



Department  
for Transport

# **Annex C: Supporting Recycled Carbon Fuels through the Renewable Transport Fuel Obligation**

## Cost-Benefit Analysis

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# Contents

Introduction	4
Objective of this cost-benefit analysis	5
Methodology and options considered	6
Results	7
Summary	13

## 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<sub>2</sub>e. 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 consensus 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 NNFFC (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<sub>2e</sub> in 2023 to 505,143 tCO<sub>2e</sub> 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<sub>2e</sub> in 2023 to 1 million tCO<sub>2e</sub> 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 <sub>2e</sub> )	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 <sub>2e</sub> )	112,953	348,320	474,352	528,627	589,036	656,272	731,107	814,399	907,104	1,010,287

**Table 1** 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 2** 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.

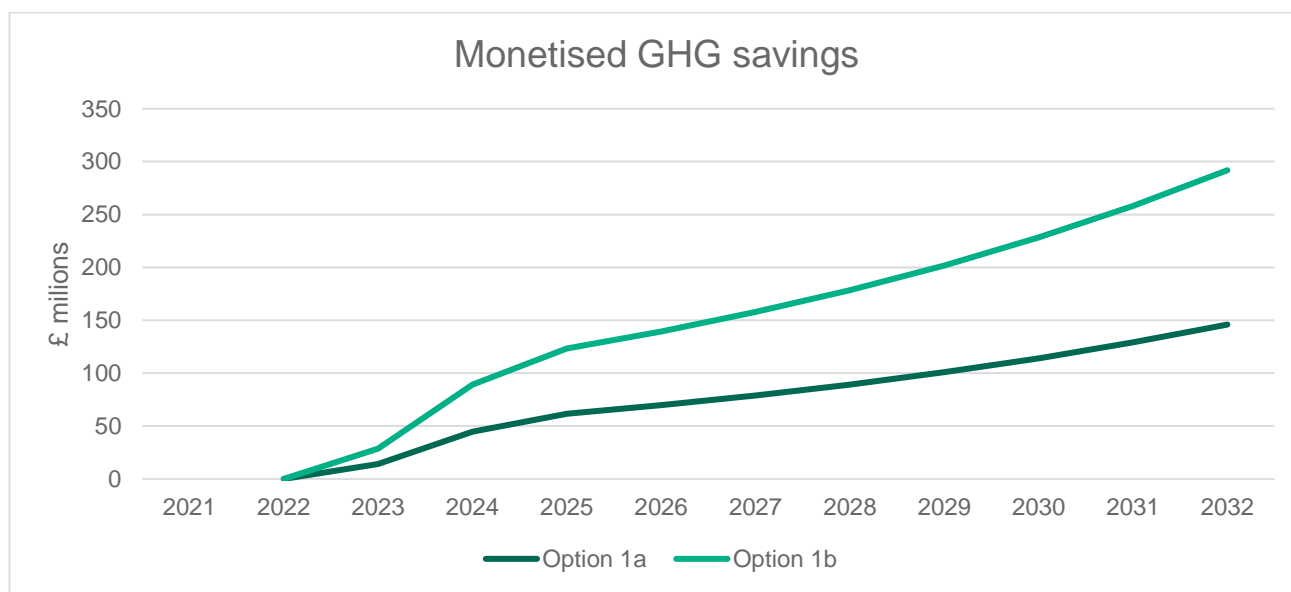
## Monetised Benefits

### *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
<b>Net present value</b>	<b>-1</b>	<b>-3</b>	<b>-2</b>	<b>-2</b>	<b>-1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>7</b>	<b>10</b>

**Table 3** 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
<b>Net present value</b>	<b>-17</b>	<b>-51</b>	<b>-65</b>	<b>-68</b>	<b>-70</b>	<b>-73</b>	<b>-76</b>	<b>-79</b>	<b>-82</b>	<b>-75</b>	<b>-655</b>

**Table 4** A summary of present value costs and benefits of option 1b (£m - rounded)