Options and recommendations to meet the RED transport target

Final report

Study commissioned by the LowCVP

29/05/2014

Author

Element Energy Limited
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Executive summary

- The LowCVP commissioned this study in order to bring clarity over the UK options to meet the Renewable Energy Directive (RED) 2020 transport target (minimum 10% renewable energy), and it will provide evidence for the Department for Transport’s current review of the UK biofuel policy framework.

- Element Energy investigated four strategies to reach the 10% target through a model able to simulate different levels of uptake of various fuels and energy vectors. Model inputs were validated by an industry stakeholder consultation.

- The four investigated strategies are:
  - **NO NEW BLENDS**: no blends higher than E10 and B7, and relying on double counting fuels.
  - **DEPOT FOCUS**: E10, B7 and high biodiesel blends for trucks and buses refuelling at depots.
  - **NEW FORECOURT BLENDS**: bring higher blends to the forecourts (E20 and/or B10 and/or E85).
  - **COMBINATION**: new higher blends at both depots and forecourts.

- For each approach, one RED scenario was derived based on analysis of cost effectiveness and respecting defined constraints. This results in four RED scenarios that differ in their reliance on feedstock/fuel availability, sensitivities to accounting rules and implementation challenges.

- In all cases, the implied uptake of new blends/vehicles and/or supply of double counting fuels suggest an ambitious implementation program and incentives will be necessary. Industry consultees highlighted the risk of such a support framework not being developed in time to meet the 2020 target.

- In all cases, the supply of double counting fuels (FAME/HVO from waste oils, Ethanol 2G, Biomass To Liquid diesel) is critical.
The emerging conclusion from modelling and industry consultation is that the **E10&B7 scenario** (‘No new blend’ approach) is the most probable case, despite the implied critical role of waste oils & fats (mainly Used Cooking Oil today)

There is a disconnect between some of the options and efforts needed to reach the RED target and the criteria for a UK fuel roadmap beyond 2020. The suggested role post-2020 for fuels made from non-food crops, with low Indirect Land Use Change risk, indicates support should be put in place even if their role will be limited before 2020 as the current production capacity is still modest.

The emerging recommendations for the UK to reach the RED target are to:

- Roll out E10 and increase the biodiesel blending up to the existing B7 specification
- Maximise the use of double counting fuels that do not use food crop feedstock; this implies a high reliance on Used Cooking Oil and other waste fats, as fuels based on other feedstock will still be in limited supply by 2020
- Despite the limited role of drop-in fuels for the 2020 target, a supporting framework should be put in place, as they offer a better prospect to decrease emissions than current biofuels in the long term

**E10&B7 scenario overview**

- Transition starting in 2014, 2015 or 2016 at the latest

<table>
<thead>
<tr>
<th>Year</th>
<th>E5</th>
<th>E10</th>
<th>B7</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Key supply assumptions**
- UCO FAME/HVO: no supply cap
- No BTL, no E2G

**Contribution to RED target in 2020 – E10&B7 case**

- Other (biomethane, electricity): 0.1%
- FAME/HVO waste oil: 1.3%
- FAME/HVO food crop: 1.7%
- Ethanol 1G: 7.0%
1. Introduction
   Introduction to the RED target and associated challenges associated and report objectives

2. Scope and approach
   Powertrain and fuels in scope, modelling approach, main outputs and stakeholder consultation contribution

3. Fuel pathways
   Assumptions regarding supply caps, costs and WTW GHG emission savings of biofuels

4. RED scenarios
   Approach to RED scenario design, presentation of four alternative RED scenarios to reach the target and comparison of their outputs, barriers and challenges for their implementation and presentation of the most probable and recommended RED scenario

5. Recommendations
   Actions and next steps for the implementation of the recommended RED strategy

6. References and acronyms

Technical Appendices are provided in a separate document, published along this report.
1. Introduction

2. Scope and approach

3. Fuel pathways

4. RED scenarios

5. Recommendations

6. References and Acronyms
Introduction and objectives of the study

- The Renewable Energy Directive (RED) sets a target of 20% of the EU energy to come from renewable sources by 2020, with a sub-target for the transport sector: at least 10% of the final energy consumption in transport must come from renewable sources.

- Meeting this target is challenging, given that coordinated changes and actions will need to be undertaken among a wide range of stakeholders (i.e. vehicle manufacturers, refiners, fuel distributors and retailers; consumers), driven by changes in the policy framework specific to each Member State that ensure long term certainty.

- At the UK level, a clear strategy has not yet been developed, as the current mechanism, the Renewable Transport Fuel Obligation (RTFO), sets the target at ~5% biofuel blending by volume. There are some longer term policy measures in place, but they are not directly relevant to the RED target (e.g. support for electric vehicles and related infrastructure).

- The LowCVP commissioned this study in order to bring clarity over the UK options to meet the RED transport target by the analysis of ‘RED scenarios’: levels of uptake of different fuels and energy vectors that would allow the UK to meet the RED transport target, in the most cost effective way for consumers and avoiding ‘lock in’ effect in a strategy not compatible with the UK longer term vision for transport.

- The analysis aims to provide a clear comparison of options, their associated costs and challenges, and make recommendations for delivery of the most adequate scenario. It will provide evidence for DfT’s current review of the UK biofuel policy framework.
1. Introduction

2. Scope and approach

3. Fuel pathways
   A. Powertrain and blends across vehicle class
   B. Biofuels scope
   C. Model, degrees of freedom, baseline
   D. Outputs and related rules
   E. Industry consultation

4. RED scenarios

5. Recommendations

6. References and Acronyms
A. Vehicles and powertrains in scope for 2020 horizon

- The transport modes in scope for the study are road vehicles (cars, vans, Heavy Goods Vehicles and buses) and Non Road Mobile Machinery (NRMM). Aviation transport is not covered in this study. The table below shows the modelled powertrains per vehicle class.

- Gas vehicles are modelled only through a dedicated Internal Combustion Engine (ICE) powertrain. Industry stakeholders see the uptake potential of dual fuel gas vehicles as very limited, because the EURO 6 specification will severely restrict the supply of these vehicles.

- Two powertrain pathways are proposed: a ‘Base’ and a ‘HighAFV’ case, where there is a greater uptake of alternative powertrains (hybrid, PHEV and BEV for cars and vans; hybrid and dedicated gas for HGVs). Powertrain pathways are detailed in Appendix C.

<table>
<thead>
<tr>
<th>Modelled powertrains per vehicle class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cars</strong></td>
</tr>
<tr>
<td>Spark Ignition (SI) ICE</td>
</tr>
<tr>
<td>Compression Ignition (CI) ICE</td>
</tr>
<tr>
<td>Dedicated Gas ICE</td>
</tr>
<tr>
<td>Hybrid ICE (SI)</td>
</tr>
<tr>
<td>PHEV/REEV (SI)</td>
</tr>
<tr>
<td>Battery EV (BEV)</td>
</tr>
</tbody>
</table>

1- NRMM (Non Road Mobile Machinery) case, presented in Appendix B

BEV = Battery Electric Vehicle; PHEV = Plug-in Hybrid Electric Vehicle; REEV = Range Extended Electric Vehicle
### A. Fuels and fuel blends considered in RED scenarios

#### Modelled fuels or blends per vehicle class

<table>
<thead>
<tr>
<th></th>
<th>Cars</th>
<th>Vans</th>
<th>HGVs</th>
<th>Buses</th>
<th>NRMMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>E5 and E10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B5 and B7(^1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>B10</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>B30</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>B100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomethane</td>
<td></td>
<td></td>
<td>Dedicated</td>
<td>Dedicated</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Drop in diesel**, that can be blended in diesel at higher blend rates (within supply constraints) is also modelled.
- The potential of bio-methanol, an oxygenate already blended in gasoline, is commented on in Appendix K.
- Excluded from modelling as their contribution to 2020 RED targets would not be significant (but part of the existing or longer term UK transport mix):
  - **LPG / bio LPG**, the overall small share of LPG vehicles is <1% of the car and van fleet\(^2\).
  - **Hydrogen**. UK H\(_2\)Mobility results indicate sales of 10,000s H\(_2\) Fuel Cell vehicles by 2020, representing <0.1% of the 2020 fleet.

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1. B2 and B5 for NRMMs
2. 160,000 cars and vans currently on the road. Source: UKLPG
B. Biofuels in scope

Biofuels modelled

- Biofuels currently supplied are considered: Ethanol 1G, FAME (from food crops and non-food crops feedstock), biomethane
- More advanced biofuels not yet supplied in the UK (or in marginal quantities) are also considered for the 2020 timeframe: Ethanol 2G (made from cellulosic feedstock) and drop-in diesel, namely Biomass To Liquid (BTL) and Hydrotreated Vegetable Oil (HVO)

The case of HVO

- FAME feedstock can be used to make HVO. Therefore, to avoid double counting of feedstock, only FAME is modelled while the share of FAME that could be HVO instead is a post-process calculation
- HVO can also be made from non-food FAME feedstock such as microbial, microalgae and tall oils. The supply prospect for this type of HVO is however very limited by 2020
- Based on the current and announced plant capacity, projections of future roll out and competition from the aviation sector, the projected supply of HVO for the EU road transport sector in 2020 is 117 PJ (2.8 Mtoe), from which 15 PJ (~450 Ml) could be available for UK

Fuels excluded from the 2020 modelling timeframe

- Butanol and drop-in gasoline fuels are not considered for the 2020 timeframe as they are in early stage of demonstration compared to other new generation fuels that are in early stage of commercialisation such as HVO, BTL or Ethanol 2G

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1 - E4tech, 2013. ‘An harmonised Auto-Fuel biofuel roadmap for the EU to 2030’. 2 - The UK ‘fair share’ is assumed to be 13%, this is the % of UK transport fuel consumption at EU level as per (ECN, 2011).
**B. Biofuels categorisation used in the modelling**

- The categorisation shown below is in line with RED sustainability criteria and accounting rules. The accounting column shows the factor used to calculate the energy contribution of a given fuel.
- The feedstock shown below are as per the RTFO reports or RTFO guidance in the case of fuels not yet supplied to the UK market.

<table>
<thead>
<tr>
<th>Biofuel type</th>
<th>Feedstock</th>
<th>Accounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol 1G</td>
<td>Barley, corn, sugar beet, sugar cane, wheat</td>
<td>1</td>
</tr>
<tr>
<td>Ethanol 2G</td>
<td>Agricultural residues (e.g. bagasse, cobs, straw, husks, nut shells, low grade starch slurry), forestry residues, non-food cellulosic and ligno-cellulosic material (miscanthus, Short Rotation Coppice)</td>
<td>2</td>
</tr>
<tr>
<td>FAME* food crop</td>
<td>Oilseed rape, palm, soy</td>
<td>1</td>
</tr>
<tr>
<td>FAME* waste oil</td>
<td>Used cooking oil (UCO), tallow category 1, brown grease, palm oil mill effluent, spent bleached earth</td>
<td>2</td>
</tr>
<tr>
<td>BTL</td>
<td>Wood energy crops, agricultural residues, municipal waste</td>
<td>2</td>
</tr>
<tr>
<td>Biomethane</td>
<td>Biogas / waste (e.g. Municipal Organic Waste)</td>
<td>2</td>
</tr>
</tbody>
</table>

*Same feedstock could be used to make HVO, as presented in the previous slide*

Electricity is counted 2.5 times (efficiency factor), the share of renewable electricity is used to calculate electricity coming from renewable energy.
C. Overview of the model developed by Element Energy for the study of the 2020 RED target

Fuel database 2013-2020

<table>
<thead>
<tr>
<th>Fuel</th>
<th>p/MJ</th>
<th>WTW g/MJ</th>
<th>Supply cap MJ</th>
<th>RED accounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel 2</td>
<td></td>
<td></td>
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<tr>
<td>...</td>
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</tr>
</tbody>
</table>

Powertrain uptake pathways
New vehicle compatibility rules

RED scenarios

Fleet model

Check supply caps not exceeded and RED target met

Biofuels use PJ
%PJ renewable

Vehicles cost and MJ/km

Fleet size and km travelled

Existing stock

OUTPUTS

WTW Mt CO₂ saved

Contribution to target

ILLUSTRATIVE
A RED scenario is a combination of:

- **A fuel pathway**, composed of the following biofuel characteristics:
  - Cost [Low – Base – High]
  - Supply cap for E2G, BTL [High – Stretch] and UCO FAME/HVO [cap or no]
  - WTW emissions [Low – Base – High]

- A set of **powertrain pathways**
  - ‘Base’ for cars, vans, HGVs and buses; or
  - ‘High AFV’ for cars, vans and HGVs. Under this pathway, there is a greater uptake of alternative powertrains (HEV, PHEV and BEV for cars and vans; HEV and dedicated gas for HGVs)

- **A level of uptake of high blends** (B30, B100) and gas vehicles among depot refuelling fleets (HVGs and buses)

- A choice of introduction dates for **new blends at the forecourts/new vehicles**: E10, E20, E85 and B10
C. Baseline scenario and 2020 energy demand

Baseline modelling assumptions

- E5 and B5 from 2014, constant to 2020 (B0 for NRMM).
- WTW GHG savings of biofuels starting at today’s performance (see table), varying according defined pathways for ethanol 1G and biodiesel (blend of FAME crop and FAME non crop).
- Fuel cost: DECC central fossil fuel prices projections and assume they account for current blends. Fuel duty and VAT excluded from fuel cost in the modelling.
- For the fossil fuel carbon intensity, the RED values are used to 2020: 83.8 gCO₂e/MJ.

Current blends (RTFO Apr2012-13)

<table>
<thead>
<tr>
<th>biofuels</th>
<th>% (vol.)</th>
<th>Average WTW savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol</td>
<td>4.7%</td>
<td>59%</td>
</tr>
<tr>
<td>Diesel</td>
<td>1.9%</td>
<td>80%</td>
</tr>
</tbody>
</table>

2020 UK road transport energy demand, PJ

- Overall demand of 1,640 PJ, equivalent to 14.2 billion litres of petrol and 32.7 billion litres of diesel.
- Modest gas demand:
  - 110 kt (5 PJ) in base case
  - 203 kt (9.3 PJ) in HighAFV case
- Very modest electricity demand:
  - 304 GWh (1.1 PJ) in base case
  - 1,014 GWh (3.6 PJ) in HighAFV case

More detail on the demand modelling is provided in Appendix D.
## D. Outputs and related rules

### OUTPUT: contribution of each fuel type to the 10% RED target

- The contribution of each fuel type to the target is consistent with the accounting rules in the RED (2009/28/EC)
- Scenario scores against proposed changes to RED accounting rules and sub-targets (EU Parliament Sept. 2013) are also presented, as a sensitivity test

### OUTPUT: Mt CO$_2$e saved per vehicle class and scenario

- The emissions (WTW MtCO$_2$e) are calculated over the lifetime of vehicles
- The abated emissions are the comparison of a scenario to the baseline case
- The cost and (‘real world’) energy consumption of vehicles are based on the projections compiled by Ricardo-AEA for the Committee on Climate Change (2012). These account for the improvement of the ICE, in consistence with the EC regulations on emissions

### OUTPUTS: cost effectiveness (£/renewable GJ and £/abated tCO$_2$e)

- Baseline costs are calculated from the baseline scenario and are the sum of:
  - Capital cost of vehicles sales over 2014-2020 (except for NRMMs where only fuel filter replacement costs are used)
  - Energy expenditure of existing stock over 2014-2020
  - Energy expenditure of vehicles sold post-2013 over their lifetime
- The cost of scenarios is calculated from the same components plus marginal maintenance costs where relevant
- The price of petrol and diesel is higher than in the baseline when biofuels are blended in at higher blend than 5%(vol)
- The effectiveness is the delta cost (scenario-baseline) divided by the delta GJ or tCO$_2$e (scenario-baseline)
### E. Industry consultation: for review of model assumptions and insights on key barriers and enablers

| Working Paper| • Compilation of all model assumptions and proposed approach; **presented to SG (16th Oct)** |
| Industry consultation| • Eleven 60min interviews (21st Oct-12th Nov)  
• Presentation to UKPIA members (23rd Oct) |
| Refine model inputs| • Main input revisions: approach to supply of ‘double counting’ fuels; cost of biofuels |
| Analysis| • RED scenario analysis  
• Derived 4 RED scenarios meeting the 10% target |
| Results| • Presented to SG (14th Nov)  
• Circulated to industry stakeholders for feedback |
| Final report| • The modelling and analysis carried out for this study is based on industry feedback and consultation, through:  
  - The Steering Group, that has members from relevant industries  
  - A consultation with a wider number of industry stakeholders |

The consultation provided insightful information about the key enablers which require government intervention and/or EC level decisions, and portrayed the general agreement among the most probable RED scenario.

The consulted organisations and Steering Group (SG) members are listed in Appendix A.
1. Introduction

2. Scope and approach

3. Fuel pathways

4. RED scenarios

5. Recommendations

6. References and Acronyms

A. Supply cap assumptions
B. Fuel cost assumptions
C. WTW GHG emission savings assumptions
Biofuel supply and model impact

Ethanol 1G – sufficient supply

FAME from food crop – predicted constraint to meet sust. criteria

FAME/HVO waste oil – competition over supply

E2G, BTL

High FAME cost

2 cases: supply cap or no supply cap

Default: no supply; ‘High’ and ‘Stretch’ cases defined for reference

• The UK supply of biofuels already relies heavily on imports\(^1\) and this trend is expected to continue in the next decades\(^2\)

• While there is sufficient supply of ethanol 1G, the supply of FAME from food crop that can meet the 50% threshold is predicted to become constrained: this is captured by a high FAME cost in the modelling

• Results presented next are very sensitive to the supply assumption of double counting fuels: waste oils (FAME or HVO), ethanol 2G, BTL diesel

• There are two main challenges for UCO (and other waste fats):
  – UK share of international supply
  – Fuel quality and associated infrastructure costs (if FAME)

• For ethanol 2G and BTL diesel, the feedstock supply is not a concern\(^3\), but the investment in production plant is. High and Stretch supply cases were developed for measure of scenario feasibility

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1 – 77% biofuels were imported in 2012/13, (2012/13 RTFO report) 2 – DECC Bioenergy Strategy 2012. Biomethane supply is also constrained, as incentives are diverting use to sectors other than transport, see Appendix E3 3 – Notably, supply of waste, Ecofys, "Low ILUC potential of wastes & residues for biofuels", 2013, ECF "Wasted, Europe’s untapped resource. An assessment of advanced biofuels from wastes & residues", 2014
A2. Opinion was divided among industry stakeholders on the future supply and use of FAME made from waste oils and fats

**View 1: limited potential for increased use of UCO**
- Limited production potential (estimated at 3,500 million litres / 117 PJ at EU level for UCO)\(^1\) and competition from other Member States
- Fuel quality if 100% UCO FAME is blended in diesel, especially in winter
- Concerns over contamination of pipelines and storage; implies extra costs
- Concerns over fraud and lack of traceability

**View 2: the UK can increase its use of FAME made from UCO and other waste oils**
- It is a world market and import from overseas has little impact on WTW savings
- UCO can be refined into good quality FAME; at least 1 UK supplier has been using 100% UCO FAME in its B7 for the last 3 winters
- Certification standards already in place (e.g. ISCC EU) and in use by UK importers, developed with EC
- New stream of waste oils beyond UCO are emerging in the UK (e.g. brown grease, palm oil mill effluent)

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**Max potential for UCO and tallow FAME, million litres**

<table>
<thead>
<tr>
<th>EU</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,462</td>
<td>480</td>
</tr>
</tbody>
</table>

**UCO and tallow FAME from waste oil in UK**, million litres

<table>
<thead>
<tr>
<th>Year</th>
<th>Max. EU UCO production(^1)</th>
<th>Current tallow supply UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008/09</td>
<td>155</td>
<td>38</td>
</tr>
<tr>
<td>2009/10</td>
<td>225</td>
<td>30</td>
</tr>
<tr>
<td>2010/11</td>
<td>514</td>
<td>35</td>
</tr>
<tr>
<td>2011/12</td>
<td>810</td>
<td>45</td>
</tr>
<tr>
<td>2012/13</td>
<td>461</td>
<td>40</td>
</tr>
<tr>
<td>2013/14</td>
<td>431</td>
<td>35</td>
</tr>
</tbody>
</table>

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Two cases modelled:
- **View 1**: supply limited at 450MI UK share of UCO EU production + current UK tallow (16 PJ)
- **View 2**: No supply limit (10% target ‘easily’ met, thanks to double counting)

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1 – Ecofys, Low ILUC potential of wastes and residues for biofuels, 2013
2 – RTFO reports; mostly UCO (80%) and tallow (16%), see Appendix E4
ISCC: International Sustainability and Carbon Certification
A3. Summary of identified ‘high’ and ‘stretch’ supply for double counting fuels other than fuels based on waste oils

- The availability of waste feedstock is not a barrier to the production of E2G and BTL (literature reports availability in the order of 1000PJ at EU level\(^1\)), but the investment in production plant is very high.

- **High and Stretch supply cases developed for measure of scenario feasibility:**
  - ‘High’ case is an ambitious case: optimistic best case scenario considering regulatory framework and investment challenges
  - ‘Stretch’ case is a very ambitious case that would require very strong intervention
  - A scenario that requires supply over Stretch limits is labelled unfeasible.

- Drop-in diesel: only BTL considered, as HVO feedstock already captured in non-food FAME

### Summary of indicative supply caps (PJ) for RED scenarios

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>2017</th>
<th>2020</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol 2G Million litres [PJ]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| High                       | 60 \[1.3\] | 120 \[2.5\] | • 2017: similar size than Crescentino plant (Italy)  
\[\] 2020: ramp up to 2 plants, or 1 plant + import |
| Stretch                    | 60 \[1.3\] | 240 \[5.0\] | • Large import / fast ramp up in production globally                  |
| BTL diesel Million litres [PJ] |      |      |                                                                      |
| High                       | 32 \[1.1\] | 127 \[4.3\] | • 2017: 50% of output from UK based Solena plant  
\[\] 2020: 1 large FT plant (750kt) at EU level, UK taking ‘fair share’ |
| Stretch                    | 32 \[1.1\] | 253 \[8.6\] | • 2020: 2 large FT plants at EU level, UK taking ‘fair share’ (13%)  |

- Total ‘High’ cases contribution = 6.8 PJ in 2020; this represents 0.8% of transport demand
- Total ‘Stretch’ cases contribution = 13.6 PJ in 2020; this represents 1.6% of demand

Further details for E2G and BTL diesel in Appendix E1 and E2. 1 – (Ecofys, 2013) and (ECF, 2014)  
Reminder: the ‘fair share’ refers to share of UK transport fuel consumption at EU level as per (ECN, 2011).
B. Fuel cost assumptions

Main assumptions
- Gasoline and diesel costs as per DECC central projections (DECC, 2012); E1G and FAME as per observed prices (Platts) for 2013 values.
- Ethanol 1G cost assumed to be constant for central scenario.
- Common expectation that FAME costs will increase due to rise in feedstock (oil/protein) costs and to supply constraints arising from tighter sustainability criteria.
- There is uncertainty on these dynamics, due to the dependency of fuel costs on a wide range of factors. This is more pronounced for new generation biofuels (as shown by the error bars in the graphs).

Main sources for cost projections
- DfT Impact Assessment, literature projections for E2G and BTL (sources for assumptions are provided in Appendix F).
- Cost projections were discussed with industry stakeholders to understand the current market dynamics of biofuels.

E2G and BTL assumed to enter UK market in 2017. Error bars show the Low and High costs, used for sensitivity analysis. Assumptions for gaseous fuels and electricity are provided in Appendix F.
C. WTW GHG emission savings assumptions. RED sustainability criteria expected to bring improvement in E1G and FAME WTW emissions

**Ethanol WTW emission savings over gasoline**

<table>
<thead>
<tr>
<th>Year</th>
<th>E1G</th>
<th>E2G</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>58%</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>76%</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>76%</td>
<td></td>
</tr>
</tbody>
</table>

**Biodiesel WTW emission savings over diesel**

<table>
<thead>
<tr>
<th>Year</th>
<th>FAME food</th>
<th>FAME non-food</th>
<th>BTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>40%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>82%</td>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>93%</td>
<td>93%</td>
<td></td>
</tr>
</tbody>
</table>

**Ethanol 1G and 2G**

- **Ethanol 1G**
  - Current value as per RTFO 2012/13 weighted average.
  - 2020 value based on observed best values and possible improvement reported by industry during the consultation. E1G from wheat produced in the UK achieves c. 70% WTW emission savings; this can be achieved by tracking feedstock origin, lowering use of fertilisers, maximising process efficiency or capturing CO₂.
  - E2G as per average RED default values.

**FAME and BTL diesel**

- **FAME**
  - Current value as per RTFO 2012/13 weighted average. Last reported RTFO values for oilseed rape, palm and soy derived FAME have been below 50%.
  - 2020 FAME food as per RED 50% threshold after 2017, this implies existing plants will report on their real performance (as opposed to use default values) and implement improvement measures.
  - 2020 FAME non-food based on RED default UCO values.
  - BTL as per RED default value (‘farmed wood FT diesel’).
1. Introduction

2. Scope and approach

3. Fuel pathways

4. RED scenarios

5. Recommendations

6. References and Acronyms

A. Renewable energy shortfall and approach to RED scenario design
B. Presentation of four RED scenarios to reach target
C. Model outputs and comparison
D. Comparison of barriers and challenges to implementation
E. Conclusion: presentation of most probable and recommended RED scenario
A. Under the E5/B5 baseline, 4.9 % renewable energy achieved in 2020. E10 & B7 bring the share up to 7.4% (if waste oil imports are limited)  1/2

### Share of renewable energy in 2020

<table>
<thead>
<tr>
<th>Base E5/B5</th>
<th>E10/B7 UCO cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.9%</td>
<td>6.4%</td>
</tr>
<tr>
<td>3.8%</td>
<td>7.4%</td>
</tr>
</tbody>
</table>

**RED**

**Real**

### Base E5/B5
- Single counted ethanol; 33 % FAME/HVO double counted; i.e. capped UCO supply

### E10/B7 with UCO cap
- E10 introduced at the pump in 2016 ramping up to 100% of forecourts by 2020\(^1\). E5 available until 2020. Effective blend 8.8%vol
- B7 with 19% FAME doubled counted; effective blend: 6.8%vol (limited UCO/waste oils supply)
- No ethanol 2G, no BTL diesel

- Under the E5/B5 baseline, 85.6 PJ of renewable energy missing to reach the 10% target.
- Bringing E10 and B7 only partially fills the gap: 42.2 PJ shortfall (if UCO/waste oils supply is limited)
- Four strategies investigated to reach the 10% target:
  - **NO NEW BLENDS**: no blends higher than E10 and B7. Options to increase renewable energy: double counting fuels and alternative fuel vehicles
  - **DEPOT FOCUS**: bring high blends in depot, use drop-in fuels if needed
  - **NEW FORECOURT BLENDS**: bring higher blends to the forecourts (E20 and/or B10 and/or E85)
  - **COMBINATION**: new higher blends at both depot and forecourts

0.2% point tolerance implemented; e.g. E10 is modelled as 9.8%vol blend

1 - Although all forecourts offer E10, sales of E10 are modelled with a cap at 80%, as some drivers will prefer to refill with E5
• Based on a literature review and feedback from industry, four strategies were devised. Out of each strategy, one RED scenario was derived, through the use of the Element Energy fleet model.
• Out of the resulting four RED scenarios, this study makes a recommendation on the approach the UK should take to meet the RED transport target.

1. Literature review
2. Industry consultation

• Element Energy fleet model
• Variation of levers (defined in slide 14)

• Criteria: cost effectiveness, implementation barriers
B. Presentation of scenarios: incremental scenarios

Achieving the target is highly dependant on the volume of double counting fuels, either waste oils based fuels or E2G/ BTL diesel

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Lever</th>
<th>Findings</th>
<th>Resulting scenario and key assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NO NEW BLENDS</strong></td>
<td></td>
<td></td>
<td><strong>Name: E10&amp;B7</strong></td>
</tr>
<tr>
<td>no blends higher than E10 and B7</td>
<td>- Powertrain pathway</td>
<td>- The HighAFV powertrain pathway offers little and not cost effective contribution to target</td>
<td>- Target met through high use of FAME waste oil (1.7 bl, which is 50% of identified EU UCO FAME production potential)</td>
</tr>
<tr>
<td></td>
<td>- Supply of UCO: capped or not capped</td>
<td>- Meeting the target with E2G and BTL would require volumes beyond the ‘Stretch’ limits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Supply of E2G and BTL</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DEPOT FOCUS</strong></td>
<td>- B30 or B100</td>
<td>- If depot uptake is limited at 10%, required volumes of E2G / BTL are beyond the ‘Stretch’ limits</td>
<td><strong>Name: DepotB30</strong></td>
</tr>
<tr>
<td>higher blends in depots, for HGVs and buses</td>
<td>- Share of uptake among depot fuelling vehicles</td>
<td>- B30 more cost effective than B100</td>
<td>- Target met through high B30 uptake at depot (36% of depot refuelling vehicles) and ‘Stretch’ E2G and BTL supply</td>
</tr>
<tr>
<td></td>
<td>- Supply of E2G and BTL</td>
<td>- Depot uptake of B30 must be 36% if ‘Stretch’ supply of BTL is available</td>
<td></td>
</tr>
</tbody>
</table>

The NRMM gas oil blend is at kept at B2 in all scenarios – the level where impact on storage and engines and thus associated costs are estimated to be manageable, based on industry feedback.
### B. Presentation of scenarios: high blends at forecourt scenarios

Double counting still key to meeting the 10% target.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Levers</th>
<th>Findings</th>
<th>Resulting scenario and key assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW FORECOURT BLENDS</strong>&lt;br&gt;Higher blends than E10 or B7</td>
<td>■ New blend: E20, B10, E85&lt;br&gt;■ % fleet compatible&lt;br&gt;■ Supply of E2G and BTL</td>
<td>■ Scope for E20 and B10 too limited for 2020, would require supply of E2G and BTL over ‘Stretch’ limits&lt;br&gt;■ E85 most promising option but still relies on some E2G or BTL</td>
<td><strong>Name: E85case</strong>&lt;br&gt;■ Target met through 6% of fleet using E85 (10% forecourts offering E85) and ‘High’ level of E2G (5%vol of total ethanol) and ‘Stretch’ BTL</td>
</tr>
<tr>
<td><strong>COMBINATION</strong>&lt;br&gt;new higher blends at both depot and forecourts</td>
<td>■ Share of B30 uptake among depot fuelling vehicles&lt;br&gt;■ % fleet compatible with E85&lt;br&gt;■ Supply of E2G and BTL</td>
<td>■ Possibility to meet the target within Stretch supply at a cost effective level&lt;br&gt;■ High challenges associated with implementation of measures both in forecourts and depots</td>
<td><strong>Name: Depot&amp;E85</strong>&lt;br&gt;■ Target met through ‘High’ E2G level and BTL level in between ‘High’ and ‘Stretch’. 10% forecourts offering E85 and 10% depot refuelling vehicles using B30</td>
</tr>
</tbody>
</table>

See Appendix I4 for the E85 deployment assumptions
B. Summary of RED scenarios

**E10 & B7**

- **2013**: E5
- **2016**: E10
- **2020**: E10

**DepotB30**

- **2013**: E5
- **2016**: E10
- **2020**: E10

**Key supply assumptions**
- UCO FAME/HVO: no supply cap
- No BTL, no E2G

**Key uptake assumptions**
- E5
- E10
- B7

**E85case**

- **2013**: E5
- **2016**: E10
- **2020**: E10

**Depot&E85**

- **2013**: E5
- **2016**: E10
- **2020**: E10

**Key supply assumptions**
- UCO FAME/HVO: capped
- Stretch BTL and High E2G

**Key uptake assumptions**
- 6% of car fleet use E85 by 2020

---

E10 rollout start could be in 2014, 2015 or 2016. 2016 is perceived as the latest year for a rollout start as that year E10 become the certification fuel. The E10 rollout start was modelled from 2016 on this basis.
C. Contribution to RED target comparison

### Contribution to RED target

<table>
<thead>
<tr>
<th></th>
<th>Ethanol 1G</th>
<th>FAME food crop</th>
<th>FAME waste oil</th>
<th>E2G</th>
<th>BTL</th>
<th>Other (biomethane, electricity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depot&amp;E85</td>
<td></td>
<td>2.9%</td>
<td>4.1%</td>
<td>1.9%</td>
<td>0.7%</td>
<td>0.1%</td>
</tr>
<tr>
<td>E85case</td>
<td></td>
<td>2.9%</td>
<td>3.8%</td>
<td>1.9%</td>
<td>0.3%</td>
<td>1.0%</td>
</tr>
<tr>
<td>DepotB30</td>
<td>1.3%</td>
<td></td>
<td>4.9%</td>
<td>1.9%</td>
<td>0.6%</td>
<td>1.0%</td>
</tr>
<tr>
<td>E10&amp;B7</td>
<td>1.7%</td>
<td>1.3%</td>
<td>7.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- The high use of FAME from waste oils differentiates the E10&B7 case from other scenarios, that all see a significant contribution of
  - FAME made from food crop (1.9 - 2.5 billion litres)
  - E2G and BTL diesel (E2G: 120-240 million litres; BTL: 162-253 million litres)

### HVO case

- Under the projection of 15 PJ (~450 Ml) of HVO for the UK road transport sector\(^1\), ~15-20% of the FAME used for the RED scenarios could be HVO, where ~5% would be HVO coming from non-food feedstock and ~15% from food feedstock\(^2\)

---

1 – See slide 11
2 – Split HVO from food vs. non food feedstock based on current EU plant capacity, Element Energy analysis
C. RED targets comparison: E10&B7 has lowest real renewable energy % but only case immune to proposed change in RED accounting rules

- The reliance on double counting fuel means the real renewable energy share is only 6-8%
- Only one scenario (E10&B7) would meet the 10% target under the proposed change in RED accounting rules (European Parliament Sept. 2013)
- However, the proposed RED sub-targets (EP Sept. 2013) are proving challenging in all cases:
  - Advanced fuel target is never met
  - Cap on crop fuel respected only under E10&B7
  - Ethanol target met only through use of E85

RED targets comparison, % renewable energy in 2020

- The reliance on double counting fuel means the real renewable energy share is only 6-8%
- Only one scenario (E10&B7) would meet the 10% target under the proposed change in RED accounting rules (European Parliament Sept. 2013)
- However, the proposed RED sub-targets (EP Sept. 2013) are proving challenging in all cases:
  - Advanced fuel target is never met
  - Cap on crop fuel respected only under E10&B7
  - Ethanol target met only through use of E85

Proposed RED sub-targets (EP, Sept. 2013) - % energy in 2020

- The reliance on double counting fuel means the real renewable energy share is only 6-8%
- Only one scenario (E10&B7) would meet the 10% target under the proposed change in RED accounting rules (European Parliament Sept. 2013)
- However, the proposed RED sub-targets (EP Sept. 2013) are proving challenging in all cases:
  - Advanced fuel target is never met
  - Cap on crop fuel respected only under E10&B7
  - Ethanol target met only through use of E85

EP: European Parliament
C. Cost effectiveness is similar across the scenarios with the exception of the more expensive Depot30 case.

- Only Depot30 case is significantly more expensive, as it accumulates vehicle conversion costs and marginal maintenance costs.
- Cost effectiveness is sensitive to cost inputs as a high range of biofuels cost is used to capture uncertainty around future fuel costs. All scenarios are equally sensitive to cost inputs.

Reminder: costs captured include vehicle capital & marginal costs and energy expenditure (excl. tax).
Costs do not include cost of incentives nor potential infrastructure upgrade.
C. Comparison of scenarios: as expected the scenario with high reliance on double counting achieves lowest emission savings

Cumulative 2014-2020 WTW emission savings, MtCO$_2$e
Baseline cumulative 2014-2020 WTW emissions = 1,066 MtCO$_2$e

- Highest WTW savings achieved in scenarios involving E85 blends, related to cars’ high contribution to WTW emissions
- Results not very sensitive to WTW saving inputs as possible range for WTW savings is limited by sustainability criteria thresholds
- Cumulative WTW savings represent 1.3%-1.6% of total cumulative WTW emissions
D. Common challenges to the implementation of RED scenarios and emerging conclusions from industry consultation

• All scenarios face the following barriers of challenges – albeit to different degrees:
  – Supply of E2G and drop-in fuel or securing high volume of waste oils (mainly UCO today)
  – Reliance on FAME from food crop when the regulatory framework is uncertain for 2020 (e.g. share of food crop based fuels, ILUC factors) and undefined post-2020
  – Introduction of E10 at the forecourts
  – Stimulating the demand of new blends

• The DepotB30, E85 and Depot&E85 cases face extra challenges (e.g. further demand support, supply of new vehicles, infrastructure cost, use of E2G and BTL) and the emerging conclusion from discussions with industry is that the E10&B7 case is the most probable case, despite the critical role of waste oils supply.

• Consultation revealed a general frustration and scepticism of stakeholders, coming from:
  – Lack of UK government support for E10 and action towards meeting the target
  – Uncertain EC regulatory 2020 framework and undefined post-2020 framework
  – Inconsistent transposition of RED across Member States

  as key enablers virtually all require government intervention and/or EC level decisions
### D. Comparison of common challenges: securing sustainable feedstock supply and commercialisation of new fuels

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Barriers</th>
<th>Enablers</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Securing &amp; using high volume of waste oil based fuel</strong></td>
<td>• Non-food FAME quality</td>
<td>• Refined biodiesel standard or use of HVO over FAME</td>
<td>• Ultimately no guarantee of supply as no control over demand from outside the EU</td>
</tr>
<tr>
<td></td>
<td>• Supply competition – UK UCO production not enough</td>
<td>• Harmonisation of MS policies could help prevent distorting of supply share</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Waste oil collection systems quality and reach</td>
<td>• Support collection of waste oils</td>
<td></td>
</tr>
<tr>
<td><strong>Supply of E2G and BTL fuel</strong></td>
<td>• Production plants require high capital (typically over €100million)</td>
<td>• Further technology innovations to improve economics and emission savings</td>
<td>• Double counting mechanism not well regarded by industry: unclear for investors and not encouraging high volumes</td>
</tr>
<tr>
<td></td>
<td>• Biofuel policy framework is uncertain (delayed ILUC factor decision, new accounting rules, no post 2020 strategy announced)</td>
<td>• Incentives and support for investment</td>
<td>• Proposed DfT support of £25million seen as too low</td>
</tr>
<tr>
<td></td>
<td>• [E2G] Decreasing petrol demand</td>
<td>• Clearer regulatory and policy framework</td>
<td>• Decision on ILUC factor and new accounting rules delayed until 2015</td>
</tr>
<tr>
<td><strong>Reliance on FAME from food crop</strong></td>
<td>• Not all existing production plants can be upgraded to meeting 50% threshold</td>
<td>• Relaxation of threshold for existing plants</td>
<td>• Clearer framework unlikely to help new plants as food crops are unlikely to be supported by EC in the long term</td>
</tr>
<tr>
<td></td>
<td>• Investment in new plants unlikely under uncertain regulatory framework</td>
<td>• Clearer framework for future new plants</td>
<td></td>
</tr>
</tbody>
</table>

---

1 – The WTW performance of FAME can be improved through investment in efficiency technology (e.g. Combined Heat and Power) or use of better feedstock (e.g. crop using less fertiliser). Interviewed industry stakeholders however reported that not all FAME producers would be willing /able to make the investment, or access a selected crop supply at a competitive price.
D. Comparison of common challenges: the 2-grade system calls for a (currently lacking) coordinated roll out of E10

- The UK gasoline distribution is a 2-grade system; it means a maximum of 2 gasoline grades using the distribution infrastructure can be offered at the forecourts. Further blends would rely on truck delivery and thus be volume limited.
- In a 2-grade system, a new blend (e.g. E10) is expected to become the main grade while the protection grade (E5) would become the premium grade. This implies the roll-out within a region / fuel distribution area will be quick, as opposed to E10 being slowly introduced alongside other blends like in France.
- This creates challenges for ‘first movers’, i.e. retailers taking the risk of selling E10 when the demand is not in place yet – barriers are detailed below.

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Barriers</th>
<th>Enablers</th>
<th>Comment</th>
</tr>
</thead>
</table>
| Introduction of E10 at the forecourts | • Most fuel retailers are non-obligated  
• Consumer acceptance: see below  
• Lack of government support (to address consumer acceptance, lack of endorsement, RTFO capped at 4.75%)  
• Lack of rollout coordination – 2 grade system means rollout must be quick | • Address non-obligated retailers, e.g. mandate  
• Coordinated roll-out  
• Address demand: see below  
| • In all cases, strong role for central government and/or affiliated agency | • Consumer acceptance: refrain non obligated as well as obligated retailers |

| Stimulating the demand for a new blend – consumer acceptance | • End users unwilling to pay price premium for CO₂e savings  
• End user concern over impact on engine  
• End user rejecting biofuel sustainability credential | • Incentive address cost premium over lower blends, e.g. energy based taxation and preferential differential  
• Fuel labelling  
• Information communication | • Finland provides example of successful communication campaign¹ |

---

1 – E10 was introduced in January 2011 and by December 2011 represented 51% of gasoline sales, a success partly attributed to a education and communication campaign (CE Delft and TNO, 2013)
D. Additional challenges specific to DepotB30, E85 and Depot&E85 cases

Introduction of B30 for fleet vehicles

► Demand:
  - No tax differential or incentive in place at the moment making the adoption of biodiesel cost effective for users – only a marginal number of users will pay a premium for cost savings. Past support program (20p/l fuel duty rebate in 2002-2010) yielded less than 10% uptake of biodiesel fuel among commercial fuel sales¹.
  - Beyond costs, there are consumer acceptance issues (fuel quality and sustainability credential)
► Supply of vehicles:
  - EURO 6 specification hard to meet for wide range of biodiesel blends – OEMs unlikely to optimise and certify for one blend type. CEN fuel standard in development for B30
► Distribution*: dedicated channels required or additional cleaning procedure to avoid contamination.
► Storage*: conversion to compatible materials required. Impact on low usage storage unknown.

Introduction of E85 at forecourts

► Demand:
  - Beyond fuel demand, vehicle demand must be incentivised
► Supply of vehicles:
  - OEMs already make FlexFuel Vehicles (FFVs) but unclear how easy it is to bring to UK market. EC CO₂ regulation does not reward OEMs for FFVs anymore.
  - Risk of FFVs being refuelled with E5/E10, giving sub-optimal fuel consumption and lower emission savings
► Distribution*: only 2 petrol grades available, E85 will stay niche to 2020 (supply by road from refinery)
► Poor post-2020 prospect for E85 considering petrol/diesel unbalance and unlikely status of grade fuel: barrier for refuelling infrastructure investment and OEMs effort to supply

¹ – Source: UKPIA

*Associated cost not included in cost effectiveness calculation
E. Decision on recommended RED scenario to be taken forward: the E10&B7 approach is the recommended strategy for the UK

- When comparing the four RED scenarios in terms of cost effectiveness, sensitivity to double counting rules, reliance on commercialisation of new fuels, reliance on FAME/HVO made from food crop, and implementation challenges, the E10&B7 case emerges as the best approach.
- The E10&B7 scenario achieves less cumulative WTW emission savings over 2013-2020 than the other scenarios (c. 3Mt or 20% difference with E85 case), due to its higher use of double counting fuel. However, its overall much reduced implementation challenges, notably around investment in infrastructure upgrade and new vehicle introduction, make the E10&B7 case the most plausible pathway for the UK to meet the RED transport target, with the lowest risk of ‘lock in’ with fuel blends not desirable or sustainable in the long term.
- Industry stakeholders also believe the E10&B7 is the most realistic approach.

<table>
<thead>
<tr>
<th>Criteria (slide number for quantitative values)</th>
<th>E10&amp;B7</th>
<th>DepotB30</th>
<th>E85 case</th>
<th>Depot&amp;E85</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTW emission saved (slide 33)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>£/tCO$_2$e and £/GJ (slide 32)</td>
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<tr>
<td>Sensitivity to double counting changes (slide 31)</td>
<td></td>
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<td></td>
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<tr>
<td>Reliance on waste oils supply (slide 27)</td>
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<tr>
<td>Reliance on high volumes of BTL and/or E2G (slide 30)</td>
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<tr>
<td>Reliance on FAME/HVO from food crop (slide 30)</td>
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<td></td>
</tr>
<tr>
<td>Requires support for new vehicles and/or new blend adoption</td>
<td></td>
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<tr>
<td>Requires transformation/upgrade of distribution infrastructure</td>
<td></td>
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<td></td>
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<tr>
<td>Overall industry preference</td>
<td></td>
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</tr>
</tbody>
</table>
The recommended trajectory implies:
- c. 1,300 Ml of E1G (or slightly less if some double counting E2G is also supplied)
- c. 650 Ml of FAME/HVO from food crop
- c. 1,700 Ml of FAME/HVO from double counting fuels (expected to be mostly UCO), or less if BTL is also supplied
- 4,600 t of biomethane

Biodiesel volumes required to achieve RED target and potential HVO contribution – E10&B7 case

- Under the projection of 15 PJ (~450 Ml) of HVO available for the UK road transport sector, up to 20% of the FAME/HVO required to meet the RED target could be HVO:
  - up to 5% of the fuel made from non food crops
  - up to 55% of the fuel made from food crops

- Despite modest projected values of HVO from non food feedstock for 2020, a higher contribution for the longer term could help to minimise the risks associated with the traceability, security of supply and technical issues associated to FAME non food feedstock

1- At the moment FAME from non food feedstock is produced mainly from UCO and tallow, whereas HVO processes are characterised by a greater feedstock flexibility
1. Introduction
2. Scope and approach
3. Fuel pathways
4. RED scenarios
5. Recommendations
6. References and Acronyms
Recommendations for the UK to meet the RED transport target

- From considerations such as cost effectiveness, sensitivity to double counting rules, reliance on commercialisation of new fuels, reliance on FAME made from food crops, and implementation challenges, the emerging recommendation for the UK to reach the RED target is to pursue the **E10 & B7 approach**, namely:
  - Roll out E10 and increase the biodiesel blending up to the existing B7 specification
  - Maximise the use of double counting fuels that do not use food crop feedstock; this implies a high reliance on Used Cooking Oil and other waste oils, as fuels based on other feedstock will still be in limited supply by 2020

- Despite the limited role of drop-in fuels for the 2020 target, a supporting framework should be put in place, as they offer a better prospect to decrease emissions, and could make up for supply shortfall of waste oils feedstock and displace FAME based on food crops over time

- Some of these actions can be taken by UK actors (e.g. the introduction of E10), while other enablers require actions at European level, such as reaching a final decision on the sustainability criteria and accounting rules to bring the regulatory clarity currently lacking for investment in new biofuels

- An overarching issue for the industry players that are meant to implement the changes required to reach the RED target is the inconsistent transposition of the RED across Member States. The UK should therefore communicate its chosen strategy, in order to give the EC the opportunity to consider actions that could harmonise policies across the EU

- The next slides discuss the actions or next steps required to implement the recommendations for the UK to achieve 10% of renewable energy in road transport
The successful introduction of E10 at UK forecourts will require a dedicated programme and actions from government and industry

- While the RTFO incentivises fuel suppliers to blend ethanol in gasoline, this is not sufficient for the introduction of E10, as the RTFO is capped at 4.75% vol blend and the non obligated fuel retailers (>60% of retail operators, with supermarkets selling c.40% of retail petrol and diesel) have no incentive to propose a product that might not be in demand.

- The recommended actions to facilitate the introduction of E10 are:
  1. **Support the uptake of E10 among fuel suppliers and retailers**
     - Establish a biofuel pathway to at least 2020, e.g. raise the RTFO blend cap, clarify what feedstocks are supported in the long term
     - Incentivise non-obligated retailers, e.g. mandate adoption for large retailers
  2. **Stimulate the consumer demand and acceptance**
     - **Establish an information campaign**, including harmonised fuel labelling¹, that makes customers aware of changes in biofuels, clarify compatibility aspects as well as biofuel sustainability benefits. Finland provides an example of a successful campaign and roll-out
     - **Make E10 a commercial proposition**, e.g. through changes in fuel duty taxation, to be based on energy rather than in volume terms or/and preferential differential taxation
  3. **Organise a coordinated rollout of the blend** to minimise the risk of pioneer retailers bringing the blend to the market

- Stakeholders that can deliver these actions are the government (or affiliated agency) and the fuel suppliers & retailers. Vehicles OEMs also have a role to play in the communication campaign on vehicle compatibility.

¹ – Fuel labelling is already defined in the British Standard
Increasing the biodiesel blend to the 7% limit will require safeguards around fuel quality and both UK and EU action to secure waste oils supply

- As diesel vehicles are already compatible with B7*, increasing the blend level of biodiesel up to 7% presents less barriers than introduction E10. It does however require incentives for the fuel supply chain and ironing out concerns regarding fuel quality reported by some industry stakeholders.
- The recommended actions to reach 7% blending in diesel and maximise the use of UCO & other waste oils are:
  1. **Support the uptake of B7 among fuel suppliers and retailers**
     - Establish a biofuel pathway to at least 2020, e.g. raise the RTFO blend cap, clarify what feedstocks are supported in the long term
     - Elaborate refined biodiesel standards that ensure an appropriate quality level of FAME made from UCO/waste oils, that does not compromise engine behaviour under winter conditions, e.g. by updating BS EN14214 standard. Revision of the diesel standard (BS EN590) could also be required, e.g. for cold flow properties. The case of NRMM might require special consideration*.
  2. **Improve the security of a sustainable supply of UCO and other waste feedstock**

A consolidated supply chain needs to be developed that secures the 2020 UK levels of non-food FAME/HVO, expected to be highly reliant on imports. Enabling actions:

- Maximise the collection of traceable waste oils at EU level
- Continue take action to mitigate the risks of fraud, through the establishment of a traceability framework that ensures the verification of the supply chain

The overall need for biodiesel could be decreased (by a modest amount, c. 55ML) by limiting the obligated volumes to transport fuels (the current obligated volume includes non-transport gas oil).

* NRMMs fleet and related fuel storage are not compatible with B7.
Supporting the commercialisation of new biofuels will require actions both at UK and EU level

- To support the investment in new production capacity of new fuels (E2G, drop-in fuels), the recommended actions are:

  - At EU level
    
    Provide short-term **certainty in the regulatory framework** towards 2020 (clarifying the position around ILUC factors, accounting rules and introduction of sub-targets if relevant), as well as long term certainty, by defining a post-2020 framework.

  - At UK level
    
    **Attract investment in commercial-scale biofuel plants** (E2G, drop-in fuels).
    
    This will require an assessment of efficient mechanisms that bring the most clarity to investors. Consulted stakeholders commented loan guarantees proved efficient in the US, that the £25million grant offered in the UK was too low and that double counting for RTFCs was not as clear as setting volume targets.
1. Introduction
2. Scope and approach
3. Fuel pathways
4. RED scenarios
5. Recommendations

6. References and Acronyms
References (1/2)

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<tr>
<td>AFV</td>
<td>Alternative Fuel Vehicle</td>
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<tr>
<td>BEV</td>
<td>Battery Electric Vehicle</td>
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<tr>
<td>BTL</td>
<td>Biomass To Liquid</td>
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<td>EV</td>
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<td>E1G</td>
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<td>E2G</td>
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