Recycled Carbon Fuels and Nuclear Derived Fuels analytical note and cost benefit analysis

Overview of current powers and schemes

The UK Government has powers within the Energy Act (2004) to implement Renewable Transport Fuel Obligations. These are provided within Part 2 Chapter 5 of the Act[1].

The powers have been used to create the Renewable Transport Fuel Obligation (the RTFO), which obligates road fuel suppliers to ensure a certain amount of the fuel they supply is from renewable sources. The Government is also planning to bring forward a similar scheme to promote the supply of sustainable aviation fuel (the SAF mandate). The operations of these schemes must cause or contribute to a reduction of carbon emissions and contribute to sustainable development or the protection or enhancement of the environment generally.

The schemes are imputed tax and spend measures due to their design as certificate trading mechanisms. The cost of generating the necessary compliance certificates are borne by fuel suppliers, with these costs passed on to consumers through increases to pump prices (RTFO) or airline tickets (SAF mandate).

New powers sought via the Energy Bill

The existing powers within the Energy Act (2004) limit the types of fuels that can be supported under Renewable Transport Fuel Obligations to those produced from renewable energy sources. The proposed new powers would broaden the eligible fuel types beyond only renewable fuels by adding two further categories of low carbon fuel. These are known as recycled carbon fuels (RCFs) and nuclear derived fuels (NDFs). Both fuel types can result in alternatives to conventional fossil fuels whilst providing carbon emission savings which are comparable to renewable fuels already supported under the powers.

RCFs are fuels made from fossil wastes like unrecyclable plastic and industrial gases. There are environmental benefits to producing fuels from some fossil wastes where they can be more efficiently processed into a fuel employing advanced facilities, instead of disposing of them via conventional means, such as landfill or incineration. RCFs can encourage a more effective use of waste by offering greater energy recovery. They can deliver greenhouse gas (GHG) emission savings, as the resulting fuel can be used to displace conventional transport fuel. Strict eligibility criteria with the RTFO and SAF mandate will ensure use of these fuels deliver minimum GHG savings compared to traditional fossil fuels.

NDFs are fuels made using energy (likely electricity or heat) generated by nuclear power stations. Through the process of electrolysis, this energy can be used to

[1] https://www.legislation.gov.uk/ukpga/2004/20/part/2/chapter/5

produce hydrogen. Hydrogen can be used directly as fuel or further processed into liquid fuels for use in internal combustion engines both for road and aviation applications. The processes are identical to that already supported where renewable electricity is used for hydrogen production, so supporting identical fuels that utilise nuclear power is considered appropriate. The schemes will include detailed eligibility criteria to ensure that where these fuels are supported, they deliver additional GHG savings compared to using fossil fuels. Similar criteria are already in place where renewable energy is used to produce fuels.

Non-quantified Analysis

Changes to the primary powers concerning the creation of Renewable Transport Fuel Obligations will have no direct primary legislation impacts. This is because further secondary legislation will be needed to implement RCF and NDF eligibility within current future support schemes.

Even at the secondary legislation stage, the direct costs of introducing new fuel types will be negligible. The total costs and benefits of the RTFO scheme are governed by the overall obligation target which defines the minimum % of renewable fuels of total fuels that need to be supplied. These proposed changes will make no changes to those obligation levels, and no suppliers will be required to use either RCFs or NDFs to discharge their obligation. These fuels will simply become an option for qualifying supply.

Increasing the range of fuels which suppliers can utilise to meet obligations may make it easier for suppliers to meet targets for qualifying fuel supply and deliver carbon emission savings required. Any RCF or NDF supplied would not be mandatory or additional to the current RTFO. Suppliers would make a second-order decision whether or not to supply these fuels but would likely only do so if the supply cost of these newer options is below the supply cost of the other renewable fuel options that RCFs and NDFs would displace.

In respect of RCFs a detailed consultation on their introduction to the RTFO was published in July 2022[2]. It included a draft cost benefit analysis (CBA) indicating their possible impact on compliance costs within the scheme. This draft CBA is provided below and available alongside the consultation referenced above.

In respect of NDFs, no similar analysis has yet been undertaken, due to significant uncertainty as to secondary legislation impacts. This is driven by uncertainty over future deployment of NDF production. Currently we are not aware of any specific nuclear energy to hydrogen production deployed in the UK. Future deployment will depend on the development of the UK energy grid including new nuclear capacity as well as wider low carbon generation.

These can only be assessed during development of detailed proposals to be implemented in secondary legislation which will be carried out via a focused

[2] https://www.gov.uk/government/consultations/supporting-recycled-carbon-fuels-through-the-renewable-transport-fuel-obligation

consultation. This will enable us to gather further information regarding the likely deployment of NDFs in future years, the impacts, and if this technology is commercially feasible. There is also significant uncertainty as to future hydrogen and e-fuel demand, and with multiple production pathways future projections are challenging. However, NDFs can be regarded as carbon neutral fuels with their utilisation in schemes like the RTFO dependent on the cost of production. If NDFs can be produced at a competitive price, suppliers will be able to use them to discharge their wider obligations cost effectively. Further analysis will be published as the detailed policy is developed and projections can be more accurately mapped.

Small Micro business assessment

The RTFO database records suppliers by company name[3] to indicate the number of firms in scope. As a result, in 2021 there was a total of 45 businesses in scope including 16 business obligated under the RTFO (those that supply fossil and renewable fuel), and 29 businesses that are not obligated (only renewable fuel suppliers).

Table 1: RTFO 2021 supplier statistics by obligation and not obligated[4]

	2021
Obligated	16
Not obligated	29

Employee data was not so readily accessible to understand business sizes for the Small and Micro Business Assessment (SAMBA), so the RTFO company list has been matched to Companies House data to include sectoral codes for the RTFO companies. These sectoral codes have then been matched to the ONS business statistics[5] to provide the average employment and turnover size frequencies for the same sectors as in the RTFO and therefore a proxy for what is in scope of these amendments.

Note that one sectoral code has been omitted based on judgement ("Other retail sale not in stores, stalls or markets" which would likely not be representative of fuel suppliers under the RTFO scheme).

As a result, there are a range of small and micro businesses (50 or fewer employees) recorded under the current RTFO and therefore in scope of impacts of these amendments. However, the distribution is much more evenly distributed when looking at turnover and the distribution for both employees and turnover are more evenly distributed than the UK economy on average.

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1116862/2021-final-rf-01-rtfo-tables.ods

[4] RF0109: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1116862/2021-final-rf-01-rtfo-tables.ods

[5] https://www.ons.gov.uk/file?uri=/businessindustryandtrade/business/activitysizeandlocation/datasets/ukbusinessactivitysizeandlocation/2022/ukbusinessworkbook2022.xlsx

Table 2: The number and % of firms, by employment size band in the UK from ONS data for RTFO business sectors 2021.

	Employment Size Band							
	0-4	**5-9**	**10-19**	**20-49**	**50-99**	**100-249**	**250+**	**Total**
Total	19,795	4,540	2,395	1,295	530	290	175	29,020
Total %	68%	16%	8%	4%	2%	1%	1%	
Economy Avg	2,162,700	313,505	155,805	83,290	26,985	14,840	10,575	2,767,700
Economy Avg %	78%	11%	6%	3%	1%	1%	0%	

Table 3: The number and % of firms, by turnover band in the UK from ONS data for RTFO business sectors 2021.

	Turnover Size Band (£000's)										
	0-49	**50-99**	**100-249**	**250-499**	**500-999**	**1000 - 1999**	**2000 - 4999**	**5000 - 9999**	**10000- 49999**	**50000 +**	**Total**
Total	4,070	3,430	6,265	4,400	3,475	2,545	2,415	990	970	455	4,070
Total %	14%	12%	22%	15%	12%	9%	8%	3%	3%	2%	14%
Economy Avg	486,340	621,865	867,415	344,140	197,390	110,960	76,735	28,430	25,820	8,605	2,767,700
Economy Avg %	18%	22%	31%	12%	7%	4%	3%	1%	1%	0%	

In terms of distributional impacts, the proposed NDF and RCF changes are not expected to have any direct impact to firms. As previously stated, these proposed powers would allow suppliers an additional option to meet their RTFO or SAF mandate targets but they are not required to use NDFs and can maintain the status quo of utilising current feedstocks and technology to supply qualifying renewable fuels. The RTFO target itself is not changing within this amendment therefore the magnitude of burden is unchanged to the status quo.

RTFO and SAF mandate targets will remain under constant review to ensure they are best placed to deliver cost effective decarbonisation of the transport system. Future changes to targets will take into account a full range of factors, including feedstock / low carbon fuel availability and cost. As such, increasing the range of eligible fuels could increase the availability and decrease the cost of qualifying fuels. Any future changes to target levels would be accompanied by a full cost benefit analysis, as has been the case for all previous changes to targets. We cannot presuppose how the RTFO may change right now and the exact impact within this primary legislation – especially as road transport fleets electrify, it will reduce the total amount liquid fuels used transport and the RTFO % target will have a diminished absolute impact. For an indication of impact, we can use the latest 2021 RTFO amendment CBA which appraised the impact of increasing the RTFO in 2022-

2031. This concluded an abatement cost of £/tCO2e 165-170 which is cost effective measure compared to the published BEIS carbon values[6].

Even if manufacturers do choose to use NDFs or RCFs, they logically would only do so if the cost of this is below the cost of alternatives, suggesting only benefits to business rather than burdens. There are likely to be low familiarisation costs associated with both the primary and future secondary legislation amendments. Fuel suppliers will not need detailed familiarisation as to eligibility criteria as they simply require fuel producers to provide them with certificates issued by the RTFO unit confirming eligible fuel has been supplied. Those producing either RCF or NDF fuels will need to ensure they comply with scheme eligibility criteria, though this is standard for any low carbon fuel supplied to the relevant schemes. As a result, the total familiarisation cost (the cost to read and understand legislation) is likely to be minimal for this amendment. Additionally, DfT hold regular quarterly workshops with stakeholders (policy or operational level) to guide them through policy changes and familiarisation. These will continue and minimise any potential familiarisation costs to businesses.

Provisions for exemptions or derogations are not necessary for small and micro businesses as this would undermine any potential flexibility benefits to small and micro suppliers to utilise this technology to supply renewable fuels versus their competition.

Finally, in terms of unintended barriers to entry under these proposals: the RTFO scheme is based on a variable cost imputed tax and subsidy mechanism. As a result, for an individual supplier to meet the obligation they do not necessarily have to bear a significant up-front fixed cost which would disproportionately burden smaller firms to produce a renewable fuel. They instead have the flexibility to utilise the variable-cost penalties and trade certificates with other suppliers. The obligation targets are also based on the percentage of total fuel each supplier supplies making the absolute burden proportionate to a firms volume of output and size.

EANDCB and BIT

For the Equivalent Annual Net Direct Cost to Business (EANDCB) and Business Impact Targets (BIT), the RTFO; the NDF; and RCF amendments are classified as “imputed tax and spend” policies due to their certificate trading mechanisms and penalty mechanism under the RTFO. As a result of this classification, these amendments are out of scope under section 22 of the Small Business, Enterprise and Employment (SBEE) Act 2015 and the Better Regulation Framework and do not fall under the Business Impact Target.

However, even if these changes and the RTFO were in scope of the BIT, these amendments are not likely to have any direct impacts at either the primary or secondary legislative stage. Furthermore, if indirect impacts were to occur this would likely be a net gain to business as firms should not choose a new technology to deliver their obligation unless cost effective versus the alternative options.

[6] https://www.gov.uk/government/collections/carbon-valuation--2#carbon-valuation-in-policy-appraisal

ANNEX: List of RTFO company sectors and size

	Employment Size Band							
Sectoral Code	0-4	5-9	10-19	20-49	50-99	100 - 249	250 +	Total
06100 - Extraction of crude petroleum	20	10	10	5	0	5	20	70
19201 - Mineral oil refining	40	15	5	10	10	5	10	95
20110 - Manufacture of industrial gases	25	5	0	5	0	0	0	35
20140 - Manufacture of other organic basic chemicals	80	15	15	10	15	20	5	160
20590 - Manufacture of other chemical products not elsewhere classified	255	60	55	40	35	15	10	470
27900 - Manufacture of other electrical equipment	435	100	85	65	30	10	5	730
32990 - Other manufacturing not elsewhere classified	2,960	675	210	85	30	10	5	3,975
35110 - Production of electricity	3,895	565	350	30	20	10	10	4,880
35210 - Manufacture of gas	5	5	0	0	0	0	0	10
35220 - Distribution of gaseous fuels through mains	5	5	0	5	0	5	5	25
38110 - Collection of non-hazardous waste	2,070	425	270	210	70	35	30	3,110
38210 - Treatment and disposal of non-hazardous waste	680	160	100	110	50	25	10	1,135
46120 - Agents involved in the sale of fuels, ores, metals and industrial chemicals	890	130	65	15	10	0	0	1,110
46711 - Wholesale of petroleum and petroleum products	825	270	115	75	30	15	10	1,340
46719 - Wholesale of other fuels and related products	825	270	115	75	30	15	10	1,340
47300 - Retail sale of automotive fuel in specialised stores	775	800	455	225	85	30	5	2,375
52290 - Other transportation support activities	4,915	710	385	275	100	85	40	6,510
46770 - Wholesale of waste and scrap	1,095	320	160	55	15	5	0	1,650
47990 - Other retail sale not in stores, stalls or markets	8,045	810	200	55	15	5	5	9,135

	Turnover Size Band (£000's)										
Sectoral Code	**0-49**	**50-99**	**100-249**	**250-499**	**500-999**	**1000-1999**	**2000-4999**	**5000-9999**	**10000-49999**	**50000+**	**Total**
06100 – Extraction of crude petroleum	5	0	5	0	5	5	10	0	5	30	65
19201 – Mineral oil refining	10	5	5	10	10	5	5	5	20	20	95
20110 – Manufacture of industrial gases	5	5	10	5	5	5	0	0	0	0	35
20140 – Manufacture of other organic basic chemicals	20	15	25	15	10	10	15	10	20	20	160
20590 – Manufacture of other chemical products not elsewhere classified	75	50	80	45	40	40	45	35	45	15	470
27900 – Manufacture of other electrical equipment	100	115	170	95	70	60	65	30	20	5	730
32990 – Other manufacturing not elsewhere classified	805	960	1,080	500	330	145	105	25	20	5	3,975
35110 – Production of electricity	1,025	470	1,020	695	625	485	355	85	75	45	4,880
35210 – Manufacture of gas	0	0	5	0	0	0	0	0	0	5	10
35220 – Distribution of gaseous fuels through mains	0	0	5	0	0	0	0	5	5	10	25
38110 – Collection of non-hazardous waste	280	380	1,070	405	365	190	215	95	90	20	3,110
38210 – Treatment and disposal of non-hazardous waste	120	120	285	155	115	85	115	60	70	10	1,135
46120 – Agents involved in the sale of fuels, ores,	175	135	285	185	110	85	65	25	30	15	1,110

metals and industrial chemicals											
46711 – Wholesale of petroleum and petroleum products	125	90	275	185	160	150	135	75	75	70	1,340
46719 – Wholesale of other fuels and related products	125	90	275	185	160	150	135	75	75	70	1,340
47300 – Retail sale of automotive fuel in specialised stores	60	45	190	295	415	490	595	160	105	20	2,375
52290 – Other transportation support activities	980	780	1,085	1,355	825	465	420	255	260	85	6,510
46770 – Wholesale of waste and scrap	160	170	395	270	230	175	135	50	55	10	1,650
47990 – Other retail sale not in stores, stalls or markets	1,425	3,685	2,415	860	435	170	95	30	15	5	9,135

Annex: Cost Benefit Analysis – Supporting Recycled Carbon Fuels through the Renewable Transport Fuel Obligation

Introduction

Recycled carbon fuels (RCFs) are fuels made from fossil wastes like unrecyclable plastic and industrial gases. They provide significant carbon savings compared to traditional fossil fuels like petrol and diesel. However, due to their cost, additional support is needed to deliver these fuels at scale to the UK market.

There are environmental benefits to producing fuels from some fossil wastes if they can be more efficiently processed into a fuel employing advanced facilities, instead of disposing of them via conventional means, such as landfill or incineration. RCFs can encourage a more effective use of waste by offering greater energy recovery. They can deliver greenhouse gas (GHG) emission savings, as the resulting fuel can be used to displace conventional transport fuel.

Many fuels could potentially be produced from RCF feedstocks but there is particular interest in those which could provide drop-in replacements for existing fossil fuels, helping to decarbonise sectors which have fewer alternative decarbonisation options such as electrification. For example, RCFs can be made which are sufficiently similar to fossil diesel and petrol and can be mixed to very high blends, which could be used to decarbonise heavy goods vehicles. There is also considerable interest in using RCF feedstocks to produce sustainable aviation fuel – a key government priority.

Background on the RTFO

The Renewable Transport Fuel Obligations Order 2007 established a certificate trading scheme, known as the Renewable Transport Fuel Obligation (RTFO) and is the government's main mechanism for decarbonising transport fuel. While increasing vehicle efficiency and encouraging zero emissions vehicles will help secure net zero targets, these changes will take time. Liquid fuels will continue to be needed in the short term for the vehicles already on the road and in the longer term for use in sectors that currently cannot be easily electrified.

The RTFO operates by promoting a market for renewable fuels. It places obligations on larger suppliers of fossil fuel to ensure the supply of renewable fuels. Suppliers meet their obligations by acquiring certificates which are awarded for the supply of sustainable renewable fuels. The trade of these certificates provides a revenue stream for suppliers of renewable fuels.

In 2020, as a result of the RTFO, 2.54 billion litres equivalent of renewable fuel was supplied for use in UK transport (5.9% of total fuel) delivering greenhouse gas savings of 5.24 million tonnes CO_2e. RTFO target increases over the coming years are anticipated to deliver additional savings equivalent to a further 1.5 million average cars by 2032.

Since 1 January 2019 there has also been an additional sub-target supporting the uptake of development fuels which need greater support and fit the UK's long-term strategic needs. Development fuels are made from sustainable wastes or renewable energy, deliver

higher carbon reductions than traditional biofuels, and include fuels of strategic importance such as aviation fuel, substitute natural gas, drop-in diesel or petrol, and renewable hydrogen. Fuels that meet the development fuel definition are eligible to receive development renewable transport fuel certificates (dRTFCs) and are awarded two dRTFCs per litre of fuel supplied.

The development fuel target has intentionally been set at an ambitious level with a higher buy-out price and a target that increases year-on-year. This is designed to provide a strong incentive to develop these advanced fuel types. To-date, no supplier has fully met the development fuel target with dRTFCs alone with all suppliers at least partially buying out of their obligation.

Policy proposals

Currently, the RTFO only supports low carbon fuels of renewable origin. Developments in fuel technologies now enable advanced low carbon fuels to be developed from fossil-derived wastes – so-called RCFs. RCFs are different to renewable fuels in that they are produced from fossil wastes that cannot be prevented, reused, or recycled but still have the potential to reduce GHG emissions relative to petrol or diesel. Examples of feedstocks include the fossil fraction of municipal solid waste (MSW) (e.g. non-recyclable plastic) and industrial waste gases. RCFs can deliver comparable carbon savings to renewable fuels already supported under the RTFO and therefore meet the wider policy intent of the RTFO – to cut carbon emissions from harder to decarbonise transport modes.

In March 2021, the Department for Transport (DfT) issued a consultation entitled "Targeting net zero – next steps for the Renewable Transport Fuel Obligation". This included proposals to support RCFs under the RTFO. It was proposed that only RCFs that meet the definition of a "development fuel" should be eligible for support under the RTFO. In July 2021, DfT issued a government response confirming our intention to support RCFs which meet the definition of a development fuel under the RTFO.

Whilst there was a large stakeholder consensus supporting RCF inclusion, there was significant variation of opinion on how to include RCFs in the RTFO with evidenced arguments brought forward both for and against our proposals regarding feedstock eligibility and biogenic content, the reward rate and the proposed GHG methodology and threshold. Consequently, after reviewing additional evidence, commissioning further research, stakeholder engagement, and developing alternative proposals, we are now issuing a further consultation to explore how best to support RCFs under the RTFO. This cost-benefit analysis has been produced in support of this further consultation.

In terms of risk, there is a risk if the policy is not designed adequately that support will not be sufficient to deliver RCFs. There is also a risk that RCFs could divert wastes from more efficient uses, such as recycling. These risks are being mitigated via further consultation on the detail of the support and eligibility criteria. This involves a range of technical experts, other government departments, fuel suppliers and wider stakeholders.

Objective of this cost-benefit analysis

The main policy objective is to maximise the carbon savings delivered by the RTFO. To do this, increasing the range of fuels that can be considered, particularly in relation to the

development fuel target, ensures we minimise buy-out and maximise the replacement of traditional fossil fuels with lower carbon alternatives.

In supporting RCFs we will also help to foster investment and innovation in the advanced fuel sector which may be vital to our ambitions to decarbonise hard to electrify modes such as aviation and HGVs. Supporting RCFs will also encourage the innovation needed to increase the deployment of low carbon fuels in transport sectors which are more challenging to decarbonise such as aviation and HGV's.

This cost-benefit analysis has been undertaken to test and, where appropriate, monetise, the impact of the RCF policy, while having regard to the core policy objective – maximising the carbon savings delivered by the RTFO. The cost-benefit analysis sets out the impacts of the policy measures in further detail and compares these to the costs and benefits of the other options.

Methodology and options considered

Methodology

There has been investor interest in developing UK RCF plants for the purpose of Sustainable aviation fuel (SAF) development. As a result, the supply of RCFs in this analysis is based on SAF capacity assumptions, up to the limit on feedstock supply. The assumptions used in this analysis are based on the best available data and consensuses from other analysis in this area. However, we are continuously evaluating and welcome feedback on our assumptions to better reflect the nature of this emerging industry.

SAF capacity assumptions are based on information on potential SAF plant projects supplied by industry. The analysis assumes that these plants operate at 80% of their proposed capacity. There is no evidence available to support the RCF supply assumption, but it is an assumption consistent with other analysis in this area, aimed to account for any optimism bias in industry's expected capacity levels. The supply assumptions represent an upper bound level of potential supply, and it is very possible that the supply of RCFs could be lower than this. Therefore, any supply projections from this analysis should be considered optimistic.

The feedstocks included in the analysis are only sourced in the UK and include plastics, RDF, waste gases, and oil and waste lubricants. Information on the availability of feedstocks was sourced from NNFCC (DfT technical research contractors).

The net cost of supplying RCFs is assumed to be at most equal to the buy-out price. This assumes that if the cost of supplying RCFs was greater than the cost of buy-out or the cost of supplying alternative development fuels, then suppliers could choose not to supply them. If this is true, suppliers would always choose to supply the cheaper alternative. There is little data available on the cost of producing RCFs. As part of the consultation on RCF we invite respondents to be open with the Department regarding the cost of supply for future RCFs and whether this assumption regarding the cost of production is the actual position or not.

The above assumption therefore means that in option 1a all RCF fuels supplied will cost no more than 40p per litre to produce as this is equivalent to the incentive level provided under the RTFO in that option. However, in option 1b given the RTFO incentive is doubled a slightly different assumption is made regarding supply, which is doubled in comparison to option 1a. The analysis assumes that extra incentive opens suppliers to a wider range of fuels to produce some of which may be more expensive, but still retaining the ability to produce some fuels at 40p per litre. Therefore, in option 1b half of the total fuel supply is estimated to cost 40p per litre to produce and the other half will cost 80p per litre to produce to simulate this range. It is understood that this assumption is likely not a reflection of the reality, however, there is currently a lack of data in this area to help inform this further. As part of our consultation we will be asking respondents for their views on costs of production of RCFs. GHG savings were estimated based on this supply of feedstocks relative to the lifecycle emissions of the GHG value of the fossil fuels which would have been supplied instead.

The carbon saving benefits were monetised using the central carbon price from the latest BEIS guidance and discounted in line with the HMT green book. The appraisal was calculated using a 10-year period from 2023.

Question C1: Do you agree or disagree that the assumptions made in the cost-benefit analysis are reasonable? Please give reasoning for your answer.

Question C2: Do you have any evidence on the estimated costs of producing RCFs?

Options considered

Three options were considered as part of this CBA:

Baseline – No RCFs supported under the RTFO. Under the RTFO, fuel suppliers are required to meet a development fuel target. Like the RTFO main obligation, the development fuel target operates as a certificate trading mechanism, whereby certificates (dRTFCs) are issued to suppliers of renewable transport development fuel to demonstrate that an obligated supplier has met their obligation. Where suppliers fail to redeem sufficient dRTFCs, they must pay buy-out price of 80 pence per dRTFC. If RCFs remain ineligible for support under the RTFO, there will remain no incentive to supply them. Therefore, in the absence of any policy change, suppliers will face the cost of continuing to supply other non-RCF development fuels or the cost of buying out.

Option 1a – reward RCFs under the RTFO with a reward rate of 0.5 dRTFCs per litre of eligible fuel supplied.

Option 1b – reward RCFs under the RTFO with a reward rate of 1 dRTFCs per litre of eligible fuel supplied.

Results

RCF supply and GHG saving projections

The analysis underpinning this CBA assumes a high level of uptake in RCF supply, which is shown in Table 1. The supply of RCFs in this analysis is based on the assumptions outlined in the methodology.

Under option 1a, supply would begin with 38 million litres in 2023 and increase to 340 million litres by 2032. The GHG savings anticipated under this option will increase from 56,477 tCO_2e in 2023 to 505,143 tCO_2e in 2032.

Under option 1b, supply would begin with 76 million litres in 2023 and increase to 680 million litres by 2032. The greenhouse gas savings anticipated from supplying RCFs, instead of buying out of the development fuel obligation, will increase from 112,953 tCO_2e in 2023 to 1 million tCO_2e by 2032.

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Option 1a: projected RCF supply (millions, litres)	38	118.3	160.7	178.9	199.1	221.6	246.6	274.5	305.5	340
Option 1a: GHG savings (tCO_2e)	56,477	174,160	237,176	264,313	294,518	328,136	365,553	407,199	453,552	505,143
Option 1b: Projected RCF supply (millions, litres)	76.0	236.6	321.4	357.7	398.1	443.1	493.2	548.9	611	657.9
Option 1b: GHG savings (tCO_2e)	112,953	348,320	474,352	528,627	589,036	656,272	731,107	814,399	907,104	1,010,287

Table 4 Projected supply of RCFs and corresponding GHG savings used in the cost benefit analysis

Costs

Monetised Costs

On-going Costs

The majority of the costs associated with allowing RCFs to be supported under the RTFO relate to the cost of supplying the fuel, relative to the cost buying out to meet the obligation:

Total cost = Cost of buyout – Cost of supplying RCFs.

Allowing RCFs to be eligible to claim support under the RTFO will have negligible impacts on cost to suppliers. Under the RTFO order, suppliers are already obligated to supply a portion of development fuel or buyout at a fixed price. Widening eligibility to RCFs will widen the types of fuel businesses can choose to provide, rather than generate new costs. If they do choose to supply RCFs, we assumed that the cost of supplying them would be

the same or lower than buying out. Otherwise a rational supplier would always choose to buy-out their obligation.

The net cost of supplying RCFs is assumed to be at most equal to the buy-out price. This assumes that if the cost of supplying RCFs was greater than the cost of buy-out or the cost of supplying alternative development fuels, then suppliers could choose not to supply them. If this is true, suppliers would always choose to supply the cheaper alternative. Therefore, there should be no direct additional costs over the baseline from granting RCFs support under the RTFO.

Whether this assumption holds true will depend on the cost of supplying them and level of incentive offered under the RTFO, such as the number of dRTFCs offered per litre. For RCFs, under option 1a, it is proposed that 0.5 certificate will be earned per litre produced. Therefore, a rational supplier will only supply RCFs where the net cost of supplying the fuel is less than 40p per litre (or 80p per RTFC). Under option 1b, it is proposed that 1 certificate will be earned per litre produced. Therefore, a rational supplier would only supply RCFs where the net cost of supplying the fuel is less than 80p per litre.

Additionally, we expect that even if RCFs were eligible for support under the RTFO, that RCFs would remain a small part of the overall scheme. Therefore, as with the baseline option, the cost of buying out to meet the remainder of the development fuel sub target would remain the main cost to business under option 1. Hence, the present value total cost to fuel suppliers (and by proxy, motorists) over the appraisal period in option 1a would be £0.

Under option 1b, we assumed RCF producers supply half the total possible RCF supply at 40p per litre, meaning they would save 40p per litre on that portion of supply, relative to buying out at 80p per litre. If this assumption holds true, a net saving to business of £585m is expected across the appraisal period. However, data on the cost of producing RCFs is scarce, and there is no evidence to back this assumption.

Loss of revenue to government

Under the RTFO, suppliers can buyout of their development fuel target obligation at a price of 80 pence per dRTFC. Under option 1a, RCFs will earn 0.5 certificates per litre produced, meaning the cost would be 40p per litre (or 80p per dRTFC). Under option 1b, RCFs would earn 1 certificate per litre produced, meaning the cost would be 80p per litre.

Any receipts from suppliers that buy-out are surrendered by the Department to the Exchequer, in line with HM Treasury rules. However, the buy-out was not designed to be a revenue raising mechanism for government. The development fuel buy-out price is intended to support a high value for development fuels, as the higher certificate value means while there are insufficient development fuels available to meet demand, there should be a demand for them equivalent to £1.60 a litre. So, it stops prices spiralling upwards while creating a high value market for certain fuels.

As such, the supply of RCFs is a redistribution of costs, which results in lost revenue for government. Due to the varying reward rates under the two options, the loss of revenue varies significantly. Based on the level of RCF supply assumed in this analysis, the total loss of revenue under option 1a (a 0.5 certificate reward per litre) for government over the

appraisal period would be £684m. However, under option 1b (a 1 certificate reward) the total loss of revenue for government over the appraisal period would be £2,723m.

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Projected revenue from buy-out receipts (£m)	299.1	341.4	378.7	398.6	411.6	418.4	419.6	415.6	401.0	381.7	3,865.7
Option 1a: Projected revenue with policy change (£m)	283.9	295.8	318.9	334.3	342.6	344.3	339.9	330.0	309.1	283.0	3,181.7
Option 1a: Net lost revenue from buy-out receipts (£m)	15.2	45.7	59.9	64.3	69.1	74.2	79.7	85.6	91.9	98.7	684
Option 1b: Projected revenue with policy change (£m)	238.3	158.8	139.3	141.4	135.4	121.8	101.0	73.3	33.4	0	1,142.7
Option 1b: Net lost revenue from buy-out receipts (£m)	60.8	182.6	239.4	257.2	276.2	296.7	318.6	342.2	367.6	381.7	2,723

Table 5 Summary of losses to government revenue as a result of policy change

However, the overall level of lost government revenue is likely to be lower than this figure indicates. Some of this revenue will be recuperated by the taxes on fuel at the point of purchase, such as fuel duty and VAT. However, due to the complexities with fuel demand and differing blend levels, it is not possible to calculate how much this would be. Furthermore, the buy-out was not designed to be a revenue raising mechanism. The intention when the RTFO was designed was for the utilisation of buy-out to reduce as more development fuels are bought to market.

Unmonetised Costs

There may be some administrative costs to business of supplying RCFs. For example, a small amount of Full Time Standard Equivalent (FTSE) may be required to ensure that RCFs are certified and verified as sustainable. However, this cost is likely to be negligible.

Benefits

The main benefits of including RCFs under the RTFO are (1) contributing to additional carbon savings associated with supplying RCFs instead of traditional fossil fuels (2) supporting RCFs to get to market at scale.

Monetised Benefits

GHG savings

RCFs offer the potential to reduce emissions by substituting a portion of petrol and diesel emissions with materials made from fossil-derived wastes (e.g. MSW or industrial waste gases) that would otherwise be landfilled or incinerated.

Introducing supports for RCFs under the RTFO would widen the types of fuels available for businesses to supply to meet the development fuel target. However, there would be no requirement for businesses to supply RCFs. Therefore, GHG savings in this section are based on an assumed level of RCF supply, based on information on the availability of feedstocks and production assumptions.

GHG savings have been measured against a counterfactual state where no RCFs are supplied in the absence of support under the RTFO. Savings are measured relative to the lifecycle emissions of the GHG value of fossil fuels. The carbon savings benefits were monetised and discounted in line with the HMT green book.

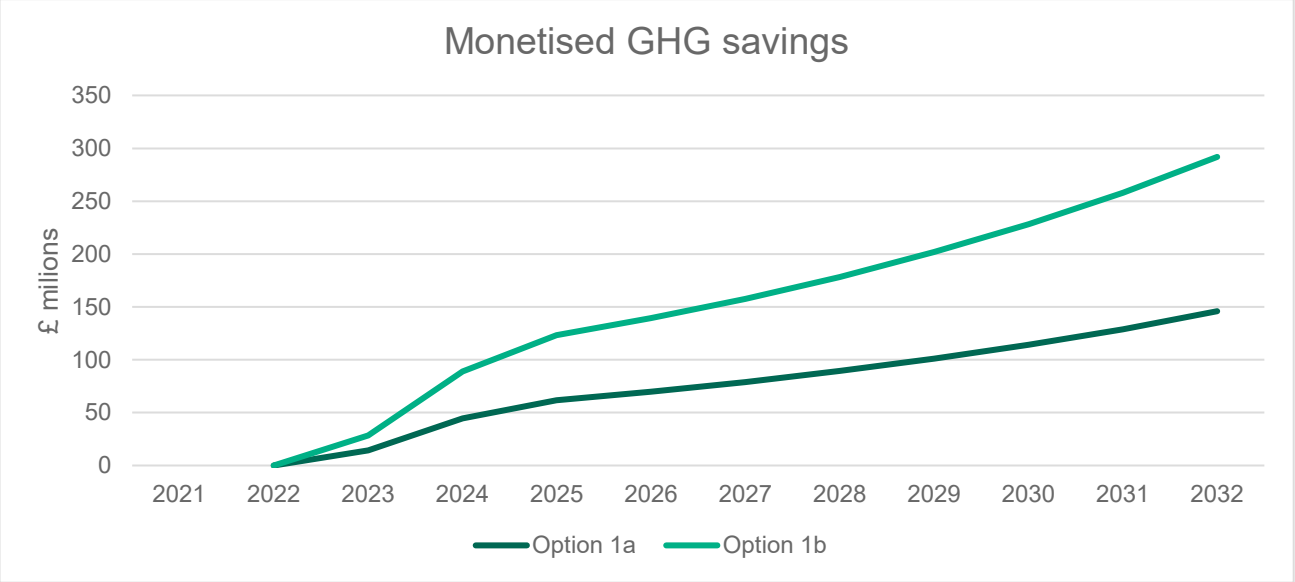

Figure 1 Present value monetised GHG savings of option 1a and 1b

The present value of GHG savings that could arise across the appraisal period of 10-years is £694 million under option 1a, and £1,388 million under option 1b. The majority of these GHG savings are derived from municipal solid waste (MSW) feedstocks.

Unmonetised Benefits

Air quality

RCFs are not expected to alter the air quality characteristics of fuels generally. The fuels are designed and produced to be chemically similar to the fossil fuels they displace. As a result, air quality impacts are expected to be negligible and are not quantified. Where RCFs are used in existing internal combustion engines, air quality pollutants are linked

more to the engine and exhaust system than the fuel itself. The final fuels will still need to fall within existing fuel standards in terms of their quality and chemical composition.

Diverting waste from landfill

In addition to GHG benefits, adding RCFs to the RTFO could divert waste from landfill or incineration. However, it is difficult to estimate and monetise how much waste would be diverted upon allowing support RCFs. There is likely to be competing demands for the use of municipal solid waste outside of the fuel industry, for example, as input for electricity generation.

Facilitating the decarbonisation of challenging sectors

RCFs have the potential to make an important contribution to net zero goals as they are suitable for producing aviation fuel and "drop-in" road fuel suitable for heavy goods vehicles – sectors with fewer decarbonisation options.

Supporting the emerging advanced fuels industry

Including RCFs under the RTFO would provide crucial revenue support for an emerging industry seeking to use advanced conversion technologies to produce fuels such as sustainable aviation fuel (SAF). The UK is a strong early player in this market and this policy has the potential to support the development of a world leading UK SAF sector.

Including RCFs in the RTFO would provide support to other advanced fuels industries, such as the sustainable aviation fuel (SAF) industry, which will be crucial for decarbonising transport. The production of RCFs would likely require research to develop optimal production methods. This research and development knowledge could be transferred to the emerging SAF market.

Wider economic benefits of supporting an emerging industry

Supporting an emerging industry like RCFs would lead to wider economic benefits in the areas where the plants are located, such as job creation and the facilitation of future investment. This has the potential of partially offsetting the tax losses set out above.

Risks and uncertainty

The supply of RCFs for the analysis in this CBA is based on SAF capacity assumptions on proposed SAF production, up to the limit on feedstock supply. As such, this presents a maximum scenario for the supply of RCFs. As such, it is very feasible that the supply of RCFs could be much lower than that presented.

If the overall supply of RCFs were to be half this amount over the appraisal period, then there would be lower associated emissions savings. In addition, there would be a reduction in lost revenue for government, as a higher level of buy-outs would be required to meet the development fuel target.

Under option 1a, if the actual supply of RCFs is half that assumed, the present value of emissions savings under option 1a would be £347m, and the loss in revenue for

government would be £342m. This would result in a net present value of £5m. Under option 1b, the present value benefit of emissions savings would be £694m and the loss in revenue for government would be £1,362m.

Summary

The proposed option to allow RCFs to be eligible to claim support under the RTFO is anticipated to have a present value cost of £684m in option 1a and £2,042m in option 1b. In terms of benefits, a small number of RCF producers will see a benefit from this policy. Currently, this is not possible to monetise due to high levels of uncertainty and the counterfactual (that any RCF fuel would displace fuel supplied by different businesses).

The cost to suppliers is low because of the counterfactual. Fuel suppliers must either meet their development fuel obligation through supplying development qualifying fuel or paying the buy-out price. As a result, any RCF fuel supplied under the development fuel target would mean that suppliers do not need to buy-out of that part of their obligation. In this way, the overall cost is expected to be neutral. Therefore, the net cost of this policy to the motorist will be £0 or a potential small cost saving.

If RCFs are supplied, there will be a loss in revenue to government from a reduction in buy-outs required to meet the development fuel target. However, the RTFO and its option to buy-out of obligations were not designed to raise revenue. Based on the level of RCF supply assumed in this analysis, the total loss of revenue for government under option 1a over the appraisal period would be £684m. Under option 1b the loss in revenue for government over the appraisal would be £2,723m. However, the net loss in revenue is likely to be lower than this due to fuel duty and VAT on the fuel supplied at the point of purchase. In addition, there are a range of non-monetised benefits, which will offset some of the financial cost and be of high strategic (e.g. supporting SAF production) or reputational importance (e.g. making effective use of difficult to manage wastes).

Based on the assumed RCF supply, the present value of GHG savings that could be delivered across the appraisal period under option 1a is £694 million and under option 1b is £1,388 million. In addition, the production of RCFs repurposes hard to manage waste that could have otherwise been disposed of via incineration or landfill.

Under option 1a, where the reward for RCFs is 0.5 dRTFCs, the net present value is £10m. in comparison, the net present value under 1b, where the reward would be 1 dRTFCs, the net present value would be -£655m.

This appraisal has not included an overall value for money assessment with a benefit cost ratio due to the nature of the policy change. The supply of RCFs will lead to a redistribution of costs causing a reduction in revenue for government. However, the RTFO was not designed to be a revenue raiser for the exchequer. Furthermore, a significant benefit to supporting RCFs is the strategic benefit in the form wider support it would give to the SAF sector, which is unmonetizable, a BCR would not be a fair mechanism to assess this policy.

Summary tables

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Present Value Cost	15	46	60	64	69	74	80	86	92	99	684
Present value benefit	14	43	57	63	68	75	82	89	97	106	694
Net present value	**-1**	**-3**	**-2**	**-2**	**-1**	**1**	**2**	**3**	**5**	**7**	**10**

Table 6 A summary of present value costs and benefits of option 1a (£m - rounded)

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Present Value Cost	46	137	178	193	207	222	239	257	276	286	2,042
Present value benefit	28	86	115	125	137	149	163	178	194	212	1,388
Net present value	**-17**	**-51**	**-65**	**-68**	**-70**	**-73**	**-76**	**-79**	**-82**	**-75**	**-655**

Table 7 A summary of present value costs and benefits of option 1b (£m - rounded)