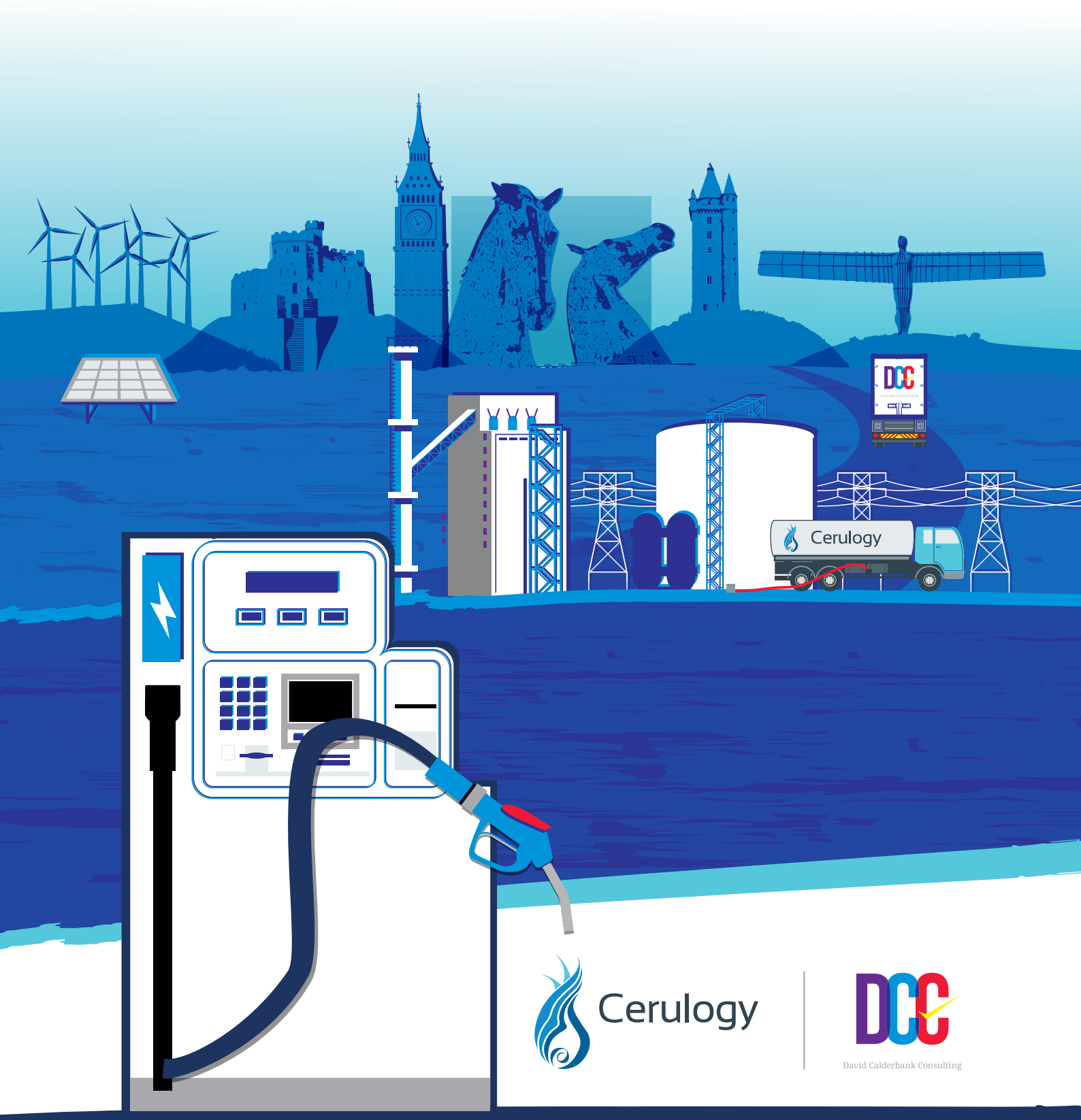
# FUELLING DEVELOPMENT

Building an effective UK alternative transport energy policy

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## Acknowledgements

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**Note to readers:** the references in this report are included as endnotes. Endnotes are indicated with superscript Roman numerals (I, ii, iii etc.), while footnotes are indicated with superscript Arabic numerals (1, 2, 3 etc.).

# 1. Executive summary

Over the last ten years, transport fuel policy in the UK, and in Europe more broadly, has had some successes but has also in some respects failed to deliver. In the UK, the Renewable Transport Fuel Obligation (RTFO) has provided the framework for significant increases in the supply of renewable fuels for transport. It is accompanied by a world leading system for sustainability oversight, and by one of the world's most transparent systems for data reporting on renewable fuels. As concerns grew about the use of food crops as biofuel feedstock the RTFO has supported increased reliance in the UK on waste and residual materials. The flipside of these successes is that neither the RTFO nor its equivalents in EU Member States have created a basis for sustained investment in advanced biofuel production or the production of renewable fuels of non-biological origin, and that the sustainability requirements imposed on first generation fuels remain limited and scope and ill-equipped to govern new supply chains for advanced fuels. While the RTFO has been effective in bringing renewable fuels to the on- and off-road markets, there has been little progress in aviation and shipping, which are priority markets for alternative fuels in the medium and long term. Finally, while the deployment of electric vehicles is acknowledged as central to on-road decarbonisation, the RTFO and electric vehicle support mechanisms are not linked in anyway meaning that sub-optimal decision making is likely to occur both in government and in industry.

The European Federation for Transport and Environment (T&E) asked us to develop proposals for how the UK could take advantage of the new legislative flexibility available following Brexit to build a more effective and more sustainable long-term renewable transport energy policy. T&E asked us to consider five goals:

1) Provide greater investor certainty to support the deployment of electrofuels and of advanced biofuels from wastes and residues;

2) Credit the use of renewable electricity used in vehicles alongside liquid and gaseous renewable fuels;

3) Shift the consumption of renewable fuels increasingly into the aviation and maritime sectors;

4) Reduce and eliminate the use of crop feedstock derived fuels; and

5) Strengthen sustainability standards.

At the heart of this report is a proposal to introduce a novel policy framework to support the deployment of advanced alternative transport fuels (referred to as development fuels in the current RTFO) through two complementary policy tools: continuation of the development fuel obligation on fuel suppliers, and introduction of a system of 'contracts for difference' (CfDs) awarded to specific fuel producers. The proposal to introduce these CfDs is a policy response to a concern repeatedly raised by advanced fuel companies, namely that despite the relatively high potential value of support from the development fuel obligation in the RTFO, the lack of any mechanism to guarantee revenue makes it difficult to secure investment. We have proposed that CfDs would be awarded to the fuel producers able to deliver the most competitive proposition, under which the government would take on the risk of reductions in the price of fuel, and most importantly, the risk of reductions in the value of certificates awarded for development fuels. In the event that the sum of the value of the fuel and the value of the certificates fell below the contract price, the government would make top-up payments to producers, enabling them to remain

operational. Reducing the risk to fuel producers in this way may even reduce the overall cost of the development fuel obligation to fuel consumers, by allowing fuel producers to access capital at lower cost.

Regarding crediting of renewable electricity, the report discusses the legal barriers to providing support to renewable electricity in an RTFO under the Energy Act (2004), and suggests legislative changes that could make it possible. It reviews issues around the identification of electricity as renewable, and notes that as the population of electric vehicles grows in the coming decade electricity could become a significant generator of RTFO credits. This section also discusses measures to deliver value from RTFO certificates to expand parts of the system that are needed to encourage wider uptake of electric vehicles, such as the public charge points.

Regarding the aviation and maritime sectors, obligating fossil fuel supply to those markets would rectify the imbalance of allowing the provision of renewable fuels to those sectors to be rewarded whilst imposing the associated costs on suppliers of on and off-road vehicle fuels. Such a situation is unlikely to be politically sustainable, and therefore taking early action to equalise the treatment of aviation and shipping would provide a clearer market signal for the deployment of advanced renewable transport fuels into those sectors. The report discusses the potential advantage of setting specific obligations for aviation and maritime fuel, and also recommends offering more favourable revenue guarantees under the proposed CfD system to new projects supplying fuels to these markets.

The report discusses options to reduce the use of crop-based biofuel in the UK either de facto by encouraging the supply of other alternatives to deliver full compliance with the RTFO, or de jure by reducing the crop cap to zero. It also discusses the opportunity provided by regulatory divergence from the EU for the UK to develop a sustainability governance framework that strengthens the existing framework for both crop and waste/residue derived fuels.

Finally, in the second part of the report we discuss and present modelling on the potential impacts of the current Government policies of introduction of E10 and increasing the buy-out price, and of allowing electricity used in vehicles to generate RTFCs.

# Contents

# 2. Introduction

At the beginning of 2021, the need for aggressive action on climate change has never been clearer. The departure of the UK from regulatory alignment with the European Union creates an opportunity for Britain to create a more agile regulatory framework to support investment in decarbonisation. The imperatives for climate action in the UK remain aligned with those in the EU, with clean growth and green investment at the heart of the Industrial Strategy[i], but the UKs departure from the EU gives the UK an opportunity to build on the policy framework that has been developed within the European Union and create a truly world leading investment environment.

Delivering the UK goal of zero net GHG emissions in 2050[ii] will require action across all sectors of the economy, and transport remains one of the most challenging to decarbonise. For passenger transport the clear trajectory is the electrification of the vehicle fleet - it is the Governments stated position that sales of new fossil-fuelled passenger vehicles will be banned in the UK as early as 2030[iii]. While the pathway to full electrification of the passenger fleet is relatively clear, questions remain about how rapidly it will be possible to electrify heavy duty vehicles and whether there may be limits to the penetration of electric technologies in such end uses.

For aviation and marine, the challenge is arguably even greater. There is no realistic prospect of electrification of long-haul aviation by 2050, and energy density of batteries may also limit the potential for fully electrifying large ships. Between aeroplanes, ships, trucks and the many cars with internal combustion engines that will continue to drive on UK roads for decades to come, there is an enormous opportunity to deliver GHG emissions reductions through alternative fuels if genuinely low-carbon technologies can be commercialised.

At present, the main instrument used to support the supply of renewable transport fuels in the UK is the Renewable Transport Fuel Obligation (RTFO). The RTFO mandates that each year a certain percentage (by volume) of UK transport fuel should come from renewable sources, a requirement that is currently more or less entirely met with biofuels. Increasing targets for renewable fuel use in transport are set through to 2032, after which new legislation can be expected to set an onwards trajectory to 2040 and beyond[1]. The RTFO also sets minimum sustainability standards.

The RTFO operates by placing an obligation on suppliers of fossil transport fuels to the UK market to redeem Renewable Transport Fuel Certificates (RTFCs) at the end of the year corresponding to a certain percentage of the volume of fossil fuel they supplied. The main mechanisms by which obligated fuel supplier obtain RTFCs are directly from the government by supplying renewable fuels, and by purchasing certificates from other fuel suppliers. Obligated suppliers also have an option at the end of the year to pay a 'buy-out price' as an alternative to redeeming RTFCs. This buy-out price increased from 30 pence to 50 pence per RTFC not redeemed from the start of 2021. The buy-out price puts an effective cap on the cost of compliance with the RTFO – if renewable fuels cost over 50 pence per litre more than fossil fuel, then it is cheaper for obligated suppliers to just supply fossil fuel and pay the buy-out price.

Since the RTFO was first introduced in 2008, the use of 'first generation' biofuels from crops have been controversial due to potential land use impacts and impacts on food and feed markets and prices, and therefore on food security. The UK has led Europe in providing additional incentives to supply biofuels from non-crop materials, and in placing limits on the contribution of food- and feed-based biofuels to meeting targets. This is referred to as the "crop cap". Starting in 2020, less

1 In the absence of new legislation the target will remain fixed at the 2032 level indefinitely.

than half[2] of the 9.75% target for renewable transport fuels in the UK transport fuel mix may be met with crop-based fuels. Starting in 2019, the main RTFO mandate has also been complemented by a mandate for the use of "development fuels". This mandate is designed to support biofuels (from most waste and residue feedstocks) and electro fuels where they are produced using not yet commercialised technologies.

Development fuel targets start at a very modest level, reflecting the lack of operational commercial facilities producing such fuels, but increase to reach 1.4% of UK fuel supply by volume in 2030.

The early years of the 2020s represent an opportunity for the UK to put its foot on the accelerator for decarbonisation in transport. For the last twenty years, the development of new advanced renewable transport fuel technologies the world over has been characterised by lack of progress and missed targets. The new flexibility offered by the UKs departure from the EU, gives the UK a chance to build on elements that work from the European Union's recast Renewable Energy Directive and Green Deal whilst learning from the experience of past advanced renewable transport fuel policies that have failed to deliver. The UK can thereby develop a world leading market for renewable energy in transport, and ensure that UK businesses are in the vanguard of this part of the low carbon transition.

In this study, we have been asked by the European Federation for Transport and Environment to consider regulatory changes that could deliver the following outcomes for UK renewable energy use in transport:

1. Provide greater investor certainty to support the deployment of electrofuels and of advanced biofuels from wastes and residues;
2. Credit the use of renewable electricity used in vehicles alongside liquid and gaseous renewable transport fuels;
3. Shift the consumption of renewable fuels increasingly into the aviation and maritime sectors;
4. Reduce and eliminate the use of crop feedstock derived fuels; and
5. Strengthen sustainability standards.

Where possible, we have looked to propose solutions that would be achievable within the legal framework provided by the Energy Act 2004 (as amended) and have aimed to clearly identify what would be needed from an amended or entirely new Renewable Transport Fuel Obligations Order. Where our consider that our proposal is not achievable given the current Energy Act, we have identified what primary legislation amendments we consider would be necessary.

The report is structured by topic, and each topic is split into sections discussing the current situation, the legal position, suggested policy solutions, other possible approaches, and important interactions with other parts of the policy proposals and other UK climate policies.

2 A maximum of 4% of road transport energy.

# 3. Developing the legal framework for support

The main mechanism to drive the supply of lower carbon energy into UK road and non-road transport is the Renewable Transport Fuel Obligations Order 2007 (as amended) ('RTFO')[iv], which sets targets for the fraction of UK transport fuel that should be of renewable origin and sets sustainability requirements for the feedstocks used to produce that fuel. The RTFO is 'secondary legislation', meaning that it is made under powers granted by primary legislation, in this case the Energy Act 2004 (as amended) ('Energy Act')[v].

The RTFO has developed over the last decade alongside the relevant EU directives. The RTFO was subject to significant amendments: in 2011 to implement the biofuels requirements of the EU's Renewable Energy Directive (2009/28/EC) ('RED I')[vi]; in 2013 to include off-road fuel use as required by the European Union Fuel Quality Directive (98/70/EC) ('FQD7a')[vii]; and in 2018 to implement the amendments made to the RED I and FQD7a by the EU directive known as the 'ILUC Directive (2015/1513)[viii].

As part of the European Union's 2030 climate package, the EU adopted in 2018 the 'Renewable Energy Directive – Recast to 2030' Directive (2018/2001[ix]) ('RED II'), setting the basis for renewable energy and fuel policy in the EU from 2021 to 2030. EU Member States have until June 2021 to implement the RED II. While the requirements of the RTFO are already consistent in many respects with the requirements of the RED II, the UK is no longer required to implement EU directives or to follow the lead of the European Commission in interpreting the UK implementations of previous EU directives. Additionally, the UK can no longer use EU directives as a legal basis when developing secondary legislation (which used to be possible via the European Communities Act 1972).

UK fuel suppliers affected by the RTFO will be in competition for supplies of alternative fuels with suppliers in the EU who are subject to the RED II. UK officials have indicated that they have analysed the provisions of RED II, including to understand the differences between the current UK and incoming EU sustainability criteria, and that due consideration will be given to maintaining a degree of consistency with EU rules in order to facilitate trade and minimise verification burdens for fuel suppliers. The EU/UK co-operation agreement requires that biofuels meet robust sustainability and greenhouse gas saving criteria (article ENER.22[x]).

Notwithstanding this, the UK may wish to keep and/or develop its current approach on some sustainability questions so as not to weaken standards. For example, the RED II adopts a new fossil fuel comparator value that is higher than the RED I value. This has the effect of weakening the GHG savings thresholds set by the legislation, and the UK may continue with the comparator unchanged at the current level (83.8 $gCO_2e/MJ$).

For several years up to 2020 the RTFO was complemented by the Motor Fuel (Road Vehicle and Mobile Machinery) Greenhouse Gas Emissions Reporting Regulations 2012 (as amended) ('GHG Regs')[xi].

For the GHG Regs, the primary legislation is the European Communities Act 1972 (prior to its repeal) which was used, in 2018, to implement articles 7a to 7e of the European Union Fuel Quality Directive (98/70/EC) ('FQD7a')[xii] as inserted by Directive 2009/30/EC as well as Directive 2015/652[xiii] which set out calculation methods for FQD7a. Among other requirements FQD7a

created an obligation for fuel suppliers to deliver a 6% carbon intensity reduction in the fuel they supply by 2020 compared to a 2010 baseline. The GHG obligation and credit mechanism in the GHG Regs will stop at the end of 2020.[3]

It should also be noted that the UK's devolved system of government adds complexity to the legal situation. Some issues can be legislated solely by the UK Parliament for the whole of the UK, but others have been devolved to one or more of Scotland, Wales and Northern Ireland and hence would require legislation to be passed by developed administrations[xiv]. An example of this is the Renewables Obligation (now closed to new participants) where separate legislation was passed in Scotland and Northern Ireland, with Scotland choosing to pass laws allowing a single 'Great Britain' scheme. Northern Ireland passed slightly different laws featuring similar criteria but more generous subsidy. A similar divergence on the Renewable Heat Incentive gave rise to significant issues which led to both the early closure and the retrospective reduction of incentives for renewable heat supply in Northern Ireland[xv].

To date the RTFO (and the GHG Regs) have been considered 'reserved' (i.e. not devolved) and one set of legislation has applied through the whole of the UK. We believe that the majority of policy options discussed below could continue to be applied in this way as they do not fundamentally alter the concepts covered by the RTFO, with the exception of the proposals on Contracts for Difference ('CfD'). However, given that all policy proposals are consulted upon between Government Departments, including the devolved administrations, T&E should consider engaging with the devolved administrations as well as UK Government Departments when recommending these proposals.

## 3.1. Scope for changes under the Energy Act

*The text of the section in the Energy Act which sets out the legal possibilities for an RTFO is included in Annex A.*

The Energy Act allows for the creation of one or more Renewable Transport Fuel Obligations (RTFOs). An RTFO places obligations on specified obligated fuel suppliers to supply[4] a given quantity of defined renewable fuel in a given period. Each RTFO created may be defined by a piece of secondary legislation referred to as an RTFO Order. To date, there has only ever been a single RTFO in effect in the UK. Creating additional obligations may be necessary when considering specific mandates for certain fossil fuel types (e.g. aviation). That said, the Energy Act allows options to provide differentiated support to fuels based on environmental and technical characteristics. We believe that for many of the policy options discussed below, it would be equally possible to use one differentiated RTFO or multiple nominally distinct RTFOs. We have not come to a definitive view of to whether any of the proposals would require the creation of multiple separate RTFOs. Should any of these policy options be pursued the precise legal structure will need to be determined by the Government in consultation with the stakeholder community.

3 This reflects an understanding at the time of implementation into UK law that the FQD7a target would apply only in 2020. Note that more recently the European Commission has disseminated revised legal advice and that fuel suppliers in the EU will be expected to permanently maintain the GHG intensity of the fuel they supply at least 6% below the 2010 baseline. As the UK had left the EU by the time this revised legal advice was issued, it has no bearing upon the UK.

4 The Energy Act allows for an obligation to be met through the redemption of certificates which enable the RTFC market.

The Energy Act allows for all of the following to be determined in an RTFO:

- what is obligated;
- what the level of obligation is;
- whether the level varies according to any characteristics (e.g. minimum thresholds, different obligations on different type of fuel or obligation based on GHG emissions);
- what can be rewarded;
- how much reward is given and whether this varies due to specific characteristics (e.g. energy density or GHG emissions); and
- how the certificates given for supply are counted towards an obligation (which enables carry over from year to year).

Additionally, the Energy Act specifically states that provisions in an RTFO giving effect to any part of the list above may take into account:

- carbon emissions;
- agriculture;
- other economic activities;
- sustainable development; and/or
- the environment generally.

The effect of this, as set out in the Explanatory Memorandum[xvi] given to Parliament alongside the Energy Act, is to allow "a wide degree of flexibility in the operation of an RTFO, in particular, as regards what fuels 'count' towards the discharge of an RTFO, and to what extent".

Additionally, the Energy Act:

- does not specify the time period for an obligation. Whilst we do not propose any change to the current one-calendar-year obligation periods, multiple year obligations could be developed if these were regarded as beneficial;
- allows for buy-out payments to be made instead of supplying renewable fuel (or obtaining credits from those who do supply);
- allows for an RTFO to cover any mode of transport including non-road machinery, aircraft and trains.

It does however place some limitations on the applicability of an RTFO:

- the obligated party must be a fuel supplier to, or for onwards delivery to, the UK; and
- to be rewarded as renewable fuels, fuels must be:
    - solid, liquid or gaseous (see the section on electricity for further discussion of the implications of this requirement); or
    - produced wholly from energy from a renewable source or a process powered

by energy from a renewable source. "Partially" renewable fuels are split into a renewable and non-renewable part for the purpose of RTFO accounting. This renewability requirements creates a legal barrier to the reward of recycled carbon fuels made from 'waste' fossil energy, such as waste plastics or carbon monoxide from industrial processes.

The policy options presented below are based on this interpretation of the Energy Act and take into account that whilst it is possible to amend the current RTFO (or introduce a new one) via secondary legislation, the process usually takes a minimum of a year including public and within Government consultation.

Where we believe that either amendment to the Energy Act or entirely new primary legislation would be needed, we have indicated this. It should be noted that whilst simple amendment to an existing piece of primary legislation should take a similar amount of time to consult on as secondary legislation, there needs to be a suitable proposed Act (knowns as a 'Bill') to include it in. In the published list of Bills for 2020/2021[xvii] there is only one government initiated candidate – the Environment Bill, which is already at committee stage and hence too late for any proposal in this document to be included. It may also be possible for the Government to add an amendment to a private member's bill such as the Climate and Ecology Bill or the Decarbonisation and Economic Strategy Bill.

More complex or original primary legislation often requires multiple rounds of public consultation (first on concepts and then on detail), parliamentary time to pass and

be involved, it took 5 years from the initial public consultations that led to the Energy Act in 2003[xviii] to the RTFO being put in place in 2008.

In the rest of this chapter, we consider five policy areas identified as of interest to T&E, discussing the current policy and legal situation and presenting suggestions for policy developments that could deliver T&Es target outcomes. We cover:

1 Support for 'advanced' renewable fuels;

2 Rewarding renewable electricity under the RTFO;

3 Supporting the use of development fuels in aviation;

4 Supporting the use of development fuels in marine applications;

5 Reducing incentives for crop-based biofuels.

## 3.2. Support for advanced renewable transport fuels – guaranteeing revenue through a contract for difference system within an RTFO

### *3.2.i) Summary*

In this section we propose a system to drive investment in advanced renewable transport fuels that is based on the Contracts for Difference model previously used to support renewable

power projects. Under this system, potential fuel producers would be awarded Contracts for Difference ("CfDs") for specific projects which would provide a guaranteed minimum value per litre of qualifying fuel produced. If the revenue from fuel sales plus the value from the RTFO was below the level set in the CfD, the Government would make up the difference. We anticipate that these CfDs would operate within the existing framework provided by the RTFO to support development fuels – so that if the value delivered by development RTFCs was high enough to meet the minimum price, the Government would not have to make any payments. In this way, the CfDs can be understood as offering a form of insurance against uncertainty in the value of development RTFCs, or similarly could be thought of as providing an effective floor price on development RTFCs (on a per project basis). Advanced renewable transport fuel projects that were not successful in gaining a CfD could still compete in the development fuel market but would be more exposed to low development RTFC prices.

The prime feature of the proposed approach is that it addresses the issue which is most commonly cited as holding up deployment – delivering investor certainty. Boosting investor confidence should bring projects to market faster, and allow project developers to access capital at cost. By complementing rather than replacing the development fuel targets under the RTFO, the proposed system would at the same time take advantage of the market orientated approach of the certification system in the RTFO to deliver value for taxpayers / consumers, whilst capping potential costs to consumer via the buy-out price.

The proposed system is inspired by the CfD system which has been successful in delivering significant increases in renewable electricity in the UK, combining investor certainty with competition to win contracts to ensure best value for consumers. The proposed system differs from the UK electricity CfD in that it would act in parallel to a mandate, and because the fuel market is not subject to the same kind of transparent pricing seen in electricity markets.

In order to allow government to assess the expected revenue from advanced renewable transport fuel sales without creating a moral hazard by relying on self-reporting by fuel producers, we propose a change to the development RTFC market so that development RTFCs could not be sold directly company to company, but only via a government managed blind-auction system. This would add price-transparency to the development RTFC market.

While we have assumed in describing the CfD system that the eligibility requirements for CfDs would be similar or identical to the development fuel eligibility definitions, in principle the regulatory structure we describe could support the deployment of any advanced renewable transport fuel. We have not directly considered what criteria should be used to define fuels as 'advanced': the criteria could consider feedstock, output fuel molecules, end uses and/or other related sustainability requirements. They could be based directly on the existing criteria to identify development fuels, or could be drawn more narrowly or more broadly depending on policy objectives. The system described is intended to be an effective basis to support advanced renewable transport fuel deployment irrespective of the precise set of projects that are made eligible for support.

Simple examples of how this CfD system could support investment are provided in Annex C.

### *3.2.ii) Context*

The RTFO supports advanced renewable transport fuels (biofuels and RFONBOs) via the 'development fuel mandate'. This mandate was introduced in 2019 and ramps up from requiring

0.05% of development fuel in the total UK transport fuel volume to 1.4% in 2032. Note that all development fuel volumes are "double counted" towards targets under the current system, and the headline target percentages are therefore double this (rising from 0.1% to 2.8%). Any excess development fuel RTFCs can either be carried over to future years in the same manner as general RTFCs or may be used towards meeting the main obligation.

A 'development fuel' has to meet criteria for both feedstock and produced fuel type. The feedstock criteria are that:

- the feedstock must be a double counting waste or residue (excluding 'segregated oils and fats', e.g. UCO and tallow); or
- the fuel should be a Renewable Fuel of Non-Biological Origin.

The fuels eligible to be considered as development fuels are:

- Hydrogen;
- Aviation fuel (either aviation kerosene or avgas);
- Renewable methane (produced by gasification or pyrolysis); or
- Road fuels having the capability to be blended into petrol or diesel to at least 25% (whilst meeting the relevant BS EN standards) (sometimes referred to as drop-in fuels).

The development fuel obligation is supported by a buy-out of £1.60 per litre (the headline figure for the buy-out price is £0.80, but due to double counting this implies a maximum support value of £1.60 per litre[5]). This compares to the current main obligation buy-out of £0.50. The buy-out price for development fuels functions as an effective cap on the value of support, but in a short market (i.e. where available volumes of development fuel are inadequate to meet the mandated target) it also provides a guide to the price of a development RTFC, as it would be economically rational for an obligated supplier facing a shortage of development RTFCs to buy available certificates at any price up to slightly below the buy-out price.

If this full value of support could be realised by a producer we calculate that it would be equivalent to a carbon price of the order of £1,000 per $tCO_2e$ abated[6]. The authors believe that this makes the potential support under the RTFO one of the most generous in the world for advanced renewable transport fuels. It can be compared, for example, to credit prices under the California LCFS capped at \$200 /$tCO_2e$, or a value potential to cellulosic biofuels under the U.S. Renewable Fuel Standard of about \$0.9 per litre[xix]. Even combined, those incentives would not reach the maximum value from the development fuel RTFC.

There has only been one full year in which the development fuel mandate has applied – 2019. The final 2019 statistics show that only a very small amount of hydrogen has been delivered (the equivalent of 2,716 litres of fuel) against a mandate of 56m litres. This means that the cost to fuel suppliers of the buy-out from the development mandate in 2019 was ~ £45m. The second provisional statistics for 2020 show a similarly small volume of hydrogen as the only development fuel to which RTFCs have been awarded so far.

5 Or equivalent for gaseous fuels.

6 The precise implied carbon price would depend on the reportable GHG intensity of the fuel.

Alongside support within the RTFO, the UK government has run two grant funding competitions:

- the Advanced Biofuels Demonstration competition for advanced biofuel production plants in the UK, with three plants gaining funding totalling £25m[xx]; and
- The Future Fuels for Flight and Freight competition with grants for four plants totalling £20m[7].

These grant funding opportunities are modest compared to expected capital costs in the hundreds of millions of pounds to build commercial scale development fuel plants.

### *3.2.iii) Managing uncertainty in the value of support*

One aspect of the current RTFO system is that whilst the maximum potential value of support for development fuels is world leading, there is no guarantee that a development fuel producer investing today would actually be able to achieve the maximum potential value when they start producing. If development fuel supply were to exceed the level of the development fuel obligation in any year, the price of a development RTFC (and hence the support value to producers) would be determined by the market and could be rapidly eroded. Indeed, there is no mechanism to set a firm price floor for development RTFCs, so in an oversupplied market it would be theoretically possible for the certificate price to approach zero.[8] This is considered a particularly acute risk while the development mandate is at a relatively low volume, as a relatively small number of new market entrants could cause a situation of oversupply. It has led to commentary from industry players that the mechanism as it currently stands is not a 'bankable' one, i.e. investors are not willing to rely on income from development RTFCs when deciding whether to invest.

There are various ways in which uncertainty in the value proposition from a renewable energy mandate can be mitigated. To take an example from renewable electricity, the Renewables Obligation (supporting deployment of renewable electricity capacity in the UK from 2002-2017) was able to in effect set its expected minimum value of support at the same as the maximum price by adjusting the mandate level every year to an amount that was above the amount of renewable electricity that was expected to be supplied. This meant that there was a 'structural short' in the market for RO Certificates which hence generally traded for close to the buy-out price. The Government was able to maintain the structural short due to its knowledge of the amount of renewable electricity capacity coming on stream in the UK. There are two issue with this attempting such an approach for the RTFO,

- in a global fuels market, it is almost impossible for the Government to identify the maximum potential supply to the UK in any given year and set a mandate above what that is expected to be; and
- it would mean that the support level would always be at or close to the maximum set by the buy-out. This would negate the role of the certificate market in allowing compliance

7 https://www.gov.uk/government/news/orange-peel-rubbish-and-fatbergs-the-fuels-behind-the-future-of-green-transport

8 In practice, because development RTFCs may be used in the main RTFO obligation the value of a development RTFC should never fall below the main RTFC price. As development fuels are always awarded two certificates per litre, that means that the value per litre of development fuel should not fall below twice the value of a standard RTFC.

to be delivered at the best value for the section of society that is ultimately paying for it (transport users in the case of the RTFO, electricity users in the case of the RO).

Another option would be to move away from market-based value setting entirely. The FITs and RHI both operate by providing a legislatively guaranteed price over a number of years to any eligible scheme. The costs of this are borne by the taxpayer. As the potential deployment under both schemes is extremally large, the costs were constrained by the introduction of capacity banding (e.g. under the RHI heat production systems are banded by the number of kilowatt hours they produce, with a lower tariff applying when a device goes above that level). In addition, 'degression' changes are applied whereby all tariffs for new capacity for a particular technology type are dropped when existing deployed capacity for that technology type goes over a certain threshold.

Such a system could be applied to advanced renewable transport fuel, offering a defined support price to each supplier of an eligible fuel. Under such a system, costs could be constrained by predictably reducing the support available when a particular supplier goes over a given volume or when total supply for that 'type' of fuel goes over a particular volume. However, given the likely split between advanced biofuel production companies (who may not be UK based) and UK fuel suppliers, this would be difficult to manage through a supplier-side support scheme. Such a system would also need direct taxpayer subsidy, which may be considered undesirable given current fiscal constraints.

An alternative approach to managing value uncertainty for renewable electricity generators is provided through the CfD[xxi] system, which is the current support mechanism for renewable electricity and is intended to reduce the cost of capital for new renewable capacity by providing a guaranteed price to the generator. It operates by:

- The government announcing an allocation of money that it will auction off to electricity generators as support for renewable generation. This can be split into technology pots.
- The electricity generators bidding for support in the form of a 'strike price' of a certain value per unit of supply (i.e. £/MWh) for a certain capacity.
- The government then 'filling' the allocated amount of money from the bottom up (i.e. lowest £/MW bid first) until the allocation is filled. This allows different generators/schemes to achieve different strike prices, but as it is competitive has been credited with driving down the price of renewable electricity generation in the UK.
- A contract is drawn up between a government owned company and the generator with the strike price in it and requiring the generator to start supply within a set number of years or face a reduction in the strike price. This prevents generators 'hording' contracts until technology is cheaper to deploy. The contracts last for 15 years.
- Once the generator is supplying electricity the strike price is compared against a reference market price. If the market price is above the strike price, then the generator pays the government CfD company the difference. If the market price is below the strike price, the government CfD company pays the generator the difference. The cost of CfD payments when the market electricity price is below the strike price is raised from electricity suppliers through the Supplier Obligation Levy – and any proceeds when the strike price is below the market price are returned to electricity suppliers. The CfD for electricity is therefore supported by electricity consumers rather than taxpayers.

This system is not combined with a renewable electricity mandate, but (as discussed below) we

believe that a version of such a system could be productively combined with the development fuels mandate of the RTFO to strengthen the value signal while minimising the direct cost to government.

### *3.2.iv) Legal position*

The Energy Act 2004 does not address the issue of direct grant funding. We understand that The Advanced Demonstration Competition funding was at levels that did not require explicit legislative authority.

The legislation used to run the CfD for power relies upon the Energy Act 2013[xxii] which, whilst it provides a useful template, is not suitable to underpin legislation dealing with any similar system for advanced fuels. The Energy Act 2004 does not allow for any form of financial support mechanism other than the buy-out price and therefore introducing a CfD for development fuels would require Primary Legislation, with the commensurate lead times.

### *3.2.v) Suggested solutions*

The system we propose is based upon two complementary policy tools. The first element would be based on the existing development fuel mandate of the RTFO, setting a target volume and creating a price signal through a buy-out price. The second, novel, element of the system would be in the form of a fuel CfD. Rather than as the primary support mechanism as with CfDs for electricity, this would be conceived as a government backed insurance mechanism guaranteeing the value proposition from the development fuel mandate to contracted development fuel producers. This complementary policy system can be seen as providing two market signals:

1. The value signal, which has an upper and lower constraint set by, respectively:
    1.1. The buy-out price, which represents a maximum price the market could be willing to pay.
    1.2. The contracted CfD price which is a minimum viability price the production facility needs to be able to supply to the UK market;
2. The volume signal, which is the mandated volume of supply set by the obligation level.

The proposal below has been developed with the aviation fuels market in mind, however the concept could be applied to any advanced renewable transport fuel market. It could be operated as either a single system across multiple end-uses (aviation, maritime, on-road etc.) or as separate systems. A single system would have the advantage that any excess certificates from fuel supplied to a given end use could be redeemed against other obligations, thereby potential providing additional price support. Separate systems would however provide a very clear market signal as to the desired volumes of fuel supply for each end use. Nested systems (in which excess certificates may flow in only one direction between use categories) could provide an intermediate solution.

While the Government should avoid making regular changes to eligibility conditions for the development fuel mandate of the RTFO in order to foster market confidence, it would have considerable flexibility in setting the eligibility conditions to bid for CfDs within this system. For example, CfDs might be limited to companies producing development fuels within the UK. In that case, international development fuel producers would still be able to compete for market share

within the development fuels mandate, but would not have the added benefit of a price guarantee from a CfD. The Government could also consider setting additional technology or sustainability requirements to bid in a given CfD auction (for example restricting one auction or part of one auction to electrofuels), and would have flexibility to change requirements between auctions to respond to market conditions.

Under the CfD in the electricity market, renewable electricity generators are required to make payments when market prices exceed the agreed CfD price. Given that the development fuel industry is at a very early stage, we feel a that it is not necessary to ask development fuel producers with CfDs to pay back the difference between their CfD price and the buy-out price. Allowing producers to keep the 'upside' profit on produced fuels could further incentivise investment; this would need to be further considered before finalising a proposal to introduce such a system (see below for further discussion).[9]

### ***Buy-out price (set as part of an RTFO)***

The buy-out price for development fuels would continue to be set in legislation at a price which meets the concept of 'prohibitive but not punitive'. However, the setting of buy-out prices has to date been a relatively unresponsive activity with the price being set at above what industry entities believe is the price differential for the supply of renewable fuel but at a level which does not impose an undue cost upon transport fuel users. In a system combining a development fuel mandate with a system of CfD auctions, the prices set in successful CfD bids could be used to inform future adjustments to the buy-out price.

### ***CfD price (set via separate contracts) - application***

Under the CfD system, the Government would periodically announce a total value of CfD commitments that it is willing to support at an auction round and invite bids. As in the electricity CfD system, prospective producers of advanced renewable transport fuels would submit bids for the CfD price guarantee at which they would be willing to produce, with CfDs awarded to the companies proposing to produce fuels for the lowest guaranteed price per litre.

The bidding process could be done via a sealed auction with allocation occurring on a 'bottom up' basis – i.e. from the lowest required support price first.

The CfD price proposed in each winning bid would then be written into a contract between the producer and the government, thereby providing commercial certainty as to the minimum price the production facility will achieve if it supplies into the UK market.

9 The electricity CfD also includes the Supplier Obligation Levy mechanism whereby electricity suppliers (who are legally segregated from electricity generators) must cover the cost of payments made under contracts for difference. Such a system could be considered for a fuel CfD, but we believe that it may not be necessary because of the character of the proposed fuel CfD as a form of RTFC price insurance. Provided the value of the development RTFC remains relatively high (which to some extent is in the Governments control as they set the mandate), the revenue to producers would not need to be topped up by government and therefore we would expect only limited amounts of funding to be needed to cover CfD obligations under the proposed system.

## *Reference price for CfDs – determining the market value of a litre of fuel*

The CfD system would offer a guarantee to producers on the minimum revenue they would receive per litre of eligible fuel supplied to the UK market. In the electricity CfD is the reference price is taken to be the price achieved on the spot market for the relevant time period and compared to the agreed CfD price. In the renewable transport fuel market there is limited price transparency, and the assessment of price is made more difficult because a given producer will receive a combination of the value of the associated development RTFC and the value of the fuel itself as an energy carrier. In practice, the price achieved by a given producer will also depend on the commercial terms agreed with off-takers. Under the fuel CfD system, we propose that the agreed CfD price should be compared to a reference price defined as the sum of the market price of the development RTFC and the market price of the fuel. If this reference price is less than the CfD price, then the government would make top-up payments to the fuel producer. This would require that the price of a development fuel RTFC should be transparent (to the government at least) – which we consider in the next section.

The logic of setting the reference price in this way can be seen if we consider the case of a development fuel producer, who holds a CfD, and supplies it's own drop-in diesel fuel to the market and hence is awarded the corresponding number of development RTFCs. The fuel itself can be sold to consumers for the same price as conventional diesel fuel. The development RTFCs can then be sold to obligated suppliers. The revenue per litre delivered to the producer is therefore approximately the price of diesel plus the price for two development RTFCs. If a producer sold the fuel directly to a fuel supplier rather than supplying the fuel directly to market then the producer would not be issued any development RTFC, but we assume that the negotiated price would include pass through of the development RTFC value.

The sum of these values may not exactly correspond to the actual revenue achieved by the producer, but this approach would allow the system to be assessed transparently without the government having to rely on self-reporting of revenues. Producers would be expected to consider any expected difference between this reference price and their actual price when deciding their bids for the CfD auctions.

One implication of this approach to determining when each CfD would pay out is that CfD payments would be less likely the higher the development RTFC price is. Indeed, if the development RTFFC price is relatively high and stable, it may never be necessary for payments to be made under the CfDs. This is why we have characterised the fuel CfDs as a form of insurance for producers against low development RTFC prices.

### Certificate price

In order to determine an accurate market value for the development RTFCs we have considered two approaches. These are:

1. Continuing to allow development RTFCs to be sold and transferred bilaterally (or via traders) and requiring any producer who holds the CfD to be 'open-book' to the government on the price achieved and to obtain full, independent financial auditing of those books; or
2. Requiring any development RTFC that are to be transferred between parties to be sold

via an auction platform in order to ensure that a fair market price is set in a transparent manner.

The first system, whereby self-reporting by producers with CfD contracts would be the basis to assess whether CfD payments should be made, would create a moral hazard as there would be a direct financial incentive to manipulate RTFC prices or to misreport or otherwise disguise revenues in order to maximise CfD payments. It may also be difficult to reconcile with commercial arrangements under which the fuel producer would not be the company supplying the fuel to the UK market and receiving the development RTFCs (where the value of the fuel and the RTFC could be bundled into a single agreed offtake price to a third party).

We therefore prefer the introduction of an auction system for development RTFCs. Under such a system, all development RTFC sales would be undertaken via periodic public auctions. We believe it is necessary to require that all development RTFC sales would be made through these auctions rather than bilaterally in order to ensure that recorded auction prices are representative of the market. Such auctions would provide price transparency and prevent the manipulation of RTFC prices to increase CfD revenues. Price transparency could provide additional investment benefits by providing market information to support investment by producers not holding CfDs.

While the sale of development RTFCs themselves would be permitted only through the auction system, fuel companies would be free (as they are currently) to negotiate regarding which company would be the 'supplier' of the fuel to the market under the RTFO (the owner as the fuel crosses the duty point).

The auction system would have the following features:

1. Development RTFCs would be issued to the company supplying the fuel to the UK market (i.e. the owner of the fuel as it crosses the duty point) as they are now. This could be the same company that produced the fuel and holds the CfD, or could be a second company that holds an offtake agreement with the producer. In the latter case, the fuel producer would need to agree commercial terms that would transfer some or all of the RTFC value back to them (either explicitly transferring value back after the certificates are auctioned or implicitly transferring value back through the agreed offtake price).

    1.1. To be eligible for CfD payments a producer would need to show that development RTFCs had been issued for the supply of that physical volume of fuel.

2. An auction platform would be created on which development RTFCs would be sold on a regular basis (e.g. quarterly). No development RTFC transfers would be permitted except through placing them into an auction (i.e. there would be no pre-arranged bilateral certificate sales).

3. Any company holding certificates would have the right to release some or all of them into each auction. The detailed rules for auctions should be established by government in consultation with the industry. In terms of facilitating the CfD system, the important point is that the auction system results in a transparent certificate price (which may be the average of certificate prices achieved at a single auction or at several auctions in a given period).

    3.1. It may be appropriate to set a minimum on the number of certificates that could be released for sale at auction by a single entity as auctions of very low numbers of

certificates could result in misleading price information (e.g. it wouldn't be worthwhile for an obligated supplied to engage in an auction to buy a single certificate).

4. The auction could be open to traders as well as registered fuel suppliers. This would enable a secondary market in certificates for compliance with obligation purposes.
5. Entities wishing to buy certificates would bid against each other – again, the precise details of auction rules should be developed in consultation with industry – with the certificates on sale awarded to the highest bidders.
6. Where there are multiple companies selling certificates in any one auction, the auction revenue would need to be pooled and distributed in proportion to the number of certificates sold i.e. each seller would achieve the average price in that auction. The administrator would need to set up systems to collect and allocate the monies involved.
7. The contribution from development RTFCs to the reference price would then be calculated by the administrator based on the average price achieved in all auctions across a given time period (the exact time period would need to be determined – averaging across a full obligation year would seem appropriate in the first instance).
    7.1. In the event that there were no development RTFCs submitted for auction in a given period (e.g. if one obligated supplier had supplied all of the available development fuel volume and used all of the resulting certificates for its own compliance) then the reference price would instead be based directly on the buy-out price (reflecting an assumption that a lack of sales would reflect an under-supplied market, in which the value to an obligated supplier of an additional development RTFC would be equal to the buy-out price).

### Fuel price

The fuel price would be determined by referring to existing market data on the price of aviation fuel in the UK market. We do not envisage that producers would be asked to provide information on the difference between the reference fuel price and the exact sale price they achieved (or that overseas producers would be permitted to include currency movement) as these are risks that it is reasonable to expect the producer to absorb.

### *Volume signal*

The third feature of this system is the volume signal. The development fuel obligation level could continue to be set as a single target for fuels supplied to all transport modes (aviation, marine, on-road, off-road etc.) or could in principle be broken out to give sub-obligations to target sectors where the government wishes to target advanced fuel deployment.

The current development fuel mandate has been set at a level which was felt to be stretching, but there is no defined mechanism to consider adjustments to the mandate based on market intelligence about what is being delivered as the obligation goes forward. For example, recent announcements by DfT officials have indicated that they have had over 120 applications [xxiii] for development fuel status, which could suggest that the current mandate level could rapidly be filled.

We therefore propose that the volume signal should be kept under review by the government and that powers are granted to the Department for Transport to easily increase the development fuel volume mandate when it reasonably believes that the market will be able to develop fast enough to deliver increased volumes. We do not propose similar flexibility to reduce the mandate – as reductions in the mandated level would undermine market confidence. If mandates are not being met, the appropriate response is to keep a steady hand on the tiller and wait for investments to come through. Should the Government be concerned about the burden on fuel suppliers from development fuel buy-out payments in an undersupplied market, it could consider reintroducing 'buy-out recycling' (whereby the money from buy-out payments is returned pro-rata to fuel suppliers rather than kept by the treasury).

By ensuring that the development fuel mandate (or mandates if split by mode) is continuously stretching, the Government would maximise the rate at which capacity is brought to the market and make it unlikely that the development RTFC price would fall to the level of the standard RTFC price. This would have the double effect of improving the value signal from the development fuel mandate to producer operating outside the CfD framework, and of avoiding large payments to producers with CfD contracts. The information obtained by the Government through CfD contracts and development RTFC auctions should allow a higher level of responsiveness from government than is currently possible.

### ***CfD – other systems features***

The above system will need a number of other features to function correctly, and could be further refined to meet different policy objectives. Given that the system described would be novel and need to be carefully designed, it has not been possible to outline all of those features in this work and the authors believe that further development would be best achieved in collaboration with industry players who may be able to identify further refinement to prevent unfair advantages or fraudulent behaviour.

Features that we recommend are considered include:

- The administrator applying different specifications to different allocation pots to reflect emerging challenges to deployment, e.g. if ammonia into maritime is showing significant potential but deployment is proving highly capital intensive, a specific 'ammonia into shipping' CfD pot could be allocated.
- The contracts to the producers should specify a minimum volume (or percentage of production) that has to have been supplied into the UK in any given period for that contract to remain eligible for CfD support. This will ensure that supply to the UK is somewhat buffered against price signals in other markets. This is important if the mandate is to be raised based upon expected supply
- The time lapse between contract award and supply of a specific volume to be incorporated into the contract with either a reduction in the support price or cancellation of the contract where there is late delivery.
- Secondary sales of development RTFCs that have been through the auction would be permitted, but the price achieved in any subsequent sale would be ignored when determining the reference price.
- It should be noted that in this system, revocation of certificates after the auction has

occurred would prove problematic as the purchaser has no control over which certificates they receive and therefore cannot price the risk of revocation into their bidding. Therefore, we propose that a 'claw back' clause be placed into the contracts which would enable the administrator to recover the value of revoked certificates from the producer. If the reason for revocation is of sufficient severity the CfD would be terminated.

### ***Cost recovery and buy-out***

Under the CfD system for electricity generation, projects are required to pay back to the government when electricity prices are higher than the price agreed for the CfD. We suggest that for the fuels market there should be no equivalent requirement to pay revenue back to the government if the reference price is above the CfD price, at least not for the initial rounds of CfDs. There are several reasons that we believe it would be reasonable to allow producers to keep any additional profit on the 'upside' when they achieve higher revenues.

Firstly, the development fuel market is much less mature than the renewable power market. The overarching goal of support for development fuels is to accelerate investment, innovation and technology development. Additional revenues to development fuel companies can be expected to be recycled at least in part into investment in additional facilities to support this goal.

Secondly, as we envision a system where the development fuel mandate is for larger volumes than can be supplied by producers with CfDs alone, producers with CfDs will be in competition with other companies (including importers) for space in the development fuel market.

It would be counterproductive to the development of UK industry to give importers the full benefit of high development RTFC prices while limiting profits to the producers who won the CfD auctions.

Thirdly, the two cases are different because the assessment of prices in the electricity market can be much more precise than in the renewable fuel market due to electricity market price transparency. If the calculated reference price under the fuel CfD was higher than actual prices achieved by a given producer, requiring pay back on the basis of the reference price could actually impose losses on the producer when the development RTFC price is high, which would be an entirely perverse outcome.

Finally, the maximum price achievable by a producer would still be limited by the development RTFC buy-out price, and thus the potential for profit for CfD holders would be limited.

While the CfD system should bring more development fuel to market faster and thereby reduce the need for fuel suppliers to pay a buy-out to meet their obligations, buy-out could still occur under our proposed system as it can under the existing system. The revenue from the buy-out fund could be thought of as offsetting the cost to the government of CfD payments (while noting that CfD payments are more likely in years of over-supply during which buy-out payments should not be necessary, and therefore we would expect that payments under CfD contracts would be in different years to payments into the buy-out fund).

We have provided simple examples in Annex C to illustrate how this scheme could support producers in practice.

### *3.2.vi) Other possible approaches*

#### ***Awarding development RTFCs to producers***

1) We have suggested above that under the development fuel mandate plus CfD system RTFCs would continue to be awarded to the owner of the fuel as it crosses the duty point. The Government could also consult on whether it would be advantageous to instead issue development RTFCs to the fuel producing entity. This may allow the fuel producers more control over the value of the RTFC, but would introduce additional administrative complexities to the system as the Government would not be able to use HMRC data to verify fuel volumes.

#### ***Grant funding***

2) Increased grant funding. The model used for the advanced demonstration competition could be used to grant fund further commercialisation of advanced biofuels. Such an approach is not directly antagonistic to the one proposed above, however any production facility that received such grant funding would have to have this factored into when setting the CfD terms or making support payments. We have not further considered such combinations of support. Direct grant funding could be a less efficient use of government funds as the intention of the CfD is to better leverage the existing RTFO support.

#### ***Advanced Alternative Fuel Support Obligation***

3) Cerulogy has previously proposed the introduction of an advanced alternative fuel support obligation ('AAFSO')[xxiv]. The main difference between this structure and that of an RTFO is that fuel suppliers would be obligated to buy a pro rata share of all renewable fuel certificates generated in a given year, even if the quantity of supplied alternative fuel exceeded an annual target. A 'target price' would be set for certificates at the start of the year with a similar role to the buy-out price in the RTFO. Rather than allowing the market to set certificate price directly, suppliers would be obliged to buy all available certificates either at the target price (if supply was less than or equal to the target) or at a proportionately reduced price if supply exceeded the targeted quantity. Under this system if supply was double the target quantity for a given year, the mandated price for buying certificates would therefore halve. The total cost to fuel suppliers to buy the certificates would thereby be capped, but the uncertainty in certificate value would be much reduced. This is very different to a development fuel mandate within an RTFO, where if supply was double targets in a given year we would expect the certificate price to collapse. The AAFSO approach would give more value clarity to producers and could pull additional advanced fuel into the market if production capacity was available, without increasing overall compliance cost to obligated suppliers. An AAFSO system may be an effective alternative to the proposed combination of a development fuel mandate and CfDs. The AAFSO would be a novel legal instrument, and there would be several challenges to its implementation. Two significant issues are: a) the AAFSO has generally been perceived as a complicated instrument when discussed with stakeholders and it may be more difficult to build support for an AAFSO than for a CfD system that has obvious similarities to the system already successfully used in the power sector; and b) that the AAFSO creates a direct obligation for

a defined financial transfer from fuel suppliers to AAFSO certificate holders rather than the market mediated transfers that occur under the RTFO, which may be more controversial to obligated parties and require further legal assessment.

### *3.2.vii) Interaction with other proposals / UK schemes*

The proposed scheme will interact with any support mechanism for the sectors upon which it is targeted, and that will need to be taken into account when setting up the CfD auctions.

## 3.3. Electricity

At present, the UK vehicle fleet is dominated by internal combustion engine vehicles running on petrol and diesel. This picture is set to change rapidly as sales of electric vehicles accelerate in the coming decade. Whereas in the past decade biofuels have been by far the most significant source of renewable energy for transport, during the 2020s an increasing quantity of renewable electricity will be consumed in the transport sector. In the EU, the supply of renewable electricity counts alongside biofuels towards targets set under the RED II. Liquid renewable transport fuels and renewable electricity are also credited alongside each other under the California Low Carbon Fuel Standard. T&E would like the supply of electricity to electric vehicles to be eligible to receive RTFO certificates in the UK, in order to provide an additional driver for passenger vehicle electrification and infrastructure development.

The supply of renewable electricity for battery electric vehicles is not currently eligible to earn certificates under the RTFO. While electricity for transport is currently excluded from the RTFO, suppliers of electricity were allowed to claim credits under the GHG Regs, the credit mechanism part of which ended in 2020.

Final 2019 data (Renewable Fuel Statistics 2019[xxv]) shows a very small amount of electricity being claimed under the GHG Regs (0.1% of credits). While there is a gap between the reportable GHG intensity achieved by the supply of fuels under the RTFO and the 4% target for 2019 (rising to 6% in 2020), this is being filled by credits from upstream emissions reductions (UERs). These account for nearly 25% of credits awarded under the GHG regs in 2019 (2020 data was not available at the time of the production of this report).

The GHG regs defined the electricity supplier as the owner of the electricity at the point that it is metered, linking to the Electricity Act 1989 to do this. In practice this means that to be a claimant of electricity under the GHG Regs a company had to be a registered electricity supplier with Ofgem.

Only the renewable part of the electricity was rewarded. Renewability was assessed based on each supplier's annual 'Fuel Mix Disclosure[xxvi]' to Ofgem, which in turn is a function of the 'Renewable Energy Guarantees of Origin' (REGOs) that they hold. REGOs are issued to generators of renewable energy and may then be sold to electricity suppliers as a basis to claim that electricity supplied has renewable credentials. There is therefore not necessarily any physical connection between the source of electricity supplied and any REGOs that are held by the supplier. Whilst the price of REGOs isn't published in a central register, some sources indicate that costs are rising due to increased demand for renewable tariffs and are currently around £0.50 per MWh[xxvii,xxviii]. This is a modest cost compared to the wholesale price of electricity in the UK which was up to ~£60 per MWh pre-COVID-19 and now is around £30 per MWh[xxix]. This value differential provides a clear

indication that the REGO market does not send a strong signal for investment in new renewable capacity into the electricity supply market. The limitations of the REGO system as a basis to support renewable power generation have been discussed extensively in the context of e-fuels[xxx].

We have engaged with a limited number of renewable electricity suppliers and EV manufacturers who were either directly or via commercial contracts claiming GHG credits for electricity supplier to EVs. All have regarded the GHG Regs as a 'proving ground' for the concepts involved and are interested in the scheme being reintroduced and/or rolled into the RTFO. Introducing electricity into the RTFO would provide a more comparable treatment between hydrogen fuel cell technology (with hydrogen from electrolysis currently eligible for 'development' RTFCs) and electric battery technology in terms of their ability to claim RTFCs. Support for renewable electricity under the RTFO could be used as an additional signal to the market supporting EV deployment. As the market develops, it could also be used as an opportunity to replace existing direct support mechanisms in favour of a market-based mechanism allowing competition between different transport energy carriers. While making electricity supply eligible for support from the RTFO could contribute to accelerating the transition to electric passenger vehicles, it should also be noted that introducing a new credit generation option into the RTFO could be disruptive to the existing liquid fuel market. As such it would be important to give proper consideration to the need not to undermine good-faith investments in other low carbon fuels.

### *3.3.i) EV deployment*

The Government has recently announced ending the sale of new petrol, diesel cars and vans by 2030 and hybrids from 2035[xxxi]. As the role of electric vehicles in the UK fleet grows, there is a case for the supply of renewable energy to these vehicles to be rewarded on the same basis as the supply of renewable energy in liquid and gaseous fuels.

Whilst numerous scenarios can be developed for the amount of electricity that will be needed by electric vehicles, there is a clear expectation that as electric vehicles become the norm for passenger cars electricity will form a significant part of overall transport energy consumption. For example, the cases assessed in the National Grid Future Energy Scenarios 2020[xxxii] for 2030 and 2050 give a potential contribution from electricity to road transport energy consumption from 4%-10% in 2030 and from 53%-73% in 2050 (with hydrogen supplying the 2050 remainder in three of four cases presented).

### *3.3.ii) Which electricity should count?*

The distribution of electricity is fundamentally different to the distribution of renewable fuels. Renewable fuels are (usually) chemically distinct from the fossil alternatives, and it is possible to physically track the movements of batches of renewable liquid or gaseous fuels. Renewable electricity, in contrast, is indistinguishable at the point of use from fossil-derived electricity, and in general renewable electricity is supplied over the same grid as fossil power with no possibility of physical tracking of 'renewable electrons'. Providing support to renewable electricity supplied to electric vehicles would therefore require rules to be introduced to determine when supplied electricity may be treated as renewable. There are four broad options as to which electricity could be rewarded under the RTFO:

1 Any electricity that is used in an EV, regardless of the source of that electricity;

2 Only the same proportion as the national grid average renewability;

3 Any electricity for which the claiming entity (or the supplier to the claiming entity) has a guarantee of origin stating that it is renewable (a REGO);

4 Only electricity that the claiming entity is able to demonstrate has come from 'additional' renewable power generation based on a defined set of rules.

Setting rules to identify electricity as renewable is also an issue for RFONBOs[xxxiii], and there has been extensive discussion of when electricity used to produce electrofuels can and should be treated as renewable. While the basic question is the same for RFONBOs and for electricity supplied to EVs, the context is different because of the large differential in energy efficiency between the two systems. Producing electrofuels has a low efficiency compared to supplying electricity directly to EVs, and electrofuels are then used in internal combustion engines that are much less energy efficient than electric drive alternatives. A megajoule of electric power supplied to an electric vehicle could move it five or six times further than the same megajoule could move a comparable internal combustion engine vehicle if converted to electrofuel. This hierarchy of efficiencies means that electric vehicles are likely to deliver GHG emission reductions compared to conventional vehicles even if powered with 'average' grid electricity, whereas making electrofuels with grid electricity would result in significant GHG emissions increases. It may therefore be appropriate to set different levels of stringency on renewability accounting between electricity for EVs and for electrofuels.

Note that current support for RFNBOs excludes biomass derived electricity (the logic being that when the electricity used to produce an e-fuel is of 'biological origin', the fuel is also of biological origin and may be considered as a biofuel).[10] This exclusion may not be relevant for electricity supplied directly to EVs.

Each of these four options for crediting electricity in an RTFO has advantages and limitations:

1 *Counting all electricity*

The current GHG Regs do not explicitly differentiate electricity by its renewability, however the amount of reward is varied by the carbon intensity of the electricity supplied as derived from the supplier Fuel Mix Disclosure. This means that renewable electricity does receive additional credit.

Arguments in favour:

- Any EV running on the current UK grid average energy mix is associated with less GHG emissions than an equivalent internal combustion engine powered vehicle using liquid fossil fuels.
- There are other mechanisms in place to incentivise the deployment of renewable electricity and therefore it may not be necessary to use the RTFO as a further incentive mechanism to drive renewable power installation.
- It is administratively simpler for both the claimant and the RTFO administrator.

10 The use of biomass-based renewable electricity for electrofuels is also potentially problematic as biomass electricity is generally assessed to have significant lifecycle GHG emissions. Even if these are lower than for natural gas electricity the GHG intensity is unlikely to be low enough to deliver a net climate benefit after conversion to electrofuel.

Arguments against:

- It rewards non-renewable electricity under (what is currently) a renewable energy incentive scheme.
- It doesn't send a signal to the market that electricity for EVs should be renewable.
- It is different to the approach taken in the current RTFO for Renewable Fuels of Non-Biological Origin ('RFNBOs'), including electrolytic hydrogen, where any electricity used has to be from non-biomass renewable sources.

2 *Using the grid average renewability*

Argument in favour

- Directs a level of reward to EVs that is in proportion to the renewability of the electricity supply at the national level.
- Uses an already established figure that could be applied by the RTFO administrator without requiring any further evidence from the claiming entity.

Arguments against

- It doesn't send a signal to the market that electricity for EVs should be made increasingly (ideally entirely) renewable.

Renewables were 37.0% of the UK electricity mix in 2019/20, including biomass power.[xxxiv] Cases from the National Grid FES 2020 project that between 60% and 100% of UK power will be renewable by 2030.

3 *Using supplier claimed renewability (via the REGO system)*

Argument in favour

- This would mirror the current system used in the GHG Regs to determine greenhouse gas intensity (and hence reward level) for electricity used in vehicles.
- It allows for the transfer of 'renewability' from generators to any of the possible claimant entities.
- It would act as a market signal that the government wishes renewable electricity to be used in EVs.
- It is similar in concept to the way that renewable gas can be injected in one part of a gas grid and a claim made for its withdrawal in a different part of the gas grid under the RTFO.

Arguments against

- As REGOs have a low market value purchasing REGOs for this purpose provides only a weak market signal with regards to the desirability of renewable electricity.
- There has been criticism of the REGO system in that it allows suppliers to 'greenwash' their supply[xxxv] (i.e. allow a supplier to claim 100% renewability without actually increasing renewable power generation).

- Electricity suppliers may be able to create a subsidiary company to handle the supply of electricity to the EV market and therefore only have to obtain REGOs for that part of their supply.
- With levels of renewability potentially sensitive to accounting practices as much as actual renewable power generation, it would be difficult to forecast rates of certificate generation and to set appropriate targets.

4 *Crediting only additional renewable power*

Arguments in favour

- Create a real link between supply of electricity to electric vehicles and additional renewable power capacity.
- Make renewability claims more credible, and potentially allow greater consistency with approaches being developed in the EU for crediting RFONBOs as wholly renewable.

Arguments against

- As seen in the discussion in relation to RFONBOs, demonstrating additionality may be complex and require the development of novel protocols.
- Even with additionality requirements, the signal from such a measure for deployment of additional renewable power may be weak compared to signals from other mechanisms.

### ***Which entity should be rewarded?***

If (renewable) electricity is to be made creditable under the RTFO, it would be necessary to define which entity should be eligible to claim reward. We have identified three options:

- The electricity supplier (as currently under the GHG Regs);
- The charge point operator (where there is a separate entity owning the charge point, which is usually the case for non-domestic charging); or
- The vehicle manufacturer (assuming that vehicle manufacturers are able to gather electricity consumption data from the computer systems onboard the vehicle).

In terms of supporting the deployment of electric vehicles, providing support to either the charge point operator or the vehicle manufacturer is a better option than the electricity supplier. It is unlikely that value returned to the electricity supplier through RTFCs would be ringfenced to support the roll out of EVs or EV infrastructure. We note that under the California Low Carbon Fuel Standard conditions have been placed on electricity suppliers to require part of the revenue to be recycled to support EV deployment.

When comparing the case for crediting charge point operators vs. vehicle manufacturers we have taken into account the following points:

- Charge points operators can be divided into domestic and non-domestic operators. We haven't further distinguished between types of non-domestic operators (e.g. private

publicly available charge points, public authority operated charge points, and private non-publicly available charge points such as return to base fleet charging).

- It is unclear whether the UK will follow the EU in placing a requirement on motor vehicle manufacturers to gather real-world energy consumption data for new cars[xxxvi,xxxvii].
- Currently UK electricity metering in domestic settings does not allow for separate metering of electric vehicles.

We would also like to note two further issues with regards to rewarding the vehicle manufacturer. The first is that the more efficient a vehicle, the lower the reward would be. It might be possible to counter any undesirable signals to the market that less efficient vehicles receive more reward via a tiering system for the number of RTFCs issued, but this would add further complexity to the RTFO. The second issue is that rewarding the vehicle manufacturer would rely upon data collected by them. This raises challenges in monitoring and verification and any transfer of data including the actual amount of electricity used by customers would open up significant administrative (including GDPR) issues.

Finally, issues could arise if electric vehicle batteries are used as a form of distributed storage, with power being returned to the grid under some conditions. In that case, there would need to be a mechanism to avoid rewarding electricity that is returned to the grid without being consumed for transport purposes.

### ***Rewarding electricity use and the Energy Act***

The Energy Act has, to date, been interpreted as preventing the inclusion of electricity into the RTFO due to the requirement that a renewable transport fuel is a liquid, solid or gas. It is not clear to us that specifying the permitted states of matter in this way in the Energy Act is useful. We have been unable to find any documentation of why this requirement was put into the Energy Act, either in the consultation documents from the time nor in the explanatory memorandum submitted to Parliament[xxxviii]. If the intention of this text was to exclude electric power it could have been done more directly – we believe that in fact it is likely that the intention of this language was to confirm the broad scope allowed for an RTFO, and therefore that the exclusion of electricity may be an unintended consequence. We believe that it is possible to make an argument that electricity could still be regarded as included in the current RTFO, by considering the charged battery as a form of solid fuel, and have set this argument out in Annex B. This would represent a change in interpretation, and Department for Transport officials were unable to provide a categorical view on whether this argument has legal merit. If T&E is interested in pursuing this line of argument it is suggested that independent legal analysis may be required.

If it is not possible to change the current interpretation, then the Energy Act would need to be amended to enable electricity to be rewarded under an RTFO. This could be done simply in a similar manner to how the GHG Regs have operated, involving either the removal of the requirement for a renewable transport fuel to be 'solid, liquid or gaseous' or the insertion of words explicitly adding 'or renewable electricity' in the definition of what constitutes a renewable transport fuel.

The Energy Act specifies that RTF certificates may be issued to transport fuel suppliers, and this would make it impossible to issue credits directly to vehicle manufacturers unless they were to adopt a business model to sell or lease an electric vehicle and the electricity to charge it as a

package. Allowing the reward for renewable electricity supply to electric vehicles to go to the vehicle manufacture would therefore require significant additions to the Energy Act.

We believe that it is possible to interpret the current Energy Act as enabling charge point operators to be rewarded as the Energy Act describes a 'transport fuel supplier' as an entity that 'supplies transport fuel at or for delivery to places in the UK'.

The Automated and Electric Vehicles Act 2018[xxxix] gives the Government powers to set up secondary legislation to require public charge points to be smart and to provide information to any entity required by secondary legislation. This could include the RTFO Administrator (or another government entity which could then pass the information onto the RTFO Administrator).

## *3.3.iii)Suggested solutions*

### ***Resolving whether electricity can be included in an RTFO under the current Energy Act***

1) In order to resolve whether electricity can be included in an RTFO under the current Energy Act T&E should (with other interested parties) seek a definitive view from DfT.

### ***Target reward at public charge points***

2) Move the reward from the electricity supplier to the charge point operator for charging at charge points not at a domestic dwelling as this sends a clearer market signal on the need to increase the deployment of charge points.

3) For charge points at domestic dwelling, the reward should continue to go to the electricity supplier as they are in the best position to offer tariff incentives to domestic customers. Charge point operators would need to obtain the fuel mixture disclosure from the electricity supplier(s) they utilise.

    a. For non-domestic charge points, a tiering system based upon the amount of electricity delivered should be introduced which provides extra incentive to small throughput charge points to assist in the incentivisation of the roll out of charge points to out of the way locations, which will help to reduce 'range anxiety'.

This system would be similar to that introduced in California under the LCFS[xl].

### ***Rewarding all electricity used in EVs***

4) If electricity supplied to EVs is made eligible to be counted under the RTFO, rewarding all electricity used would be justifiable due to the inherent energy efficiency of EVs compared to internal combustion engines, the steadily increasing renewability and declining GHG intensity of UK grid electricity and the administrative complexity involved in allocating renewability to specific end uses. This would create a formal inconsistency with the more stringent approach required for RFONBOs, and therefore the government should carefully consider and consult on the relative benefits of other options before deciding on this approach.

#### *Adopt an 'opt-in' approach*

5) Make claiming of RTFCs for electricity 'opt in' rather than required in order to minimise the administrative burden of locating all charge point owners (for non-domestic charging) and electricity suppliers (for domestic charging – who may not know that they are supplying charge points).

### *3.3.iv) Other options considered*

#### *Mandatory additionality*

Requiring renewable electricity to be additional to that already generated. This is not recommended as (i) unlike e-fuels, EVs are less carbon intensive when run upon the current UK energy mix and hence the additionality is not required to ensure carbon savings, and (ii) doing so would require both a significantly burdensome administrative system and a high price signal to secure additional generating capacity.

#### *Hypothecating credit revenue*

We have considered the option of crediting the electricity supplier and requiring them to pass (a part of) that reward to specified parts of the system (such as charge point operators or the electricity district network operators). Whilst we believe that this could be done under the Electricity Suppliers License conditions (which BEIS can direct Ofgem to include matters relating to the environment in), doing so would require the cooperation of BEIS and Ofgem and create the need to determine what the correct level of pass through is, therefore it is simpler to, where possible, move the reward onto charge point operators.

#### *Issuing credits to the vehicle manufacturer*

Whilst this would potential boost vehicle deployment and/or could be utilised to reduce the plug-in vehicles grant, we don't believe that this is the right proposal for the following reasons: (i) the UK government is currently intending to prohibit new petrol, diesel and hybrid car and van sales from 2040 and has recently consulted on bringing this forward to 2030 or 2035. This already sends a very clear signal to vehicle manufacturers and (ii) any such system would either have to reward the vehicle manufacture at the point of sale based on the expected usage of the vehicle over its lifespan or require a system that tracked actual usage (either directly via manufacture data, if recorded, or via millage as a proxy (which could be obtained via the MOT system), either of which would introduce significant additional administrative effort.

### *3.3.v) Interactions with other proposals / UK schemes*

The system outlined above would interact with both the plug-in vehicles grant and the infrastructure grant schemes, however as both are grant schemes they are within the gift of the government to amend should the combined level of reward become overly generous.

## 3.4. Aviation obligation

Fossil fuel used in aviation is currently not obligated in either the RTFO or the GHG Reg. Renewable fuel used in aviation (either as a replacement for kerosene or for aviation gasoline, 'avgas') can be rewarded under both schemes and is eligible for development fuel RTFCs under the RTFO (if it meets the other development fuel criteria).

Aviation fuel used on domestic routes, flights to Gibraltar and (if agreement is reached) on flights to EEA member states is subject to the EU-ETS and will be included in the UK successor scheme (UK-ETS) starting in 2021. The next UK-ETS phase mirrors the EU-ETS in running from 2021-2030, however aviation has two sub phases (2021-2023 and 2024-2030) to align with the CORSIA pilot phase (see below). The UK is setting the cap on emissions in aviation at 5% below the EU-ETS cap and is awaiting input from the Committee on Climate Change on a net-zero trajectory. How the UK-ETS will be aligned with CORSIA after the pilot phase is currently unclear [xli,xlii].

The aviation industry, via International Civil Aviation Organisation ('*ICAO*'), has committed to a scheme entitled 'Carbon Offsetting and Reduction Scheme for International Aviation ('*CORSIA*')[xliii]. The nominal goal of CORSIA is to hold aviation's carbon emission at 2020 levels up to 2035 despite predicted growth, although as the scheme does not immediately apply to the whole of international aviation global emissions will increase compared to 2020 levels regardless of the success of the scheme. The tools identified to manage emissions are a combination of:

- Operating efficiencies
- Aircraft technology improvements
- Lower GHG intensity aviation fuels (referred to as sustainable aviation fuel, 'SAF', and low carbon aviation fuel, 'LCAF')
- Carbon offsetting measures.

In practice, CORSIA is expected to primarily drive the use of offsets with limited impact on other emissions reduction options as offsets are likely to be the cheapest option to comply.

The UK aviation industry has set out a 'pathway to net zero' by 2050[xliv] which relies heavily on the EU-ETS (the report was published before the creation of the UK-ETS), CORSIA and 'to be determined' other 'market-based mechanisms' to reach net zero. It envisages around 4.5 million tonnes of SAF in the long-term (defined as a 2040-2050 timeframe) reducing net aviation $CO_2$ emissions by 32%. This report also calls for the RTFO to be amended to reward recycled carbon fuels and for the reward multiplier of 1.2 from REDII to be implemented. We note that the pathway to net zero does not address the non-$CO_2$ global warming impacts of aviation, and that even if the measures identified were delivered the overall warming impact of aviation would remain considerable[xlv]. Even ignoring non-$CO_2$ effects, neither the EU/UK-ETS nor CORSIA will achieve the desired level of decarbonisation by 2050 (let alone earlier decarbonisation) in their current format.

According to ONS 2018 environment statistics, aviation turbine fuel is ~25% of total UK petrol, diesel, gas oil and aviation fuel[xlvi]. Whilst this will drop significantly in 2020 due to the COVID caused reduction in air travel, it demonstrates the scale of aviation fuel use in the UK. It is widely recognised that aviation is a sector that is particularly difficult to decarbonise because of its reliance on liquid fuels and the practical barriers to rapid development and deployment of new airframes and engine technologies. Reducing the carbon footprint of aviation in the period to 2050 will therefore require the deployment of low carbon liquid fuels (likely alongside measures

to reduce the rate of growth of the industry). The aviation industry has welcomed the inclusion of aviation fuel as creditable under the current RTFO, and the development fuel mandate has the potential to support investment in aviation fuel technologies as in on-road technologies.

Whilst the current approach sends a clear signal to industry that the UK Government wants to support renewable aviation fuel, by allowing aviation to receive credits in the RTFO without placing any obligation upon it the current system effectively transfers the cost of deploying renewable aviation fuels from airlines and passengers to road users. This is not consistent with the principle that the 'polluter pays', and is unlikely to be politically sustainable as the alternative aviation fuel market grows. This hanging political question will also become a barrier to investment if the industry believes that there will need to be a fundamental overhaul of the incentive system in the short to medium term, as it further reduces the clarity of the value proposition to renewable aviation fuels. The European Union has recognised that it will be necessary in due course to introduce some form of obligation on the aviation industry in its ReFuelEU initiative, part of the European Green Deal. The most recent round of consultation discussed three forms that a mandate for renewable fuel use in aviation could take, but accepts as a given that some form of mandate is desirable, including a sub-mandate on power-to-liquids fuels to be introduced after 2030.

Delivering renewable aviation fuel will be challenging, but it also represents an enormous opportunity for UK business. Aviation consumes about 300 billion litres of jet fuel every year, and this consumption is set to increase even with action on climate change. That's a potential global alternative aviation fuel market worth hundreds of billions of pounds. Policies that bring investment in novel renewable fuel technologies could give the UK a real head start as development of that market starts to accelerate. It is important that policy makers should recognise that many technologies to produce alternative aviation fuels (such as Fischer-Tropsch fuel synthesis) will tend to output a spread of fuel molecules only some of which will be appropriate for aviation. Policies that support only the aviation fuel fraction of the output may be less successful at driving investment than policies that also support the fractions of output more suited to the petrol and diesel pools.

### *3.4.i) While support for renewable aviation fuel has been clearly signalled, no similar clarity has been given on whether and when fossil fuels used in aviation will be obligated under the RTFO. This means that for the moment any funding from the RTFO for renewable aviation fuel development and deployment is coming at the expense of road and non-road mobile machinery users. Legal position*

The Energy Act allows any liquid transport fuel to be obligated in an RTFO.

As the current RTFO includes renewable fuels used in aviation, there is already a mechanism in place to monitor fuel volumes. This could be applied to fossil fuels as well.

The obligation of fossil aviation fuel under either the existing RTFO or a new RTFO appears to raise no legal issues under the Energy Act. However, the Chicago Convention[xlvii] prohibits signatory states from charging taxes upon fuel transported into a country in the fuel tanks of a plane. This may be interpreted as preventing the UK from imposing an obligation on fuel used by incoming flights.

### *3.4.ii) Suggested solutions*

1. A clear signal should be given that aviation fuel will be obligated by announcing an intended start date for it to be included either into the existing RTFO or into an aviation-specific RTFO. One appropriate time point would be with the initiation of the main phase of CORSIA in 2024. The UK could remove aviation from the UK-ETS at this point in favour of a direct RTFO obligation. As this would move the burden of compliance from large numbers of aviation carriers to a much smaller number of fuel suppliers whose movement of fuel is already regulated by HMRC, this would have the benefit of reducing administrative burden upon the aviation industry.

2. The obligation should be placed upon all aviation fuel supplied in the UK, regardless of the end destination of the aircraft. As this is different to the UK-ETS approach which only obligates certain routes, it would reduce compliance administrative costs and complexity.

   As industry players warn that this may lead to an increase in the tankering of fuel (i.e. aircraft transporting the fuel needed for the return journey with them in order to avoid higher fuel charges), the UK government should work with other Chicago Convention signatories to exempt carbon reduction / renewable energy requirements from the prohibition on charging taxes upon imported fuel, unless an equivalent obligation has already been discharged on that fuel.

3. Bringing investment into the aviation fuel market will require specific incentives for aviation-grade fuels. This could be delivered by placing aviation fuel in a separate obligation from the current RTFO, and making only development fuels (or a similarly defined set of advanced renewable transport fuels) eligible. . If the complementary system of a development fuel mandate and CfDs that we have proposed above were introduced, it may be possible to successfully bring alternative aviation fuels to market within a unified development fuel obligation by placing requirements on projects receiving CfDs – for example that at least 30% of output fuel for successful bids should be supplied to the aviation market.

4. Please see the section on supporting advanced fuel deployment across all sectors for the mechanism for setting the volume mandate.

### *3.4.iii) Other options considered*

1) Maintaining a 'reward only' approach for aviation. This approach would perpetuate the cross subsidy from road users to aviation users, and would therefore be inconsistent with the 'polluter pays' principle. As noted above, we believe such a system would become unsustainable as alternative aviation fuel deployment grows and would therefore be a source of policy uncertainty and become a barrier to investment.

2) Increasing the level of reward within the existing RTFO as advocated by the Sustainable Aviation Forum[xlviii] based on the reward multiplier in REDII. We believe that the twin proposals made (in this section) to obligate fossil aviation fuel and (in the section on support for advanced biofuels) to introduce a CfD system for development certificates provide a much clearer signal.

3) Maintaining separate obligations upon aviation carriers in the UK-ETS and CORSIA

schemes. The UK-ETS scheme places the decarbonisation of aviation in the same value pool as decarbonisation of UK heavy industry[11] and therefore is unlikely to result in the same sustained investment in aviation specific production capacity as an aviation fossil fuel mandate. It is generally recognised that the price signal from ETS would not support the supply of biofuels for on-road applications, and it is much less likely to support the development of innovative but expensive alternative aviation fuel technologies. Maintaining just the CORSIA approach will not result in reductions in actual carbon emissions for UK aviation due to its heavily reliance upon carbon offsetting schemes. If the UK requires airlines to stay within the CORSIA approach then credit for alternative fuel supply under an aviation RTFO can be allocated to the airlines according to commercial relationships with fuel suppliers.

### *3.4.iv)Interaction with other proposals / UK schemes*

This proposal obviously interacts heavily with the UK-ETS and CORSIA schemes and we recognise that any shift away from those schemes would lead to significant legislative and administrative changes, however the benefit of the proposal above is both an eventual reduction in administrative overheads and a clear signal of government intent.

## 3.5. Maritime obligation

### *3.5.i) Current situation*

UK shipping (domestic and international) emits 3.4% of the UKs GHG emissions (split 1% and 2.4% respectively) and the need to address these emissions is recognised by both the Government and the marine industry in the Clean Maritime Plan[xlix].

Fossil fuel used in 'inland waterways vessels and recreational craft when not at sea' is already obligated under the current RTFO as it falls within the scope of non-road mobile machinery. Any renewable fuel supplied to that sector is therefore eligible for reward. DfT does not distinguish between different 'non-road' end uses in its statistics and therefore it is not possible to say whether any such supply is occurring.

The inclusion of NRMM in the RTFO does not cover maritime end uses and therefore the Clean Maritime Plan says UK intends to consult on changes to the RTFO to include low carbon fuels in maritime.

Domestic shipping is covered in UK carbon budgets and the Maritime 2050 strategy[l] says that the UK gov will consider setting targets for decarbonisation.

The conceptual issues facing maritime are very similar to those facing aviation, even if the technology solutions may be different. These are:

1) Any system that solely rewards the supply of renewable fuels within the existing RTFO (i) risks cross subsidy from road vehicle users to the maritime sector users and (ii) does not send a clear signal that the government will mandate the decarbonisation of this sector.

11 https://www.gov.uk/government/news/new-emissions-trading-system-proposal-would-see-uk-go-further-in-tackling-climate-change

2) The different technological solutions in this sector will have different support needs and hence deployment in this sector if competing against road sector deployment may not occur as rapidly as is needed.

### *3.5.ii) Legal position*

As the Energy Act defines fuel used for a transport purpose as including 'vessels', we believe that maritime end uses could be included within an RTFO without any primary legislation changes.

The government would need to decide what the appropriate obligation/certification point is, however under the current Energy Act structure this would be the 'supplier' of that fuel.

### *3.5.iii)Suggested solutions*

1) In order to ensure that a clear signal is given that maritime fuel will be obligated, a start date for it to be included in the RTFO should be announced. This time point should be as soon as is reasonably possible to introduce the required RTFO amendment.

2) The obligation should be placed upon all maritime fuel supplied in the UK, regardless of the end destination of the vessel.

   As this may lead to tankering of fuels into UK waters, the import of fuels in a vessel could be regarded as being 'supply' to the UK and hence obligated (unless that fuel was already obligated at the point it was loaded onto the vessel). As this aspect of the system will need further discussion with the industry to deliver a workable, verifiable monitoring system the obligation should only be placed on UK supplied fuels until this is in place, however as fuel volumes appear to already be reported under $CO_2$ emissions monitoring legislation[li] there may be a system already in place that could be adapted.

3) Maritime fuel should be placed under a separate obligation from the current RTFO. Please see the section on "support for advanced renewable transport fuels" for our proposal for supporting advance fuel deployment across all sectors, including the mechanism for setting the volume mandate.

### *3.5.iv)Other options considered*

1) Only apply the obligation to UK domestic shipping due to the potential for international shipping to import the fuel needed for the UK leg of their journey and hence avoid the obligation.

   Such an approach has two issues:

   i) The government has recently issued a call for evidence[12] which included a request to industry to provide information on the '*size and key characteristics*' of the sector. It is not clear that there is currently any mechanism to define and monitor 'domestic only' vessels movement.

   ii) Mid-sized commercial vessels will switch between UK-to-UK port voyages and

12 https://www.gov.uk/government/consultations/domestic-shipping-air-pollution-call-for-evidence

UK to non-UK port voyages depending upon commercial requirements (e.g. one voyage could be Hull to London (domestic) and the next London to Rotterdam (non-domestic)). As such, creating a system that allocated the full loaded in the UK (say in Hull in the above example) to the two voyages would be extremely complex.

### *3.5.v) Interaction with other proposals / UK schemes*

The proposed approach is clearly in line with the UK government's Clean Maritime Plan and builds on the proposed approach in that to send a clearer decarbonisation signal.

The detailed structure of the proposed system will need to be aligned with any proposals coming out of the IMO[lii].

## 3.6. Removing crops from the RTFO

### *3.6.i) Current situation*

The usage of crops is currently capped in the RTFO at 4.0% of total transport fuel volume in 2020, dropping to 2% by 2032. The limit of 2% in 2032 volume is the lowest limit for crop-based fuels set in any European biofuel support policy that the authors are aware of, and is more stringent than the maximum allowable in the European Union under the RED II. Crops-based fuels are completely excluded from the current development fuel mandate.

The 2% by volume cap was set with a view to reduce the risk of ILUC and to continue to incentivise the use of waste biofuels[liii]. The introduction of E10 as the standard UK petrol blend will increase the potential to supply crop-based ethanol to the UK market, but this potential is somewhat constrained by the crop-cap. We estimate that the crop cap limits the maximum potential 2032 UK crop-based ethanol market to a little below 1 billion litres, depending on the rate of deployment of electric vehicles and assuming complete elimination of crop-based biodiesel from the market. This is still potentially a potentially larger UK market for crop-based ethanol than at any point since the introduction of the RTFO, but a significant additional supply of waste/residue-based or cellulosic ethanol (over 500 million litres) would be required to deliver full E10 blending.

In 2019, supply of crop-based biofuels equated to 1.6% of total fuel supply and therefore was already below the level of the 2032 crop cap. Crops-based ethanol represented 1.3% of total supply. Crop-based biofuels were 31% of the total volume of renewable fuel supply, corresponding to 18% of the RTFCs issued[13].

In the EU, the RED II creates a new category of 'high ILUC-risk' feedstocks, the supply of which will not be counted towards targets in 2030. Where the European Commission finds a feedstock to be high ILUC-risk, Member States are limited to providing support to no more fuel than the 2019 supply level during the period 2021-2023. After 2023 the amount of fuel supported must be reduced to zero by 2030. On the initial assessment, only palm oil has been assessed as meeting the threshold to be high-ILUC risk, with the second highest deforestation risk being ascribed to soy oil ([liv]). Only a modest fraction of UK biofuel supply in 2019 came from either feedstock (2.6% and 1.4% respectively by volume).

13 The difference between these fractions is explained by the high percentage of UK biofuel that is eligible to be awarded double certificates.

Transport and Environment's position on crop-based biofuels was set out in their response to the consultation upon REDII ([lv]), stating that European governments should *"phase-out food and feed-based biofuels as soon as possible."* T&E would support amendment to the UK RTFO to eliminate support for crop-based fuels entirely by 2030.

### *3.6.ii) Legal position*

The current Energy Act allows for any feedstock to be counted in any way that is set out in an RTFO Order. As such, the inclusion of ILUC factors in the calculation of whether a GHG savings threshold has been met, the exclusion of particular feedstocks due to high-ILUC risk or the exclusion of all crops would be possible by change to the RTFO by Statutory Instrument. This legal understanding is consistent with the exclusion of crop-based feedstock from the development fuels category.

### *3.6.iii) Suggested solutions*

(i) The UK RTFO does not currently include explicit measures in relation to high ILUC-risk feedstocks. There is extensive evidence that palm oil is associated with high ILUC-risk as defined in the RED II[lvi], and that soy oil is also likely to be associated with relatively high ILUC emissions and levels of deforestation[lvii]. The UK market has been one of the most successful if not the most successful in Europe at limiting the use of these feedstocks, and there seems to be broad consensus in the UK community that this should not be reversed. The UK Government should consider formalising this consensus by removing support from these feedstocks entirely well before 2030.

(ii) The crop cap could be reduced to 2% in the near term. This would more closely reflect the current low-level of crop-based fuel supply. There seems to be little justification to encourage the supply of crop-based biofuels to increase towards the current 4% cap only to subsequently reduce it back to 2%. If UK ethanol is competitive with imports, then the 2% cap would still allow significant expansion of supply – if UK ethanol cannot compete with imports, then raising the cap may provide little succour to UK producers. Capping the use of ethanol from food crops as an E10 blendstock creates a clear market opportunity for waste/residue or cellulosic ethanol, which may be double counted but which is not eligible to be a development fuels. This investment signal will not be as firm as that provided by the development fuel mandate (with or without the additional of a CfD scheme) but could still allow the UK to be an appealing destination for waste/residue or cellulosic ethanol producers.

(iii) T&E's objective of eliminating the use of crop-based fuel in the UK could be achieved 'de facto' if other, better options are available to generate RTFCs. This could occur if production of development fuels ran significantly ahead of the development fuel mandate, if it were possible to further increase the use of double counted feedstocks under the main RTFO, or by introducing additional credit generation options such as the supply of renewable electricity for EVs.

(iv) T&E's objective of eliminating the use of crop-based fuel in the UK could be achieved 'de jure' by further reducing the crop cap from 2% in the short term to 0% by 2032. This would clearly signal a need to shift all ethanol production to waste or cellulosic feedstocks within the next 10 years.

### *3.6.iv) Other options considered*

1) The Government could consider whether it was possible to allow only UK produced crop-based ethanol to be eligible for certificates under the RTFO (possibly further limited to fuel from UK grown feedstocks). We believe that this may be possible under the Energy Act (which is silent on whether geographical areas are one of the criteria upon which whether to count or not can be based), however a legislative preference for UK production or feedstocks (without any additional sustainability justification) could create trade tensions and may not be permissible under World Trade Organisation rules. If the UK seeks to become an exporter of advanced renewable transport fuels, it may be counter-productive to directly impose very restrictive conditions on other countries in the short term.

2) We reviewed briefly whether ILUC factors could be included in the determination of whether a consignment met the minimum greenhouse gas savings thresholds. Whilst this would provide a degree of logical consistency with the exclusion of high-ILUC risk feedstocks, if all crops are to be removed by 2030 there may be limited additional benefit of legislating to introduce ILUC factors for what could be a period of only a few years.

### *3.6.v) Interaction with other proposals / UK schemes*

This proposal does not interact with any other UK renewable energy schemes that the authors are aware of.

# 4. Strengthening sustainability standards

Currently, mandatory sustainability standards in the RTFO follow the requirements of the RED I, and:

- Set a maximum on the assessed GHG intensity of biofuels supplied in the UK (not including ILUC emissions);
- Proscribe the production of biofuels on land recently converted from defined high carbon stock statuses; and
- Proscribe the production of biofuels on land recently converted within areas with high biodiversity value.

In addition to these mandatory requirements, the RTFO includes a Biofuel Sustainability Standard (referred to as the RTFO meta-standard prior to implementation in the UK of RED I). This standard, against which an audit may be undertaken, additionally includes requirements on soil conservation, sustainable water use and air quality, and several social sustainability indicators. This reflects other agricultural sustainability standards, which almost uniformly have broader scope than the limited requirements of the RED II. Divergence from the EU's RED II gives the UK the opportunity to consider elevating additional sustainability criteria to be mandatory requirements under the RTFO.

The current sustainability criteria are also clearly targeted at crop-based biofuels. This is understandable given that crop-based biofuels are generally understood to present the greatest sustainability challenges, but risks leaving the collection of other feedstock resources such as farm and forestry residues inadequately supervised. As the focus of the RTFO has shifted firmly to wastes, residues, cellulosic fuels and development fuels, the focus of the sustainability oversight regime needs to keep up.

## 4.1. Legal position

The Energy Act 2004 allows for any sustainability issue to considered when setting up how an RTFO operates and DfT have amended the RTFO Guidance on numerous occasions to address issues in the application and oversight of sustainability (e.g. mass balance rules for gas grids and approaches to verification of the origin of Used Cooking Oil). Whether the proposals below would need changes to the RTFO or whether they could be achieved by guidance changes is a matter for DfT.

## 4.2. Proposed approach

### *4.2.i) Sustainability for crop-based fuels*

The Government should review the applicability of the RTFO Biofuel Sustainability Standard and consider expanding making the full standard mandatory for biofuels supplied in the UK. In many

cases the sustainability schemes such as ISCC and RSB that are already used to demonstrate compliance with the current mandatory sustainability rules would also be able to demonstrate compliance with an expanded set of rules.

### *4.2.ii) Agricultural and forestry residues*

The current sustainability criteria do not address sustainability issues associated with collection of agricultural and forestry residues, in particular the risk that over-harvesting of residues could cause soil carbon reductions and undermine the climate benefit of the RTFO. The approach proposed by the BioFrontiers[lviii] programme could be considered as the basis for expanded UK regulatory requirements.

### *4.2.iii) RFNBOs/electrofuels GHG intensity*

The GHG intensity of any 'e-fuels' (i.e. those synthesised using electricity) is inherently dependent upon the GHG intensity of the electricity used in the process. As previously discussed by Cerulogy[lix] the relative energy inefficiency of existing electrofuel production pathways makes It vital that only electricity with a very low GHG intensity is used to produce electrofuels. It is therefore important that strict rules requiring the use of additional, very-low GHG intensity renewable electricity are developed.

### *4.2.iv) More transparency on double counting and development fuel assessments*

The assessment of double counting or development fuel status for a feedstock/fuel pathway is done by a specialist team within the Department for Transport who can call upon technical support from external contractors and who seek insights from other UK government entities (such as those dealing with other environmental issue or food/animal feedstock issues) and other European regulators[14]. Currently there is a limit to the publicly available information on the assessment process is, and on what matters were taken into account for specific assessments. The transparency of these assessments should be improved by publishing the assessment criteria for both double counting status and development fuel status and subjecting the criteria to a period of consultation. Such a consultation system would need to take into account commercial confidentiality issues associated with the development fuel assessments in particular.

### *4.2.v) Sustainability schemes (voluntary schemes)*

Voluntary schemes are independent, often commercial, entities which are accredited under the RTFO (often based on European Commission assessments[lx] for the RED I) to provide audit and assurance of both the sustainability characteristics of the original feedstock and the chain of custody of both the feedstock and the fuel up to the point of supply into the UK. A large fraction of biofuel supplied into the UK is certified by one scheme, International Sustainability and Carbon Certification ('ISCC'[lxi]).

Under RED I and RED II, Member States must accept the validity of a sustainability scheme

14 This is done via the 'Renewable Fuels Regulators Club (see http://www.refurec.org/)

statement that a biofuel has met the sustainability criteria, and the UK continues to recognise all voluntary schemes approved by the European Commission.

Currently the European Commission is moving to develop a system, required in the RED II, whereby the EU will hold a single database for the tracking of all consignments of feedstocks and biofuels (as one of the biggest risks of fraud is in the duplication of paperwork proving sustainability). The Commission will be able to remove individual consignments of biomass or biofuel from the database should there be allegations or proof of fraud. This is partly a response to a well-publicised episode of biodiesel fraud uncovered in the Netherlands, although we note that there is limited public information available about this[lxii],

The UK government should ensure that it has at least commensurate powers to the Commission regarding the approval of voluntary schemes and should work with the schemes to ensure greater transparency to the UK on scheme rules and approaches to non-conformities. This could include removing existing proofs where a producer is found to be non-compliant, even if this results in the revocation of RTFCs.

The UK should give serious consideration to working with the EU to require that all fuels supplied to the UK should be registered in what would become a joint UK/EU database. Additionally, the UK should adopt the same approach as the Commission in being able to remove (or block from supply to the UK) any information that is either under investigation or proven to be fraudulent.

### *4.2.vi)Rewarding the actual renewability of FAME and HVO*

The current RTFO treats FAME and HVO fuels as fully renewable, thus implicitly treating the normally fossil-derived methanol and hydrogen incorporated into the molecular structure of these fuels during production as if they were renewable.

In order to both (i) reflect the true renewability of FAME and HVO made with fossil methanol/hydrogen and (ii) to encourage the development of renewable products in the chemicals sector, the government should consider revising the treatment of these fuels to more accurately reflect the 'true' renewability, for instance by reducing the number of RTFCs awarded to FAME and HVO unless it could be shown that the methanol and hydrogen inputs were from renewable sources. Producers of FAME and HVO would still be able to achieve full renewability by sourcing renewable methanol or hydrogen.

# 5. Potential impact of regulatory changes

The character of the RTFO has changed fundamentally in terms of the types of fuel supplied since it was launched in 2008. Up to 2010[15], supplied fuel volumes under the RTFO were dominated primarily by crop-based biodiesel, as can be seen in Figure 1. This changed for the biodiesel market with the introduction of "double counting" of biofuels from waste and residual feedstocks, in line with the EU Renewable Energy Directive. Since then, the UK biodiesel supply has been dominated by double counting waste oils, primarily used cooking oil. On the ethanol side of the market, the supply reached a level consistent with 5% ethanol blending in petrol by about 2012, and total ethanol supply has been fairly stable ever since. Most ethanol continues to be crop-based, and the feedstock mix has been sensitive to levels of imports from the United States – in particular, in years when imports of U.S. corn ethanol have been higher, the supply of UK wheat ethanol has been reduced.

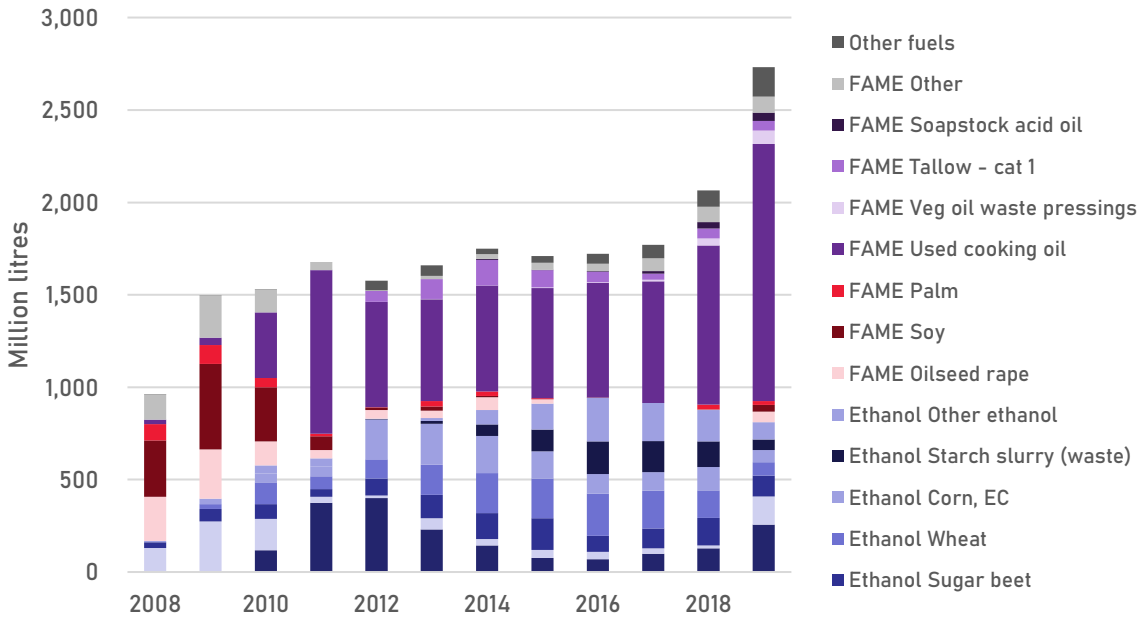


**Figure 1. Renewable fuels and feedstocks supplied to UK under RTFO**

*Source: RTFO statistics (adjusted to calendar years)*

The RTFO target was held at 4.75% for several years (2013-17) due to concerns around ILUC and the food versus fuel debate. Since 2017 targets have risen again, with supply growth dominated by

15 Note that in this section we present biofuel statistics by calendar year on an approximate basis. Until 2018 the RTFO ran on an accounting year (April – March). For earlier years, consumption by calendar year has been approximated by assuming a roughly even supply of biofuels in each feedstock/fuel category through each reported year. The approximated calendar year values do not compensate for seasonal features of the market such as reduced biodiesel supply in the winter, but are considered a reasonable basis to review market trends.

biodiesel from used cooking oil and other double counted waste oils. Figure 2 illustrates that the growth of the supply of double counted biofuels has been most responsive to increased targets.

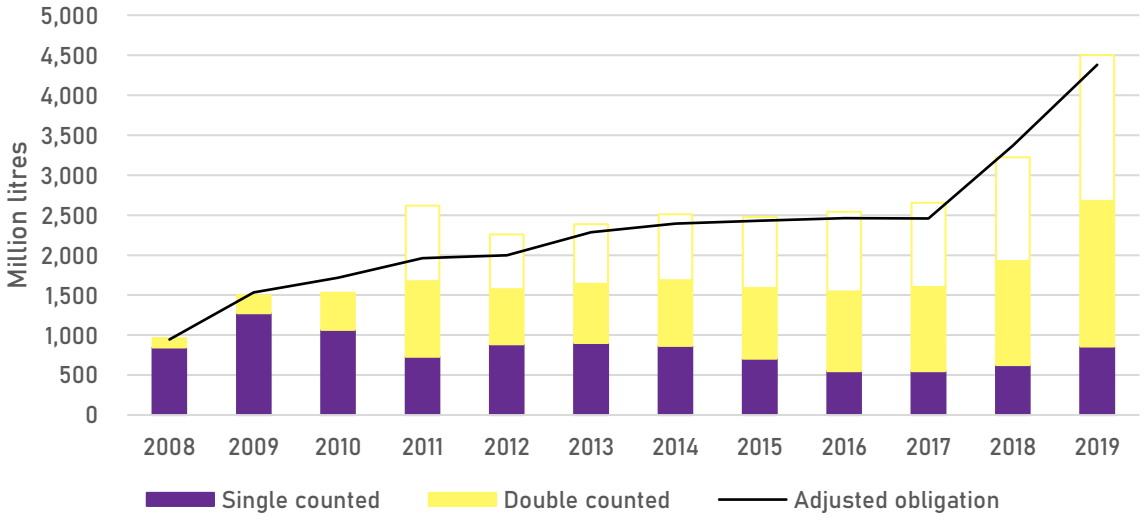


**Figure 2. Contributions to RTFO compliance from single and double counted renewable fuels**

*Source: RTFO statistics (adjusted to calendar years)*

Indeed, the UK has become something of a magnet for supplies of used cooking oil for biodiesel from all over the world; in 2019, used cooking oil was reported with 79 different countries of origin. As shown in Figure 2, the most recent growth has been led by oil from China.

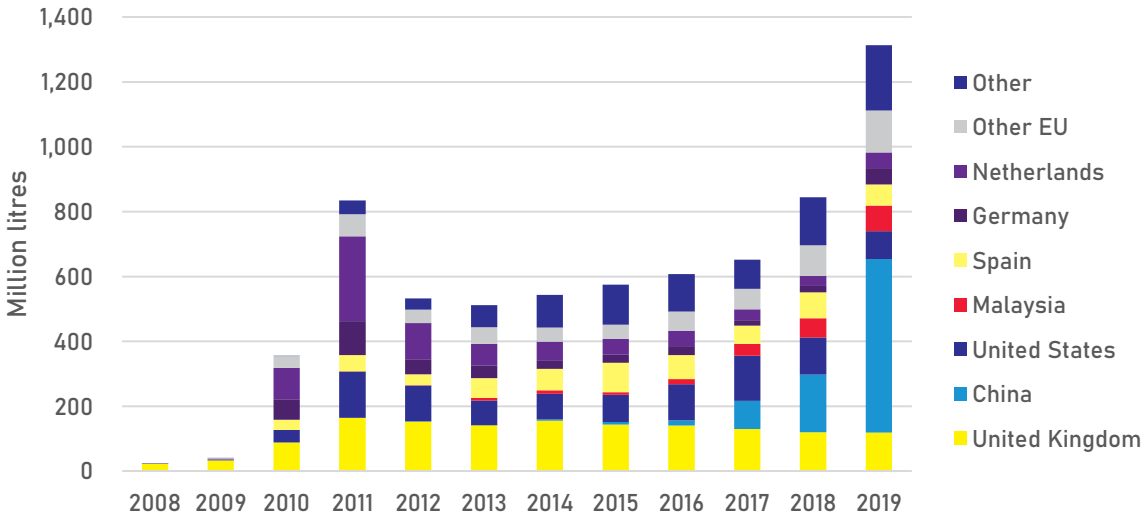


**Figure 3. Country of origin reported under the RTFO for UCO**

*Source: RTFO statistics (adjusted to calendar years)*

The consumption for UK and EU biofuel mandates of ever-growing volumes of used cooking oil has caused concerns to be raised in some quarters about the sustainability and verifiability of this supply chain. Outside of Europe (where regulation limits utilisation options) used cooking oil may in many cases have existing uses. While some of these uses (such as 'recycling' into oil for human consumption) are problematic in themselves, consuming this resource may be expected to have indirect effects, potentially increasing demand for fuel oil, virgin vegetable oils and/or other animal feed materials. Concerns have also been raised about the difficulty of establishing whether shipments labelled as used cooking oil are genuine, with voluntary schemes, industry associations and European national governments looking to strengthen supply chain monitoring after a high-profile case of mislabelling in the Netherlands[16].

In the EU, one response to such concerns has been to set a limit on the extent to which biofuel from used cooking oil and animal fats may be counted towards compliance with targets under the recast RED (a maximum of 1.7% of transport energy), although Member States have some leeway to adjust this limit to reflect "the availability of feedstock". The UK is already above this level (about 2.7% of UK transport energy in 2019) but has not yet indicated an intention to adopt a similar rule. The impact of other RTFO changes will be highly sensitive to whether continued growth in used cooking oil consumption is viable.

## 5.1. Impact of recent and proposed changes

Several changes to the UK framework for renewable fuels have been discussed and/or proposed by the DfT in the last year. In this section, we review potential impacts of these changes on the UK renewable fuel market and associated environmental impacts.

Parts of the analysis are supported by a simple model of UK transport fuel use to 2032 developed for the purpose – the model is introduced in additional detail in Annex A. The model includes a fairly rapid increase in sales of electric passenger cars, assuming a ban on fossil fuel internal combustion engine sales from 2030, but liquid fuel sales remain significant throughout the period (falling from about 52 to about 35 billion litres per year between 2020 and 2032).

### *5.1.i) Introduction of E10 as standard petrol blend*

The UK Government has recently consulted on increasing the standard petrol blend in the UK from E5 to E10. This change would create additional space to supply ethanol in the petrol pool, allowing overall renewable fuel supply increases without investment in "drop-in" fuel technologies. The consultation on introducing E10 petrol argues that introducing E10 could support the UK ethanol industry and UK feedstock farmers.

The impact of increasing the standard ethanol blend depends on:

- Whether ethanol blending increases to the maximum allowable blend;
- What type of ethanol is supplied to meet the increased demand;
- Which other fuels are displaced.

As noted above, at present the UK renewable fuel market is characterised by maximum supply of ethanol to the E5 blending limit and by the use of primarily waste-based biodiesel to meet the rest of RTFO targets. The impact assessment on the introduction of E10 petrol therefore assumes that

16 Cf. https://www.argusmedia.com/en/news/2130456-wastegrade-biodiesel-market-calls-for-tougher-policing

increased ethanol supply would push some double-counted waste-based biodiesel out of the market. We also consider a scenario in which the availability of waste oils for biodiesel becomes constrained and ethanol could be an alternative to an increase in the supply of single counted biodiesel and/or HVO to meet RTFO targets. We first consider the implications of a move to E10 without any change to current RTFO targets, and then a move to E10 accompanied by an increase in targets (no interaction with the development fuel target is considered as ethanol is not eligible for consideration as a development fuel). Changes in fuel consumption and associated GHG emissions are considered for the period 2021-2032. Fuel carbon intensities for renewable fuels are based on 2019 reported values for relevant fuel types, and the RTFO fossil fuel comparator (83.8 $gCO_2e/MJ$) is used for fossil petrol and diesel.

**Case 1: increased supply of ethanol largely displaces double counted biodiesel (no change to targets)**

We assume that average ethanol blending increases to 9.5% by volume between 2021 and 2027, and then stays at 9.5%. We assume that the supply of double counted ethanol remains constant at the 2019 level, so all increases come from single counted ethanol. Ethanol supply increases by up to 800 million litres per annum due to the increased blending, although total ethanol volumes reduce again after that as the total demand for petrol declines due to roll out of electric vehicles. Across the period considered, an additional 6.5 billion litres of ethanol are supplied. As a result, fossil petrol consumption reduces by 4.3 billion litres.

Increased ethanol supply allows targets to be met with less renewable diesel substitutes required – over the period, a reduction of 2.7 billion litres of double counted biodiesel, 600 million litres of single counted biodiesel and 200 million litres of HVO[17]. This is offset by a 3.3 billion litre increase in fossil diesel consumption. Overall, an additional 1.9 billion litres of liquid fuels are supplied due to reductions in the average energy density associated with increased ethanol use.

The GHG implications of these changes are complex. When including ILUC emissions (following the ILUC factors used in RTFO reporting) we expect single counted ethanol to be higher carbon intensity than the double counted biodiesel it replaces (less GHG saving per litre), but without double counting the total volume of renewable fuel supplied increases (more litres delivering GHG savings). Overall, we model a relatively modest increase in emissions (700 thousand tonnes $CO_2e$ over the period) across the system as a whole as a result of the E10 roll out. This is similar to the result given in the impact assessment accompanying the E10 consultation.

**Case 2: increased supply of ethanol largely displaces single counted renewable diesel substitutes (no change to targets)**

In the second case, we assume that availability of waste oils for biodiesel use in the UK reduces after 2022, with the same ramp up of ethanol use as in case 1. This could reflect increased competition as biofuel mandates increase in other jurisdictions, increased demand from the aviation sector or government action to bring total use in line with the limit given by the RED II (1.7% by energy). In this case, without E10 the supply of single counted biodiesel and HVO would need to increase to meet targets. When including ILUC emissions, there is little carbon penalty from reducing the consumption of these diesel substitute fuels, and therefore in this case there is a significant net saving modelled from increasing the ethanol blend (5 million tonnes $CO_2e$ over the period).

**Case 3: increased supply of ethanol alongside increased targets, no growth in supply of**

17 The model assumes that HVO is supplied to meet targets where there is not space for additional biodiesel under the blend wall.

**waste oils**
For the third case, we consider the same rate of ethanol blend ramp up, no change in the availability of waste oils as biodiesel feedstock, and an increase of 2.5% points in the main RTFO obligation by 2032 (to 12.1%). This is compared to a case with E5 and no increase in targets. As there is limited space to increase biodiesel blending and the increase to E10 is not enough to meet the full increase in targets in the short term, the increase in ethanol supply is accompanied by an increase in HVO. This is assumed to be single counted. This case sees a reduction in both diesel and petrol use as additional ethanol, biodiesel and HVO are pulled into the market. When ILUC emissions are included, a net carbon saving of 7 million tonnes is delivered over the period by the combination of the increased target and E10 blending.

As with all questions of biofuel policy analysis, assessing the potential climate benefits and costs of the changes to the RTFO discussed above is highly sensitive to assumptions about the GHG intensity of the considered fuels. Using the ILUC-included GHG intensity values from RTFO reporting provides a characterisation of the expected carbon impact of biofuel use, but the uncertainty bars on these assessments are large. The numerical results presented above should therefore be considered only as an indication of potential outcomes. It is important to note that the carbon intensity values given for double counted biofuels, biodiesel in particular, do not include any indirect emissions effects. Including such a term for biodiesel from imported UCO would affect our understanding of the policy options available.

### *5.1.ii) Change to buy-out price*

The DfT has recently confirmed its intention to raise the buy-out price for the main RTFO from 30p per litre to 50p per litre for 2021. This change reflects the fact that the buy-out price has not increased with inflation, and a desire on behalf of the DfT to ensure that the cost of supplying renewable fuels does not become a barrier to meeting RTFO targets through fuel supply. It has been reported that the RTFO certificate price has been around the level of the buy-out price during 2020, which could be an indication that there is a risk of some suppliers choosing to buy-out of their obligations rather than supply renewable fuel or buy RTFCs.

The RTFO is already a relatively generous incentive to biofuel producers in terms of value per tonne of estimated $CO_2e$ savings. Based on the carbon intensity value for single counted ethanol in the 2019 RTFO statistics (ILUC included), if certificates trade at the level of the 30p per litre buy-out that is equivalent to a carbon price of £320 per tonne $CO_2e$. Going to a 50p buy-out raises that implied carbon price for first generation ethanol to about £530 per tonne $CO_2e$.

It is difficult to make any firm assessment of the likely impacts of raising the buy-out price in this way without undertaking comprehensive modelling of feedstock and biofuel production costs and of the interaction between the UK and other biofuel markets. Certainly, such an increase in the buy-out price could reasonably be expected to ensure that few suppliers will buy-out of their main obligations in the near future. It is possible though that certificates will continue to trade within their current range (below 30p each), and that the increased buy-out will not be proven necessary.

### *5.1.iii)Removal of GHG target*

For 2019 and 2020 the volumetric target of the RTFO has been accompanied by a GHG-intensity reduction requirement, related to Article 7a of the EU's Fuel Quality Directive. Under this parallel system of obligations, renewable fuel supplied in the UK has been eligible to receive not only

the RTFC for supplied volume but also a (less valuable) GHG reduction credit proportional to the estimated carbon savings from delivering that fuel (based on a calculation that excludes ILUC emissions. Whereas the RTFC is delivered equally per litre for ethanol, biodiesel or drop-in fuels, the GHG credit provides more value per litre to more energy dense fuels (as they displace more fossil fuel). Based on the 2019 RTFO statistics, the GHG credits provide the largest value per litre to low carbon-intensity double counted biodiesel, which has a higher value of support per litre than single counted biodiesel, which has a higher value of support per litre than either single or double counted ethanol.

Removing the GHG credit will remove a marginal incentive to improve GHG-intensity performance, but it is unclear how effective this incentive has been during its brief period of implementation, either at changing production practices or at driving selection of lower carbon intensity fuels. As shown in Figure 4, reported carbon intensities for all major fuel types have trended down over time, and reported values for single counted fuels in particular appear to be below-trend for 2019, but this may have ulterior explanations.

It is expected that with the removal of the GHG credit the value of the RTFC will adjust upward to maintain the incentive for supply of renewable fuels (this is part of the DfT's reasoning for increasing the buy-out price). This will give a slight marginal advantage to ethanol over biodiesel (in the single counted market at least), supporting our assumption in the modelling above that ethanol can be expected to be supplied more or less to the blend limit after the introduction of E10.

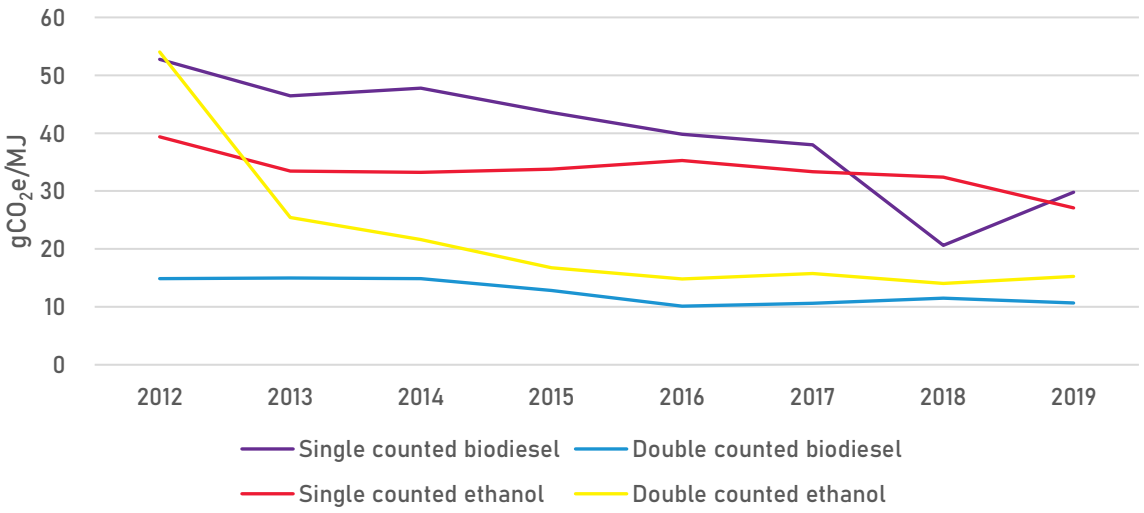


**Figure 4. Reported GHG intensity of fuels under RTFO over time**

Source: RTFO statistics (adjusted to calendar years)

### *5.1.iv) Adding electricity supplied to EVs into the RTFO*

As discussed above, the RTFO does not currently support crediting for electricity supplied for plug-in electric vehicles. While EVs are still a relatively small part of the vehicle fleet as we enter 2021, this is set to change rapidly through the decade if the targeted ban on sales of solely fossil-fuelled cars and vans is to be achieved by 2030. As the electric vehicle fleet grows its consumption

of electricity will similarly grow, and therefore by 2030 electric vehicles could become one of the main consumers, or even the primary consumer, of renewable energy for transport[18].

If electricity supply is made eligible for crediting under the RTFO, this consumption of renewable energy by electric vehicles will therefore become a significant contributor to meeting renewable energy targets. On the one hand, this could make more challenging targets achievable. On the other hand, the growth of the EV market could complicate the market signal for other renewable fuels by reducing the volumes of liquids required to fulfil mandates.

In order to explore these potential interactions we have considered the contribution to meeting RTFO targets that could be delivered by EVs based on scenarios for electricity consumption by electric vehicles set out in the National Grid Future Energy Scenarios 2020[lxiii] ("FES2020"). In particular, we have considered the electricity consumption shown in the "steady progression" and "leading the way" scenarios. The leading the way scenario would be consistent with delivering nearly 100% of sales as fully electric by 2030, while the steady progression scenario would reflect a slower ramp up of sales, failing to meet the declared government target for 2030. Figure 5 and Figure 6 illustrate the sales share and total share of electric vehicles in the UK passenger car market for the two scenarios.

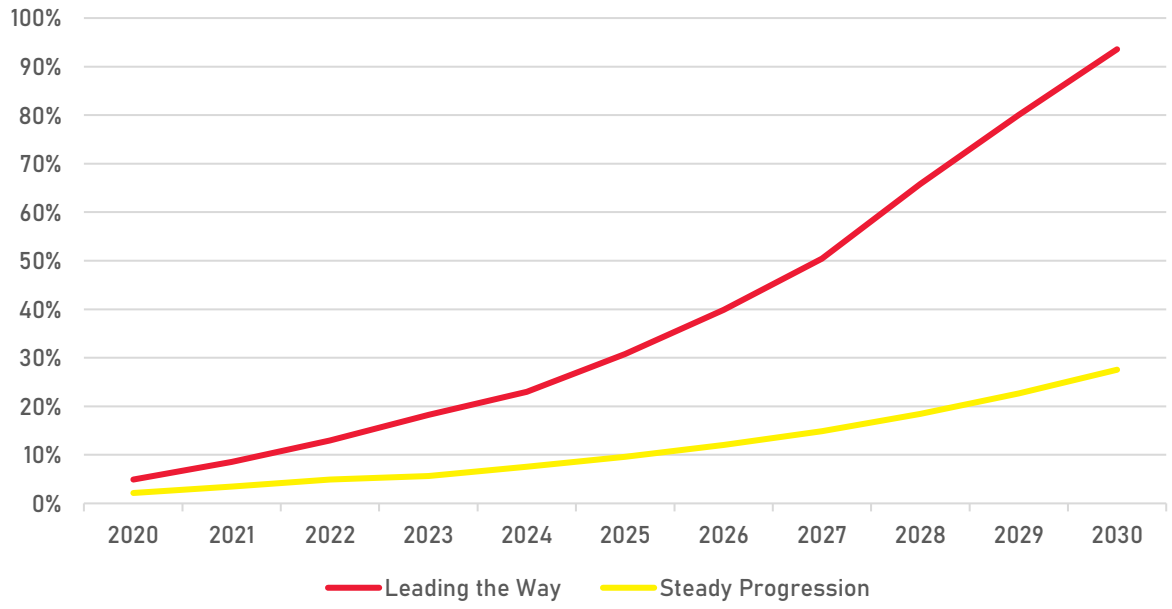


**Figure 5. Battery electric vehicles as share of passenger car sales implied by FES2020 scenarios**

*Source: own calculation based on data from FES2020*

18 Similar trends can be seen in modelling of contributions to meeting 2030 targets under the California Low Carbon Fuel Standard, see e.g. https://www.cerulogy.com/supply-assessments/californias-clean-fuel-future/

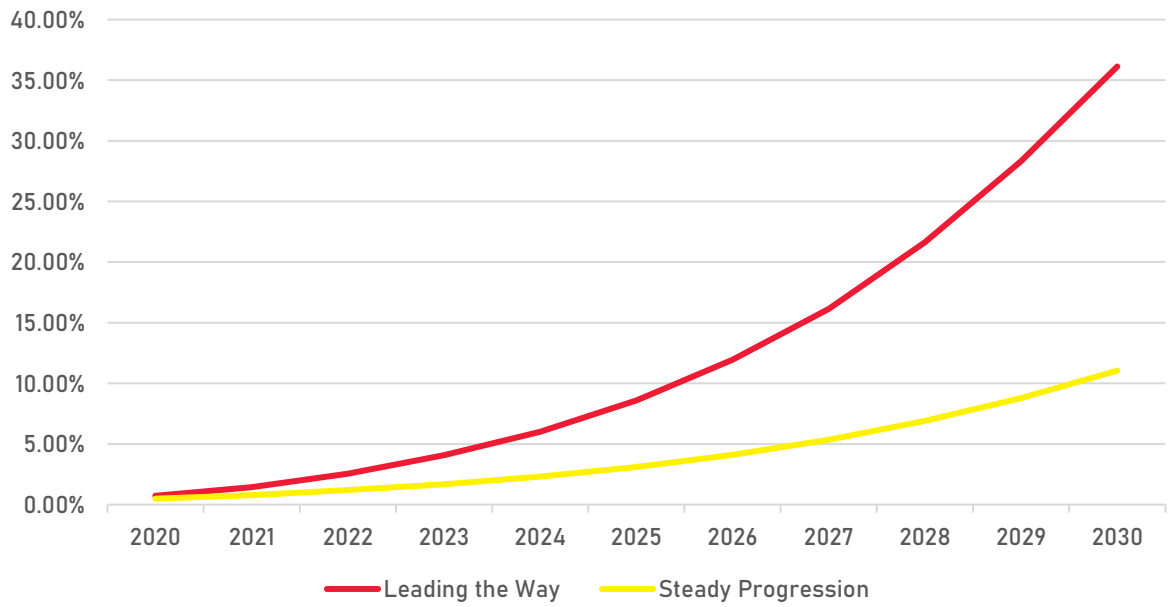


**Figure 6. Battery electric vehicles as percentage of passenger car fleet according to FES2020 scenarios**

*Source: FES2020*

The potential contribution of electricity supplied to electric vehicles to an RTFO target is dependent not only on the rate of EV deployment but also on the accounting rules assumed. In particular, it depends on whether all or only some of the electricity supplied is treated as renewable and on whether the electricity used by electric vehicles is accounted based on the physical quantity on energy supplied, or is given additional credit for the higher efficiency of the electric drive train. In the motor fuel GHG reporting regulations and in other jurisdictions energy supplied to electric vehicles 'energy efficiency ratios' (EERs) have been used to reflect the greater efficiency of the electric drive train compared to internal combustion engines, multiplying up the contribution counted. In the motor fuel GHG reporting regulations the EER was set at 2.5, while in the California LCFS the EER is set to 3.4 and in the recast EU RED the EER is set to 4. The results presented here assume that the electricity supplied is treated as 100% renewable and considers a case in which only the physical quantity of electricity supplied is counted towards RTFO targets, and a scenario in which the contribution from electricity is multiplied up by an EER of 3.3 (based on the JEC Well-to-Wheels report version 5, 2020).

The resulting potential contributions to RTFO targets from electricity supplied to electric vehicles are shown in Figure 7 for the two scenarios from FES2020 and the two EER assumptions, a total of four cases. By 2030, the contribution is between 3% and 8% if accounted without an EER, and between 10% and 28% if accounted with the EER of 3.3. Any of these contributions would have a material impact on achieving the current 2030 RTFO target of 12% of transport energy from renewable sources (including development fuels). When using an EER of 3.3, electricity would allow the non-development part of the target to be fully met with no supply of non-development renewable liquid fuels even in the steady progression scenario. Including electricity for EVs in the

RTFO could therefore provide context to make the underlying RTFO targets more ambitious, but could also be seen as an alternative to continued supply of crop-based biofuels.

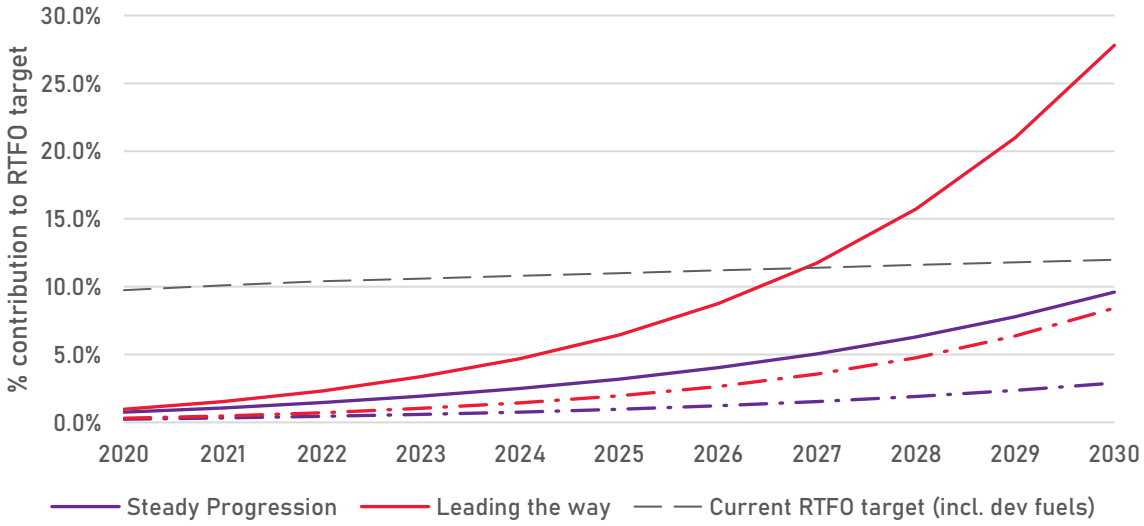


**Figure 7. Modelled contribution from electricity supplied to electric vehicles to RTFO targets based on actual energy supplied (dashed lines) and on efficiency-adjusted energy supplied (solid lines)**

*Source: own calculation using data from FES2020*

Clearly, the supply of renewable electricity to electric vehicles has the potential to make a very substantial contribution to the overarching goal of increasing the use of renewable energy in the transport sector. Equally, counting renewable electricity supply towards RTFO targets has the potential to be quite disruptive to other market participants. Relatively small changes to the rate of EV deployment achieved in the UK could significantly affect the incentives available to renewable fuel producers operating outside the development fuel mandate.

# 6. Recommended further work

The authors of the report recommend that further work is undertaken on a number of issues related to this report. These include:

1) As the proposed advanced renewable transport fuel support system is novel (although built upon the current RTFO and the CfD for electricity approaches), we recommend engagement with policy makers and industry to determine (i) whether they agree that the proposed approach would send a strong enough signal to unlock investment, (ii) to identify any potential flaws in the system as outlined which could lead to gaming and (iii) determine the best approach for variables such as length of contracts or how target increases should be determined.

2) Reviewing possible auction structures and proposing in more detail rules for the development RTFC auctions.

3) Investigating options to allow 'avoided emissions' to be credited under the proposed dedicated obligation/reward systems for maritime and aviation. Whilst this report has not considered these in detail, these could include alternative energy systems (such as the use of wind in maritime and alternative propulsion taxi systems in aviation) and/or emissions reduction approaches (such as hull lubrication in maritime).

4) Reviewing the functioning of the sustainability schemes in greater depth than the EU Commission reviews in order to determine whether they are truly ensuring that renewable fuels meet the sustainability criteria.

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# Annex A. Section 126 of the Energy Act (2004) as amended

**126 Determinations of amounts of transport fuel**

(1) An RTF order may make provision about how amounts of transport fuel are to be counted or determined for the purposes of provision made by or under this Chapter.

(2) The provision that may be made by virtue of this section includes, in particular—

(a) provision for amounts of renewable transport fuel to count towards discharging a renewable transport fuel obligation for a period only if the fuel is of a specified description;

(b) provision for amounts of renewable transport fuel of a specified description to count towards discharging such an obligation only up to a specified amount;

(c) provision for such an obligation not to be treated as discharged unless a specified minimum amount of renewable transport fuel of a specified description has been counted towards its discharge;

(d) provision for only such proportion of any renewable transport fuel of a specified description as is attributable to a specified substance, source of energy, method, process or other matter to count towards discharging such an obligation;

(e) provision as to how that proportion is to be determined;

(f) provision for an amount of renewable transport fuel of a specified description to count towards discharging such an obligation only if, or to the extent that, specified conditions are satisfied in relation to its supply, the person by or to whom it was supplied or the place at or for delivery to which it was supplied;

(g) provision for evidence produced by a supplier in relation to any fuel not to count for the purposes of his renewable transport fuel obligation for a period if evidence in relation to the same fuel has previously been produced (whether by him or by another supplier);

(h) provision for evidence produced by a supplier in relation to any fuel not to count for those purposes if, after the supply to which the evidence relates, the fuel is supplied by any person at or for delivery to a place outside the United Kingdom or a specified part of the United Kingdom;

(i) provision about the measurement of amounts of different descriptions of transport fuel;

(j) provision for units of transport fuel of a specified description to count for more or less than the same units of transport fuel of other descriptions;

(k) provision about how measurements in different units of different descriptions of transport fuel are to be aggregated;

(l) provision for the application of presumptions where specified matters are shown.

(3) The provision that may be made by virtue of this section also includes, in particular, provision which—

(a) is made having regard to one or more of the effects mentioned in subsection (4) (whether in the United Kingdom or elsewhere); or

(b) requires regard to be had to one or more such effects.

(4) Those effects are the effects of the production, supply or use of fuel of a particular description on—

(a) carbon emissions;

(b) agriculture;

(c) other economic activities;

(d) sustainable development; or

(e) the environment generally.

# Annex B. The case for electricity to be considered as renewable fuel under the Energy Act 2004

The Energy Act currently allows for any ''solid, liquid or gaseous' renewable transport fuel to count under and RTFO (provided it meets any other specifications in the RTFO). The Energy Act defines renewable but not 'transport fuel' and there appears to be no definition of fuel in other relevant legislation (such as the Motor Fuel (Content and Composition) Regulations 1999.

The chemistry of combustion is characterised as a 'reduction/oxidation' (redox) process and what occurs during that process is the movement of electrons from being in either carbon-carbon or carbon-hydrogen bonds in the hydrocarbon (assuming no other elements are present) to being in carbon-oxygen (carbon dioxide) and hydrogen-oxygen (water) bonds (assuming 100% reaction efficiency). That the electrons are in a lower energetic state after the reaction results in the release of energy.

A battery electric system is also a redox process, with the cathode being reduced (gaining electrons) and the anode being oxidised (losing electrons). The anode, cathode and any electrolyte (which allows for the movement of ions in the opposite direction) that sits between them are themselves always either a solid, liquid or gas (which of these they are is irrelevant for the purpose of this argument).

Therefore, its is possible to consider a battery electric vehicle as being powered by a (usually) solid / liquid fuel – i.e. the charged battery and the way in which energy is extracted from the flow of electrons is irrelevant – in the same way that the physical expansion caused the change from a liquid to a gas during hydrocarbon combustion is irrelevant, but important to how energy is extracted.

How an energy delivering system is refuelled (using electricity to recharge a battery vrs adding new liquid fuel to an internal combustion engine) is not considered in the Energy Act, so is again irrelevant to the consideration of whether battery electric vehicles can be rewarded under the RTFO.

It is also worth considering that hydrogen fuel cell powered vehicles are regarded as being eligible under the RTFO and a hydrogen fuel cell is effectively a battery (as they are a redox reaction involving an anode, cathode and electrolyte), the difference being that the electrons are stored in the hydrogen rather than the anode ([19]).

19 https://en.wikipedia.org/wiki/Fuel_cell

# Annex C. Simple examples of operation of the dual development mandate/CfD

## C.1. Example 1: Fishy Tropes Biofuels Ltd.

David owns a company looking to develop a biomass-to-liquids technology, gasifying agricultural residues and then producing synthetic fuels using the Fischer-Tropsch process. David's analysis shows that the production process should be able to achieve a levelised cost of production of £1.20 per litre of synthetic fuel if he could borrow capital at an interest rate of 15%. He expects the fuel to have an underlying value of 40 pence per litre based on his analysis of the pre-tax price of petrol, diesel and jet fuel. In order to break even, David would therefore need to be able to access at least an additional 80 pence per litre from the value of development RTFCs.

David goes to his local investment bank to request a loan, and explains that development RTFCs could be worth up to £1.60 per litre, which would make his business very profitable. Unfortunately, his banker has never heard of the RTFO and wants to know what guarantee there is that the credits will be worth that much. David explains that the buy-out price should provide a guide to the value if the market is under-supplied, but the banker isn't convinced. The banker's data on standard RTFC values shows that they have been trading at about 25 pence each – with double counting, the banker isn't willing to assume that David will make more than 50 pence per litre on the RTFCs. At 50 pence a litre, David's project wouldn't be profitable.

David is very sad that he won't be able to proceed because he has been refused the loan. But then he hears about a new government initiative to offer something called a 'contract for difference' to projects like his. David puts together a CfD bid, explaining his project and stating that he will produce 20% jet fuel, 40% diesel fuel and 40% naphtha. He says to the government that he will be able to produce fuel at a contracted minimum revenue of £1.25 – he sets his bid a little above his levelised cost of production because he knows that he may not be able to recoup the full value of hid development RTFCs when he sells to a larger fuel company.

David sends his bid to the Department for Transport and waits to hear back. In due course, David gets good news – he has been successful and has been offered a contract for difference to produce 20 million litres of fuel a year with a CfD price of £1.25. David goes back to his local investment bank to tell his banker the good news. With a revenue guarantee the banker is willing to lend David the capital he needs, and because the government is taking on much of the price risk he even gets a lower interest rate than he expected.

David gets building, and three years later his plant starts producing fuel. When he starts producing, there are still no other large development fuel plants selling into the UK market, which is therefore undersupplied. David supplies his first batch of fuel to the market for 35 pence per litre (the price is a little down) and puts his RTFCs into the next development RTFC auction. Facing the alternative of paying the buy-out price, a obligated fuel suppliers buy all the available RTFCs for an average price of 76 pence each – that means David gets £1.52 per litre of fuel he supplied due to double counting. The reference price for the year for David's CfD is therefore 35 pence (the fuel price)

plus £1.52 (the average development RTFC price – a total of £1.87). That's well above David's contract price of £1.25 so he doesn't get a CfD payment, so there's no additional cost to the government. David doesn't mind that though because his revenue is more than he needs to break even. The extra revenue will allow him to consider expanding his project, or even reinvesting into a second facility.

## C.2. Example 2: Ebeneefuelzer Goode Ltd.

Chris owns a company looking to produce RFONBOs from electrolytic hydrogen. His modelling estimates the levelised cost of production for these electrofuels as £1.80 per litre. Chris knows that this levelised cost of production is much higher than his friend David is achieving producing Fischer-Tropsch biofuels, and is worried that he may not be able to compete in the development fuel market. Chris made a bid for a contract for difference in the same auction as David, but because he was asking for a higher amount than other projects including David's, he was unsuccessful.

In fact, there were no successful bids for CfDs for RFONBO projects in the first auction, and the government is concerned that without additional help these projects may not develop. They therefore announce that the next CfD auction will consider RFONBO projects only. Chris decides to enter his bid again, he asks for a contract price of £1.80 per litre. This leaves no margin over his estimated levelised cost of production, but he knows that the value of development RTFCs has been robust in the last couple of years and hopes that he will often be able to achieve more revenue than his contracted price.

Competing only with other RFONBO projects, Chris is successful at winning a CfD the second time round. It takes three years to get his plant built, and it becomes operational a couple of years after David's. The underlying fuel price has risen again to 40 pence in the interim, but with several projects being successfully built after the first CfD auction the market for development RTFCs is now better supplied. The average development RTFC price at the auctions held in Chris' first year of production is only 60 pence each – worth £1.20 per litre with double counting. That means that the reference price calculated for Chris' CfD is £1.20 + 40p = £1.60. Chris' CfD therefore pays out for him this year, worth 15 pence for every litre he supplied to the UK market. That extra revenue helps him remain operational even though he is not as profitable as he had hoped. The following year, the development mandate rises in line with the stated targets and there are again not enough development RTFCs on the market to meet all the obligation. This year, Chris' development RTFCs are worth 75 pence each (£1.50 per litre of fuel). Chris's turnover is higher with this extra revenue and no payment Is required from the government under the CfD.

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