	-0.19
2016	-0.19
2017	-0.18
2018	-0.18
2019	-0.18
2020	-0.17
2021	-0.17
2022	-0.17
2023	-0.17
2024	-0.16
2025	-0.16
2026	-0.16
2027	-0.15
2028	-0.15
2029	-0.15
2030	-0.14

Source: Internal analysis (DfT)

179 A decrease in overall fuel consumption is caused by a decrease in total vehicle kilometres driven. The following series shows average km/litre and allows us to calculate a reduction/increase in vehicle kilometres from a reduction/increase in total fuel consumption.

Figure A5: vehicle kilometre per litre conversion factors for petrol and diesel

	Average Petrol km/L	Average Diesel km/L
2012	13.57	16.25
2013	13.79	16.38
2014	14.03	16.49
2015	14.32	16.64
2016	14.61	16.77
2017	14.90	16.90
2018	15.18	17.02
2019	15.45	17.13
2020	18.85	20.68
2021	15.94	17.33

2022	16.15	17.41
2023	16.34	17.49
2024	16.52	17.55
2025	16.67	17.59
2026	16.80	17.63
2027	16.90	17.66
2028	16.98	17.68
2029	17.04	17.69
2030	17.09	17.70

Source: DfT analysis

180 An increase/reduction in vehicle kilometres is estimated to produce benefits which can be quantified in monetised terms. For example, fewer cars on the road will lead to less time lost through congestion. A change in vehicle kilometres has been explicitly linked to the following benefits through the (£/vehicle km) presented in the following table.

Figure A6: monetised benefits conversion factors for vehicle kilometre changes

	Diesel AQ	Petrol AQ	Infrastructure	Accidents	Noise	Congestion
2012	-0.00161	-0.00017	-0.00076	-0.01792	-0.0014	-0.02149
2013	-0.00161	-0.00017	-0.00076	-0.01814	-0.00142	-0.02271
2014	-0.0016	-0.00016	-0.00076	-0.01836	-0.00143	-0.02392
2015	-0.0015	-0.00016	-0.00076	-0.01858	-0.00145	-0.02514
2016	-0.0015	-0.00016	-0.00076	-0.0188	-0.00147	-0.02635
2017	-0.0015	-0.00016	-0.00076	-0.01903	-0.00148	-0.02757
2018	-0.00149	-0.00016	-0.00076	-0.01926	-0.0015	-0.02879
2019	-0.00149	-0.00015	-0.00076	-0.01949	-0.00152	-0.03
2020	-0.0014	-0.00015	-0.00076	-0.01973	-0.00154	-0.03122
2021	-0.00139	-0.00015	-0.00076	-0.01996	-0.00156	-0.03243
2022	-0.00139	-0.00015	-0.00076	-0.02021	-0.00158	-0.03365
2023	-0.00139	-0.00014	-0.00076	-0.02045	-0.0016	-0.03487
2024	-0.00139	-0.00014	-0.00076	-0.0207	-0.00161	-0.03608
2025	-0.0013	-0.00014	-0.00076	-0.02094	-0.00163	-0.0373
2026	-0.0013	-0.00014	-0.00076	-0.0212	-0.00165	-0.03851
2027	-0.00129	-0.00014	-0.00076	-0.02145	-0.00167	-0.03973
2028	-0.00129	-0.00013	-0.00076	-0.02171	-0.00169	-0.04094
2029	-0.00129	-0.00013	-0.00076	-0.02197	-0.00171	-0.04216
2030	-0.00121	-0.00013	-0.00076	-0.02224	-0.00173	-0.04338

Source: DfT analysis

Annex 10 — dieselisation assumptions

181 Assumptions around dieselisation of the road transport fleet have been taken from the DECC energy model. The following table shows the projection of dieselisation rates used in the modelling.

Figure A7: dieselisation projection for road transport fuel

	diesel	petrol
2012	56%	44%
2013	57%	43%
2014	58%	42%
2015	59%	41%
2016	59%	41%
2017	60%	40%
2018	61%	39%
2019	61%	39%
2020	62%	38%
2021	62%	38%
2022	62%	38%
2023	63%	37%
2024	63%	37%
2025	63%	37%
2026	64%	36%
2027	64%	36%
2028	64%	36%
2029	64%	36%
2030	65%	35%

Source: DfT analysis

Annex 11 — Energy demand, carbon emissions and carbon values

182 Figure A7 shows projected demand for transport energy over the period from 2010 to 2030. Road diesel, road petrol and rail figures are taken from DECC energy modelling. The estimate for NRMM is based on internal analysis conducted by the Department. Figure A9 shows estimated GHG emissions that have been calculated using the energy figures in Figure A7 and the lifecycle GHG emissions factors which are listed in Figure A8.

Figure A8: Transport Energy Demand Projections across energy price scenarios (terajoules)

LOW						
	diesel	petrol	rail	NRMM	total diesel	total petrol
2012	943,047	775,932	30,496	84,111	1,057,654	775,932
2013	962,377	775,835	30,263	85,013	1,077,653	775,835
2014	982,519	766,983	30,066	85,481	1,098,066	766,983
2015	1,000,549	754,581	29,931	85,636	1,116,116	754,581
2016	1,017,581	740,593	29,661	85,649	1,132,891	740,593
2017	1,026,045	720,803	29,395	85,604	1,141,044	720,803
2018	1,034,272	704,346	29,134	85,533	1,148,940	704,346
2019	1,042,175	690,211	28,878	85,451	1,156,504	690,211
2020	1,050,200	678,394	28,627	85,445	1,164,273	678,394
2021	1,057,851	668,399	28,381	85,478	1,171,710	668,399
2022	1,065,573	660,158	28,140	85,529	1,179,242	660,158
2023	1,072,617	653,392	28,140	85,590	1,186,347	653,392
2024	1,079,177	647,689	28,140	85,655	1,192,972	647,689
2025	1,085,771	643,020	28,140	85,723	1,199,634	643,020
2026	1,092,426	639,366	28,140	85,793	1,206,358	639,366
2027	1,099,321	637,117	24,946	85,862	1,210,130	637,117
2028	1,104,101	632,337	24,946	85,862	1,214,910	632,337
2029	1,108,913	627,525	24,946	85,862	1,219,722	627,525
2030	1,113,702	622,736	24,946	85,862	1,224,511	622,736
CENTRAL						
	diesel	petrol	rail	NRMM	total diesel	total petrol

2012	966,778	754,695	30,066	84,111	1,080,955	754,695
2013	982,736	741,147	29,931	84,111	1,096,778	741,147
2014	999,304	727,291	29,661	84,111	1,113,076	727,291
2015	1,008,154	708,234	29,395	84,111	1,121,660	708,234
2016	1,017,081	692,638	29,134	84,111	1,130,326	692,638
2017	1,025,830	679,386	28,878	84,111	1,138,820	679,386
2018	1,033,800	667,800	28,627	84,111	1,146,539	667,800
2019	1,040,932	657,709	28,381	84,111	1,153,424	657,709
2020	1,047,910	649,215	28,140	84,111	1,160,161	649,215
2021	1,054,084	642,102	28,140	84,111	1,166,334	642,102
2022	1,059,722	636,012	28,140	84,111	1,171,973	636,012
2023	1,065,349	630,925	28,140	84,111	1,177,599	630,925
2024	1,071,013	626,833	28,140	84,111	1,183,264	626,833
2025	1,076,900	624,123	24,946	84,111	1,185,957	624,123
2026	1,081,583	619,440	24,946	84,111	1,190,640	619,440
2027	1,086,296	614,726	24,946	84,111	1,195,354	614,726
2028	1,090,987	610,035	24,946	84,111	1,200,045	610,035
2029	1,095,625	605,398	24,946	84,111	1,204,682	605,398
2030	1,100,233	600,789	24,946	84,111	1,209,290	600,789
HIGH						
	diesel	petrol	rail	NRMM	total diesel	total petrol
2012	956,229	746,460	30,066	83,193	1,069,488	746,460
2013	969,110	730,871	29,931	82,945	1,081,986	730,871
2014	983,105	715,501	29,661	82,748	1,095,513	715,501
2015	989,688	695,262	29,395	82,570	1,101,654	695,262
2016	996,434	678,578	29,134	82,404	1,107,972	678,578
2017	1,003,029	664,286	28,878	82,242	1,114,149	664,286
2018	1,008,886	651,706	28,627	82,084	1,119,597	651,706
2019	1,013,956	640,664	28,381	81,931	1,124,268	640,664
2020	1,018,910	631,248	28,140	81,783	1,128,833	631,248
2021	1,023,113	623,236	28,140	81,640	1,132,892	623,236
2022	1,028,130	617,052	28,140	81,604	1,137,873	617,052
2023	1,033,821	612,254	28,140	81,622	1,143,583	612,254
2024	1,039,895	608,621	28,140	81,667	1,149,702	608,621
2025	1,046,350	606,417	24,946	81,725	1,153,022	606,417
2026	1,050,900	601,867	24,946	81,725	1,157,571	601,867
2027	1,055,480	597,287	24,946	81,725	1,162,151	597,287
2028	1,060,038	592,729	24,946	81,725	1,166,709	592,729
2029	1,064,544	588,224	24,946	81,725	1,171,215	588,224
2030	1,069,021	583,746	24,946	81,725	1,175,693	583,746

Source: DECC UEP[14] projections and internal analysis (NRMM)

Figure A9: Lifecycle GHG emissions from fossil fuel

	$kgCO_2/L$ (lifecycle)
diesel	3.16
petrol	2.79

Source: Renewable Energy Directive

Figure A10: Fossil fuel and biofuel energy density assumptions

	MJ/litre
diesel	36.57
petrol	32.84
biodiesel	33.10
bioethanol	21.29

[14] http://www.decc.gov.uk/en/content/cms/statistics/projections/projections.aspx

Source: Fossil fuel values from Digest of UK and Energy Statstic[15]s. Biofuel values from CCC analysis[16]

Figure A11: Lifecycle GHG emissions projections for transport fuel (central energy demand)

	CO_2 emissions ($MTCO_2$)		
	diesel	petrol	total
2012	86.3	60.7	147.0
2013	87.3	59.5	146.8
2014	88.6	58.3	146.9
2015	89.8	57.2	147.0
2016	90.9	56.1	147.0
2017	91.7	55.1	146.8
2018	92.2	54.1	146.2
2019	92.4	53.0	145.4
2020	92.3	51.9	144.2
2021	92.2	51.0	143.2
2022	92.1	50.2	142.2
2023	92.0	49.4	141.4
2024	91.9	48.8	140.7
2025	91.8	48.3	140.0
2026	91.7	47.7	139.4
2027	91.7	47.1	138.8
2028	91.7	46.6	138.3
2029	91.8	46.1	137.9
2030	92.0	45.6	137.5

Source: DfT analysis (based on energy demand projections in Figure AX and life cycle GHG emission factors in Figure AX). Diesel emissions captures road, NRMM and rail diesel.

Figure A12: Carbon Price projections

	£/tCO_2	
	non-traded	traded
2012	55	15
2013	56	15
2014	56	15
2015	57	16
2016	58	16
2017	59	16
2018	60	16
2019	61	17
2020	62	17
2021	63	22
2022	64	28
2023	65	33
2024	66	39
2025	67	45
2026	68	50
2027	69	56
2028	70	61
2029	71	67
2030	72	72

Source: DECC

[15] http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/
[16] http://www.theccc.org.uk/other_docs/Tech%20paper%20supply%20side%20FINAL.pdf (p.41)

Annex 12 — Expansion of scope (alternative GHG saving options under the FQD)

183 In addition to crop derived bioethanol and biodiesel, there are a number of additional abatement options available to obligated suppliers under the Fuel Quality Directive. These include improvements to fossil fuel extraction/refining processes, waste derived biofuels (e.g. biomethane, switching to less GHG intense fossil fuel (e.g. fossil methane, LPG) and advanced biofuels. It has not been possible to produce robust estimates of uptake for these options. The following text provides a qualitative discussion of potential and deployment issues.

Extraction/refining process improvements

184 Lowering the GHG intensity of fossil fuel extraction can be achieved through a number of means such as reduced flaring of natural gas (which is often released during the extraction of crude oil) or switching from heavier to lighter varieties of crude oil (which require less energy to refine). It is unclear what feasible potential there is to achieve these reductions. Much of global flaring takes place in regions which are remote/underdeveloped (e.g. Russia, Nigeria, Iraq) and therefore may lack the necessary infrastructure to make effective use of gas that would otherwise be flared. In theory, it should be possible for refiners to switch to lighter sources of crude (although there may be some technical issues related to switching); however, it has not yet been agreed at EU level whether such savings will be counted towards the FQD target.

185 Analysis carried out by the Energy Crops Company on behalf of the Department suggests that there is limited potential for refining improvements to deliver GHG savings within the UK as all feasible options have been exhausted under the EU Emissions Trading Scheme which covers all large transport fuel refineries. Indeed the prospect that UK emissions may rise due to a trend towards the use of heavier crude oil in UK refineries raises the prospect that baseline emissions from fossil petrol and diesel may rise over time. In contrast, internal Department analysis indicates that GHG from changes to extraction/refining processes may fall within the range of –0.6% to +1.6% of total transport sector emissions. Owing to these uncertainties, GHG savings/emissions from extraction/refining processes have not been explicitly captured in the modelling.

Waste derived biofuel

186 Waste-derived biofuel is currently supplied in significant volume under the RTFO. Volumes supplied in the 09/10 obligation year can be seen in figure A7. Under a GHG savings framework, the waste-derived biofuel supply would be expected to increase as it would receive a larger relative level of subsidy (compared to crop-derived bioethanol and biodiesel with lower average GHG savings). However, there is considerable uncertainty over the feasible potential UK transport sector supply of waste-derived biofuel and how it will react to an increase in demand. This is because the overall supply potential is difficult to estimate and there is competing demand in other markets for these commodities, both domestically and globally.

Figure A13: volumes of waste derived biofuel supplied under the RTFO in obligation year 09/10

Fuel Type	Volume Supplied (litres)	Percentage
tallow	185,805,587	11.85%
used cooking oil	47,555,359	3.03%
biomethane	195,797	0.01%

Source: Renewable Fuels Agency

Switching to alternative fossil fuels

187 GHG savings can be delivered through fuel switching from petrol and diesel to less GHG intense fuel such as LPG and CNG. There is considerable uncertainty over the feasible potential UK transport sector supply. LPG and CNG have been available for quite some time in the UK at a lower rate of duty relative to road diesel and petrol. Despite this financial incentive, there has not been considerable uptake of these fuels. Therefore, there is no strong reason to believe that uptake would increase dramatically following the introduction of a GHG savings obligation.

Advanced biofuels

188 Biofuels other than crop-derived bioethanol and FAME biodiesel have not been explicitly captured by the modelling used in this paper. However, they can be used towards meeting the FQD target. In the most recent RTFO obligation year, no advanced biofuels were supplied. This is thought to be primarily attributable to the relatively high cost of such fuels. It is unclear if, and when, advanced biofuels will become cost competitive.

Electric Vehicles

189 In contrast to the RTFO (in its current form), electricity used in road transport is eligible to count towards meeting the FQD greenhouse gas saving target. Therefore GHG savings from running vehicles on electricity rather than fossil fuels, as long as the amount of electricity supplied for this purpose can be proven and verified, could help achieve the FQD target. In principle, suppliers of electricity for use in road vehicles could group with obligated suppliers to contribute toward GHG targets under the FQD. Therefore suppliers of electricity destined for road transport could generate revenue from supplying electricity to EVs. This may provide them with the incentive to encourage the uptake and use of electric vehicles (EVs).

190 Given the uncertainties around the uptake and use of EVs, further analysis of uptake trajectories and how electric vehicles might be included in the FQD is required in order to build a deeper understanding of this issue. For this reason electric vehicles have not been reflected in the modelling at this stage.

Annex 13 — expansion of scope (NRMM)

191 In addition to road transport fuel the FQD also covers fuel destined for NRMM. This term is used loosely to capture applications such as includes inland waterway vessels when not at sea, construction machinery, agricultural and forestry tractors, and recreational craft when not at sea. Internal Department analysis estimates the NRMM fuel supply to be around 2 megatonnes (2.3 billion litres) of diesel annually. This figure has been used to capture the NRMM supply in the cost benefit analysis modelling.

Annex 14 — OECD-FAO Aglink-Cosimo model

192 The biofuel prices that are assumed in the analysis are derived from outputs produced by the OECD-FAO Aglink-Cosimo model.

193 The OECD-FAO Aglink-Cosimo model is a partial equilibrium agricultural commodities model that has a biofuels module attached to it. The biofuels component of the model is focused on four major economic centres: the EU27 group, the USA, Canada, and Brazil. Other important

economic areas also enter the modelling, however, including Indonesia, Thailand, Argentina, and China. This gives good coverage of biofuel production: these areas accounted for 95% of world ethanol production and 82% of world biodiesel production in 2007. The model operates by taking a bottom up approach to estimating ethanol and biodiesel prices. Net cost production functions take into account feedstock prices, production costs, revenues from by-products and capital costs. These net cost functions interact with demand functions that are defined by mandates and the price of fossil fuel substitutes. This market clearing price mechanism operates in terms of a global market, taking into account prevailing restrictions on international trade.

194 The OECD-FAO Aglink-Cosimo model was used to generate ethanol and biodiesel price outputs under different EU27 biofuel mandates against a baseline level of demand from other key economic regions. Each run of the model generated one mandate/price output scenario that was interpreted as an individual point on a EU27 consumption supply curve. This process was repeated over a variety of oil price and agricultural yield scenarios in order to give a range of possible biofuel costs and prices. These supply curves were then be used to estimate the price of ethanol and biodiesel assuming that the UK is a price taker in the EU27 market.

Annex 15 — GHG accounting methodology

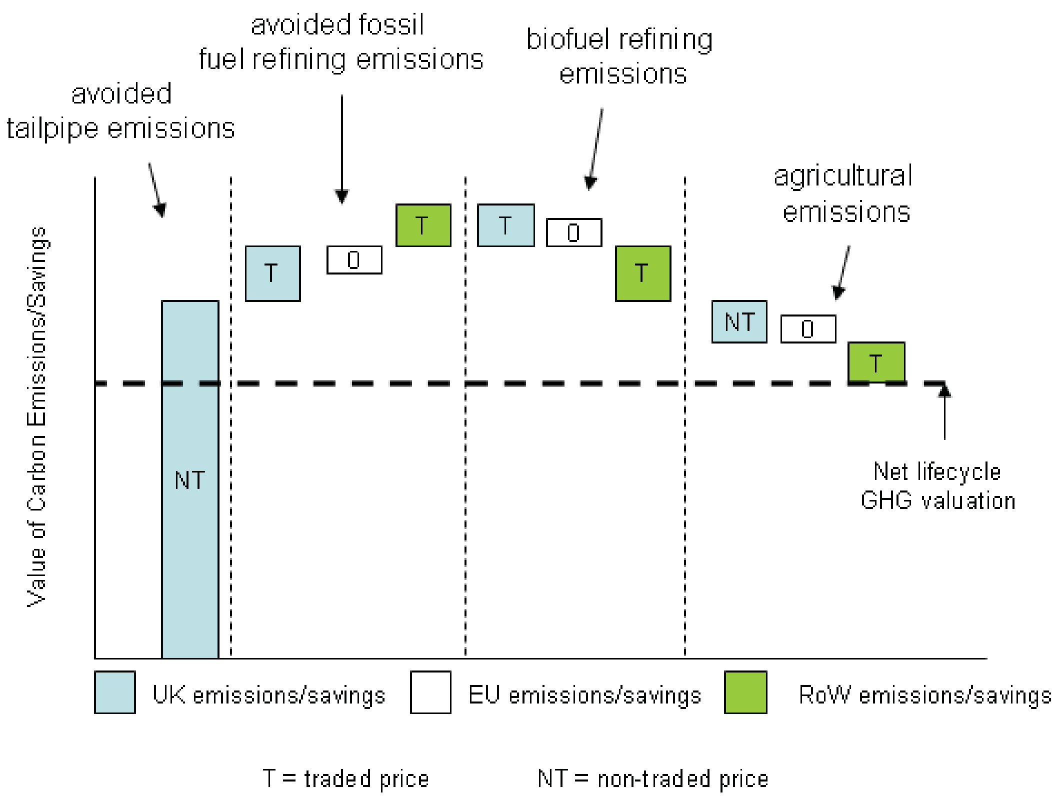
195 In order to monetise the net change in lifecycle GHG emissions which are projected to occur under a GHG savings obligation, GHG savings and emissions have been split into various sectors and valued at the relevant carbon price. The monetised value of GHG emissions is subtracted from the value of GHG savings to produce a value for lifecycle GHG savings.

Figure A14: Allocation of GHG savings/emissions to carbon prices

	UK	EU	RoW
Tailpipe	non-traded	n/a	n/a
Industry	traded	zero	traded
Agriculture	non-traded	zero	traded

196 Geographically, emissions/savings have been split into the UK, the EU (ex-UK) and rest of the world. From a sectoral point of view, GHG emissions savings have been split into i) tailpipe savings from displaced fossil fuel (non-traded sector carbon price used); ii) industry savings from lower emissions due to less fossil fuel refining (carbon price location dependent); industry emissions from biofuel refining (carbon price location dependent); and iv) agricultural emissions from feedstock production (carbon price location dependent). The allocation of savings/emissions to carbon price is summarised in figure A14.

FigureA15: Graphical Illustration of GHG accounting methodology



197 UK transport sector (tailpipe) and agricultural emissions are valued using the non-traded sector carbon price in line with cross-government GHG guidance[17]. There are no tailpipe emissions in the EU (ex-UK) or the rest of the world as this is a UK policy. EU (ex-UK) emissions/savings have not been valued as any change is assumed to be offset under individual member states' carbon reduction schemes and the EU ETS. Emissions/savings in the rest of the world are valued at the traded price in line with cross-government GHG guidance.

Annex 16 — Average GHG savings trajectory assumptions

198 Future GHG savings from the UK biofuel supply are highly uncertain. The following analysis sets out the average GHG savings trajectories, both under an FQD GHG savings obligation and under an RTFO baseline, used in the cost benefit analysis modelling and underlying assumptions.

Fuel Quality Directive average GHG savings trajectories

Figure A16: FQD crop-derived bioethanol supply in 2011

	LOW		HIGH	
	GHG Saving	Market (%)	GHG Saving	Market (%)
Sugarcane	71%	60%	71%	60%
Wheat	50%	20%	60%	20%

17 http://www.decc.gov.uk/assets/decc/statistics/analysis_group/122-valuationenergyuseggemissions.pdf

Sugar Beet	60%	20%	70%	20%
Average	65%		69%	
Scenario mid-point	**67%**			

Source: DfT analysis

Figure A17: FQD crop-derived bioethanol supply in 2020

	LOW		HIGH	
	GHG Saving	Market (%)	GHG Saving	Market (%)
Sugarcane	71%	35%	80%	35%
Wheat	50%	60%	70%	60%
Sugar Beet	60%	5%	80%	5%
Average	58%		74%	
Scenario mid-point	**66%**			

Source: DfT analysis

Figure A18: FQD crop-derived biodiesel supply in 2011

	LOW		HIGH	
	GHG Saving	Market (%)	GHG Saving	Market (%)
Veg Oils (FAME)	35%	100%	45%	100%
HVO	50%	0%	70%	0%
Average	35%		45%	
Scenario mid-point	**40%**			

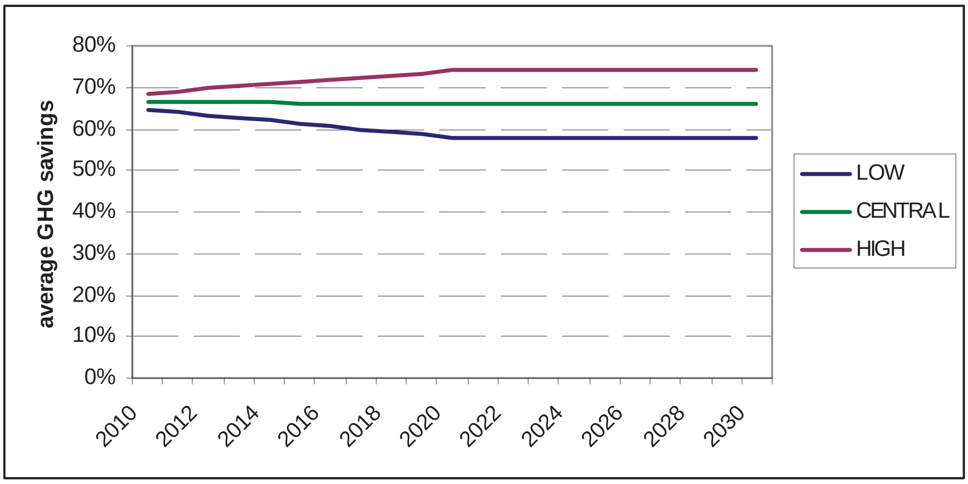
Source: DfT analysis

Figure A19: FQD crop-derived biodiesel supply in 2020

	LOW		HIGH	
	GHG Saving	Market (%)	GHG Saving	Market (%)
Veg Oils (FAME)	50%	100%	60%	84%
HVO	50%	0%	70%	16%
Average	50%		62%	
Scenario mid-point	**56%**			

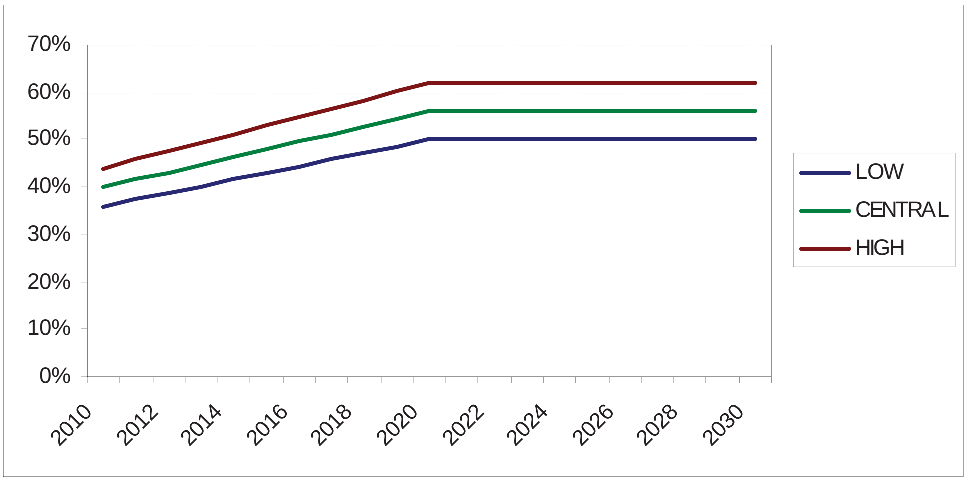
Source: DfT analysis

Figure A20: FQD average GHG savings trajectories for crop-derived bioethanol



Source: DfT analysis

Figure A21: FQD average GHG savings trajectories for crop-derived biodiesel



Source: DfT analysis

199 Under a GHG savings obligation biofuel producers will have a strong incentive to increase the average GHG savings delivered by biofuels. The preceding tables (Figures A16 to A20) show illustrative average GHG savings scenarios in 2011 and 2020 which would be expected to occur under a GHG savings obligation. High and low scenarios and a weighted average mid-point GHG saving are shown for both of these years. Illustrative feedstock mixes and GHG savings are also shown. These illustrative scenarios have been developed in conjunction with stakeholders.

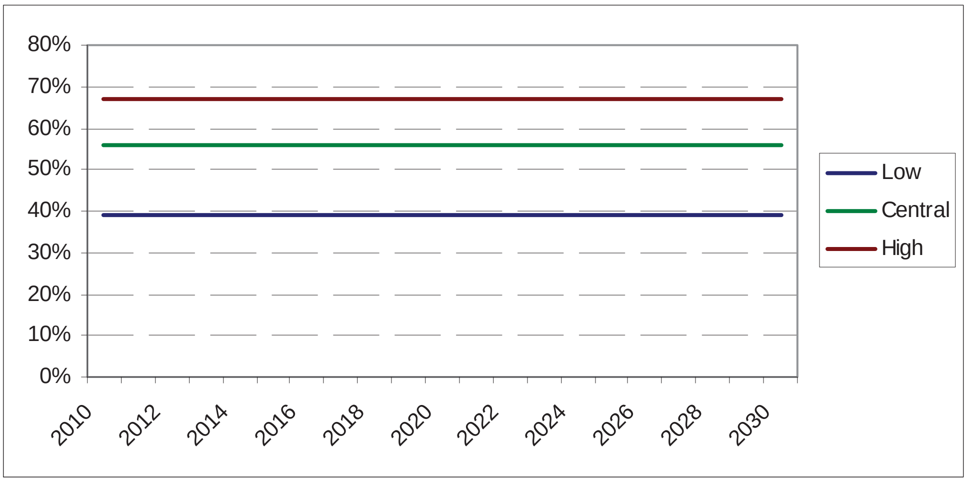
200 Average GHG saving trajectories for biodiesel (figure A21) and bioethanol figure (A20) have been plotted between these points which assume a gradual evolution in GHG savings as biofuel producers optimise their processes to deliver increased lifecycle GHG savings.

201 The central bioethanol scenario remains relatively constant (at around 66% - 67% GHG savings) across the period. This is because high GHG saving Brazilian sugarcane bioethanol contributes significantly to the relatively low volumes of bioethanol required at the start point of the trajectory. As demand increases, Brazilian sugarcane bioethanol is assumed to form a lower proportion of the overall bioethanol mix and contributes less to overall GHG savings. Improvements to GHG savings for other sources of bioethanol over time offset this effect, keeping aggregate GHG savings constant across the period to 2020. The low scenario moves from average GHG savings of 58% to 65% and GHG savings in the high scenario move from 69% to 74% over the period 2011 to 2030. GHG savings are assumed to remain constant from 2020 to 2030.

202 The central biodiesel average GHG savings scenario rises gradually from 40% in 2011 to 56% in 2020. This is driven by process improvement and improvements to agriculture for FAME biodiesel and some penetration of Hydrogenated Vegetable oil biodiesel (which typically delivers higher GHG savings). The low scenario moves from average GHG savings of 35% to 50% (jumping to 50% in 2017 when minimum GHG savings requirements are assumed to be introduced) and GHG savings in the high scenario move from 45% to 62% over the period 2011 to 2030. GHG savings are assumed to remain constant from 2020 to 2030.

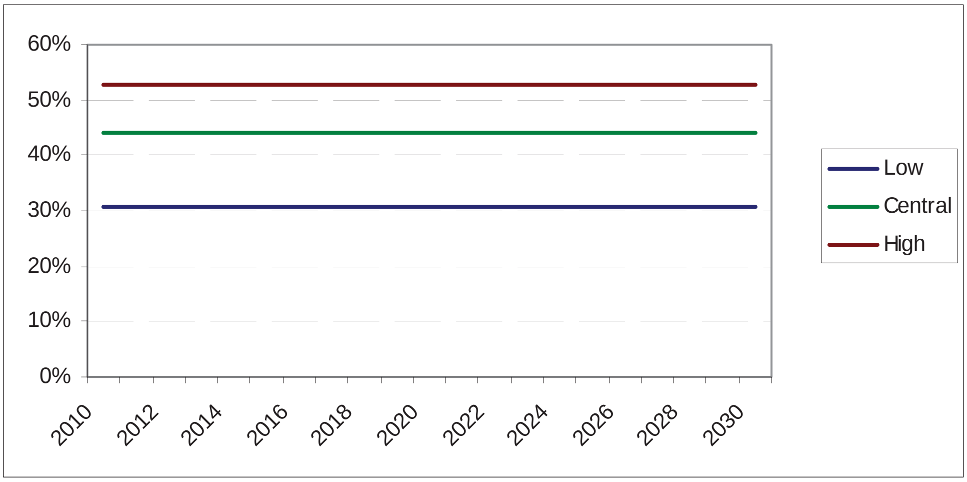
RTFO (baseline) average GHG savings trajectories

Figure A22: RTFO average GHG savings trajectories for crop-derived bioethanol



Source: DfT analysis based on RFA data

Figure A23: RTFO average GHG savings trajectories for crop-derived biodiesel



Source: DfT analysis based on RFA data

203 Average GHG savings under the RTFO baseline (assuming that the current trajectory remains unchanged) are highly uncertain over the period to 2020, therefore a wide range of illustrative GHG savings has been taken.

204 Reported average GHG savings from bioethanol started off very high in the first year of the RTFO[18] (70% average GHG savings) due to the very high proportion of Brazilian sugarcane bioethanol in the mix. In the second obligation year, the proportion of Brazilian sugarcane bioethanol fell and (provisional) average GHG savings also fell to 63%. At the time of writing, average GHG savings from bioethanol in the first two months of the (provisional) average GHG savings from bioethanol stand at 48% due to a further fall in the proportion of Brazilian bioethanol supplied. The (illustrative) central scenario for average GHG savings from bioethanol has therefore been set at 56% across the period to 2030. The low scenario has been set at 30% below this level at 39%, rising to 50% in 2017 when the EU mandatory sustainability criteria requirement of 50% minimum GHG savings kicks in. The high scenario has been set 20% above the central scenario at 67%. The low scenario is more heavily weighted due to the downside risk of other EU member states introducing GHG obligations (therefore providing the incentive for suppliers within those countries to outbid UK suppliers for high GHG saving biofuel).

205 Reported average GHG savings from biodiesel (including waste-derived biodiesel[19]) were 47% in the first year of the RTFO and 46% in the second year of the RTFO (provisional estimates). At the time of writing, average GHG savings from bioethanol in the first two months of the (provisional) average GHG savings from biodiesel stand at 43%. The (illustrative) central scenario for average GHG savings from crop-derived biodiesel has been set at 44% across the period to 2030. The low scenario has been set at 30% below this level at 31%. The high scenario has been set 20% above the central scenario at 53%. The low scenario is more heavily weighted due to the downside risk of other EU member states introducing GHG obligations (therefore providing the incentive for suppliers within those countries to outbid UK suppliers for high GHG saving biofuel).

[18] Reported RTFO GHG savings data can be found on the RFA's website http://www.renewablefuelsagency.gov.uk/carbon-and-sustainability/rtfo-reports

[19] Waste derived biodiesel has been included in average GHG savings trajectories for the baseline, as the RTFO provides an incentive on a per litre basis and therefore does not offer differentiated support levels for crop-derived biodiesel and waste-derived biodiesel.

Annex 17 — IEA biofuel price sensitivity

206 During the consultation which preceded this final stage impact assessment, a number of stakeholders suggested that the biofuel price projections used in this analysis are too high and therefore lead to overestimates of the cost of expanding the UK biofuel supply. International Energy Agency biofuel price projections were suggested as an alternative.

207 The government acknowledges that future biofuel (and fossil fuel) prices are highly uncertain, as is demonstrated by the considerable volatility seen in markets in recent years. The biofuel prices used in this impact assessment have been developed using the OECD-FAO Aglink-Cosimo model and are intended to be consistent with underlying DECC oil price projections. However, these projections are significantly different to the IEA price projections. In order to address stakeholders concerns, an additional sensitivity using IEA price projections. IEA biofuel price projections (alongside the OECD-FAO Aglink-Cosimo prices for comparison) are shown in figure A24. The results of the cost-benefit analysis modelling using IEA prices are shown in Figure 25.

Figure A24: IEA and OECD-FAO Aglink-Cosimo model (central) price projections

IEA biofuel prices

	biodiesel	bioethanol
2012	66	31
2013	66	31
2014	66	31
2015	66	31
2016	66	31
2017	67	31
2018	67	31
2019	67	31
2020	67	31
2021	67	31
2022	68	31
2023	68	31
2024	68	31
2025	68	31
2026	68	31
2027	68	31
2028	68	31
2029	69	31
2030	69	31

DfT prices (based on Aglink crop prices)

	biodiesel	bioethanol
2012	75	48
2013	75	46
2014	74	46
2015	73	45
2016	72	45
2017	72	44
2018	71	43
2019	71	43
2020	70	42
2021	70	42
2022	70	41
2023	70	41
2024	69	41
2025	69	41

2026	69	41
2027	69	41
2028	69	41
2029	69	41
2030	69	41

Figure A25: IEA and OECD-FAO Aglink-Cosimo model (central) price projections

IEA biofuel prices

Cost Benefit summary		option 1	option 2	option 3	option 4	option 5
additional compliance cost to 2030 (£m)	£m	-1,881	-2,336	-2,487	-2,627	-3,216
additional administrative costs to 2030 (£m)	£m	-5	-6	-6	-7	-7
high-blend vehicle costs to 2030 (£m)	£m	-2,251	-2,394	-2,614	-2,468	-4,634
additional infrastructure costs (£m)	£m	-285	-285	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	3,766	4,368	4,577	4,703	5,771
ancillary benefits to 2030 (£m)	£m	1,129	1,266	1,344	1,341	1,907
NPV to 2030 (£m)	£m	473	612	529	657	-464

DfT biofuel prices

Cost Benefit summary		option 1	option 2	option 3	option 4	option 5
additional compliance cost to 2030 (£m)	£m	-3,510	-4,384	-4,723	-4,933	-6,181
additional administrative costs to 2030 (£m)	£m	-5	-6	-6	-7	-7
high-blend vehicle costs to 2030 (£m)	£m	-2,251	-2,394	-2,614	-2,468	-4,634
additional infrastructure costs (£m)	£m	-285	-285	-285	-285	-285
additional GHG savings to 2030 (£m)	£m	3,766	4,368	4,577	4,703	5,771
ancillary benefits to 2030 (£m)	£m	1,013	1,178	1,251	1,271	1,614
NPV to 2030 (£m)	£m	-1,272	-1,523	-1,801	-1,719	-3,722

Annex 18 — High Blend Vehicle Costs

209. The following tables contain estimates of the additional capital and operating costs associated with high-blend (E85 car and B100 HGV) vehicles. These values were developed for the Department for Transport by AEA technology.

Figure A26: High-blend vehicle capital and operating costs

annualised capital costs (£/year)	
B100	E85
222	10

operating costs (£/km)	
B100	E85
0.04	0.01

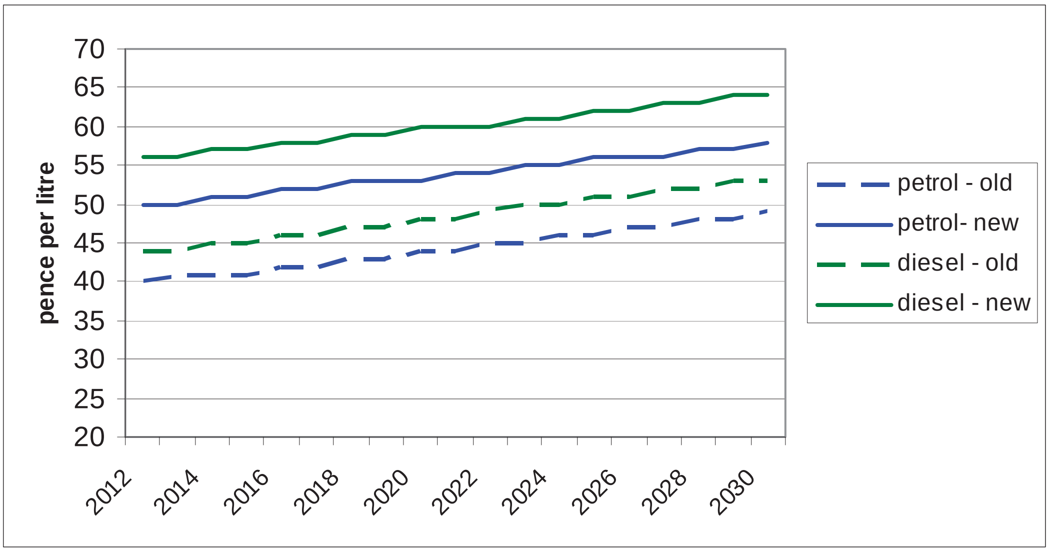
Source: AEA Technology – 'modes' research

Annex 19 — Updated Assumptions

210. Since the consultation stage impact assessment was published, government fossil fuel and biofuel price projections have been updated. The latest projections have been used to inform the cost-benefit analysis in this impact assessment. The net impact of the new price projections is a fall in the projected additional cost (relative to fossil fuel) of supplying biofuel.

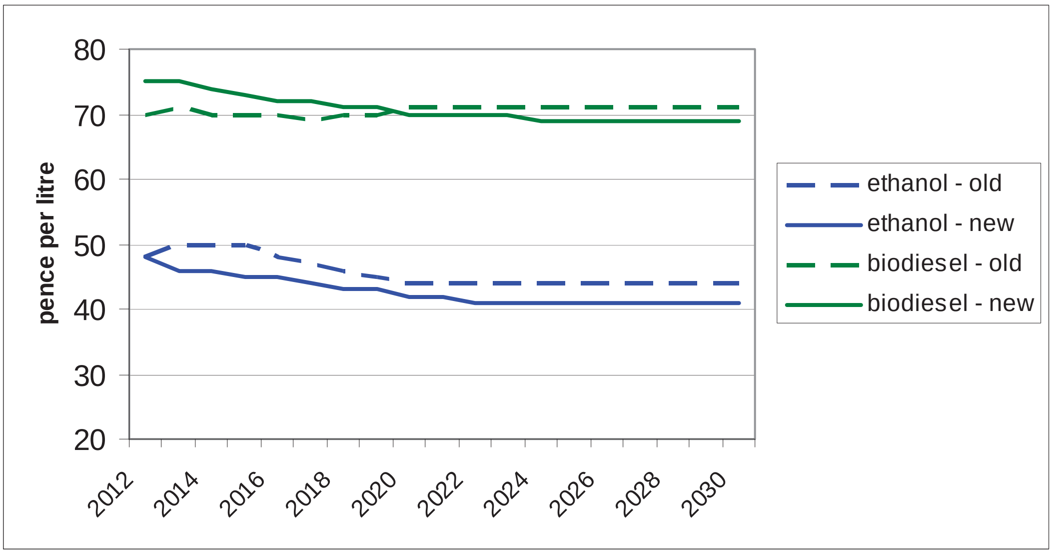
211. Figure A27 compares the old and new petrol and diesel price projections. As can be seen from the chart, the new prices are around 25% higher then the old price projections.

Figure A27: Old and new fossil fuel price projections



212. Biofuel price projections have also been updated using latest crop prices from the OECD-FAO Aglink-Cosimo model. Figure A28 compares the old and new biofuel price projections. As can be seen, there is little difference between both set of price projections.

Figure A28: Old and new biofuel price projections



213. The cost of subsidising biofuels is determined by the additional cost of supplying biofuel relative to fossil fuel. Figure A29 shows the additional cost (which has been adjusted to reflect variations in energy density) of supplying biofuel under the old and new price assumptions. The net effect of the changes to biofuel and fossil fuel price projections is a 45% fall in the additional cost of supplying biofuel. This change is primarily driven higher projected fossil fuel prices which make biofuel a more cost effective option.

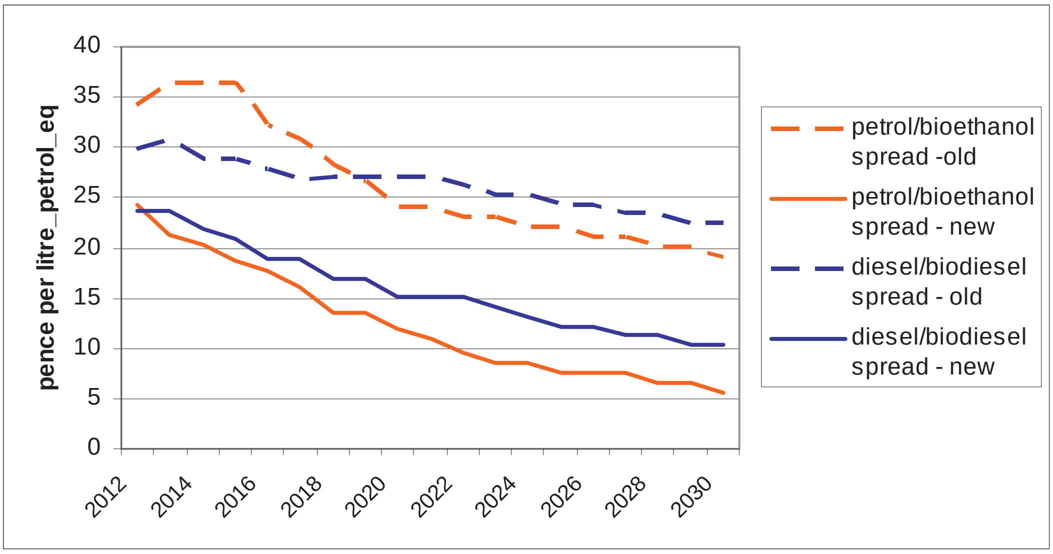


Figure A29: Projected net impact of the additional cost of supplying biofuel

214. In addition to the above amendments, this final stage impact assessment has updated analysis (in comparison to the consultation-stage impact assessment) on the costs of introducing 'high-blend' biofuels, on potential costs to industry, and on the sensitivities applied throughout its modelling. All of these updates have been made in response to the evaluative comments of the Regulatory Policy Committee, which are published alongside this document. The relevant changes are located in paragraphs 22, 23, 24, 89, 90, 91, 127, 128, 129, 134, 145 and in the addition of annexes 18 and 19.

Annex 20 - Summary of final policy for FQD implementation

1. Further to consultation Ministers judged that the preferred option outlined in this impact assessment, policy option 6, could potentially incentivise fuel suppliers to prepare to meet the 6% reduction in 2020 in ways that may not, in the long term, transpire to be sustainable or cost-effective. This alteration to the Government's preferred option was announced and articulated in the Government's Response to consultation, which was published on 11 September 2012.

2. The Government has therefore altered its preferred approach to implementing the Fuel Quality Directive from policy option 6 as laid out in this document. As initially proposed, Government will not set intermediate GHG reduction obligations for meeting the FQD 6% reduction requirement. However, in a change from the approach proposed in the consultation, Government has decided not to transpose the 2020 6% reduction obligation into UK law at this time.

3. This is because there remain uncertainties at European level in a number of key areas - including the ongoing development of measures to address ILUC and measures to account for the GHG intensity of fossil fuels - which will in turn alter a) the calculation of the lifecycle emission values for biofuels, b) the final methodology that will be used to calculate the lifecycle emission values for fossil fuel, and c) the baseline figure against which the 6% GHG intensity reduction will be measured. We do not feel it would be meaningful to obligate suppliers until these uncertainties are resolved and we can better understand what any such obligation would mean in practice.

4. Final details of the Government's policy are contained within the Government Response to consultation, which is published on the gov.uk website at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/2455/fqd-government-response.pdf