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Transport Energy Task Force

Options for transport energy policy to 2030

Prepared by the Members of the
Transport Energy Task Force

FINAL REPORT March 2015

Contents

Foreword

I have long believed that there is no single solution to climate change, and that reducing greenhouse gas emissions from fuels would be a necessary part of any solution, irrespective of the progress towards fuel efficiency and electrification of transport. The historical lack of consensus around biofuel policy has been disappointing, and while we don't have full consensus, the Task Force has re-shaped the conversation, creating a framework for the necessary political decision-making.

There is now a need for political leadership, to capture the momentum and alignment created by the Task Force. My personal view is that providing a robust and long-term route for ensuring the sustainability of all transport energy including biofuels is an essential next step. Without this the inevitable contradictions and disagreements about how to meet the shorter-term 2020 targets will re-emerge. It is also necessary to create a positive investment environment, by ensuring appropriate rewards are provided to existing operators, as well as those who will be needed to deliver future sustainable advanced biofuels.

The Task Force is an excellent example of open policy making, engaging a large and diverse group of stakeholders. It has been a pleasure to work with the Task Force, the staff from the Department for Transport and the Low Carbon Vehicle Partnership. They have all listened generously to the views of others, while communicating the needs of their own communities with clarity, moving beyond the simple rhetoric of advocacy. As a senior participant from Brussels commented, the constructive tone of the debate on biofuels, even when there was disagreement, was very unusual in Europe.

Chris Mottershead

Membership

The Task Force was chaired by Chris Mottershead, Vice Principal, King's College London, with support from the vice-chairs: Rob Wakely, Head of Low Carbon Fuels (DfT) and Andy Eastlake, Managing Director (LowCVP).

The Task Force was organised around five working groups. Chairs of these groups were:

Ausilio Bauen - E4Tech (WG 1); Chris Mottershead - Kings College London (WG 2); David Baldock - Institute for European Environmental Policy (WG 3); Rob Wakely - DfT (WG 4); Clare Wenner - Renewable Energy Association (WG 5).

The membership of the Task Force consisted of:

Aaron Berry - Department for Transport
Adam Baisley - Olleco
Adel Pishneshin - Jaguar Land Rover
Andrea Tyrrell - Vivergo
Andrew Owens - Greenergy Fuels Ltd
Angel Alberdi - EWABA
Angela Bowden - SCOPA
Anja Hazebrook - Vivergo
Baden Gowrie-Smith - CNG Fuels
Ben Allen - Institute for European Environmental Policy
Charlotte Morton - Anaerobic Digestion and Biogas Association
Chris Biggs – Sainsbury's
Chris Chandler - Lex Vehicle Leasing
Chris Hunt - UK Petroleum Industry Association
Chris Malins - International Council on Clean Transportation
Chris Patience - AA
Diana Raine - Air Products Ltd
Dickon Posnett - Argent Energy
Dominic Scholfield - Gas Bus Alliance
Doug Parr - Greenpeace
Eddie Jenkinson - The Co-operative
Emma Butcher - Society of Motor Manufacturers and Traders
Grahame Buss - Shell International Ltd
Grant Pearson - Ensus
Hilary Stone - Imperial College
Hugh Tucker - UK Petroleum Industry Association
Ian Bacon - SMMT
Ian Waller - Five Bar Gate
James Beard - WWF
James Mills - National Farmers Union
Jay Parmar - BVRLA
Jeremy Tomkinson - National Non-Food Crops Centre
Jeremy Walton - ASDA
Jerry Burton - Tesco
Jo Howes - BP Oil UK Ltd
Joe Platt - MBP Group
John Baldwin - CNG Services Ltd
John Webb - Lex Vehicle Leasing
Jonathan Murray - LowCVP
Keeley Bignal - Department for Transport
Keith Bushell - Airbus
Keith James - WRAP
Kenneth Richter - Friends of the Earth
Konstanze Scharring - Society of Motor Manufacturers and Traders
Leigh Hudson - British Airways
Maddy Cobb - Virgin Atlantic
Magdalena Golebiewska - TUI (Thomson)
Mark Rolph - Downstream Fuel Association
Mark Todd - Morrisons
Marta Chrusch - BP Oil UK Limited
Michael Chesshire - Evergreen Gas
Mike Goldworthy - National Non-Food Crops Centre
Neville Jackson - Ricardo plc
Nigel Tait - Shell International Ltd
Patrick Lynch - Greenergy Fuels Ltd
Patrick Mocatta - Gasrec
Paul Blacklock - Calor
Paul Gehres - British Airways
Paul Watters - AA

Peter Smith - Cargill
Philip Monger - PRA
Richard Kneller - Department for Transport
Richard Moore - Jaguar Land Rover
Rick Taylor - Vivergo Fuels
Robert Arnold - RAC
Robert Walker - Society of Motor Manufacturers and Traders
Roy Murray - BP Oil UK Limited
Teresa Sayers - Downstream Fuel Association
Tom Parsons - BP Oil UK Limited
Vikram Paul - Shell International Ltd
William Bushby - Anaerobic Digestion and Biogas Association

In addition a number of government departments participated in the Task Force in an observer role. These were: Department for Business, Innovation & Skills, Department of Energy and Climate Change, Department for Environment, Food and Rural Affairs and HM Treasury.

Disclaimer

The output from the Transport Energy Task Force contained in this final report constitutes a broad consensus of opinion on a wide range of issues developed through the activities of the individual work groups and the high level group. However the views and opinions of organisations and their representatives that participated in the Transport Energy Taskforce may differ from those in this report.

Introduction

The Department for Transport (DfT) and the Low Carbon Vehicle Partnership (LowCVP) established the Transport Energy Task Force as a mechanism for stakeholders to help the Government to examine and formulate options for policy regarding transport energy. Specifically the Task Force was asked to consider how the EU 2020 greenhouse gas emissions reduction and renewable transport fuel targets should be reflected in UK policy and determine how low carbon fuels can help reduce greenhouse gas emissions from UK transport in the period to 2030 and beyond.

Transport is a major source of greenhouse gases. Around a quarter of domestic carbon dioxide (CO_2) and other greenhouse gas emissions in the UK come from transport. Reducing greenhouse gases from transport will help the UK achieve its long-term goal of reducing the greenhouse gas emissions by at least 80% compared to 1990 levels by 2050. Biofuels can help reduce greenhouse gas emissions from transport but it is important that unintended impacts are avoided, such as indirect land use change.

Indirect land use change (ILUC) occurs when a crop previously used for food or feed is redirected to fuel markets, causing a market deficit and resulting in land elsewhere being brought into production to compensate. This can result in increased carbon emissions as it is predicted that land use change such as deforestation occurs to facilitate the increased demand for land. Accounting for ILUC using ILUC 'factors' significantly increases emissions for scenarios where high volumes of crop biofuels are used. However, there is a high degree of uncertainty on the extent of ILUC effects, and in consequence there are different views amongst stakeholders on appropriate ways to address the issue.

The Task Force was asked to identify and assess options to decarbonise transport energy by providing expertise from a broad stakeholder group. The Task Force explored the potential for building broad consensus amongst stakeholders on the role transport energy could play and how this could be delivered, and provided advice and input to future work commissioned by Government with respect to road transport energy policy, if required.

This document has been developed in consultation with members of the Transport Energy Task Force. It contains views and information from a range of sources including industry experts, government departments and published research. A series of working groups collected evidence and made recommendations on specific issues and a high level group considered the evidence and directed the drafting of the final report which reflects the broad consensus of the group. Where consensus wasn't achieved the variety of views are reflected in the document.

The Task Force first met on 29 September 2014 and delivered its findings to the Department for Transport in March 2015.

Key Messages

The Transport Energy Task Force was established to consider how to decarbonise transport energy, however the group ***agreed*** that continuing effort on energy efficiency and demand management will also be important in decarbonising transport.

The following key messages arising from the work undertaken by the Task Force are intended to be viewed as a coherent set that are read and interpreted together.

Reducing greenhouse gas (GHG) emissions now and in the future

Transport energy can and should make a significant contribution to GHG savings particularly in the longer term. Electrification of transport is a cornerstone of current policy to reduce carbon emissions from transport energy. We ***agreed*** that actions to ramp up the adoption of electric vehicles should be continued to increase energy efficiency and decarbonise transport energy. Because electrification will take time and may not be effective in all transport sectors, ***we agreed*** that there will be an opportunity for the foreseeable future for sustainable biofuels to play a role towards the achievement of deep reductions in carbon from transport.

Focus on pathway to 2030 goals and align delivery of 2020 targets with that pathway

The Renewable Energy and Fuel Quality Directive targets for 2020 are challenging and not necessarily consistent with the longer term GHG and sustainability aspirations. ***We agreed*** the pathway to delivery of GHG emission reductions in 2020 needs to be consistent with that for the UK's goals for 2030. ***We agreed*** that the 2030 goals should include a focus on securing the greatest possible cost effective GHG emission reductions from transport energy, and providing greater certainty about the sustainability of all fuels.

Adopt options which minimise risk and uncertainty

We agreed that the deployment strategy for replacement fuels and blends must ensure that fuel supply remains fit for purpose for use with available vehicles and infrastructure. All options available contain risks and uncertainty, but ***we agreed*** that we should focus on adopting policy where risks can be mitigated and options exist to manage uncertainties. There were varying views on the best way forward, and some members disagreed on whether the targets were achievable or desirable. However, if the UK Government wishes to meet the EU 2020 transport targets there are two measures which would probably be necessary to achieve them.

We agreed that displacing petrol with higher bioethanol levels (E10: bioethanol made from crops or wastes/residues, and blended in petrol above 5% and up to 10%) would probably be required to meet the RED target in the petrol market. The majority of petrol vehicles are currently compatible with E10 and the UK has three bioethanol facilities offering fuels with lower ILUC risks than crop biodiesel. There are risks around market acceptance, which can be mitigated by learning the lessons of roll-outs in other countries. Some members had concerns around locking in unsustainable crop based fuels, and they considered that E10 should not be introduced until there were further measures in place to ensure sustainability, mitigate food price impacts and support advanced biofuels.

We agreed that displacing diesel with high levels of waste and residue derived biodiesel (using B7) would be preferred over crop derived biodiesel in meeting the RED target in the diesel market. There are uncertainties regarding the availability of sufficient supply of waste and residues, and concerns around maintaining fuel quality. These would need to be monitored and actively pursued by industry.

Longer term, the UK is currently well placed to move both petrol and diesel biofuels towards more advanced and sustainable supplies based upon the knowledge and investments of domestic producers.

There was support for consistent sustainability definitions across all energy sectors which use biomass and we considered that the UK is well-placed to continue to lead this debate.

Become progressively more sustainable

We agreed the need for the UK to work towards and champion a robust and consistent definition of 'sustainability' which is stable and evolves predictably over time. A risk based approach may enable progress to be made as the definitions and systems are better understood and developed to identify feedstocks from local areas or specific sites which are demonstrably at low or no risk of causing ILUC or competition with food production. This should be introduced as soon as possible post-2020. ***We agreed*** that until such a sustainability system can be assured, an appropriate crop cap combined with a minimum GHG saving threshold could be used to limit potentially unsustainable crop based biofuels. There were a range of views on what level at which a crop cap should be set. The report includes a range of scenarios and the potential associated implications for complying with the EU 2020 target*s*, including scenarios without increased crop based fuels.

Build on the current position to create UK success and deliver 2030 objectives

We agree that the UK should invest in sustainable advanced fuels to deliver increased energy security, industrial growth, skills and jobs, and that there are a number of routes to achieve this objective. Investment in completely new facilities is one pathway and extending incentive mechanisms to sectors such as aviation and maritime could widen the pool of potential investors. There are also opportunities to build on existing investments such as adding advanced capacity to the current UK ethanol industry that could offer a more cost effective solution.

We agreed that the commercialisation of sustainable advanced biofuels should be a priority for meeting 2030 goals, and that mobilising investment will be vital to achieving this. Long-term confidence is required to stimulate this investment. **We agreed** that the adoption of a target for sustainable advanced biofuels would contribute to this goal, but that additional complementary policies such as fiscal and capital support may be needed to accelerate commercialisation.

The Key Messages are drawn from the detailed findings and recommendations of the Transport Energy Task Force which are presented in the Conclusions at the end of the report.

Working Group 1: Evidence and Modelling

The key task for Working Group 1 was to examine the evidence base surrounding the potential uptake and supply of biofuels, and to assess the robustness of data and modelling.

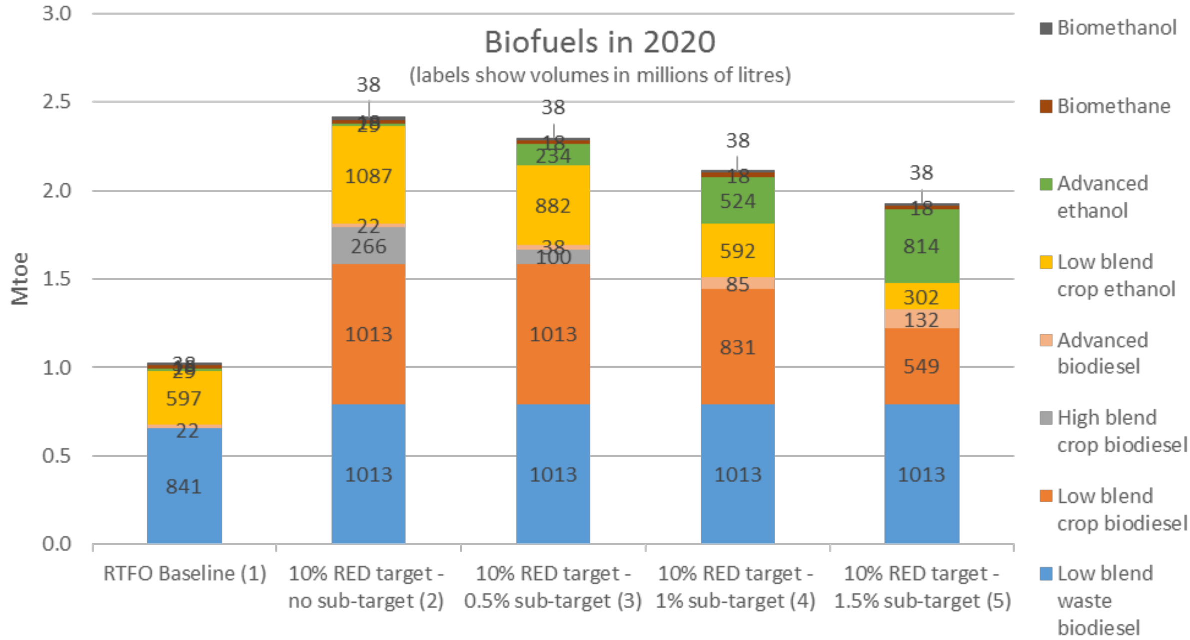
Key findings

Overall, the group concluded that:

- If targets are increased under the current RTFO to meet the RED target, then the central scenarios developed in the Task Force indicated that suppliers could meet their obligations with:
    - An increased uptake of crop biodiesel to 2020.
    - An increase in ethanol supply including the introduction of E10.
    - Each with associated ILUC risks.

- The RED target could be met with varying contributions of crop and waste based biofuels depending on the policy options chosen and wider market issues.
- An advanced biofuel targets of around 0.5% may be achievable by 2020, whilst higher levels are unlikely in this period. There is greater scope for advanced biofuels to 2030.
- It is not expected that the volume of biofuels supplied to meet the RED target will be sufficient to meet all of the 6% reduction in carbon intensity of transport fuel by 2020, as required by the Fuel Quality Directive (FQD).
- Fossil derived liquid transport fuels, including for road vehicles, are expected to still be dominant in 2030. Sustainable biofuel supply would be expected to displace fossil fuels.

RED to 2020



			10% RED Target, Central Waste			
		RTFO Baseline (1)	No sub-target (2)	0.5% sub-target (3)	1% sub-target (4)	1.5% sub-target (5)
Additional cost in 2020 (total)	**£m, 2014**	361	694	742	834	934
Additional cost (per MWh)	**£/MWh**	30	25	28	34	42
Reduction in emissions	**MTCO2e**	2.7	3.5	3.7	4	4.3
Abatement cost	**£/tCO2**	133	197	201	208	216
Crop %	**%**	0.82	4.22	3.58	2.58	1.58

(See Annex A for the biofuel cost projections used to inform the cost-benefit modelling.)

NB – Sub-targets refer to advanced biofuels by % of total transport energy. RTFO Baseline assumes no change in current policy. All scenarios, except 1 and 4, include E10 deployment. It should also be noted that scenarios 2 to 5 assume the RED target is met; some have highlighted the risk that it is not met. Total transport energy (for the purposes of the RED) in 2020 is predicted to be 36.9Mtoe (429TWh, or 1543PJ).

A range of scenarios were developed for the Task Force due to inherent uncertainties, particularly around the availability of waste oils and fats for biodiesel. The full range of scenarios developed, including high and low waste scenarios can be found in Annex B and on the LowCVP website.

Though the RED mandates that 10% of transport fuel energy be renewable in 2020, we expect that the effective level required to meet the legal target will be lower (around 7% including electricity) due to provisions in the directive for multiple-counting of electricity and waste derived fuel.

Further points the group discussed:

- **Waste biodiesel:** There was disagreement over how much waste biodiesel would be available in 2020. Some argued that foreign demand for feedstocks as 2020 approached would limit UK supply, while others believed that there would be enough to provide B7 without recourse to crop biodiesel. It was noted that the double-counting of waste biodiesel would provide incentives to supply even at a very high (up to 60p/litre) premium over fossil diesel, though this could create the potential for fraud. For the central scenario, the model assumes that half of B7 (approx. 1bn litres) would be met through wastes.

- **E10:** It was generally agreed that, without very high levels of waste biodiesel, E10 would be likely to be deployed towards meeting the RED target in 2020. It was noted that this would be difficult, however, due to public acceptance issues, and government support would be key. Butanol could extend renewable content supply beyond E10, but there is no evidence of how much would be available by 2020.

- **High blend biodiesel:** The ability of the market to absorb high blend biodiesel (defined as biodiesel blended above 7%, or used unblended) was questioned. This was an especial concern for the low waste scenarios, as these imply a high uptake of high blend crop biodiesel being required to meet the target. As this has been modelled as the ‘biofuel of last resort’, it is unclear how or whether the RED target would be met in a low-waste scenario. Hydro-treated Vegetable Oil (HVO) could provide a drop-in biodiesel given sufficient demand, though supply may be limited.

- **Advanced biofuels:** The availability of advanced biofuels, which are expected to be largely waste-derived and provide considerable GHG savings, was considered limited to around 0.5% by energy in 2020, and likely to be dominantly ethanol rather than biodiesel. As the advanced biofuel industry requires considerable up front capital investment, and are consequently more expensive than conventional biofuels, the group agreed that it will be important to provide long-term investor certainty if we wish these fuels to come online.

FQD to 2020

It is unlikely that the UK will be able to meet the 6% reduction in the carbon intensity of fuels by 2020, mandated by the FQD, using biofuels alone.

FQD 2020	gCO2e/MJ	% fall
Target emissions (2015 FQD amendment)	88.45	6.0%
RTFO Baseline	91.7	2.6%
10% - no sub-target	89.4	4.9%
10% - 0.5% sub-target	89.6	4.8%
10% - 1.0% sub-target	89.8	4.6%
10% - 1.5% sub-target	89.9	4.4%

NB – Target emissions are based on a 6% fall against a fossil-fuel baseline of 94.1 gCO2e/MJ.

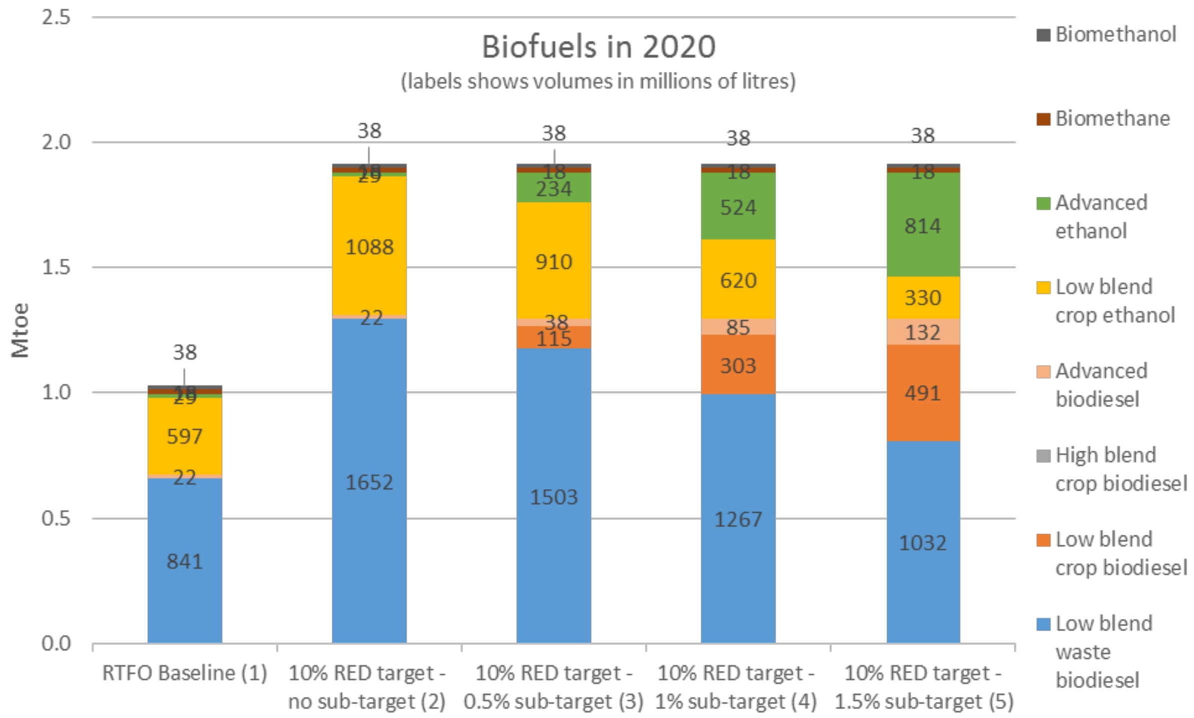
As shown in the table above, the central scenario (0.5% sub-target) only provides a 4.8% fall. It is likely that the remainder will need to be made through upstream emissions credits, provided for in the FQD, though it is still currently unclear precisely how these will work.

Crop Cap

In the EU, in order to address concerns around ILUC, revisions to the RED have been proposed that would introduce a cap on the contribution that crop based fuels can make to meet the 2020 target. The level of cap has proved highly contentious with various proposals between 5 and 7% by energy being proposed. Central scenarios of biofuel supply modelled for WG1 anticipate a crop share below 5%, and no scenarios exceed 7%.

Some Task Force members considered that the cap proposed at EU level was too high. They proposed a cap on crops at current levels, which would mean a cap at around 1.38% of total transport energy in 2020 for the UK.

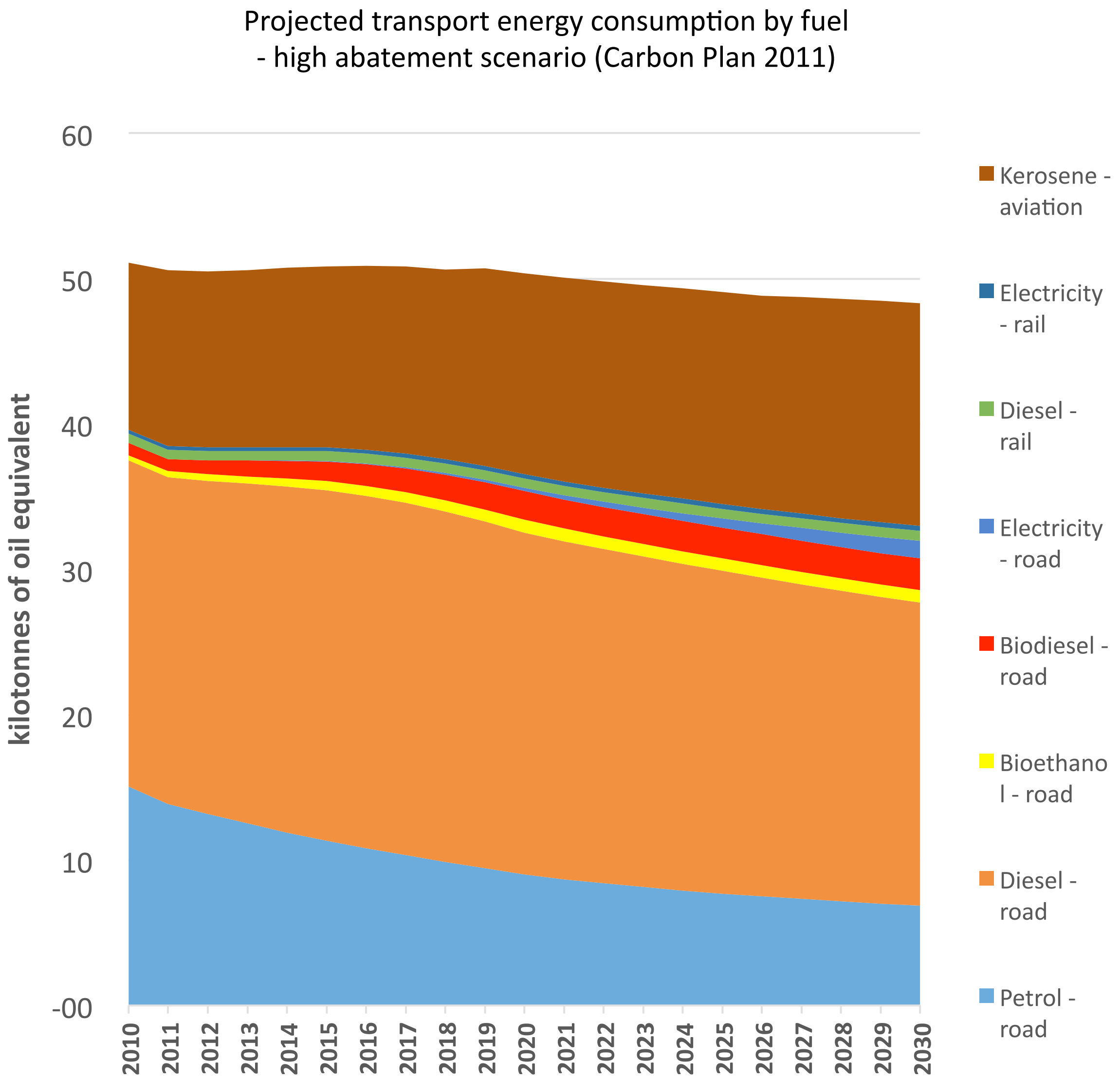
The scenarios below illustrate a crop cap at 1.5%. These illustrate that very high levels of waste biodiesel would be necessary under such a constraint, which some stakeholders felt was unrealistic. It was noted that a cap at around 1.5% could allow for deployment of E10 (anticipated to be 1.5 – 2% of transport energy in 2020), provided that crops were deployed mainly in ethanol rather than biodiesel. The UK ethanol industry at current capacity would be equivalent to under 1.25% of transport energy in 2020, and therefore within a low cap, but there were concerns about the effect such a cap could have on the UK ethanol industry. There were also concerns that a low cap would restrict fuel supply options and potentially increase prices.



			10% RED Target, Crop Cap			
		RTFO Baseline (1)	No sub-target (2)	0.5% sub-target (3)	1% sub-target (4)	1.5% sub-target (5)
Additional cost in 2020 (total)	**£m, 2014**	361	663	706	1032	920
Additional cost (per MWh)	**£/MWh**	30	30	32	46	41
Reduction in emissions	**MTCO2e**	2.7	5	4.9	4.6	4.4
Abatement cost	**£/tCO2**	133	131	145	180	211
Crop %	**%**	0.82	1.5	1.5	1.5	1.5

(See Annex A for the biofuel cost projections used to inform the cost-benefit modelling.)

Biofuels to 2030



As the above chart shows, even under high electrification scenarios consistent with meeting future carbon budgets, we expect liquid transport fuels to still be dominant in 2030. Although partially due to the higher efficiency of electric vehicles, this nonetheless shows that sustainable biofuels can make a considerable contribution to the decarbonisation of transport. This would need to be weighed up against the possibilities for equivalent savings to be made in other areas.

The UK has more options to 2030, as we do not have a specific EU renewable transport target to meet. We also expect advanced biofuels to be available in greater quantity, though to what degree is highly uncertain.

Higher ethanol blends, in particular E20, would be possible to 2030, and may offer considerable GHG savings. However, the UK would need to begin preparing for this in the next few years to roll this out this would include the development of internationally recognised fuel standards.

Working Group 2:
Sustainability & Policy Objectives

The key task for WG2 was to set out potential objectives for transport fuel policy to 2030 and to examine and agree definitions of biofuel sustainability and advanced biofuels.

Key Findings

The key findings of the group were:

- It was recognised that liquid fuels would be dominant in the transport sector in 2030
- Biofuels are a viable option to replace some fossil fuels and provide carbon savings to 2030. However, careful assessment would be required to determine where carbon savings could most effectively be achieved, including other sectors of the economy.
- Biofuels can be sustainable with careful application and auditing of sustainability monitoring measures.
- 'Advanced' biofuels are those using non-conventional technologies that can convert non-food crop biomass including wastes and residues into biofuel and deliver substantive GHG savings even when ILUC is included.
- "Advanced" biofuels are not inherently sustainable – sustainability depends on the feedstock actually used
- Though subject to questions of availability, wastes were considered to be a lower risk feedstock than land using feedstocks for the production of advanced biofuels.
- The sustainability of land using feedstocks can vary greatly. There are low risk land using feedstocks, but a robust and effective mechanism would be required for their use to be widely supported.
- There is disagreement about the sustainability of crop based biofuels and whether they should be used beyond current levels.
- Sustainable advanced biofuels should be encouraged. A 0.5% advanced biofuels sub-target was considered a useful development, though some members questioned whether it is achievable.

These findings are set out in more detail below.

A role for biofuels?

- Even under optimistic scenarios for road transport electrification and ongoing improvements in vehicle efficiency, it was recognised that liquid fuels would be dominant in the transport sector in 2030. Some Task Force members concluded that sustainable biofuels would be necessary to achieve the Government's carbon budgets. Other members took the view that whilst biofuels should not be ruled out as an option, equivalent carbon savings might be better achieved in other areas outside of the transport sector.

- In the longer term towards 2050, aviation, road haulage (including buses) and shipping in particular would continue to use liquid fuels, implying a need for low carbon alternatives to incumbent fossil derived sources.

Sustainability

- Most stakeholders agree that to be considered sustainable, biofuels should at least meet the following conditions:

    - be produced in line with RED/FQD sustainability criteria
    - pose low impacts on carbon stocks, soil, air, water and biodiversity
    - deliver significant GHG savings (though with different views as to whether ILUC should be taken into account, for example through ILUC factors)

  Additionally, the claims made concerning sustainability should be subject to verification.

- For some stakeholders, social sustainability was also important. Social sustainability criteria could include minimal impacts on food security, protection of land rights and guarantee of workers' rights in the production chain.
- Some stakeholders also considered that feedstocks used to produce biofuels should not compete with other uses including food production. There were different views on whether, under what conditions, and the extent to which crop based biofuels compete with food production. Some stakeholders highlighted that biofuels could provide food and fuel, for example by producing high value animal feed protein, and also contribute to improving farm income.
- There was also a view that a common framework for sustainability for bioenergy should be applied across all energy sectors.

Advanced biofuels

- It was generally agreed that 'advanced' biofuels are those using non-conventional technologies that can convert non-food crop biomass into biofuel. There were divergent views on whether it was appropriate and in what circumstances for energy crops, such as miscanthus, to be used for advanced fuels. There were also varying views on whether the definition of 'advanced' fuels should be limited to technologies at a particular stage of development and whether there is a fuel quality component.
- There was agreement that biofuels using 'advanced' technologies do not necessarily equate to 'sustainable' biofuels. For example, a number of feedstocks that can be converted by advanced technologies have alternative uses and if these feedstocks are consumed in the biofuel sector there may be unsustainable 'indirect' displacement effects.

- It was agreed that the type of advanced biofuels that should be encouraged are those offering high GHG savings even when ILUC factors are included.
- There was a degree of consensus that developing sustainable advanced biofuels technology should be supported and developed even if precise targets were not agreed.

Biofuels to 2030

Scenarios modelled in WG1 illustrated that (predominantly liquid) fossil fuels would remain dominant in the transport sector in 2030 and a significant source of carbon emissions. Some Task Force members concluded that there should therefore be a role for sustainable biofuels to 2030 as a necessary component of the Government's carbon reduction commitments given the embedded liquid fuel infrastructure. Some took the view that there should be further assessment of carbon mitigation options in transport and other sectors to ensure the best and most cost effective options are pursued.

Given the long timescales, differing viewpoints and high potential for variables, WG2 did not consider a specific target for biofuels to 2030. It was noted that the Government's approach to identifying costing and reviewing carbon savings options, within and across sectors, are conducted through the carbon budget process.[1] The carbon budget currently assumes an 8% by energy contribution from biofuels between 2020 and 2027.

Wastes and residues

Biofuels derived from appropriately certified wastes and residues were considered likely to be more sustainable. Sustainability criteria and effective monitoring would be needed however, to ensure that only appropriate wastes and residues were used and at appropriate levels, in particular that their use did not result in negative displacement effects. It was noted that competition for waste and residue feedstocks in a number of sectors including other energy uses could be expected to increase, with consequences on availability, cost and the impact of their use for transport fuels. It would therefore be important for the Government to determine relative priorities for the use of such feedstocks as well as improving data capture on such feedstocks produced and consumed within the UK.

A study on EU availability of wastes and residues as biofuel feedstocks was considered; it indicated that there is enough resource sustainably available for up to 16% of EU transport fuel to be derived from waste in 2030. However, it was noted that not all of these feedstocks would be economic to collect, and that for plants to be viable feedstock would need to be concentrated geographically and that there may be growth in competition from other biomass users. It was suggested therefore that a more realistic figure for an achievable level of supply in 2030 might be half that number or even lower.

1 https://www.gov.uk/government/policies/reducing-the-uk-s-greenhouse-gas-emissions-by-80-by-2050/supporting-pages/carbon-budgets

Land using feedstocks

Biofuels derived from feedstocks using land, whether in the form of energy crops or other crops, were considered to have some risk of indirect effects. However, the level of risk and potential impact could vary significantly by feedstock and location. Views on an appropriate role for land based feedstocks in 2030 were mixed. For some they should only be used in limited circumstances. It was noted that this presented significant challenges. Others felt that such a constraint on land based biofuels unnecessarily excluded some feedstocks that might deliver GHG savings at levels necessary to satisfy RED and FQD standards, as well as other benefits.

Some members considered that:

- Demonstrating sustainability on a local level through auditing land using feedstocks could be acceptable as long as sustainability is demonstrated and verified at local level (there were significantly differing views on this within the group).
- Where biofuels produce food/feed co-products this needs to be taken fully into account when considering land use.

It was noted that existing ILUC models already include a treatment of these co-products, but some stakeholders felt this treatment could be improved.

Biofuels to 2020

There was agreement that the UK Government's transport biofuels policy to 2020 should put an emphasis on 2030 objectives including carbon reduction commitments. There were differing views on how and whether the 2020 targets should be met. Some members considered that the UK should not meet the EU targets for 2020 if they could not be achieved sustainably. **It was noted that the UK has a legal requirement to meet the targets. Further, failing to do so may lead to infraction proceedings which could result in the UK being subject to very substantial fines.**

Other members noted that there are challenges in meeting 2020 targets, including the following:

- Available time to implement changes to the RTFO ahead of 2020.
- Customer acceptance of E10.
- Potential over-obligation of the UK market if the majority of low sulphur gas oil continues to be counted as NRMM under the RTFO.
- Global availability of verifiable waste feedstocks faced with increasing demand for waste based biofuels in Europe.
- Uncertainty over UK electric vehicle (EV) take-up, the ratio of battery electric vehicles (BEV) to Plug-in Hybrid Electric Vehicles (PHEV) in the EV mix and the renewable content of electricity supply.

Scenarios developed in Working Group 1 of the Task Force for 2020 indicate that in the absence of additional policy measures, a significant expansion in crop based biofuels in the period to 2020 could be expected, from under 2% of transport fuel supply in Year 6 of the RTFO to around 4% under a central scenario. This was anticipated to mainly comprise of crop based biodiesel.

Some stakeholders considered that crop based biofuels should not be expanded beyond current levels, and that their use should be phased out after 2020 due to ILUC and potential impacts on food prices.

Other stakeholders considered that crop-based biofuels provide other benefits, e.g. by providing an alternative market for feedstocks they could reduce market volatility for farmers. These stakeholders believe that some crop-based fuels deliver environmental benefits, that impacts on food price may have been overstated and that any overall impacts on food markets are acceptable in the context of delivering emissions reductions. In the UK, the production of crop based biofuels has provided investment and supports jobs.

An **advanced sub-target** of 0.5% to 2020 was generally considered a useful development and consistent with anticipated post-2020 policy. However, some members were sceptical whether 0.5% was realistic given there was little evidence presented that there would be sufficient volumes of these fuels commercially available in the UK by 2020, especially if the EU and other Member States set similar binding targets. There were also concerns about the time required to put in place the necessary legislation and the lead time for investment.

Working Group 3:
Policy and Investment Certainty

Purpose of Working Group 3

The purpose of Working Group 3 was to consider the policy measures required to meet the EU Renewable Energy Directive transport fuels target for 2020 and how to provide confidence to investors and the wider stakeholder community in relation to renewable transport fuels over the time horizon to 2030.

Particular attention was given to how the Renewable Transport Fuels Obligation (RTFO) as the current key policy instrument in this arena could be adapted to both meet the GHG reduction goal for 2030 and provide investment certainty to 2030. Its merits and limitations were considered alongside other possible approaches.

Key Findings

Overall the group concluded:

- Investment certainty is predicated on having reasonably clear demand for the product. There are many factors which affect investment confidence but there are no quick fixes and confidence will need to be rebuilt with predictable long-term and stable policies.
- Sustainability of individual feedstocks and supply chains need to be agreed and remain unchanged for the duration of the policy. The group called for a robust definition of sustainability for relevant feedstocks to be prioritised at EU level, with the UK using the discretion available to it in due course.
- Securing investment in advanced biofuels will require more than a sub-target for advanced fuels, including capital and fiscal support. Fiscal measures should be time bound and only to support new fuels in their development phase.
- To ensure policy is effective there needs to be a consistent public policy approach to incentivising feedstocks for use across the economy including the heat and power sector.
- There was broad support to the principle of moving towards a policy for 2030 which was based broadly on maximising GHG emission reductions, and retaining the RTFO as the principle policy mechanism.
- The group recognised that ILUC and sustainability issues needed to be addressed and in particular appropriate action to address the issue of competition for land for production of food and fuels.
- The UK should also seek to secure economic benefits from developing this market in terms of skills, intellectual property, employment and inward investment.
- It was considered that first generation biofuel plants in the UK offer economic and environmental benefits, and may offer a cost effective route to securing advanced biofuels. This should be taken into account in future policy development, including options to secure these investments.

- There was a considerable level of support for incorporating aviation and maritime renewable fuels into the RTFO. There were differing views on whether this should be on an obligated basis.
- Where targets are set there should continue to be alternative compliance mechanisms available which could, for example, include carry over, trading of certificates or buyouts.

The points raised by the working group are discussed in detail below.

Conclusions

While there was agreement on what issues need to be resolved to provide investor confidence, there were differences of opinion and uncertainty within the group as to how various specific issues were best tackled and over what timeframe. For this reason, the conclusions are presented as a combination of broad consensus together with some options.

Investment certainty

Investment certainty is predicated on having reasonably clear demand for the product. The more certain that demand, the greater the investment confidence. Investment in many of the relevant technologies is currently being inhibited by policy uncertainty. Greater clarity in policy between now and 2030 was seen as critical if new investment is to flow. However, there are also many aspects to creating market demand for specific fuels which also need to be taken into account. Several key issues to increase investor certainty were identified:

- **Sustainability of individual feedstocks and supply chains needs to be as clear as possible** - The definition of sustainability is central to providing greater investment certainty not least with respect to wastes and residues. (The sustainability and availability of Annex IX listed feedstocks may vary significantly for example and standards need to be developed at EU level as soon as possible. After 2020, it is unclear whether Member States will be permitted to set their own sustainability standards if they wish and this too needs to be clarified well in advance of 2020). The complexity of defining when a waste becomes a product creates a significant source of uncertainty which should be mitigated by clarification in EC legislation if possible.

The group recommended that a robust definition of sustainability for relevant feedstocks should be prioritised at EU level, with the UK using the discretion available to it in due course.

- **Timing and longevity** – The timing and longevity of policy regarding its introduction, review points and revision are critical parameters required to make commercial business case decisions in the supply chain.
- **Mandates are not enough** – Mandates provide a relatively high level of certainty, creating robust ways of delivering core value from investments but are not necessarily sufficient for accelerating domestic investment in advanced fuels.
- **Sub-targets for advanced fuels** – May be an achievable but challenging method to promote specific streams of production at lower scale; however, long-term clarity is still required to define the trajectory for the sub-target.

- **Early market support for advanced fuels** - Appropriate fiscal and capital support almost certainly would be important for accelerating investment in advanced fuels
- **Capital support** – could consist of support for first demonstration projects. Support for some development of certain feedstock supply chains (e.g. collecting wastes/residues) would also be likely to be needed but should not be continued for too long. The Green Investment Bank is potentially a valuable source of targeted support but may need specific encouragement from Government.
- **Increasing certainty about feedstocks** – availability and supply volumes as well as sustainability standards need to be clarified as much as possible. Continued and intensified research in this area is seen as a priority, taking account of changing policy and market dynamics.
- **Split mandate** – was identified by some members as a route to create a greater level of certainty of demand than a broad biofuel mandate, which allows the type of fuel supply to fluctuate widely based on economics. However, obligated suppliers preferred the flexibility of a broad mandate in order to provide lowest cost to the consumer.
- **Managing ILUC** - The questions surrounding ILUC and its treatment in policy were identified as critical to certainty, but there were varying views about how far the issue needed to be addressed. Some members of the group were interested in exploring the principle of utilising a 'banding' system for feedstocks / fuels according to the level of ILUC risk.
- **Demand side GHG policy** – encouraging the purchase of sustainable biofuels by the fuel users, (for example through carbon reduction targets) would potentially enable high blend biofuel uptake in suitable fleets with depot based refuelling.

Advanced Biofuels

To secure sufficient investment in advanced biofuel research, development, demonstration and production is likely to require additional measures, including support through funding mechanisms such as EPSRC, Innovate UK and alignment with the Advanced Propulsion Centre's support for ultra-low carbon vehicles and fuels.

If there is to be investment in advanced fuels then it is vital that there is a consistent public policy approach to incentivising feedstocks for use across the economy. Most notably the incentives under the Renewable Heat Incentive (RHI) scheme are more generous than incentives under the RTFO and offer more certainty, making it unlikely that certain feedstocks will be deployed for transport fuels.

Continuity

Continuity of policy was seen as important for investment confidence. In this context 5 years was considered too short a period, while 10 years would be sufficient for mature technologies, and 15 years was seen as generally more appropriate for advanced fuels where investment is needed in development as well as production. It is therefore vital that a clear vision of fuel policy to 2030 is developed and set out in a policy document such as a roadmap. Greater policy certainty can make biofuels more cost competitive, but they are unlikely to be able to compete with fossil fuels.

Climate Change Mitigation and advanced fuels

As Working Group 2 has set out that climate change mitigation should be the primary focus of policy on transport fuels, this needs to be taken into account in the RTFO or its successor. This principle applies to the aviation and marine sectors as well as road transport.

This has a number of implications for policy mechanisms, both in the period to 2030 and in the shorter term to 2020. Most of the group were sympathetic to the principle of moving towards a policy for 2030 which was based broadly on maximising GHG emission reductions rather than incentivising specific volumes of a fuel but the timing of a transition and the mechanisms deployed need further examination.

The RTFO

Although a number of alternative mechanisms or approaches to the RTFO scheme were considered, there was broad support for retaining the RTFO and adapting it. For example, it can be reconfigured to deliver GHG targets relatively easily, and building on a current mechanism avoids the time delay and uncertainty of developing a new mechanism which might require primary legislation. The RTFO generally is seen as fit for purpose and well understood by industry although there are difficulties in adjusting it in ways designed to meet the dual RED and FQD targets in 2020. However, the group did not conclude whether the RTFO should remain an obligation based scheme or move to a reward type scheme. Either way, additional policy instruments will be required, to create sufficient incentives for scaling up advanced biofuels, almost certainly including a (national) sub-target for 2030 (or thereabouts) or equivalent rewards. A re-tooled RTFO could include appropriate incentive mechanisms for advanced biofuels.

Tackling ILUC and Sustainability

The group recognised that ILUC and sustainability issues needed to be addressed and in particular ILUC appropriate action to address the issue of competition for land for production of food and fuels. This was seen as being vital in terms of securing environmental and societal benefits and also in providing investor certainty. A number of options were considered in this regard but no firm conclusions were agreed. The ability to undertake action prior to 2020 is constrained by the existing directives and the proposed amendments to these directives.

Crop Cap

The implementation of a cap on crop based fuels was recognised as a likely future requirement in the UK due to the provisions of the ILUC Directive, but no specific models were discussed. However, a crop cap was seen as a blunt mechanism due to its inability to distinguish between land based feedstocks with differing ILUC or sustainability risk. Current producers were concerned about the implications of a lower crop cap than the ILUC Directive would require or a ban on land based biofuels, as this would have negative impacts in relation to investor certainty, employment in the UK and possibly foregoing low ILUC risk feedstocks.[2]

[2] In 2013/14 1,310 million litres of renewable fuel were supplied under the RTFO, which is 3.45% of total road and non-road mobile machinery fuel market. 23% of this fuel was sourced from UK feedstocks. The aggregate greenhouse gas saving of 70% compared to fossil fuels was achieved, excluding emissions from ILUC. Even with ILUC factors applied some feedstocks can achieve significant reductions in GHG compared to fossil fuels.

ILUC

ILUC factors are an alternative mechanism to a crop cap. The use of ILUC factors was seen as problematic by many investors as they are susceptible to revision and the outputs of modelling ILUC impacts can change significantly. They would not provide investor confidence unless fixed over a long time horizon or over the life of an investment.

There was some support for an alternative approach of banding feedstocks according to the level of ILUC risk, and excluding that group which represents an unacceptable level of risk. The mechanisms for achieving this would need to be investigated further. While the categorisation of a feedstock should be open to review, the time horizon for any change in the categorisation of a feedstock or banding should be limited sufficiently to reduce risk to investors.

Sustainability

Biofuel feedstocks have the potential to have a positive impact on sustainability, depending on where and how they are grown. Feedstocks which have a positive impact on sustainability should be encouraged, while feedstocks with a negative impact equally should be discouraged. A system to do this would need to take account of the environment in which the feedstock was being produced. The use of regional or project-based schemes to assess the risk of sustainability impacts could provide the basis for such a mechanism and should be considered in more depth, as noted in WG2.

Wastes and residues

There is currently great interest in producing fuels from wastes and residues (‘wastes’). There is concern that ‘indirect effects’ could also result from the use of ‘wastes’ that have alternative uses. Clarity on what is or is not a waste and how a waste is treated is required as it represents a considerable risk to investors looking at advanced fuel investments. The treatment of wastes should be considered now as part of any solution to manage ILUC and sustainability risks.

The UK has pioneered an informed logic to identify waste feedstocks between government and industry. This permits new innovative waste and residue technologies and supply chains to be considered for inclusion which has helped provide investor certainty.

It should also be noted that the revised EU Waste Framework Directive (rWFD) defines ‘waste’ and sets out the waste hierarchy, which organisations are legally required to apply in order of priority in the treatment and use of waste and residues: (a) prevention; (b) preparing for re-use; (c) recycling; (d) other recovery, e.g. energy recovery; and (e) disposal.

Securing economic benefits for the UK

The UK should play a leadership role in tackling climate change and sustainability from transport fuels through creating demand for low carbon sustainable fuels. However, the UK should also seek to secure economic benefits from developing this market in terms of skills, intellectual property, employment and inward investment.

There has been considerable investment in a number of first generation bioethanol and biodiesel plants in the UK providing a combined capacity of 1,725 million litres of biofuel, direct employment for 900 people with investments ranging from £50m to £350m for the four largest plants[3], based on the RTFO. In addition to direct employment, each processing plant supports a larger number of indirect jobs in the supply chain. Vivergo and Ensus have estimated their bioethanol plants together employ 250 people directly while they estimate they support around 8,000 jobs in the UK.

Building on existing investments

In addition to offering employment and a source of low carbon biofuel for domestic and export markets they may also offer an attractive route to developing advanced fuels at a lower capital cost. Existing bioethanol plants potentially can be modified to produce advanced fuels at a lower capital cost than investing in a green field site. This is due to much of the downstream plant being the same for both advanced and first generation biofuels, with the investment for handling advanced biofuels required upstream in the production process. There is also potential to improve the carbon footprint of existing plants through supply chains, plant efficiency and power if there is sufficient incentive for investment.

Evolution of the RTFO

The group considered whether the RTFO was the most appropriate policy tool for meeting the main objectives for low GHG transport fuels and how it should evolve.

- Pre-2020 it was agreed that there is no practical replacement for the RTFO and that any amendments would need to be done in conjunction with those required to implement the revisions to the Directives.
- Post-2020 there were more options for revising the policy mechanism, however modification of the RTFO was seen as the most attractive way forward.

Developing legislation to 2020

Anticipated revisions to the RED later this year and agreed amendments to the FQD need to be transposed into UK legislation in the next two years. This will not be a trivial exercise and may take 18 months to over two years to implement, possibly over two legislative waves, and will take a significant proportion of the DfT Low Carbon Fuel team's capacity. Other changes need to be synchronised with this requirement.

The RTFO should also be consistent with the RED, to allow any biofuels in all forms of transport (including Aviation and Marine) to count towards the numerator, and to include road transport fuels and rail volume only in the denominator.

Table 1 illustrates the expected legislative requirements and associated DfT workload to implement anticipated changes from the forthcoming FQD 7a (on GHG accounting of fossil fuels) and the ILUC amendments to the RED and FQD. FQD 7a is anticipated to be formally adopted in March with a 24 month implementation period i.e. by March 2017. The timing of the proposed ILUC related amendments is less certain.

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[3] UK biofuel industry overview 2013, Ecofys commissioned by DfT identified nine large scale biofuel plants in the UK.

Table 1 Legislative amendments anticipated to be required by changes to RED and FQD

Note the lead time indicates the approximate time it would take to implement legislation once a decision has been made to initiate the consultation process.

Likely lead time needed	Policy option	Policy aim
18-24 month	Change the obligation level in current RTFO	1) Meeting RED target 2) Meeting FQD target
	Implementing reporting aspects of the FQD7a	Required under FQD
>2 year	Non biological low carbon fuels* (currently not included in RTFO)	1) Maximising GHG savings 2) Limit ILUC impacts 3) Deployment of advanced biofuels
	Sub-targets for advanced	Deployment of advanced biofuels
	Implement a crop cap	Limit ILUC impacts
	GHG scheme - joint reporting by suppliers (required but note possible issues with competition law which will need resolving)	Required under FQD
	Upstream emissions reductions (into FQD GHG reduction scheme, not RED energy scheme)	1) Meeting FQD target 2) Required under FQD

*Careful consideration of the definition and GHG accounting measures will be needed.

In addition it should be noted that Working Group 4 considered policy options to support the market demand for specific fuels and Working Group 5 considered policy to support the introduction of alternative fuels.

Assuming two ‘bundles’ of legislative measures by 2017 / 2018, a third stage of legislation will probably be required subsequently to put measures for 2030 in place.

<u>Approaching 2020: should the RTFO deliver the RED or FQD?</u>

A key issue has become apparent in that the RTFO may not be capable of delivering both the RED transport target, which is focused on volume/energy, and the FQD 6% GHG target. The reasons include: the introduction of multiple counting, upstream GHG savings and more aggressive dieselisation in UK than anticipated. There is now a risk of a considerable undershoot on the FQD. The LowCVP conducted an extensive study of the potential for the RTFO to deliver both the RED and FQD targets in 2008/9. This work would need to be reviewed in detail before any recommendation could be made.

The RTFO could be adapted by switching to a GHG basis which would make it better suited to delivering the FQD target and it would be more directly aligned with 2030 policy objectives.

There would be advantages in moving to the longer term trajectory for policy sooner and thereby reducing uncertainty. However, it is not clear what the impact would be on the RED target. In addition this would put considerable pressure on the DfT Low Carbon Fuels Team to implement these changes before the end of 2018 and runs the risk of it failing to deliver without time to revise it prior to 2020.

The preferred approach by most of the group would be to retain the link between the RTFO and the RED transport target until 2020, and then reconfigure the RTFO to be focused on GHG emission reductions post-2020. The reconfigured RTFO would need to be in place soon after 2020 to provide investor certainty. Therefore, it is proposed that the RTFO is realigned as soon as possible so that a direction of travel is made clear but the date the changes become effective is delayed until 2021.

Aviation and maritime

Aviation is part of the EU Emissions Trading Scheme (ETS). However, this mechanism doesn't provide as strong an incentive as the RTFO does in road transport fuels to develop demand or value for renewable fuel. There are prospects for some domestic production of advanced aviation fuel, currently in demonstration volumes only. However, even with further incentives, production is likely to be less than 5% of current biofuel consumption in the UK by 2020.

Renewable aviation fuels could be incorporated into the RTFO such that suppliers of sustainable aviation fuel would receive RTFCs which they could sell to obligated companies. There was support for such a development amongst the working group, though some members were concerned about the impact this would have on value of RTFCs, and some questioned whether aviation fuels should also be able to benefit from the ETS as this would be multiple claiming of the same GHG savings.

Maritime fuel, which is likely to be able to include FAME in future, could also be incorporated in the same manner, although this was not discussed in detail.

Evidence considered

The Working Group considered evidence from a wide range of sources produced both within the Transport Energy Task Force and from external sources. The primary sources included:

- Targets from the EU 2030 Climate and Energy framework and the UK Carbon Plan.
- Proposed or agreed changes to the EU Renewable Energy and Fuel Quality Directives and an assessment of the implementation requirements for the UK.
- An analysis of domestic policy options which could be deployed before or after 2020, and those options which could only be implemented post 2020.
- An assessment of the time scales required to implement substantive policy changes.
- The 'Sustainable Aviation Roadmap' for sustainable aviation fuels and a proposal to include aviation in the RTFO.
- A paper on the 'Value of the UK Bioethanol Industry', a paper on an 'Alternative Fuel Support Obligation Concept for Advanced Alternative Fuel Policy', and outputs from other Working Groups in so far as these were available.

The original intention was to consider which policies might be best suited to taking forward objectives identified in other Working Groups but these were not available in time for this group to work on. Consequently the group focused on leading policy options for 2020 and 2030.

Working Group 4 - Consumer Aspects

Purpose of Working Group 4

The purpose of Working Group 4 was to provide guidance to the main group on identifying customer acceptability issues and proposing ways to address these related to the fuels mix to 2020 and 2030. Consumer opinion and acceptance are particularly important when new fuels are introduced, especially if it is perceived that the most tangible effect may be reduced fuel efficiency, or risks surrounding vehicle operability.

Key Findings

- The coordination of the fuels roadmap with the vehicle technology and automotive roadmaps is critical to ensuring that compatible vehicles and fuels come to market concurrently in order to optimise consumer uptake and acceptance.
- If the Government wishes to introduce E10 to support meeting the RED target, an introduction of the fuel as soon as practicably possible is recommended to give the UK the optimum chance of maximising its deployment for 2020. A successful take-up of E10 is likely to require strong Government support including a mandate, fiscal support and a clear communications programme.
- A review of fuel taxation to better reflect carbon impact and energy efficiency could provide consumers with a robust rationale for duty rates.
- Government and industry need to prepare for an anticipated greater focus and public awareness of well-to-wheel issues, energy security and locally distributed energy innovation over time.
- If E10 is to be introduced in the UK, the group recommends the development of a cross-industry group, with DfT and LowCVP involvement, to form as soon as possible to develop an E10 communications plan and materials.

<u>Market to 2020: fuels to be considered</u>

Diesel/ biodiesel

Models from Working Group 1, including the fuels roadmaps, showed no preference for greater than B7 biodiesel in the mainstream market.

An increase in the current levels of biodiesel (currently approximately B3 on average) to B7 has to take into consideration maintenance of fuel quality to ensure that vehicle operability issues are avoided. Some members suggested that this may present more of a challenge in any 'high waste' fatty-acid-methyl-ester (FAME) scenario, particularly during the winter period where diesel fuel low temperature qualities must be maintained, and any tendency for diesel fuel filters to block is mitigated. The sustainability of this strategy will need careful review and consideration, given the cold diesel fuel solubility/filterability issues. There are also issues with the use of FAME in non-road applications particularly where the fuel may be kept in storage for several months prior to use, such as back-up applications.

Modelling also highlighted the significant increase in double-counted biodiesel that may be required (e.g. the low crop cap scenario) to meet the RED targets, and the risk of supply/ price challenges. Such scenarios would increase demand for waste-based FAME by 2020, and the implications on global supply/ demand should be considered along with consequential impacts on FAME commodity values and consumer prices for diesel in the UK.

High blend biodiesels (i.e. B20~B100) could be considered to be essentially niche markets at this stage (e.g. Transport for London's intention to run buses on a B20 blend of biodiesel). However, it should not be overlooked that Working Group discussions revealed that the volumes allocated to high blend biodiesel in the 2020 model was approximately 350 million litres (and which suggests a market demand of anything between 350 million litres (B100) and 1.2 billion litres (B30)). Therefore these volumes would seem too high for a niche marketing activity. It was recognised that further modelling work would continue to be beneficial here, in order to determine if the potential contribution to the RED 2020 target is realistic in the context of the market size and infrastructure capability to deliver these high blend biofuel pathways.

One point that also warrants further consideration concerns how other Member States intend to count used cooking oil (UCO) moving forwards in light of Germany's move to a GHG counting mechanism (meaning they no longer double-count UCO). If other Member States begin to adopt the same strategy as Germany we might see an increase in UCO coming into the UK (as the UK continues to double-count UCO it will become a more favourable customer). This coupled with seemingly potential misalignment between Member States' national standard with that of the FQD could end up being a significant issue for customers.

Therefore further exploration would be helpful as to how the different Member States intend to reward waste feedstocks, and the potential issues arising.

Petrol/ bioethanol

The modelling scenario work carried out by the Department for Transport shows that an introduction of E10, with a high uptake by 2020, would be expected to increase the achievability in the UK of the EU RED 10% transport target. In doing so the transition to a predominant E10 market would require careful and very proactive management.

Evidence to date from France, Germany and Finland (who have already rolled out E10) suggests that ensuring customer acceptance for the product would require the right infrastructure and supply chain to be in place, as well as effective communications of the benefits associated with E10. A successful roll-out with fast uptake of the product would require all stakeholders to work effectively together, with active Government support and leadership considered to be key components.

An unsuccessful attempt to introduce E10 could bring with it the risk of a consumer backlash to the existing E5 'status quo', as was the case in Germany, and make it more challenging to meet the binding RED target.

From September 2018 all vehicles placed on the market must be approved on E10 (E10 is the 'reference fuel'). Before that it is optional. (The date for new vehicle types is January 2016 but any models approved before that can continue to be placed on the market until the 2018 date).

Niche and alternative markets to 2020

The view from Working Group 4 was that that all other options for renewable fuel deployment will remain niche in the period to 2020 and therefore did not need to be covered by the Working Group 4 review of mainstream market consumer aspects.

Table 1 outlines the possible measures to achieve the 2020 RED target and Working Group 4's view on what would be necessities and priorities for the UK.

Table 1: Possible Measures to achieve the 2020 RED target

Measure for 2020	Imperative for achieving the RED target	Impact and concerns for consumer	Working Group 4 view
Introduction of E10	High: successful roll-out, with high uptake expected likely to reduce greenhouse gas in petrol fleet (~30% of fuel used in road). No substantial volume of advanced ethanol expected by 2020.	Legally required pump labelling will raise concerns, as will potentially higher price, and reduced fuel economy. A small proportion of petrol vehicles will not be E10 compatible, but E5 protection grade (97 Ron based) will be available until at least 31st December 2016.	Acceptability for this new fuel grade would largely rely on effective communications; active Government support; stakeholders working together; and support mechanisms with incentives to consumers to make attractive. Recommendations here included: a) UK Government to provide a mandate to align the date of introduction into UK market. b) UK Government to provide a fiscal incentive to offset the fuel economy impact. c) UK Government to review E10 labelling with a view to amend/ soften the labelling message (with a potential vehicle manufacturing cut-off date of 2010). d) Creation of a 'cross-industry' nationwide E10 education campaign for consumers.
Increase of Biodiesel content to B7 nationally	High: current content approximately 3% as national average. RED will require maximum use of waste-based FAME.	Risk of ongoing diesel fuel quality issues resulting in operational issues for users. Further work on fuel specification may mitigate.	Consumers will not be aware of B7 bio-content unless there are operability issues (acceptability relies on no operability issues). Current operational issues with national average B3 must be understood and addressed through specification change before consumers are exposed to B7 acceptability of which relies on no operability issues.
Introduction of High Blend (>B7) Biodiesel	Low: expected to only be used in niche markets with captive fleets4, not viewed by Working Group 4 as preferred for mainstream market	Captive fleets managed directly with supplier, no implications for mainstream consumer. Warranty concerns and vehicle compatibility issues	No activity planned. N.B. information on compatibility in fleet would be important if this option is to be considered
Introduction of niche fuels (including biomethane)/ electric vehicles	Perceived risks to meeting RED require use of all potential renewable options.	No niche/ alternative fuels seen as breaking into mainstream before 2020.	Potential confusion if mixed messages sent to consumers. Overall fuel/ energy in transport requires consistent messages about objectives and sustainability.

[4] A group of vehicles that use dedicated facilities and logistics for supply and storage of their fuel only accessible to them.

Mainstream market to 2030

Most roadmaps produced by industry for 2030, show a high probability of E20+ in the mainstream market, plus increased use of methane (in HGV), followed by hydrogen in the longer term mass market. All models show increasing electric vehicle use (mostly light vehicles). There were differing views on the extent to which current air quality concerns would impact on the ratio of diesel to petrol vehicle uptake.

The challenges of introducing a new fuel grade (E20) will be very similar to those for introducing E10, and would require the development of an internationally recognised fuel standard. The group did not see indication that new diesel grades would be introduced (increased bio blending likely to be drop-in).

Several views exist that the well-to-wheel impact of all fuels and transport may become a more mainstream consumer issue as increased awareness of the impacts emerge through discussion on electric vehicles, hydrogen etc.

Consumers are expected to become more informed on overall energy use (in fuel manufacture and vehicle use) so progressive communication on these aspects will be needed to retain consumer support for a trajectory to 2030.

Challenge of introducing new fuel grades illustrated by E10

Immediate consumer issues concerning E10

1. The current UK petrol infrastructure is not able to support a 'multi-blend' scenario, i.e. one with large volumes of two grades. (Currently around 95% of petrol sold is 95E5 (around 5% is 97RON). Therefore a full scale and rapid transition is likely to be required in order to avoid supply issues as seen in Germany. The option to be able to consider a phased regional roll out of E10 is considered unworkable principally because:

    a. UK refineries and import terminals are not configured to be able to produce regular grade (95 Ron) E10 alongside regular grade E5 – limitations exist first in the manufacturing process and then in the storage and handling systems. Midstream (inland terminals) are similarly constrained to single grade regular petrol system. UK retail sites are also similarly constrained to being able to only hold and dispense a single grade regular petrol.
    b. Geographic reach of UK refiners and importer volumes into many parts of UK.
    c. Co-mingling of multi-supplier products in downstream/ midstream terminals (particularly in the Midlands of the UK).
    d. Multi-supplier contracts for retailers mean they may deliver to their retail sites from more than one supplier from more than one region of the UK.
    e. Motorists will fill up in multiple regions of the UK – particularly business drivers travelling up and down the UK.

2. There is a legal requirement to maintain an E5 protection grade until 31st December 2016 (this applies only to large filling stations selling 3 million litres per year). The protection grade is assumed to be 97E5 and likely to be required until at least 2020.

3. The Working Group 1 model assumes a national average 8.3% bioethanol penetration where E10 is introduced. This assumes a split of 66% E10; 34% E5 protection grade in the fuel mix. This compares to a current split of approximately 95% standard grade 5% super grade. Some members questioned whether UK infrastructure and refining capability could accommodate such a split.

4. Growing consumer and political awareness around the link between air quality and diesel (and therefore on biodiesel). Consumer awareness is on the increase, and there is a risk that this could 'switch off' consumers and therefore reduce the impact B7 could have on greenhouse gas savings.

Initiatives used in other Member States to introduce E10, and identified priorities for a possible UK introduction

Table 2: Matrix of initiatives used in other markets

Activity	Finland	France	Germany	Level of priority for UK roll-out
Government led communications? Reasons given	Yes. Reasons: climate change, environmental targets.	Yes.	No.	High – Necessary. Reasons required.
Original Equipment Manufacturer (OEM) support?	Yes.	Unclear.	Mixed messages.	High – Necessary.
Fuel supplier support?	Yes.	Unclear.	Pump messaging mixed.	High – Necessary.
Lead time to launch	Lead >12months. Launch Jan 2011.	Lead time unclear. Launch Apr 2009.	Lead time unclear. Launch - Jan 2011.	Suggested minimum of 9 months.
Protection Grade	98E5.	Both 98E5 and 95E5 available.	98E5.	Expect 97E5 only (expiry date to be determined).
Introduction	National.	Regional.	National.	High - National (only workable solution).
Third grade available?	No.	Yes (Agip).	Possibly in some places.	No – UK infrastructure limitation.
Vehicle parc compatibility	List published with ACEA support 8 months prior to launch.	Appeared to be 60% at launch (official list on OJ of France).	Approximately 3 million vehicles not compatible at launch. Lack of compatibility info.	Approximately 2.5 million (12%) petrol cars not compatible in 2012. Comprehensive data on vehicle parc compatibility an absolute necessity.

Pump Price differential	Up to 10euC difference to 98E5.	95E10 approx 4euC less than 95E5 and 7euC less than 98E5.	Sold at price of 95E5 but 2euC added to price of 95E5.	Necessary to mitigate energy content (duty).
Taxation	Fuel tax based on energy and carbon.			Current volume basis penalises Ethanol use by consumers.
Current E10 penetration	63% of petrol sales (Dec14)	Approx. 32%	Approx. 15%	UK target >66% in 2020

Anticipated requirements for success to introduce a new fuel

1. A coordinated communication campaign supported by Government, auto manufacturers, and fuel suppliers (i.e. refiners, importers, renewable fuel manufacturers and retailers), which could include some/ all of the following:
   a. Clearly stated facts on benefits and downsides (fuel economy).
   b. Reasons why supported (e.g. greenhouse gas mitigation, support for UK production – businesses and jobs).
   c. Food and Fuel rather than Food versus Fuel messaging. This should include the significant contribution UK bioethanol can make to address the UK's protein feed shortage, replacing soy production in South America as well as jobs and the economy.
   d. Activity to mitigate fuel economy effects.
   e. Comprehensive compatibility information (easily accessible, positive messages).
   f. Clear information at fuel point of sale.
   g. Stickers for cars.
   h. Emphasising the pathway to more sustainable fuels/energy.
   i. Emphasising that newer vehicles are designed to use the new fuel.
   j. Use of specialist media to communicate messages.

2. A clearly defined roll-out option which ensures that the high uptake levels required by 2020 are met within the boundaries of the available timeline. Roll-out options include:
   - Voluntary – Obligated suppliers would introduce the grade as a commercial decision as they see fit to meet their renewable obligations.
   - Mandated – The Government would require E10's introduction. DfT officials have been asked to explore whether and how this might be achieved.
     - One option might be a change to the specification of 95 Ron petrol as required by the Motor Fuels (Composition and Content) Regulations 1999 (as amended) which stipulate a minimum oxygenate/ ethanol specification commensurate with a minimum ethanol content of 5%. Legislation would need to allow suppliers flexibility to continue to supply in the event of an ethanol shortage either in the market or due to restrictions in the infrastructure.
     - An alternative approach would be to, for example, mandate the replacement of the 95E5 by E10 and maintain 97E5 (Super). This would be

more likely to get more fuel into the market. However, Government support would be key to ensure that consumers take up E10, and do not merely switch to Super instead (with the associated issues that may bring).

- Non-mandated approach – The Government would support the introduction of E10 with clear (but not binding) goals set in terms of E10 pump availability. (However, care would be needed here to ensure this does not violate competition laws, and to ensure that this leads to a full scale and rapid transition, as per the reasoning outlined in section B.3; points 1 a-e).

3. Ensure a loophole-free E10 vs. E5 fiscal incentive mechanism.
4. Reduced taxation rate could be used to mitigate fuel economy impact. For example this could come in the form of a duty differential, but would need to address the ethanol content in E10 (as this can be lower than 10%). To be fully effective it would need to cover the additional costs for the supply chain, and the lower mileage (~1%) as well as offer some commercial benefit for the consumer.
5. Scrappage scheme to support removal of non-compatible vehicles. (Incentive against any new or used car).
6. Independent robust testing to give true performance picture.

Further work

CONCLUSIONS AND CHALLENGES

If a new fuel grade, such as E10, were to be introduced in the UK at high penetration levels to help meet the Renewable Energy Directive transport target then customer acceptance, product availability on the forecourt and commercial incentives will all be important considerations. Preparation to have the infrastructure in place will take 6-12 months at minimum, and an effective co-ordinated communication campaign will similarly need 6-12 months of development time. Given this, and the lessons learned from E10 roll-outs in other EU Member States, achieving the required uptake of E10 in the remaining timeframe would be a significant challenge. Therefore, if E10 is to be rolled out successfully introduction as soon as practicably possible is recommended to be the scenario which would give the UK the optimum chance of success in line with meeting the RED target.

There were also concerns about achieving the 83% market penetration level by 2020 outlined in the modelling scenarios, given the current experience of France and Germany. It was therefore suggested that further consideration could be given to higher biodiesel blends to help meet the RED target (keeping in mind the need to also address concerns about operability as they arise).

Note - Ethanol is perceived to be the lowest risk crop-based fuel in terms of ILUC (based on current and proposed ILUC factors) and to have (currently) significant UK supply capacity. Given limited resources available, focus on advanced biofuel options might be best placed in diesel to mitigate potential need for high ILUC biodiesel options if there is insufficient UCO.

Use of high blend levels (E85 or B30) was modelled by Working Group 1, but was not seen as favoured to meet the 2020 targets by Working Group 4, or any other Work Groups as far as the members of Working Group 4 understood.

UK Industrial impact: The current mandate level has meant that demand is lower than envisaged by UK ethanol producers and has resulted in poor margins and returns for investors. If demand stays at the current levels for much longer and there is no clear signal for an increasing UK fuel policy trajectory then this will potentially have a negative impact on UK jobs. (See paper at Annex C: *The Value of the UK Ethanol Industry*).

Informed consumers have come to associate improved fuel economy with reduced greenhouse gas emissions. It will be a particular communications challenge to explain how a fuel giving reduced mileage has lower greenhouse gas impact.

Note: on the 24th February 2015 the European Parliament's Environment Committee adopted the following proposed target in their position, under the ILUC dossier. As this target was proposed after the drafting stage of this chapter, Working Group 4 was unable to incorporate the implications of such a target into this paper:

"Each Member State shall ensure that the share of energy from renewable sources in petrol in 2020 is at least 6.5 % of the final consumption of energy in petrol in transport in that Member State".

At the time of publication this proposed target was still subject to ongoing EU negotiations. If agreed it would have implications on a UK roll-out of E10; therefore the Department for Transport will continue to monitor developments and will consult further with stakeholders as required.

A list of resource for Working Group 4 are provided in Annex C

Working Group 5: Alternative Fuels

Purpose of Working Group 5

Working Group 5 was tasked to:

- Set out the principal non-conventional biofuel 'alternatives', taking into consideration key uncertainties like sustainability issues and ILUC factors
- examine what supply potential exists for each fuel pre- and post-2020
- To examine the key policy barriers preventing scale-up now
- To set out high-level policy recommendations to support the development of these fuels

Key Findings

- Long-term policy certainty for all eligible fuels is key to ensure investor confidence.
- An advanced fuels sub-target should be included in the RTFO, provided a clear definition of advanced fuels can be agreed, and further work is undertaken to establish how much fuel could be available for use in the UK by 2020. A sub-target should extend to 2030 to provide investors with a signal that the UK wishes to drive investment into these technologies.
- A clear and consistent classification framework, defining all fuels and technical terms, is critical when considering new fuels.
- It will be crucial to define the policy goal of the RTFO if extending to encompass new fuels.
- There are promising fuels derived from non-biogenic carbon sources. Like any new feedstock these carry sustainability risks, which will necessarily centre on environmental factors. However, sustainability in terms of feedstock availability, cost and technology readiness levels will also need to be considered. The group recommends that further work is carried out to assess these risks and to propose a policy framework as appropriate.

The group has produced a detailed fuels and technologies matrix, intended to capture the information set out above. The matrix provides comprehensive recommendations, which are summarised below. The matrix should be referred to in conjunction with this report and is at **Annex D**.

Background

Conventional biofuels such as bioethanol and biodiesel currently account for the majority of biofuels supplied and used in the UK. However, under existing policies the UK is currently some way off being able to meet the Renewable Energy Directive (RED) 10% renewable transport fuel 2020 target and debates still continue on ILUC and the use of crops for biofuels. In addition, current low gas / oil prices and the likelihood of an EU move to a greenhouse gas abatement target for Member States post-2020 mean that serious consideration should be given as to whether alternative fuels can be scaled up moving forward. Working Group 5 was convened to examine what role alternatives to conventional biofuels can play, both in helping to meet the 2020 RED target, and also a possible post-2020 greenhouse gas abatement target.

Context

The definition of 'alternative' fuels has been carefully considered by the group. Whilst it is clear what alternative fuels are not – conventional biofuels, including crop-based – the group uses the term 'alternative' advisedly. Some fuels are waste-derived, but those produced from waste fossil gases are excluded under the RED. Similarly, whilst fuels like liquefied natural gas (LNG) and liquefied petroleum gas (LPG) can help towards meeting the requirements of the Fuel Quality Directive and any potential post-2020 European Commission greenhouse gas abatement target, their non-renewable status precludes them from efforts to meet the 2020 RED target.

Recognising that renewable energy and GHG abatement requirements place very different demands on alternative fuels, the group has sought to distinguish between pre- and post-2020 requirements. When assessing GHG savings in particular, some fuels displace other biofuels and the net GHG reduction should be considered.

In developing recommendations the group also recognises that different industries and sectors will be competing for the same limited and possibly diminishing amount of feedstock, so any supply potential of fuels derived from these feedstocks should be considered as heavily caveated.

Further, the group has considered the potential impacts of future policy decisions, for example around ILUC factors, which if adopted could change significantly the greenhouse gas footprint of alternative fuels derived even partly from crop feedstocks.

The matrix

The matrix is **not** intended as an exhaustive database of alternative fuels; rather, it details the most important / significant options currently under consideration. We recommend that this be read in conjunction with the output from WG1 (Evidence Base) which has given, for example, a more detailed consideration of the possibilities for the development of ligno-cellulosic biofuels which are not currently under active development in the UK.

In general, the matrix shows that the opportunities for the supply of alternative fuels in the pre-2020 period rely on biomethane, HVO biodiesel, a limited quantity of biopropane and renewable fuels of non-biological origin, provided legislation amending policy can be achieved in the required time-frame. There are more opportunities in the 2020-2030 period but it is difficult to correlate the availability of feedstocks with policy at this early stage.

Specific fuels – key findings

The group has identified the following alternative fuels as priorities. Separate recommendations are made for pre- and post-2020 where relevant. These recommendations must be reviewed once decisions have been made on the ILUC proposals as the agreed definition of advanced fuels is directly relevant to future policy frameworks.

Biomethane

- Resolve the legal issue around mass-balancing biomethane for transport through the gas grid.
- Reform the RHI and RTFO so biomethane for transport is supported under a single mechanism similar to the current RHI, thus providing adequate investor confidence.
- Ensure the same subsidy is provided for liquefied biomethane as for grid-injected biomethane.
- Support discussion with DECC, Defra and DCLG on waste policy to assist with removing potential barriers to biomethane supply capacity for freight transport use.
- Recognise that shifts to a gas fleet in heavy goods and buses can reduce demand for middle distillate and vegetable oil type fuels into transport.
- Recognise that biomethane into transport (liquefied or compressed) over a 2050 timeline could potentially replace all current HGV/ bus middle distillate/vegetable oil demand.
- Recognise that deployment on a 2030 timeline will need progressive targets to support investment into gas vehicles for HGV/ buses as well as drop-in type fuels into passenger cars and the aviation sector.

Jet Fuel

- Provide equivalent incentives for all advanced fuels (including aviation fuels). In the short-term, this can be achieved by allowing suppliers of advanced aviation fuel to 'opt in' to the RTFO.
- Establishment of a public-private sector initiative to stimulate the advanced aviation fuels sector in the UK.
- Clarify the status of advanced fuel technologies in the waste hierarchy to incentivise use of these technologies that capture and recycle carbon and high-energy wastes into high value products such as advanced fuels.
- Adjust the RTFO to be more technology neutral - with focus on GHG reductions and sustainability criteria - to allow the incorporation of alternative fuels (including gas fermentation using bacteria).

Biopropane

- Creating policy certainty for LPG vehicles and maintaining RTFO support will provide the investor confidence necessary for the creation of the development of a biopropane transport market and indigenous biopropane production facilities.

HVO biodiesel

- Long-term policy certainty for the sustainability of vegetable oils is required. Prior to 2020, it will be very difficult to make a business case for any HVO investment (standalone or combined processing) while there is uncertainty of ILUC factors and the availability of sustainable vegetable oils.

Renewable non-bio methanol

- Define methanol from non-biological sources as an advanced and double counting renewable transport fuel in the RTFO.
- Implement workable and transparent sustainability criteria for renewable methanol from non-biological sources.
- Resolve issues around the allocation of electricity from renewable sources for production of renewable methanol, specifically regarding use of certificates of origin for electricity transmitted on a mixed grid.
- Resolve issues around energy-balance accounting and GHG emission accounting for the product life-cycle of renewable methanol from hydrogen, both when the hydrogen is produced via electrolysis expressly for fuel synthesis and when hydrogen is provided as a by-product from another industrial process.
- Recognise methanol from carbon capture and utilisation as an advanced and renewable transport fuel if it can be shown using sustainability criteria that the process lowers aggregate life-cycle GHG emissions.

Hydrogen

- Provide a complementary support mechanism for both hydrogen infrastructure and vehicles.
- Policy should integrate the requirements of vehicles, the infrastructure and the fuel in the time period to 2023 when the market is believed to become commercial.
- Both ‘brown’ and ‘green’ hydrogen production methods should be supported up to 2020s to avoid market failure, at which point support for ‘brown’ hydrogen should tail off as ‘green’ hydrogen becomes closer to economically viability. It is envisaged that support for ‘green’ hydrogen may continue to be needed beyond this point.

Biomethanol

- Stimulate the introduction of flexible fuel vehicles.
- Introducing a sub-target for advanced biofuels as soon as possible before 2020.
- Incentivise the use of advanced biofuels post-2020: by setting a blending mandate for advanced biofuels and by extending a sub-target for advanced biofuels.

Biobutanol

- Pre-2020 needs support and clarity to help mitigate technology deployment risk.
- 2020-2030 needs progressive advanced biofuels targets to underpin project investments.

Recommendations for further work

- A thorough assessment of the likely availability in the UK of waste feedstocks in 2020 and beyond, for example Municipal Solid Waste. This should include an appraisal of how much could be made available to the individual fuel and technology pathways.
- Methodologies and assessments for non-biogenic renewable fuels and pathways.
- Thorough consultation on a clear definition of advanced fuels.
- Investigation of power to gas technologies and the role that this might play in decarbonising transport.

Conclusions

In recent years progress in reducing the environmental impact and improving the sustainability of transport fuels, and the growth potential that comes from this process in the UK, has stalled. The Transport Energy Task Force in its deliberations has come to the conclusion this need not be the case. Transport fuels can significantly reduce greenhouse gas emissions, improve sustainability and offer growth opportunities in the UK, based on the findings set out below. The Task Force has set out a package of recommendations which, if implemented, would allow the UK to meet EU 2020 GHG reduction and renewable transport fuel targets and help reduce GHG from UK transport and promote growth in the period to 2030 and beyond.

Findings & recommendations

- Transport energy can and should make a significant contribution to GHG savings both now and in the long-term.
- Climate change mitigation should be the primary focus of policy for transport fuels.
- The UK should also seek to secure economic benefits from developing the market for advanced fuels in terms of skills, intellectual property, employment and inward investment.
- 'Advanced' fuels are those using non-conventional technologies that can convert non-food crop biomass into biofuel. They are not inherently sustainable, therefore measures are required to ensure their sustainability, including the delivery of substantive GHG savings even when ILUC is included.
- The group recognised that ILUC and sustainability issues needed to be addressed. An appropriate definition of sustainability should include competition for land for production of food and fuels. This will require assessment at a project or regional level.
- Biofuels can be sustainable with careful application and auditing of sustainability monitoring measures.
- The deployment strategy for replacement fuels and blends must ensure that fuel supply is to internationally agreed specifications and remains fit for purpose for use with available vehicles and infrastructure.

Fuel options

- Electrification of transportation is a key aspect of current government policy to reduce carbon emissions from transport energy and should be supported, but appears unlikely to be effective in all transport sectors and will take considerable time to fully deploy.
- Liquid transport fuels will be the dominant form of transport energy in 2030. There is an opportunity for the foreseeable future for sustainable biofuels to decarbonise liquid fuels.
- Biofuels are a viable option to provide carbon savings to 2030, however, due to the unknowns over this period, other sectors may be in a better position to deliver these carbon savings – and careful assessment should be carried out of whether this is the case.
- Advanced fuels are being developed and offer the opportunity of sustainable drop-in fuels in the future. These fuels will be in limited supply globally before 2020 and would make an advanced fuels target above 0.5% unlikely to be achieved by 2020, though there may be greater scope to 2030.

- Wastes were considered to be a lower ILUC and sustainability risk feedstock than land using feedstocks. However there are risks relating to the availability of waste feedstocks due to potential future levels of demand.
- The sustainability of land using feedstocks can vary greatly, but some land using feedstocks are lower risk.

- **Recommendation: If land using feedstocks are to be widely supported then a robust and effective mechanism to ensure sustainability would be required.**

Existing policy framework

- The RED mandates that 10% of transport fuel should be renewable in 2020, however we expect that the effective level will be lower (around 7% including electricity) due to multiple-counting of electricity and wastes.
- If targets are increased under the current RTFO to meet the RED target, central scenarios developed in the Task Force indicate that suppliers would meet their obligations with a significant increase in crop-based biodiesel.
- Biofuel supply volumes sufficient to meet the RED target are not expected to meet all of the 6% reduction in carbon intensity of transport fuel by 2020 as required by the FQD.

- **Recommendation: If the FQD is to be met then it will require additional upstream measures**
- **Recommendation: If the government wishes to avoid a significant increase in crop-based biodiesel, it is likely that a crop cap would need to be introduced**
- **Recommendation: If the UK decides to introduce E10 as part of a strategy to meet the RED target, an early roll-out with government support may lead to higher penetration levels in 2020.**

Investment Certainty

- Investment certainty is predicated on having reasonably clear demand for the product. There are many factors which affect this investment confidence but there are no quick fixes and confidence will need to be rebuilt with predictable policies.
- Sustainability of individual feedstocks and supply chains needs to be as clear as possible.
- First generation biofuel plants in the UK offer economic and environmental benefits, and may provide a cost effective route to securing domestic production of advanced biofuels.
- There was broad support for the principle of moving towards a policy for 2030 which was based on maximising GHG emission reductions, and retaining the RTFO as the principal policy mechanism.

- **Recommendation: The group called for a robust definition of sustainability for relevant feedstocks to be prioritised at EU level, with the UK using the discretion available to it in due course.**
- **Recommendation: If investment for domestic production is to be secured, advanced biofuels will require more than a sub-target, including capital and fiscal support.**

Opportunities to build on existing investments in first generation plants should be explored alongside new-build facilities.

- **Recommendation: To ensure policy is effective there needs to be a consistent public policy approach to incentivising feedstocks for use across the economy including the heat and power sector.**

Consumer Acceptance

- The coordination of the fuels roadmap with the vehicle technology and automotive roadmaps is critical to ensuring that compatible vehicles and fuels come to market concurrently in order to optimise consumer uptake and acceptance.
- The deployment strategy for replacement fuels and blends must ensure that fuel supply remains fit for purpose for use with available vehicles and infrastructure.
- Of the proposed measures to comply with the RED renewable transport fuel target, only the introduction of E10 represents a new fuel grade.

- **Recommendation: A review of fuel taxation to better reflect carbon impact and energy efficiency could provide consumers with a robust rationale for duty rates.**
- **Recommendation: If a new grade such as E10 is introduced then a cross-industry group, with DfT and LowCVP involvement, should be formed as soon as possible to develop a communications plan and materials.**

Alternative Fuels

- An advanced fuels sub-target should be included in the RTFO, provided a clear definition of advanced fuels can be agreed, and further work is undertaken to establish how much fuel could be available for use in the UK by 2020. A sub-target should extend to 2030 to provide investors with a signal that the UK wishes to drive investment into these technologies.
- A clear and consistent classification framework, defining all fuels and technical terms, is critical when considering new fuels.
- There are promising fuels derived from non-biogenic carbon sources. Like any new feedstock these carry sustainability risks, which will necessarily centre on environmental factors. However, sustainability in terms of feedstock availability, cost and technology readiness levels will also need to be considered.

- **Recommendation: It will be crucial to define the policy goal of the RTFO if extending to encompass new fuels.**
- **Recommendation: The group recommends that further work is carried out to assess the sustainability risks of new fuels and to propose a policy framework as appropriate.**

Annex A:
Working Group 1 Biofuel cost projections

Biofuel Cost Projections

The following biofuel cost projections have been used to inform the cost-benefit modelling which feeds into the Transport Energy Taskforce report. These cost projections have been developed in consultation with industry stakeholders.

There is significant uncertainty around future biofuel and fossil prices, so wide ranges have been applied and these projections should be treated with an appropriate degree of caution. We will continue to develop our understanding of these uncertainties as new evidence emerges.

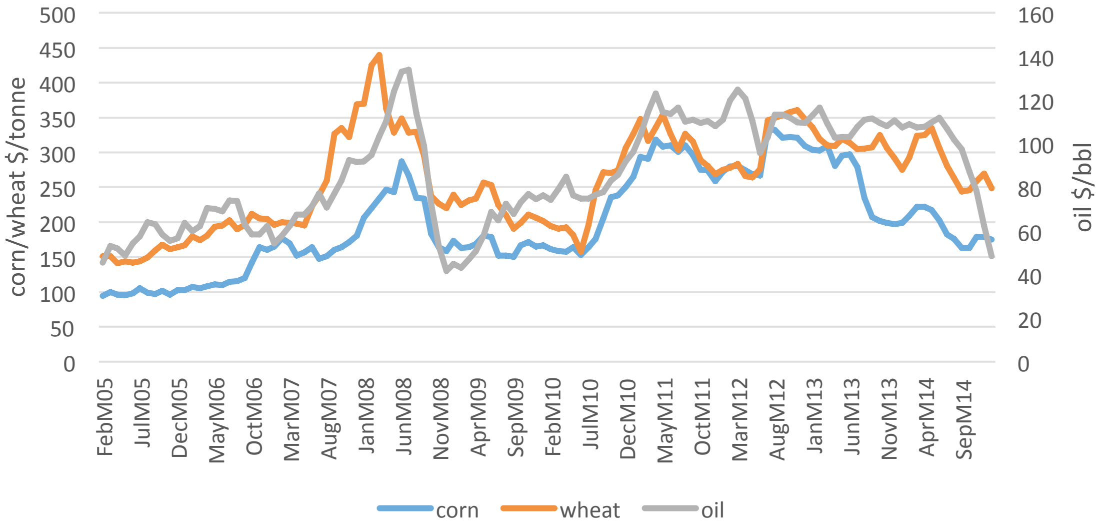
1st Generation Biofuels

Crop biodiesel/bioethanol

Overview

The cost of supplying crop-derived biofuels is largely determined by the difference between the cost of supplying the biofuel and the cost of the displaced fossil fuel. The biofuel price is thought to be strongly influenced by underlying agricultural commodity prices (e.g. wheat, corn, vegetable oils) and the fossil fuel price is determined by the oil price. Both of these variables are volatile and difficult to forecast. The chart below shows the historical oil price alongside wheat and corn (bioethanol feedstock) prices.

Chart 1: Historical commodity prices (oil, corn, wheat), nominal prices



Methodology

As the cost of biofuel policy is largely determined by the difference between the cost of supplying biofuel and the cost of supplying fossil fuel, and these costs have exhibited a high degree of correlation in the past, an approach based on forecasting the 'spread' between the cost of supplying biofuel and the cost of supplying fossil has been adopted.

The future projections of spreads are essentially based on judgement using historical price spreads observed in the biofuel and oil markets as reference.

Cost projections

Under the central cost scenario, the 2015 crop biofuel/fossil fuel spread has been set to the 2013/14 average and declines gradually over the period to 2030. The gradual decline in the spread reflects a gradually rising oil price and agricultural productivity improvements which allow supply to keep pace with increased demand without significant agricultural commodity price rises. In the high cost scenario, the spread starts at a higher level in 2015 and increases over the period to 2030. This could reflect sustained low oil prices or low agricultural productivity (which would result in higher agricultural commodity prices). In the low cost scenario, the spread starts off at a lower level in 2015 and declines gradually to parity with fossil fuel in 2030. This could reflect sustained high oil prices or strong advances in agricultural productivity (which would result in lower agricultural commodity prices).

Chart 3: Petrol vs crop bioethanol price spread (historical and projected)

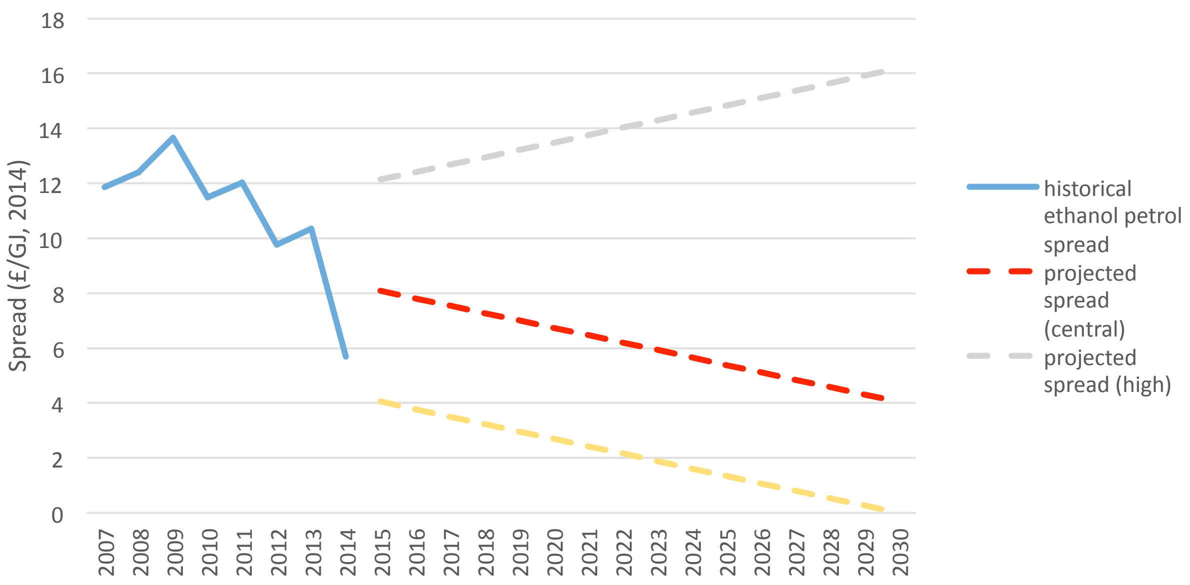
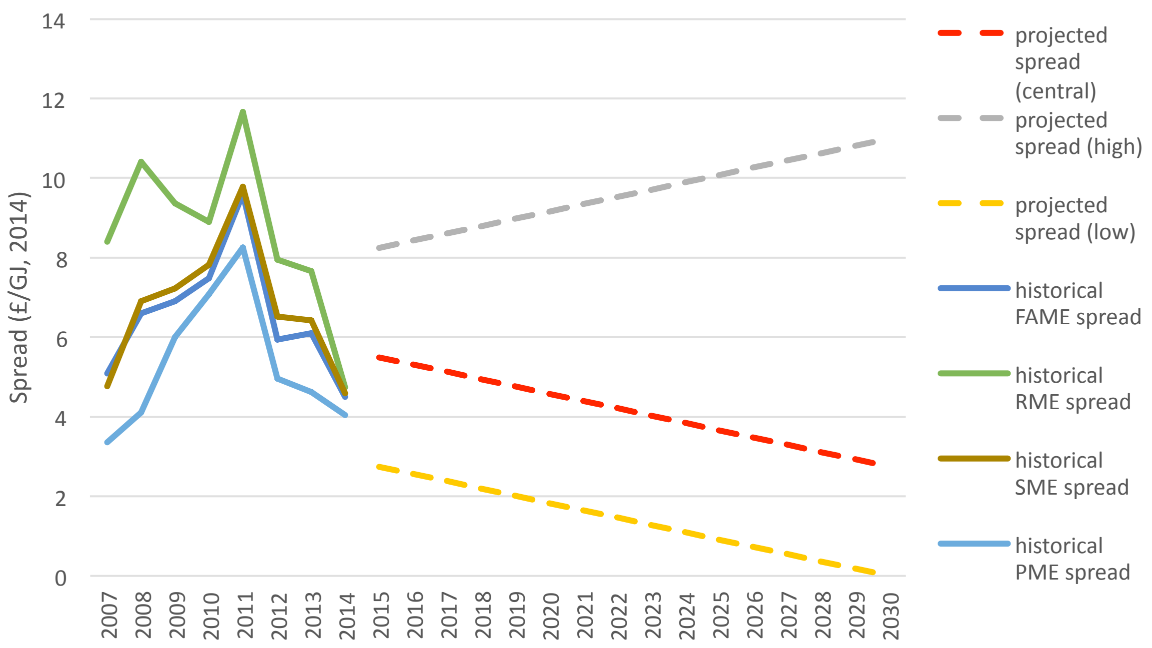


Chart 4: Diesel vs crop biodiesel price spread (historical and projected)



Waste Biodiesel

Overview

Biodiesel made from waste oils (such as used cooking oil or tallow) constitute a significant share of biofuels supplied under the RTFO. These biofuels receive 2 certificates (as opposed to one certificate) under the RTFO, so fuel suppliers are willing to pay more for these fuels.

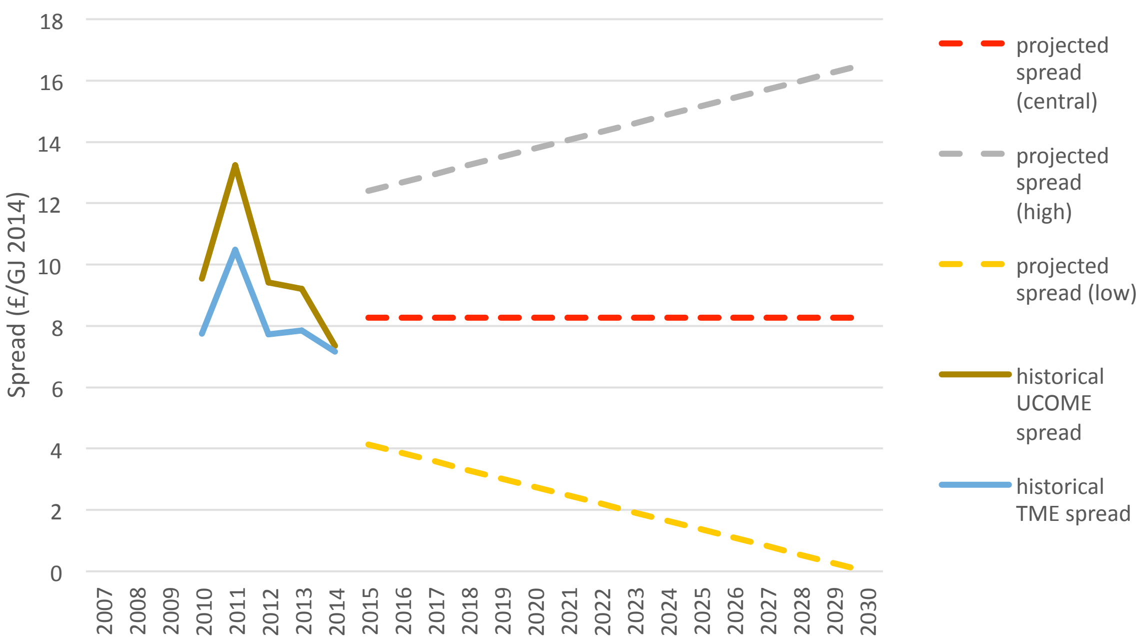
Methodology

Waste biodiesel generally trades at a premium to crop biodiesel and has exhibited strong price correlation with both fossil fuel and crop biofuels. Therefore an approach based on the spread between the cost of supplying waste biodiesel and fossil diesel has also been taken to assess the future cost of supplying waste biodiesel.

Cost projections

In the central cost scenario the 2015 waste biodiesel/fossil diesel spread has been set to the 2013/14 average. We have kept the waste biodiesel/fossil diesel spread constant over time (rather than a gradually declining trajectory which has been assumed for crop biofuels falling) in order to reflect the fact that waste oil is a relatively scarce resource which is likely to become more sought after as EU Member States increase biofuel mandates in order to meet 2020 RED targets. High and low scenarios mirror the high and low scenarios for crop biofuels.

Chart 5: Diesel vs waste biodiesel price spread (historical and projected – new methodology)



Advanced Biofuels (Cellulosic Ethanol)

Overview

Cellulosic ethanol is produced from lingo-cellusoic feedstocks (e.g. the non-food 'waste' component of crops such as corn and wheat) using technologically advanced conversion technologies.

Production cost estimates for cellulosic ethanol have been used as a proxy for all advanced biofuel production costs in the DfT/LowCVP Transport Energy Taskforce report.

Methodology

A 'levelised' cost based approach has been taken to estimate future cellulosic ethanol production costs. A 'levelised' cost is the break-even price at which a developer is assumed to make an investment in new energy production capacity for a given set of costs (capital and operating) and a given financial rate of return on capital deployed. 'Levelised' costs are a standard method for assessing the unit costs of new build energy production.

2015 Cost projections

Published data from the first generation of cellulosic ethanol plants has been used as sources for estimates of capital costs, capacity and conversion efficiency. Data from the following plants have been used:

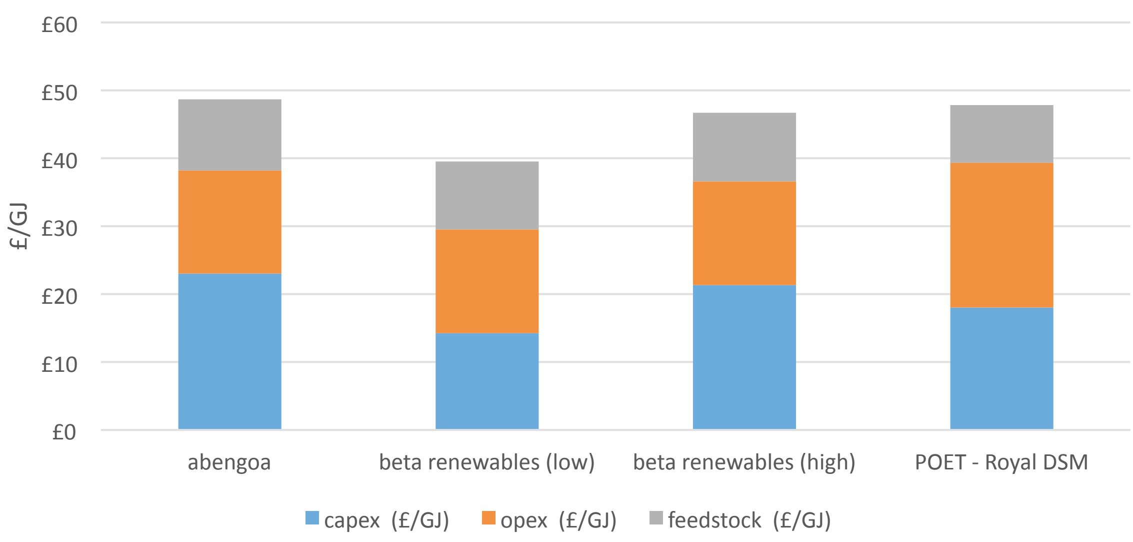
- Abengoa (cellulosic ethanol plant in Hugoton, Kansas)
- Beta Renewables (cellulosic ethanol plant in Crescentino, Italy)
- POET-Royal-DSM (cellulosic ethanol plant in Emmetsburg, Iowa)

	abengoa	beta renewables (low)	beta renewables (high)	POET - Royal DSM
capex (£m)	232	115	115	182
capacity (million litres)	95	76	50	95
electricity imports (kWh litre)				1.2
Feedstock to fuel ratio (kg to litre)	3.7	3.6	3.6	3.0

Overarching assumptions on investor discount rate, plant lifetime, feedstock costs, capacity factors and operating costs have been developed in conjunction with industry stakeholders. Electricity costs are based upon industrial electricity costs published by DECC.

discount rate	0.15
plant financial lifetime (years)	20
crop residue cost (£/tonne delivered)	60
capacity factor	0.8
opex cost assumption (£/litre)	0.325
electricity price assumption (£/MWh)	102

The 2015 'levelised' cost estimates for these inputs range from £40/GJ to £49/GJ. Our central estimate (which will be used for cost benefit analysis) is £46/GJ, the average (mean) of the plant level estimates.



	abengoa	beta renewables (low)	beta renewables (high)	POET - Royal DSM	average (mean)
capex (£/GJ)	£23	£14	£21	£18	£19
opex (£/GJ)	£15	£15	£15	£21	£17
feedstock (£/GJ)	£10	£10	£10	£8	£10
total (£/GJ)	£49	£40	£47	£48	£46

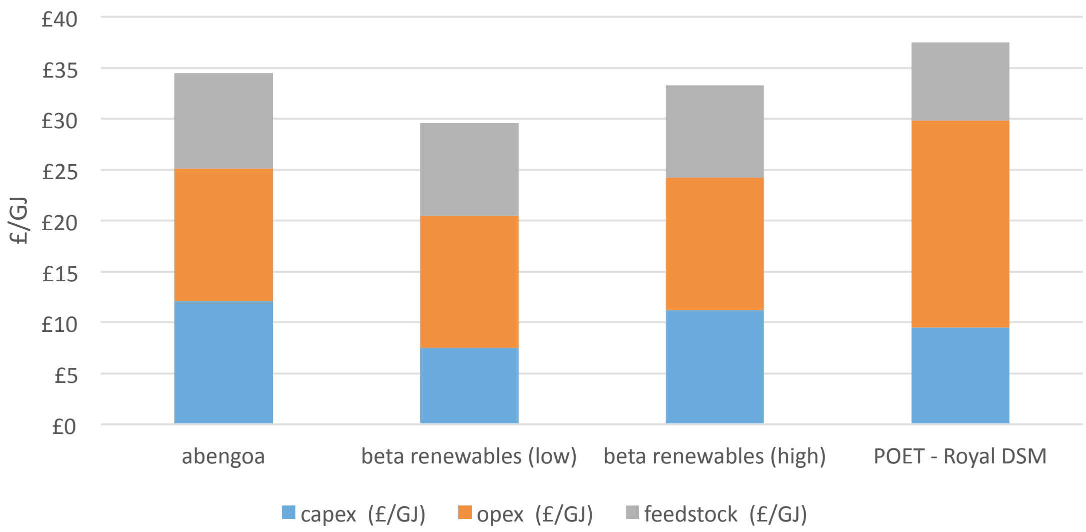
2030 Cost projections

The 2030 production cost estimates for cellulosic ethanol are largely based upon the same data as the 2015 projections. However, certain key assumptions have been changed to reflect the potential for technological development and efficiency improvements as this technology matures over the period to 2030.

Assumptions Changes (relative to 2015):

- Reduce discount rate to 10%
- Reduce capex and opex costs by 15%
- Reduce feedstock requirement by 10%
- Capacity utilisation factor raised to 95%

The 2030 'levelised' cost estimates for these inputs range from £30/GJ to £37/GJ. Our central estimate (which will be used for cost benefit analysis) is £34/GJ, the average (mean) of the plant level estimates.



	abengoa	beta renewables (low)	beta renewables (high)	POET - Royal DSM	average (mean)
capex (£/GJ)	£12	£7	£11	£10	£10
opex (£/GJ)	£13	£13	£13	£20	£15
feedstock (£/GJ)	£9	£9	£9	£8	£9
total (£/GJ)	£34	£30	£33	£37	£34

Production Cost Series

Plotting a straight line between our 2015 and 2030 cost estimates gives the cost series which has been used to model future advanced biofuel costs in the Transport Energy Task Force cost-benefit modelling. A range of +/-15% has been applied for 2015 and +/-30% in 2030 to give low and high cost scenarios.

Annex B: Working Group 1
High and Low Waste Scenarios

High Waste Scenario

2020 Supply Mix

	RTFO Baseline (1)	10% RED target – no sub-target (2)	10% RED target – 0.5% sub-target (3)	10% RED target – 1% sub-target (4)	10% RED target – 1.5% sub-target (5)
2020 GHG Savings	2.7MT	5MT	5MT	4.9MT	5MT
2020 Crop Share	0.82%	0.78%	0.5%	0.1%	0.42%
2020 Costs (2014 £s, Low–High)	142–614m/year 12–51/MWh 52–226/tCO_2	229–1049m/year 11–51(11–49)/MWh 46–212/tCO_2	289–1115m/year 14–55(13–50)/MWh 58–225/tCO_2	382–1214m/year 20–63(16–51)/MWh 78–246/tCO_2	490–1386m/year† 24–69(19–52)/MWh 98–276/tCO_2

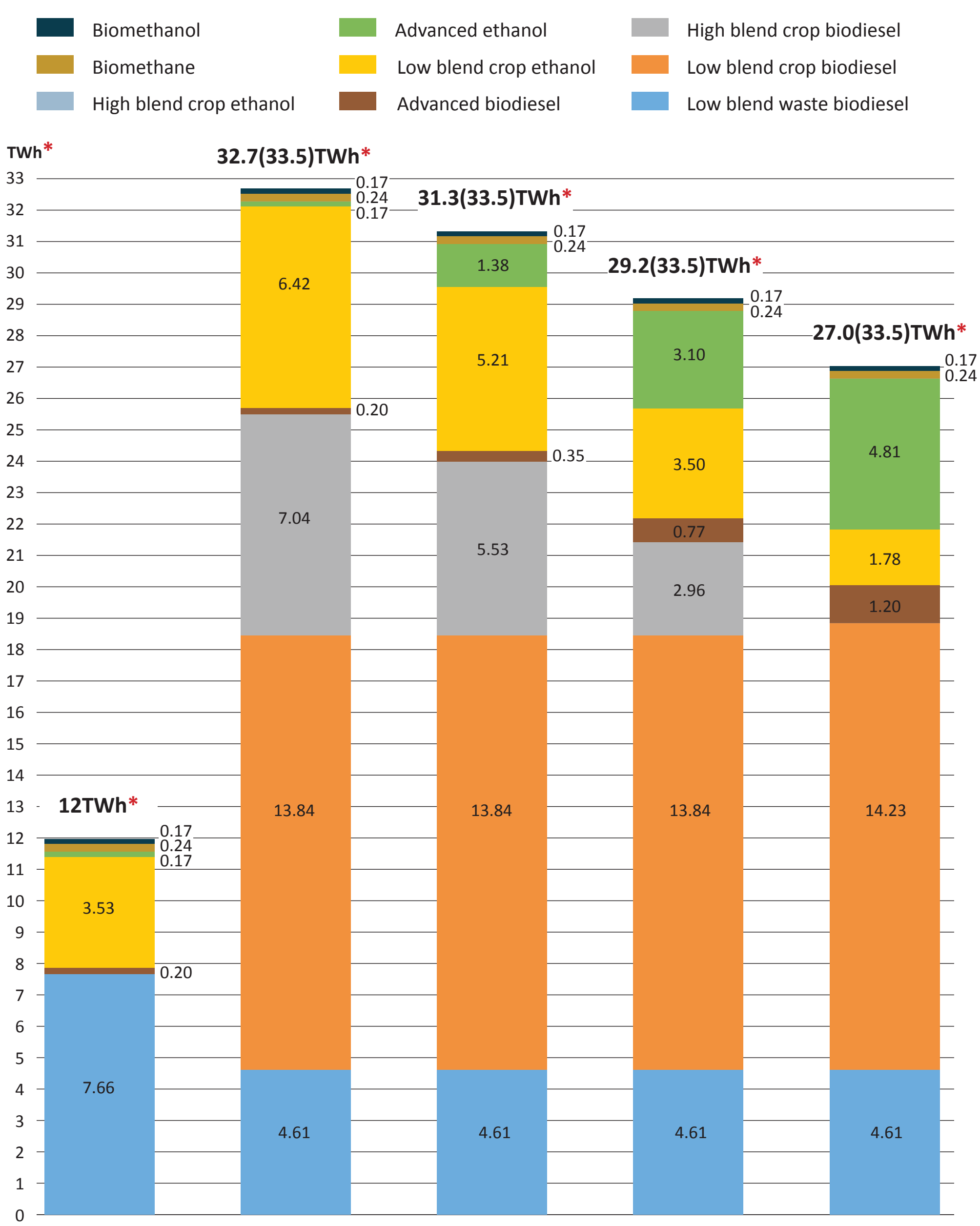
Footnotes:

* Total excludes electricity. Value in brackets shows TWh assuming Council agreement text double counting advanced biofuels to the cross-sector RED target.

† Costs of using this combination of biofuels instead of fossil fuels.

Low Waste Scenario

2020 Supply Mix



	RTFO Baseline (1)	10% RED target – no sub-target (2)	10% RED target – 0.5% sub-target (3)	10% RED target – 1% sub-target (4)	10% RED target – 1.5% sub-target (5)
2020 GHG Savings	2.7MT	2.3MT	2.5MT	2.8MT	3.1MT
2020 Crop Share	0.82%	6.37%	5.74%	4.74%	3.74%
2020 Costs (2014 £s, Low–High)	142–614m/year 12–51/MWh 52–226/tCO_2	348–1363m/year 11–42(10–41)/MWh 151–591/tCO_2	389–1395m/year 12–45(12–42)/MWh 157–563/tCO_2	453–1448m/year 16–50(14–43)/MWh 162–519/tCO2	512–1496m/year† 19–55(15–45)/MWh 165–482/tCO_2

Footnotes:

* Total excludes electricity. Value in brackets shows TWh assuming Council agreement text double counting advanced biofuels to the cross-sector RED target.

† Costs of using this combination of biofuels instead of fossil fuels.

Annex C: Working Group 4 Resources

Working Group 4 Resources

- Finland E10 website - http://www.e10bensiini.fi/en
- Finland Taxation - http://www.tem.fi/en/energy/renewable_energy_sources/energy_taxes
- Finnish Pricing - http://www.oil.fi/en/statistics-1-prices-and-taxes/11-consumer-price-update
- Articles on German E10 introduction - http://esse-community.eu/articles/the-introduction-of-e10-in-germany-a-case-of-failure/
- http://sugarcane.org/resource-library/unica-materials/Document%20on%20E10%20in%20Germany.pdf
- French fuel availability - http://travel.eni.com/en_FR/products/fuel.shtml?menu=1|0
- French vehicle compatibility list http://www.legifrance.gouv.fr/jopdf/common/jo_pdf.jsp?numJO=0&dateJO=20121106&numTexte=36&pageDebut=17333&pageFin=17336
- French pricing - http://www.prix-carburants.gouv.fr/
- Fuels Roadmap - http://www.lowcvp.org.uk/projects/fuels-working-group/red-scenarios-and-fuels-roadmap.htm

Annex D: Working Group 5 Technologies and Fuels Matrix

Biomethane

Jet Fuel

Bioethanol and drop-in jet fuel (Alcohol-to-Jet)

LPG (Liquefied Petroleum Gas)

Biopropane

Renewable methanol from non-biological sources

Hydrogen

Biomethanol

BioButanol

Fuel	Feedstock	Technology	Potential supply / availability for transport to 2020	Potential supply / availability for transport 2020 - 2030	Barriers (in order of importance)
Biomethane	Food waste	Anaerobic digestion	If all the food waste in England and Wales was processed by AD, and if all the biogas, allowing for process energy, was upgraded to biomethane for transport, then the energy value of the BfT would be about 30PJ per year. A conservative target for 2020 would be 5% of this potential, i.e. 1.5PJ per year. This figure is very dependent on policy and incentives.	Using the figures in the previous column, the production might rise, by 2030, to 25% of the potential, i.e. 7.5PJ per year.	An increasing amount of compressed biomethane is going into transport via grid injection and the use of green certificates, however this will not help with RED target if it is not allowed to be recognised. The high rate of support for grid injection vs via RTFCs means that no biomethane liquifaction plants will be built under current incentives, restricting the supply of liquified biomethane which most HGV operators would want if switching to gas. Further investment in gas infrastructure would be useful, but this is less of an issue than many people realise. Some gas suppliers will offer a station at no capital cost, amortising the station cost and incorporating it into the price of the gas. This has the benefit that the stations themselves are operated and maintained by specialist companies who can move equipment between a portfolio of sites, thus ensuring that each operator's station is correctly sized for their fleet. Government support for infrastructure would be better aimed at supporting this type of approach if possible. Vehicle costs and availability are currently more of an issue than infrastructure in many cases. OEMs are proving reluctant to invest in seriously bringing Euro VI gas vehicles to market, having just invested so much in developing Euro VI diesel technology. ILUC factors for crop based AD.
	Farm manure and slurry	Anaerobic digestion	If all the manure in England and Wales was processed by AD, and if all the biogas, allowing for process energy, was upgraded to biomethane for transport, then the energy value of the BfT would be about 25PJ per year. A reasonable target for 2020 would be 2% of this potential, i.e. 0.5PJ per year. This figure is very dependent on policy and incentives.	Using the figures in the previous column, the production might rise, by 2030, to 10% of the potential, i.e. 2.5PJ per year.	
	Farm crops	Anaerobic digestion	If, by 2020, 10,000 hectares of farm land in England and Wales is used to produce crops for AD, and if all the biogas, allowing for process energy, was upgraded to biomethane for transport, then the energy value of the BfT would be about 1.0PJ per year.	If, by 2030, 100,000 hectares of farm land in England and Wales is used to produce crops for AD, and if all the biogas, allowing for process energy, was upgraded to biomethane for transport, then the energy value of the BfT would be about 10.0PJ per year.	
	Sewage sludge	Anaerobic digestion	If all the sewage gas in England and Wales was upgraded to biomethane for transport, then the energy value of BfT would be about 10PJ per year. A reasonable target for 2020 would be 10% of this figure, i.e. 1.0PJ per year.	Using the figures in the previous column, the production might rise, by 2030, to 50% of the potential, i.e. 5.0PJ per year.	
	Total from controlled anaerobic digestion		The totals from the four categories amount to a figure of 4 PJ per year, which is considered to be conservative. Sweden is already producing 3PJ per year of biomethane for transport. Some of this biomethane will be delivered via the grid and will therefore qualify, under the current incentive schemes, for RHIs. The rest will come from dedicated on-site biomethane plants, the reason being that grid injection is economic only at a very large scale.	The totals from the four categories above amount to a conservative 25 PJ per year, which is 80% of current HGV consumption.	
	MSW	Landfill	Landfill (UK): Research indicates that of the 60PJ total resource in 2020, approx 50% (30PJ) could be economically feasible for transport. However, electricity will remain more profitable for landfill operators. 0.6PJ landfill gas (2% of total resource) could be available for transport in 2020 under current incentive structures. 30PJ = ~ 0.5m tonnes LBM. 0.5m tonnes can fuel ~22,500 dual-fuel HGVs or ~18,000 dedicated gas HGVs per year. 0.6PJ = ~10,000 tonnes LBM. 10,000 tonnes can fuel ~450 dual fuel HGVs or ~360 dedicated gas HGVs per year.	Research indicates 30PJ in 2020 dropping to ~10PJ in 2025 and <5PJ in 2030. Availability is subject to the same caveats as the supply to 2020 (eg 2% of available supply). Due to declining nature of the resource, 0PJ are available in 2030.	
Jet fuel	MSW	Numerous (including FT, pyrolysis, gas fermentation, other new techs)	*Feedstock available* (1) In **2020**, UK to produce 22.4-26.5 million tonnes of residual waste annually (GIB study, 2014). (2) UK total sustainable availability of wastes and residues in the UK in **2020** = roughly 30 million dry tonnes per year (ICCT presentation to DfT, slide 27) *Fuels* "The prospects for the UK are largely dependent on the success of the BA/Solena plan in London. In addition, some other technologies, such as the Virgin Atlantic / Lanzatech plans to process waste gases from steel production, could also be implemented in the UK before 2020." (SA Sustainable Fuels UK Roadmap, 2014 - analysis by E4Tech)	*Feedstock available* UK total sustainable availability of wastes and residues in the UK in **2030** = roughly 30 million dry tonnes per year (ICCT presentation to DfT, slide 27) *Fuels* "In the UK, we estimate that sustainable fuel production could reach between **100,000 - 640,000 tonnes** per annum in 2030. This translates to between **5 to 12 sustainable fuel plants** in the UK, producing between 20% - 60% of aviation fuel in combination with road transport fuels." (SA Sustainable Fuels UK Roadmap, 2014 - analysis by E4Tech)	* Exclusion from current policy mechanisms (RTFO) * Lack of a long-term transport fuels policy framework * Competition with other sectors (electricity, EMR), where alternative uses (incineration) are viewed as a safer investment option (vs higher-risk advanced fuels plants). * Waste hierarchy disincentivises use of residual waste as feedstock. Advanced chemical processes like gasification allow the carbon and energy from a broard spectrum of waste resources to be recycled into new fuel products. However, these pathways are currently viewed to be 'other recovery' (like incineration for power) and are placed near the bottom of the hierarchy. * Lack of project development financing (e.g. loan guarantees) * Other countries offer more attractive policy frameworks for aviation fuel project developers
	Agricultural residues	Numerous (including FT, pyrolysis, cellulosic bio-treatment pathways, gas fermentation, other new techs)			
	Waste gases	Electrolysis, bio-treatment, gas fermentation			
	Algal biomass	HEFA, bio-treatment			

Policies / steps required to address to 2020 (in order of importance)	Policies / steps required to address 2020 - 2030 (in order of importance)	GHG saving (using the RED methodology. Please state if otherwise)	Sustainability certification	Economic benefits to UK
Introducing an RTFC price floor for biomethane in the RTFO - Setting an advanced biofuels sub-target in the RTFO - Removing biomethane fuel duty (currently £0.24/kg) - Supporting greater investment in UK gas infrastructure / vehicles - Seeking clear guidance from the EC on grid injection of biomethane for transport - Successful conclusion of ILUC negotiations at EC level	Reform of UK biomethane support mechanisms so heat, electricity and transport sectors can all compete for UK's biomethane reource, eg removal of biomethane from RTFO and amendment of RHI to become cross-sectoral biomethane tariff.	Research indicates that in some applications biomethane can deliver between 32% - 52% carbon savings over diesel*. This savings figure requires more research, particularly in the context of biomethane derived from food waste and farm manure. More information on methane slip and boil-off from cryogenic tanks is required before the greenhouse gas emissions of vehicles fuelled with liquified gas can be compared accurately with diesel equivalents - this is less of an issue for vehicles fuelled with compressed gas. Research into lifecycle emissions of gas-fuelled vehicles is ongoing. [Need to know total possible / probable number of LBM vehicles expected in 2020 to make estimate of GHG saving] *Source: Ricardo-AEA. Note that this work uses the Defra average emission factor for biomethane, with the range of savings reflecting different vehicle applications and different means of delivering the gas to the vehicle. However, depending on the source of biomethane (and the feedstock), the overall savings can be much higher.	i. Independent audits under the RTFO ii. Voluntary Schemes iii. Green Gas Certification	Large fleet operators currently considering converting more vehicles to biomethane, particularly in the bus and heavy haulage sectors. Many local authority fleets are also considering gas a vehicle fuel, as part of their low emission strategies. High demand for biomethane (both compressed and liquified) as a fuel. Dual fuel conversions are made in the UK by at least three companies. Cryogenic haulage and logistics services for the delivery of LBM are provided by UK companies. A new Bio-LNG station design developed by UK companies is being assembled in the UK with partial funding from Innovate UK. Several UK companies are involved in the supply and design of compressed gas refuelling stations.
* Establish policy certainty - Implement a stable policy framework for transport fuels to 2030. **This should include a sub-target specifically for advanced transport fuels**. * Provide equivalent incentives for all advanced fuels (including aviation fuels). In the short-term, this can be achieved by allowing suppliers of advanced aviation fuel to 'opt-in' to the RTFO * Adjust RTFO to be more technology-neutral, focusing on lifecycle GHG reductions & sustainability criteria. This would extend RTFO eligibility to non-biological routes (e.g. gas fermentation using bacteria). * Increase availability of project support & financing - the Green Investment Bank can play a key role in de-risking new production plants (e.g. via loan guarantees) * Establishment of a public-private sector initiative to stiumlate the advanced aviation fuels sector in the UK * Align waste policy with advanced fuels policy to provide clarity and support for waste-to-fuels pathways. **Redefine these advanced pathways** (like gasification, gas fermentation) **as 'recycling' in the waste hierarchy**.	* Establish policy certainty - Implement a stable policy framework for transport fuels to 2030. **This should include a sub-target specifically for advanced transport fuels.** * Government funding to support each stage of the technology development cycle: -- Early stage R&D -- Pilot scale plants -- Demostration scale plants -- Commercial scale plants * R&D funding programmes should prioritise technology pathways with the: (1) highest probability of reaching commercial scale (2) highest lifecycle greenhouse gas reductions vs traditional fossil kerosene * Development of military procurement policy to drive investment for sustainable fuels (e.g. the US's 'green fleet' programme). * Supportive treatment of advanced aviation fuels in the ICAO Global Market-Based Mechanism framework	We expect advanced fuels from these feedstocks to achieve a minimum 60% lifecycle GHG reduction vs traditional fossil kerosene.	As members of the Sustainable Aviation Fuel Users Group (SAFUG), most major UK carriers have signed up to the principles of the **Roundtable for Sustainable Biomaterials** (RSB). "These fuels must avoid Direct and Indirect Land Use Change (ILUC) impacts, for example tropical deforestation." (SA Sustainable Fuels UK Roadmap, 2014)	* "Development of a domestic industry for the production of sustainable fuels could generate a **Gross Value Added of up to £265 million in 2030** and support **up to 3,400 jobs**... The successful capture of global sustainable fuel opportunities could generate additional value for the UK. **The value of global exports is estimated at £100-220 million in 2030 with the support of 500-1,000 jobs**." (SA Sustainable Fuels UK Roadmap, 2014 - analysis by E4Tech) * EU-wide job opportunities - Agricultural residue collection - **up to 83,000 permanent jobs**. Plant operations - **up to 13,000 permanent jobs**. Forest residue collection - **up to 50,000 permanent jobs**. Plant construction - **up to 162,000 temporary jobs**. (ICCT presentation to DfT) * Improves UK balance of payments. * Enhances UK's security of fuel supply. At present, the UK imports 60% of its fossil fuel. * Intellectual Property (IP) value

Fuel	Feedstock	Technology	Potential supply / availability for transport to 2020	Potential supply / availability for transport 2020 - 2030	Barriers (in order of importance)
Bioethanol and drop-in jet fuel (Alcohol-to-Jet)	unavoidable waste gases from industrial processes	gas fermentation using naturally occurring bacteria	**Using waste gases from steel making:** LanzaTech has evaluated in detail the potential for ethanol production from the UK steel industry. The two plants with the highest potential for fuel production would in combination yield over 300,000 tons (> 100 million gallons) per year of ethanol from Basic Oxygen Furnace off gases alone. Blast furnace gases from all three UK mills have the potential to additionally yield over a million tons per year (350 million gallons) of ethanol. Coke oven gases from UK steel mills and coke production facilities could add up to another 600,000 tons of ethanol (>200 million gallons).	#REF!	**Using waste gases from steel making**: Existing legislation was written prior to the development of Gas Fermentation technologies and currently does not include biofuels produced from recycling waste carbon gases, such as those generated in the chemistry of steel making. Extensive third party life cycle analysis shows that by recycling this waste carbon fuels with a 70% lower GHG footprint than conventional oil-derived fuels can be produced.
	Syngas produced from Municipal solid waste. Syngas produced from Agricultural Residues	gas fermentation using naturally occurring bacteria	**Municipal Solid Waste (MSW):** Gas fermentation can utilize municipal solid waste after conversion to syngas (carbon monoxide and hydrogen) through a process called gasification. In 2010, the UK produced 32.4 million tons of municipal solid waste. *[Municipal Waste Management in the United Kingdom, European Environment Agency, prepared by David Watson ETC/SCP, February 2013.]* Based on estimates of MSW composition, this quantity has the potential to produce approximately 5 million tons of ethanol (~1.8 billion gallons). [Composition estimates from: *Municipal Waste Composition: A Review of Municipal Waste Component Analyses, Defra Final Report, Project WR0119.*] Biomass Residues: Like MSW, biomass residues such as wheat straw can be converted to syngas through gasification, providing a suitable input stream for gas fermentation. In 2012 the UK produced over 13 million tons of wheat. [http://faostat3.fao.org/faostat-gateway/go/to/download/Q/QC/E.] If approximately 3 million tons of wheat residue can be sustainably harvested from this wheat production, based on general industry estimates, this would have the potential to make over 700,000 tons (250 million gallons) of ethanol.	Significant waste feedstock availability in the UK, including at least 100 million tonnes of carbon containing waste generated each year, and at least 14 million tonnes of bio-based residues from crops and forestry sources each year	Syngas produced from Municipal solid waste: The current "Waste Hierarchy" published bt DEFRA provides guidance on how waste is to be treated. In their current form these guidelines describe recycling waste in terms of composting, while actions like gasification that allow the carbon and energy in a broard spectrum of waste resources to be recycled via gas fermetation into new fuels and chemicals are placed lower down on the hierarchy and are only considered in terms of power production. In this sense the waste hierarchy dis-incentivises waste carbon recycling into new fuels and chemicals.
	Algal biomass	HEFA, bio-treatment			
LPG (Liquefied Petroleum Gas)	LPG is the generic name for mixtures of hydrocarbons that change from a gaseous to liquid state when compressed at moderate pressure or chilled. LPG primarily comprises propane (C3H8) and butane (C4H10). Propylene, butylenes and various other hydrocarbons are usually also present in small concentrations.	Fossil LPG is derived as a by-product, from crude oil refining or from natural gas or oil production and processing. LPG can also be captured during shale gas extraction. LPG is liquefied under pressure and stored in pressurised steel vessels	UK: LPG Production capacity currently stands at 3.34million tonnes per year. The UK produces a surplus of LPG, exporting some 1.2million tonnes per year, and production is growing globally, associated with increased natural gas extraction and particularly shale gas. LPG autogas infrastructure is already in place, with >1400 refuelling points in the UK. 93,000 tonnes of LPG was delivered to LPG autogas refuelling stations in 2013 by a robust well-established supply chain. There are an additional >2,000 bunkered storages used to refuel fixed tanks on LPG fork lift trucks (FLTs). Around one third of GB FLTs run on LPG. Europe: Europe is a net importer of LPG. It produces over 26million tonnes and currently consumes 32million tonnes. However as general gas production increases so will LPG. Global: By 2020 it is expected that global supply of LPG will exceed 300million tonnes per year.	UK: The balance of UK production of LPG beyond 2020 will be determined by North Sea Oil production, ongoing refinery production, gas field extraction and shale gas production. Europe: European production volumes are expected to increase as general gas production increases in this period. Exact figures are hard to predict, but combined with the general global surplus Europe is expected to continue to be secure in its supply. Global: Even as early as 2018 there is predicted to be up to a 15million tonne surplus of LPG. Therefore with expected increases in gas production beyond 2020 this surplus will at the very least remain steady.	A 1p duty differential reduction per year from 2015 - 2024 exists for LPG autogas. This will discourage uptake in the short to medium term. Lack of a post-2024 duty differential confirmation. Lack of OEM vehicle availability in the UK - currently the industry relies on aftermarket conversions. NB. there is no shortage of LPG ready OEM vehicles in Europe where policies actively encourage LPG use in transport. Current market penetration is small - LPG is used in about 150,000 UK vehicles which amounts to 0.5% of the total British car fleet (30 million) - accordingly awareness is low.

Policies / steps required to address to 2020 (in order of importance)	Policies / steps required to address 2020 - 2030 (in order of importance)	GHG saving (using the RED methodology. Please state if otherwise)	Sustainability certification	Economic benefits to UK
Making RTFO more technology neutral-with focus on resulting sustainability criteria/GHG reductions -accepting gas fermnetation using bacteria as an established process for biofuel production. Focus on carbon reduction in fuels, instead of solely on the use of (traditional) biomass. Re-prioritise gigelines such as the waste hirearch to incentivise technologies the use of that allow the capture and recycling of the carbon and energy in wastes for high value applications such as fuel production.		third party Life Cycle analysis by E4tech, using the RED methodology, has demonstrated GHG reduction over fossil alternative to be over 70%	independent audit by RSB	promotion of industry and job creation leading to growth in UK offering method of greening-reducing emissions from industry; improving local air quality and producing value added products such as low carbon fuel from industrial waste gases for road AND aviation
Making RTFO more technology neutral-with focus on resulting sustainability criteria/GHG reductions -accepting gas fermnetation using bacteria as an established process for biofuel production. Focus on carbon reduction in fuels, instead of solely on the use of (traditional) biomass. Re-prioritise gigelines such as the waste hirearch to incentivise technologies the use of that allow the capture and recycling of the carbon and energy in wastes for high value applications such as fuel production.				producing value added products such as low carbon fuel from waste gases for road AND aviation
Reverse the planned 1p reduction for LPG's fuel duty differential and treat all road fuel gases on the same basis. A clear and consistent policy commitment to LPG is required to re-establish investor confidence in this greener alternative fuel such as incentivising OEM's to produce LPG cars by supporting the cost of conversion as was the case with the EST's Powershift programme. Introduce grant funding for motorists and fleet operators to convert the most polluting cars to LPG (car scrappage scheme). Provide financial support for local authorities to move their fleets to LPG. Exempt LPG vehicles from the London Congestion Charge.	Continue with the policy mechanisms outlined to 2020. Confirm the fuel duty differential to at least 2030.	According to figures published by the European Commission under the Fuel Quality Directive (December 2014) LPG has a significantly lower Greenhouse Gas intensity compared to diesel and petrol: Greenhouse Gas (GHG) Intensity: Diesel: 95.1g CO_2eq/MJ Petrol: 93.3g CO_2eq/MJ LPG: 73.1g CO_2eq/MJ These WtW (well-to-wheel) numbers come directly from Annex 1 of the Fuel Quality Directive which has been agreed at a European level and will be used as the basis for implementation by Member States. Therefore substituting LPG for diesel achieves a carbon saving of 23%, whilst substituting it for petrol saves 21% (as defined in Annex V.C.4 of the Renewable Energy Directive.) Each 5% increase in penetration of LPG as a transport fuel (from its current level of 0.5%) would cut UK transport carbon emissions by approximately 1%.) LPG autogas delivers several times less NO_2 than petrol, 80% less NO_x than diesel and 98% fewer harmful particulates than diesel	Not applicable	The UK autogas industry employs 900 people with an annual turnover of £150m; the wider LPG industry provides 10,000 jobs and is worth £750m to the UK economy. LPG offers cost savings now for the UK consumer of around 40% when compared to petrol and diesel. A 10% LPG transport share by 2020 will deliver cumulative individual savings of £33billion. A 10% LPG transport share by 2020 will deliver social welfare savings of roughly £16billion across the EU, notably through reducing public health impacts through lowering emissions and pollutants. LPG significantly reduces air pollution causes an estimated 29,000 deaths a year in the UK, according to Public Health England. A 2009 government report 'The wider costs of transport in English urban areas' estimated the burden of cost to the NHS resulting from poor air quality was between £4.5 - £10.5 billion.

Fuel	Feedstock	Technology	Potential supply / availability for transport to 2020	Potential supply / availability for transport 2020 - 2030	Barriers (in order of importance)
Biopropane	**Non-HVO Biopropane:** Calor Gas has identified 14 different methods of producing biopropane using a range of feedstocks including liquid waste (e.g. glycerol) and lignocellulosic materials. Imperial College London has successfully demonstrated that biopropane could be produced from the genetic modification of e-coli bacteria with the energy required to power the process being provided via photosynthesis.	Biopropane can be produced using different types of thermal and chemical processes. The molecular structure of pure biopropane is identical to that of conventional pure propane produced from hydrocarbons, so can be blended or sold in a pure form.	It is extremely unlikely that any biopropane, other than from HVO production, will be available before 2020.	**UK:** Calor Gas has identified 14 different methods of biopropane production and, given appropriate market conditions, would look to develop one of more of these technologies to form an indigenous supply. To justify investment in production individual facilities would need to have an annual production capacity of at least 20,000 tonnes of biopropane. Five facilities woul;d deliver over 100% of current LPG use in road transport.	The main barriers are technological. There are a number of developed IPs available, but grant funding support is required to develop the necessary demonstration plants.
	HVO Biopropane: Hydrotreated Vegetable Oil (HVO) is a high-quality renewable diesel produced by hydrotreating either vegetable oils or different kinds of wastes and residues, or mixtures of them. Biopropane is produced as a residue from this process. Neste Oil's process enables virtually any vegetable oil or waste fat to be processed into renewable fuel. (See also 'Sustainability Certification' column) Currently waste and residues account for half of the renewable inputs used by Neste Oil. By 2017 Neste Oil will have the technical capability to use 100 % waste and residue raw materials in its biopropane production. Current Vegetable Oil feedstocks: Palm Oil (48% in 2013), Other Vegetable Oils (0.0086% in 2013 - Rapeseed Oil, Camelina Oil, Jatropha Oil, Soybean oil). Current Waste and residue feedstocks: 52% in 2013 including waste animal and	Hydrotreated vegetable oil (HVO), which involves the hydrogenation of vegetable oil or different kinds of waste and residue to produce diesel, is the only biopropane production process in full commercial use today. HVO biopropane can be made to the current specification of commercial LPG and used a direct substitution (i.e. drop in) for existing LPG in any proportion up to 100%. This means that no modification of existing LPG end user equipment is required regardless of the proportion of HVO biopropane used in fuel.	**UK** - Currently there is no indigenous production of HVO biopropane. From 2016 40,000-50,000 tonnes of HVO biopropane could be imported to the UK from the Port of Rotterdam. The entire Neste production has been secured by SHV Energy (Calor's parent company) on an exclusive basis through to 2020. **EU** - Similar separation facilities could be built at Neste's two other European HVO plants, and at two other European plants that are due to come onstream in 2015. **Global** - There are currently 7 HVO biodiesel plants in operation around the world, but the fuel is separated from other off-gases and purified for commercial sale at only one plant in the United States.	**UK and Europe:** The Neste production from Rotterdam will continue to deliver a minimum of 40,000 tonnes per year through the decade. This could be supplemented by an additional 160,000 tonnes per year therefore total availability would reach more than 200,000 tonnes.	**Economic:** Cost of production and supply of HVO biopropane is a barrier. UK production - The 2014 DECC Market Study estimated that the indicative cost of producing HVO biopropane, based on a hypothetical 800,000 tonnes/year plant located in the United Kingdom, to be 10.2 pence/kWh (around £1,400/tonne). European production: The cost of producing and importing HVO biopropane from the Port of Rotterdam is well above the current price of propane. **Legislative:** With the inclusion of biopropane in the RTFO there are no current legislative barriers to HVO biopropane deployment in the UK. However, the ongoing debate around ILUC may impact upon the willingness of companies to invest in brand new HVO facilities. **Technical**: There is no technical impediment to the use of HVO biopropane in the UK.
	Non-HVO Biopropane: Calor Gas has identified 14 different methods of producing biopropane using a range of feedstocks including liquid waste (e.g. glycerol) and lignocellulosic materials. Imperial College London has successfully demonstrated that biopropane could be produced from the genetic modification of e-coli bacteria with the energy required to power the process being provided via photosynthesis.	Biopropane can be produced using different types of thermal and chemical processes. The molecular structure of pure biopropane is identical to that of conventional propane produced from hydrocarbons, so can be blended in any proportion or sold in a pure form.	It is extremely unlikely that any biopropane, other than from HVO production, will be available before 2020.	**UK:** Calor Gas has identified 14 different methods of biopropane production and, given appropriate market conditions, would look to develop one of more of these technologies to form an indigenous supply. To justify investment in production individual facilities would need to have an annual production capacity of at least 20,000 tonnes of biopropane. Five facilities would deliver over 100% of current LPG use in road transport.	The main barriers are technological. There are a number of established IPs available, but grant funding support is required to develop the necessary demonstration plants.
Renewable methanol from non-biological sources	CO2	Flue gas treatment	~1350 million mt/yr (CO2 not a limiting factor)	~1100-1200 million mt/yr (assuming 10-20% reduction)	UK RTFO does not allow generation of RTFCs from renewable fuel from non-biological sources. Transport sector can't compete In many instances with feed-in tarrifs for electricity from renewable sources. Guarantees of origin for renewable electricity can not be used in the context of the renewable transport fuel mandate. Given current gasoline and diesel standards transport sector in EU-28 could consume approximately 10 million tons of methanol, through direct blending, MTBE and biodiesel.
	Hydrogen	Electrolysis	Total availability of electricity from surplus generating capacity from renewable sources in Iceland 2 TWh/yr (capacity to generate 0.2 million mt methanol). Total availability of electricity from renewable sources 650 TWh/yr in EU-28 (65 million mt methanol) and UK 35 TWh (3.4 million mt methanol).	Generating capacity from renewable sources in Iceland could potentially rise by 20 TWh/yr (2 million mt/yr methanol). If all EU-28 reach a minimum of 30% generation from renewable energy sources, total availability increases to 840 TWh/yr (83 million mt/yr methanol).	

Policies / steps required to address to 2020 (in order of importance)	Policies / steps required to address 2020 - 2030 (in order of importance)	GHG saving (using the RED methodology. Please state if otherwise)	Sustainability certification	Economic benefits to UK
Grant funding will need to be made available to support the development of the existing IPs. This could be provided via DfT, regional development funds, Scottish and Welsh Governments and EU funding streams such as Horizon 2020.	Continue with the policy mechanisms outlined to 2020. Confirm the fuel duty differential for LPG/biopropane to at least 2030. Continue incentive via the RTFO to encourage biopropane import from Europe, and globally, as well as indigenous production. Provide further legislative support to encourage the development of indigenous production facilities - i.e. capital grant funding	These will vary depending upon the feedstock and the energy sources required to manufacture biopropane.	The processes identified are based around existing biological waste streams and so should address any concerns around sustainability as ILUC will not be a factor.	The DECC Market Study identified three primary economic benefits of Biopropane: The energy-security gains from reduced reliance on imported oil or natural gas (to the extent that the biofuels are produced indigenously). The economic benefits from indigenous bioenergy production, through an improved balance of trade and the economic stimulus that it provides to the farm and/or forestry sector and related activities. The potential for reduced emissions of greenhouse gases.
Support for LPG and biopropane: A renewed policy commitment to LPG as a road fuel is required to re-establish industry confidence in LPG vehicle technology. Creating policy certainty for LPG vehicles and maintaining RTFO support will provide the investor confidence necessary for the creation of biopropane production facilities.	Continue with the policy mechanisms outlined to 2020. Confirm the fuel duty differential for LPG/biopropane to at least 2030. Continue incentive via the RTFO to encourage biopropane import from Europe, and globally, as well as indigenous production. Provide further legislative support to encourage the development of indigenous production facilities - i.e. capital grant funding	Under the rules of the Renewable Energy Directive (European Commission 2009), biopropane can be classified as a residue. This allows it to be double-counted in national carbon accounts, and gives it a very low carbon-intensity. As a residue, biopropane's carbon intensity is about 10 CO2e/MJ (UK Dept of Energy & Climate Change et al. 2014 paragraphs 1.90-1.104). Substituting it for either diesel or petrol would achieve a carbon saving (Annex V.C.4 of the Renewable Energy Directive) of 89%. This is well above the savings realised by first-generation biofuels, which range from around 16-70%, and is in line with those of second-generation biofuels, which range from about 80-95% (European Commission, 2009, Annex V.A).	All Neste Oil's raw materials are sustainably produced and can be 100% traced back to the plantations and production sites from which they come. They also meet the strict sustainability criteria set out in EU biofuel legislation, which forbids forests, wetlands, peat bogs, and areas with high levels of biodiversity from being cleared for biofuel-related purposes. Neste Oil's supply chain is monitored through regular independent third-party audits to ensure compliance. Neste Oil is a member of RSPO.	The potential exists for significantly reduced emissions of greenhouse gases and other air pollutants. This is particularly pertinent to the transport sector and to the UK air quality targets as failure to meet these environmental targets carries an economic penalty. The European Commission is currently taking legal action against the UK as a result of its failure to meet air quality targets, particularly re NOx which is mainly produced by diesel vehicles. This may result in a £300million per year fine.
Grant funding will need to be made available to support the development of the existing IPs. This could be provided via DfT, regional development funds, the Scottish and Welsh Governments or EU funding streams such as Horizon 2020.	Continue with the policy mechanisms outlined to 2020. Confirm the fuel duty differential for LPG/biopropane to at least 2030. Continue incentive via the RTFO to encourage biopropane import from Europe, and globally, as well as indigenous production. Provide further legislative support to encourage the development of indigenous production facilities - i.e. capital grant funding	These will vary depending upon the feedstock and the energy sources required to manufacture biopropane.	The processes identified are based around existing biological waste streams and so should address any concerns around sustainability as ILUC will not be a factor.	The DECC Market Study identified three primary economic benefits of Biopropane: The energy-security gains from reduced reliance on imported oil or natural gas (to the extent that the biofuels are produced indigenously). The economic benefits from indigenous bioenergy production, through an improved balance of trade and the economic stimulus that it provides to the farm and/or forestry sector and related activities. The potential for reduced emissions of greenhouse gases.
Adapting RTFO and allowing RTFCs to be generated from use of renewable fuel from non-biological sources. Allowing guarantees of origin for renewable electricity to be used in the context of compliance with the renewable transport fuel mandate. Extending UK tax benefits for acqua methanol to ultra-low carbon methanol.	Phasing out direct subsidies for renewable energy generation as technology becomes cost-competitive with nuclear and fossil generation on a LCOE basis. Adopt gasoline standard allowing higher blend of alcohols and commission research to provide auto-makers with data to support use of both ethanol and methanol in flex-fuel cars.	Renewable methanol from non-biological sources of energy can deliver at least 90%-98% carbon savings over gasoline.	i. Dutch verification protocol for renewable fuels from non-biological origin ii. ISCC Plus voluntary certification scheme	Increases availability of ultra-low carbon intensity liquid fuel, which can reduce the costs of meeting lower CO2 emissions. Production technology is scalable, and includes not only use of electrolysis but also waste gasification - for the production of renewable fuels - and increases use of hydrogen byproduct from chlor-alkali processes and fossil fuel combustion in chemical plants - for production of partially renewable fuel. Anti-knocking properties of methanol can allow for an increase of efficiency of combustion, potentially by up to 50% (although some literature shows 25 - 30% gains relative to RON-95 gasoline, and less relative to high-octane gasoline. Combustion of methanol creates fewer CO emissions, although NOx emissions are similar to gasoline engines. SOx emissions would significantly lower and could be close to zero depending on the source of the methanol. These benefits can be exploited to develop lighter, fuel efficient engines for both light vehicles and heavy transport, which allow targets for decreased CO2 emissions from transport to be met at lower cost than with alternatives. Technology to produce methanol is scalable and infrastructure to distribute liquid fuel already exists, leading to lower system-wide costs of adaptation.

Fuel	Feedstock	Technology	Potential supply / availability for transport to 2020	Potential supply / availability for transport 2020 - 2030	Barriers (in order of importance)
Hydrogen	Renewable Power	Electrolysis	Competition for renewable electrons into other processes/transportation		Investment in hydrogen infrastructure required
	Waste eg AD	Waste to Hydrogen processes (generating a biogas product or byproduct)	Competition for biomethane into other processes/transportation		High cost of vehicles and infrastructure
					Investment in renewable hydrogen production facilities
					Competition for electrons / biomethane into other processes / transportation / grid etc
	(wastes: MSW, beettops&chips&tails, manure,)	(syn)gas reforming	40.000 tonnes of bio-methanol	100.000 tonnes	- cofiring (and subsidizing) of biomass in coal plants (I do not not if this situation occurs in the UK) . Cofiring should not limit volumes of biomass available for transport / chemicals
Biomethanol	CO2 + wastes	(syn)gas reforming	(volume above)	(volume above)	- unclear wether the fuel qualifies as a biofuel or as an alternative fuel. '- If FQD proposal is adopted, (fixed default values on GHG emissions for fossil fuels) then only biofuels can be used for GHG reduction. There would be no incentive for fossil fuels or alternative fuels to reduce GHG emissions. (all (upfront) investment costs to achieve targets / reduce GHG savings to be done by biofuel producers)
BioButanol	various waste streams including whisky, agricultural	ABE fermentation	1 - 5 kte	200kte	Technology risk to deploy ABE fermentation to waste streams then advanced biofuels sub-target.

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		Renewable hydrogen would provide zero well to wheel emissions when used in a FCEV (therefore refer to published W2W standard numbers?)	None in place as yet, DfT are working with industry on a Green Hydrogen standard and initiatives also underway in EU	Bad air quality costs the UK costs between £8.5-20bn per year (Air Quality Strategy) based on life-years lost. This figure excludes the cost of morbidity.
				The additional costs to the NHS from respiratory hospital admissions triggered by air pollution. There are clear links between asthma and air quality; Asthma UK estimate the annual cost of asthma to society at £2.3 billion
				A recent survey by the UK Hydrogen and Fuel Cell Association and Energy Generation and Supply KTN revealed that UK fuel cell and hydrogen companies are expecting cumulative annual revenues to reach £1bn by 2020, bringing over 2,200 fuel cell and hydrogen related jobs to the UK.
- subtarget for advanced biofuels (regardless of EU policy, and continuing after 2020. example of Italy) '- incentives for second generation biofuels needed. No incentives for advanced biofuels under current FQD. If countries introduce GHG intermediate targets and abolish blending obligations then opportunities for second generation deminish. '- EU harmonization of markets. country level to small for decisions in investments	- post 2020 (sub)targets are needed for transport (or chemicals) '- inclusion of fossil fuels in policy of GHG reduction. P.e. if FQD proposal is adopted, the only way to reduce GHG emissions is blending biofuels while GHG performance of fossil fuels can weaken (tar sands, shale gas), wich will effectively increase GHG emissions by fossil fuel producers.	50% - 80% appr.	EU recognised voluntary schemes	
- Incentives for low carbon fuels needed. '- (RED does not foresee in the use of CO2 reuse. CO2 is non-biodegradable and does therefor not qualify as a biofuel) '- adjust the system of CCR rewarding. The producer of the CO2 is rewarded. No incentive is given for those parties / biofuel producers using the CO2 in the production proces.		Depending on biogenic or non biogenic origin, estimation is that CO2 injection can increase with an additional 8% GHG savings. (Only if CO2 is a waste and starts with 0 GHG footprint)	EU recognised voluntary schemes	
Technology investment, advanced biofuels target	Progressive advanced biofuels sub-target - 2%	Analysis not finshed but pointing towards very high as waste stream feedstock producing acetone, biobutanol, bioethanol and animal feed and Biobutanol around 20% of total output.	tbc - but could be EU RED VS or member state specific cmpliance audits	