Title: Implementing the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) **IA No**: **DfT00474** **Lead department or agency**: Department for Transport **Other departments or agencies**: Department for Energy Security and Net Zero	Impact Assessment (IA) **Date:** 16 December 2024 **Stage:** Consultation **Source of intervention:** International **Type of measure:** Secondary Legislation **Contact for enquiries:** corsiaconsultation@dft.gov.uk

Summary: Intervention and Options

Cost of Preferred (or more likely) Option (in 2019 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status** Choose an item.

What is the problem under consideration? Why is government intervention necessary?

The impact of greenhouse gases on climate change is a negative externality that arises from the market's failure to account for the wider cost to society and the environment when producing goods and services associated with these emissions. While some national carbon pricing schemes do exist, such as the UK Emissions Trading Scheme (UK ETS), these are not enough alone to combat the market failure from international aviation. In 2016, the International Civil Aviation Organization (ICAO) agreed to implement the 'Carbon Offsetting and Reduction Scheme for International Aviation' (CORSIA) as part of a basket of measures to address the international aviation sector's contribution to climate change. CORSIA requires qualifying aeroplane operators (AOs) to offset the growth in international aviation carbon dioxide (CO_2) emissions covered by the scheme above 85% of 2019 levels. As a member of ICAO, the UK is obliged under international law to adopt the relevant Standards and Recommended Practices (SARPs) relating to CORSIA into domestic law. Government intervention is therefore necessary to implement CORSIA's offsetting requirements in the UK. Implementation of CORSIA will also need to consider the UK Emissions Trading Scheme (UK ETS), where flights are in scope of both schemes.

What are the policy objectives and the intended effects?

The key purpose of government intervention is to facilitate the effective implementation of CORSIA offsetting provisions into UK law and to ensure that UK AOs comply with them. Market-based measures, like CORSIA, are an important measure for supporting decarbonisation of the aviation sector. Further, implementation of CORSIA without further consideration of the interaction between CORSIA and the UK ETS would result in AOs facing obligations under both schemes for emissions above the CORSIA baseline on flights from the UK to the European Economic Area (EEA) and Switzerland. This double charging is expected to arise from the 2024 scheme year when global aviation emissions are predicted to exceed the CORSIA baseline for the first time. The UK ETS operates on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by sectors covered by the scheme, this limits the total amount of carbon that can be emitted and decreases over time. To comply with the UK ETS, AOs must surrender a quantity of UK ETS allowances each year equal to their CO_2 emissions from aviation activity included in UK ETS scope. When considering how CORSIA and the UK ETS should interact, we have sought to ensure we can best uphold both our international commitments to implement and participate fully in CORSIA, our domestic climate ambition, and maintain a well-functioning UK carbon market.

What policy options have been considered, including any alternatives to regulation?

The titles of policy options refer to how CORSIA could be implemented on flights also in scope of the UK ETS. AOs will comply with their CORSIA offsetting obligations by purchasing and cancelling eligible emission units (offset credits) generated by projects that reduce emissions in other sectors, such as renewable energy. Implementation of CORSIA without further consideration of the interaction between CORSIA and the UK ETS would result in AOs facing obligations under both schemes for CO_2 emissions above the CORSIA baseline on flights from the UK to the EEA and Switzerland. This is expected to arise from 2024 when global aviation emissions are predicted to exceed the CORSIA baseline for the first time.

In all policy options, aside from the 'Do Nothing' option, CORSIA is implemented on all applicable flights outside of UK ETS scope. Policy options differ in how CORSIA is implemented on flights from the UK to the EEA and Switzerland.

Quantitatively assessed, and short-listed in this impact assessment:

- Option A - UK ETS only: Only the UK ETS would apply on UK to EEA and Switzerland flights. In this case, UK to EEA and Switzerland flights would not be subject to CORSIA obligations.
- Option B - Price-based hybrid: Both CORSIA and the UK ETS would apply to UK to EEA and Switzerland flights. Aeroplane operators would be compensated for the costs of CORSIA offsetting on these flights. Various scheme designs for this option are considered in the IA. This includes the mechanism used to compensate AOs for the cost of CORSIA offsetting obligations on UK to EEA and Switzerland flights: through reducing AOs' UK ETS obligations, reimbursing AOs with UK ETS allowances or financial reimbursement for AOs. Where relevant, approaches also include consideration of a corresponding supply adjustment, where an equivalent number of allowances would also be retired from UK ETS supply.

Qualitatively assessed and discounted in this impact assessment:

- UK ETS and CORSIA: The UK ETS and CORSIA would be implemented independently. Operators flying UK to EEA and Switzerland routes would be required to comply with both schemes for emissions above the CORSIA baseline and therefore have overlapping obligations for these emissions. This option would occur if CORSIA was implemented fully without further consideration of the overlap between the two schemes.
- Emissions-based hybrid: An aeroplane operator's UK ETS obligations would be adjusted by an amount equivalent to their CORSIA obligations on flights from the UK to the EEA and Switzerland. The supply of UK ETS allowances could also be reduced by an equivalent amount to avoid an over-supply of the UK ETS market.

Will the policy be reviewed? It will be reviewed 3 years after implementation.

Does implementation go beyond minimum EU requirements?		N/A		
Is this measure likely to impact on international trade and investment?		No		
Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Traded:**	**Non-traded:**	

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible SELECT SIGNATORY: ---------- Date: ----------

Summary: Analysis & Evidence — Policy Option A

Description: UK ETS only

FULL ECONOMIC ASSESSMENT

Price Base Year 2023	PV Base Year 2023	Time Period Years 13	Net Benefit (Present Value (PV)) (£m)		
			Low: 2036.9	High: 35042.6	Best Estimate: 13679.0

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0	0	12.4	**114.9**
High	0		55.2	**542.9**
Best Estimate	0		34.3	**333.9**

Description and scale of key monetised costs by 'main affected groups'

AOs operating on flights between CORSIA participating countries (outside of UK ETS scope) will be subject to CORSIA offsetting obligations. Our central estimate of the overall costs of applying CORSIA to UK departing flights is £334m. Assessing impacts on UK departing flights captures costs to UK and non-UK residents; this is the best available proxy for the total impact of CORSIA on UK residents.

Other key non-monetised costs by 'main affected groups'

There will be familiarisation costs for AOs to comply with CORSIA's offsetting requirements, and additional administrative cost to government and regulators to ensure AO compliance. On international flights outside of UK ETS scope, the addition of a new carbon cost for AOs could be passed onto consumers, which would lead to a small increase in airfares. The overall impact of CORSIA on carbon leakage is assessed to be low. There is a potential for competitive distortion to occur between operators of different nationalities on flights from the UK to the EEA and Switzerland, where the UK would not implement CORSIA offsetting on these flights, as it is an individual operator's administering state who has responsibility for implementation and enforcement of CORSIA. Overall, non-monetised costs, if monetised, would lead to a reduction in the NPV for this option.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0	0	228.9	**2151.7**
High	0		3484.4	**35157.4**
Best Estimate	0		1407.6	**14012.9**

Description and scale of key monetised benefits by 'main affected groups'

Our central estimate of the overall benefits is for a total benefit to society from the emissions savings from the purchase of CORSIA Emissions Units of £14,013m. AOs will comply with their CORSIA offsetting obligations by purchasing and cancelling eligible emission units (offset credits) generated by projects that reduce emissions in other sectors. These emission savings assume that CORSIA Emissions Units are additional.

Other key non-monetised benefits by 'main affected groups'

Introducing a carbon price on UK international flights outside the scope of the UK ETS will likely lead to slightly increased air fares in aggregate, which would reduce demand for international flights to some extent, reducing carbon emissions. In addition, the introduction of a carbon price on these routes will act as an incentive for airlines to decarbonise, which may help to reduce emissions directly. However, these impacts are likely to be limited due to the relatively low price of CORSIA Emissions Units. Overall, non-monetised benefits, if monetised, would lead to an increase in the NPV for this option.

Key assumptions/sensitivities/risks	Discount rate (%)	3.5

There are a number of sensitivities involved in this analysis, and a low/mid/high range has been used to try to account for some of this uncertainty.

A key assumption driving costs and benefits is the number of CORSIA Emissions Units demanded which is driven by assumptions on the level of UK aviation emissions and global sector growth in the wake of Covid-19. Other key assumptions include CORSIA Emission Unit prices, and the value of carbon to society. In addition, the impact of CORSIA Eligible Fuels has not been included in central estimates, with the impact being assessed separately as a sensitivity.

All of the monetised benefits under this option arise from emission reductions resulting from the purchase of CORSIA Emission Units. The analysis assumes that all CORSIA Emission Units are additional in the sense that the activity

producing the emissions savings wouldn't have occurred in the absence of carbon finance. There is some inherent uncertainty with this despite the safeguards in place (see Section 2.5.1 and Section 3.4 for further detail).
As a result, the NPV should be understood in the context of the potentially significant impacts and risks that have not been monetised in this IA. HMG will investigate ways of quantifying uncosted elements for the final stage IA, to provide a more accurate picture of the impacts of the options.

BUSINESS ASSESSMENT (Option A)

Direct impact on business (Equivalent Annual) £m:		
Costs: 34.6	**Benefits:** 0	**Net: -**34.6

Summary: Analysis & Evidence — Policy Option B

Description: Price-based hybrid scheme

FULL ECONOMIC ASSESSMENT

Price Base Year 2023	PV Base Year 2023	Time Period Years 13	Net Benefit (Present Value (PV)) (£m)		
			Low: 2719.5	**High:** 47561.6	**Best Estimate:** 18495.9

COSTS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0	0	16.5	**153.3**
High	0		74.4	**732.8**
Best Estimate	0		46.2	**449.4**

Description and scale of key monetised costs by 'main affected groups'

AOs operating on flights between CORSIA participating countries will be subject to CORSIA offsetting obligations. Our central estimate of the overall costs of applying CORSIA to UK departing flights is £449m. Assessing impacts on UK departing flights captures costs to UK and non-UK residents, however this is the best available proxy for the impact of CORSIA on UK residents. For some designs of this option, UK ETS obligations would be reduced, and this would be accompanied by an equivalent adjustment to UK ETS supply, meaning there would be a reduction in revenue to government estimated at £104m. For other designs of the hybrid, airlines may be compensated for the costs of compliance with CORSIA offsetting through reimbursed UK ETS allowances or financial reimbursement, with an equivalent estimated fiscal impact of £104m. The costs of compensation represent a transfer in costs from government to AOs, and do not make society as a whole better or worse off. These costs are therefore not included in the summary of costs above.

Other key non-monetised costs by 'main affected groups'

There will be familiarisation costs for AOs to comply with CORSIA's offsetting requirements, and additional administrative cost to government and regulators to ensure AO compliance. On UK international flights outside the scope of the UK ETS, the additional carbon cost on AOs could be passed onto consumers, which would lead to a small increase in airfares, reducing carbon emissions. There is no change in the effective carbon price on flights from the UK to the EEA and Switzerland for a price-based hybrid. Where supply of allowances is reduced by an equivalent amount to achieve equivalent emissions savings (not applicable to all hybrid designs), this is expected to increase costs to business for remaining UK ETS participants. The overall impact of CORSIA on carbon leakage is assessed to be low. Overall, non-monetised costs, if monetised, would reduce the NPV for this option.

BENEFITS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0	0	305.5	**2872.8**
High	0		4716.1	**47714.9**
Best Estimate	0		1898.9	**18945.3**

Description and scale of key monetised benefits by 'main affected groups'

The central estimate of the overall benefits is the emissions savings from the purchase of CORSIA Emissions Units of £18,945m. AOs will comply with their CORSIA offsetting obligations by purchasing and cancelling eligible emission units (offset credits) generated by projects that reduce emissions in other sectors. These emissions savings assume that CORSIA Emissions Units are additional and that UK ETS emissions savings remain the same. There is an additional benefit to AOs operating on flights from the UK to EEA and Switzerland, in the form of reduced costs, valued at £104m, through either a reduction in in their UK ETS obligations or by reimbursement. This benefit is a transfer from government to AOs where affecting UK residents, however the full reduction in costs has been valued as a transfer for the purpose of this IA and, therefore, is not included in the summary of benefits above.

Other key non-monetised benefits by 'main affected groups'

Introducing a carbon price on UK international flights outside the scope of the UK ETS, is likely to lead to slightly increased air fares on average, which will reduce demand for international flights to some extent, reducing carbon emissions. In addition, the introduction of a carbon price on these routes will introduce an incentive for airlines to decarbonise, which may help to reduce emissions further. However, these impacts are likely to be limited due to the relatively low price of CORSIA Emissions Units. For a price-based hybrid, there is no change to the effective carbon price faced by airlines on UK to EEA and Switzerland routes and therefore no impact on airfares. Overall, non-monetised benefits, if monetised, would lead to an increase in the NPV for this option.

Key assumptions/sensitivities/risks	**Discount rate (%)**	3.5

There are a number of sensitivities involved in this analysis, and a low/mid/high range has been used to try to account for some of this uncertainty.
A key assumption driving costs and benefits is the number of CORSIA Emissions Units demanded which is driven by assumptions on the level of UK aviation emissions and global Covid-19 recovery. Other key assumptions include CORSIA Emission Unit prices, and the value of carbon to society. In addition, the impact of CORSIA Eligible Fuels has not been included in central estimates, with the impact being assessed separately as a sensitivity.
All of the monetised benefits under this option arise from emission reductions resulting from the purchase of CORSIA Emission Units. The analysis assumes that all CORSIA Emission Units are additional in the sense that the activity producing the emissions savings wouldn't have occurred in the absence of carbon finance. There is some inherent uncertainty with this despite the safeguards in place (see Section 2.5.1 and Section 3.4 for further detail).
As a result, the NPV should be understood in the context of the potentially significant impacts and risks that have not been monetised in this IA. HMG will investigate ways of quantifying uncosted elements for the final stage IA, to provide a more accurate picture of the impacts of the options.

FULL ECONOMIC ASSESSMENT

BUSINESS ASSESSMENT (Option B)

Direct impact on business (Equivalent Annual) £m:		
Costs: 46.5	**Benefits:** 0	**Net:-**46.5

Contents

1.0 Policy Rationale

1.1 Policy Background

1.1.1 CORSIA

1. The vast majority of the UK's aviation emissions come from international flights. For example, in 2019, international aviation emissions represented 96% of all emissions from UK aviation.[1]
2. The global nature of the sector means that international collaboration is crucial for effectively addressing international aviation emissions, and the UK is committed to tackling aviation emissions through the International Civil Aviation Organization (ICAO).
3. In 2016, ICAO's Member States agreed to implement the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) as part of a 'basket of measures' to address the international aviation sector's contribution to climate change. Coming into effect in phases from 2021, this will require qualifying aeroplane operators (AOs) to offset the growth in international aviation carbon dioxide (CO_2) emissions covered by the scheme above a given baseline (85% of 2019 levels from 2024).
4. As a contracting State of ICAO, the UK is obliged to adopt the relevant Standards and Recommended Practices (SARPs) relating to CORSIA into domestic law. Further, market-based measures, like CORSIA, are an important measure for supporting decarbonisation of the aviation sector.
5. The UK has implemented the requirements to monitor, report and verify carbon dioxide (CO_2) emissions (Chapters 1 and 2 of the CORSIA SARPs) in UK law through the Air Navigation (CORSIA) Order 2021.[2] Further legislation is now required to implement CORSIA's offsetting provisions (Chapters 3 and 4 of the CORSIA SARPs) for the full duration of CORSIA (2021-2035) and ensure that AOs comply with them.
6. The CORSIA SARPs require offsetting obligations to be calculated annually. From 2021-2032 the calculation of offsetting obligations is based on the international aviation sector's global average growth in emissions, and from 2033-2035 an individual AO's growth in emissions will start to be considered.
7. The UK played a leading role in ICAO's adoption at its 41st Assembly, of net zero CO_2 emissions by 2050 as a new global goal for international aviation. This goal places the sector on a trajectory firmly aligned with the Paris Agreement and its 1.5ºC global temperature goal. The UK will continue to use its influence in ICAO to pursue the implementation and development of key climate measures, such as CORSIA and the new ICAO Global Framework for Aviation Cleaner Energies, in support of the net zero 2050 goal.
8. The implementation of CORSIA's offsetting provisions will need to consider the UK Emissions Trading Scheme (UK ETS) as legislated for through the Greenhouse Gas Emissions Trading Scheme Order 2020 ('the UK ETS Order'), as flights from the UK to the European Economic Area (EEA) and Switzerland are in scope of both CORSIA and the UK ETS.

1.1.1.1 Coverage and Approach

9. CORSIA is divided into three phases: the Pilot Phase (2021-2023), First Phase (2024-2027) and Second Phase (2027-2035). State participation in the scheme will increase throughout the Phases. The Pilot and First Phases are voluntary. As confirmed to ICAO in June 2020, the UK has participated in CORSIA from its start in 2021. From 2024, a total of 126 states are participating in the scheme. Together, these States are responsible for over 75% of international aviation activity.

[1] In 2019, emissions from international aviation fuel use from UK bunkers were estimated to be 36.7 MtCO2e. Domestic aviation emissions were estimated to be 1.4 MtCO2e in the same year. These figures exclude military aviation. Source: Final UK greenhouse gas emissions national statistics: 1990 to 2019 - GOV.UK (www.gov.uk)

[2] The Air Navigation (Carbon Offsetting and Reduction Scheme for International Aviation) Order 2021 (legislation.gov.uk)

10. The Second Phase of CORSIA will include all ICAO States, subject to exemptions. These exemptions include Small Islands, Least Developed Countries, Land-locked Developing Countries, and states which have less than 0.5% of air traffic – although these can still volunteer.
11. CORSIA applies to all AOs on the same routes between CORSIA participating states, regardless of the state of the operator (a route-based approach). This means that emissions from international flights where both the origin and destination states participate in CORSIA are included, and therefore subject to offsetting requirements. Emissions from international flights where the origin and/or destination states do not participate in CORSIA are excluded from offsetting requirements.
12. The role played by individual states in CORSIA is to administer and enforce the scheme for AOs attributed to that state, as determined through ICAO's attribution process. UK legislation for CORSIA, and enforcement of CORSIA's offsetting requirements, will therefore apply to UK-attributed AOs only.

1.1.1.2 How CORSIA offsetting works

13. AOs will comply with their CORSIA offsetting obligations by purchasing and cancelling eligible emission units (offset credits) generated by projects that reduce emissions in other sectors, such as renewable energy. Cancellation of eligible emissions units for CORSIA compliance takes place on three-year cycles. For example, AOs will be required to cancel enough eligible emissions units to cover their total offsetting obligations for the 2021 to 2023 compliance period by January 2025, and submit a verified emissions unit cancellation report to their state by the end of April 2025.[3] This then repeats on a three-year cycle.
14. At the 41st ICAO Assembly in 2022, several key changes to CORSIA were agreed which determine how future CORSIA offsetting requirements will be calculated.
15. CORSIA defines a baseline level of emissions on international routes above which any growth in emissions will have to be offset, effectively capping net CO_2 emissions at baseline levels. The baseline was originally defined as an average of 2019 and 2020 emissions. However, due to the Covid-19 pandemic, in 2020 the ICAO Council agreed to change this to 2019 emissions levels only for the Pilot Phase (2021-2023).
16. The 41st ICAO Assembly agreed that the baseline from 2024 onwards would be set at 85% of 2019 levels.
17. Under CORSIA, the total CO_2 emissions an individual operator is required to offset each year is calculated using a combination of:
    i. **Sectoral growth factor** (SGF): this represents the international aviation sector's global average growth of emissions each year.
    ii. **Individual growth factor** (IGF): an individual operators' growth each year.
18. As a result, an individual AO's CORSIA offsetting requirements in a given year are calculated by:

$$Operator's\ annual\ CO2\ emissions \times Growth\ factor\ (\%Sectoral + \%Individual) = Operators\ individual\ CO2\ offsetting\ requirements$$

19. The 41st ICAO Assembly also agreed changes to the percentage use of the sectoral and individual growth factors in the calculation of offsetting requirements:
    i. 2021-2032: 100% sectoral and 0% individual.
    ii. 2033-2035: 85% sectoral and 15% individual.
20. Relative to the original growth factors agreed by ICAO (at least 20% IGF 2030-2032, and at least 70% IGF from 2033), this change to the percentage use of the sectoral and individual growth factors is expected to increase the relative offsetting requirements for AOs in mature

[3] Due to the impact of Covid-19 on global aviation emissions, no CORSIA offsetting obligations have been accrued during the 2021-2023 pilot phase. ICAO publishes the Sectoral Growth Factor here: https://www.icao.int/environmental-protection/CORSIA/Pages/CCR.aspx

markets such as the UK, and decrease them for AOs in faster growing markets, including developing countries.

21. AOs can also reduce their offsetting requirements through claiming emissions savings from the use of CORSIA Eligible Fuels (CEF). CEF includes the use of both sustainable aviation fuel (SAF) and lower-carbon aviation fuel (LCAF) and the CEF must meet the Sustainability Criteria agreed by ICAO.[4] AOs can reduce their CORSIA offsetting requirements in a given compliance cycle by claiming emissions reductions from CEF. Emissions reductions from the use of CEF are calculated on a lifecycle emissions basis. This accounts for the fuel's emissions over its entire lifecycle compared to traditional kerosene, including for example accounting for feedstock and fuel conversion processes. An AO's total final offsetting requirements at the end of each compliance cycle are calculated by subtracting the emissions reductions from the use of CEF from the operator's initial offsetting requirements accrued during the compliance cycle.

1.1.2 UK ETS

22. The UK Emissions Trading Scheme (UK ETS) replaced the UK's participation in the EU ETS on 1 January 2021. The UK ETS applies to energy intensive industries, the power generation sector and parts of the aviation sector. For aviation it covers flights within the UK, flights between the UK and Gibraltar, flights departing the UK to the EEA and flights departing Great Britain to Switzerland.[5] Flights from Northern Ireland to Switzerland will be included in the UK ETS from 1st January 2025.
23. The scheme operates on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by sectors covered by the scheme, this limits the total amount of carbon that can be emitted and decreases over time. Within this cap, participants receive free allowances and/or buy emission allowances at auction or on the secondary market, which they can trade with other participants as needed.
24. To comply with the UK ETS, AOs must surrender a quantity of UK ETS allowances each year equal to their CO_2 emissions from aviation activity included in UK ETS scope.
25. In July 2024, the UK ETS Authority published the response to the Developing the UK ETS consultation and the proposed alignment with the UK's target of net zero by 2050.[6] The cap will be aligned with the legally binding 2050 targets by implementing a revised net zero consistent cap trajectory from 2024 to 2030.
26. This analysis uses CORSIA carbon price assumptions consistent with those used in DfT aviation decarbonisation modelling[7] and UK ETS carbon price assumptions published by DESNZ.[8] These assumptions are designed to illustrate the potential range of carbon prices faced by AOs in future for use in scenario analysis. The assumptions do not represent the UK Government's view on the most likely evolution of market prices under any carbon pricing mechanism. The UK Government has no view on the evolution of these prices as the UK ETS works by determining the appropriate level of emissions and allowing the price signal necessary to deliver that ambition.

1.2 Problem Under Consideration

27. The primary problem CORSIA is intended to address is the carbon dioxide (CO_2) emissions that result from international aviation activity. The latest available data indicates that aviation is

[4] ICAO defines SAF as a renewable or waste derived aviation fuel that meets sustainability criteria (https://www.icao.int/environmental-protection/pages/SAF.aspx). LCAF is defined in CORSIA as a fossil-based aviation fuel that meets the CORSIA sustainability criteria. It produces lower emissions over its lifecycle than traditional kerosene (https://www.icao.int/environmental-protection/Pages/LCAF.aspx). The CORSIA Sustainability Criteria for CORSIA Eligible Fuels can be found here: https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx

[5] The full scope of aviation activities included in the UK ETS is outlined in the Greenhouse Gas Emissions Trading Scheme Order 2020 https://www.legislation.gov.uk/uksi/2020/1265/2023-01-01.

[6] Developing the UK Emissions Trading Scheme (UK ETS) - GOV.UK (www.gov.uk)

[7] Jet zero: further technical consultation (publishing.service.gov.uk)

[8] Traded carbon values used for modelling purposes, 2023 - GOV.UK (www.gov.uk)

estimated to have accounted for around 2.4% of global CO_2 emissions from fossil fuel use in 2018, and 9% of UK GHG emissions.[9]

28. UK international aviation emissions have more than doubled since 1990, rising to 36.8 $MtCO_2e$ in 2019.[10,11] Most of the increase came in the 1990s and early 2000s, but emissions have been slowly increasing since 2012.[12] Aviation, at present, is a relatively small contributor to UK greenhouse gas (GHG) emissions. However, its proportional contribution is expected to increase significantly as other sectors decarbonise more quickly. International action is especially important for aviation emissions given the interconnected global nature of the sector. The UK is fully committed to global action on aviation emissions through international processes, including supporting collective action through ICAO. Action at an international level also presents the opportunity to achieve significant reductions in not just UK aviation emissions but all international aviation CO_2 emissions, which were around 600 Mt in 2019 – 17 times greater than the UK's contribution.[13]
29. The UK is committed to implementing CORSIA. As a member of ICAO, the UK is obliged to adopt the relevant Standards and Recommended Practices (SARPs) relating to CORSIA into domestic law.
30. When implementing CORSIA into UK law, the Government has considered how CORSIA should interact with the UK ETS on flights in scope of both schemes. Implementation of CORSIA without further consideration of the interaction between CORSIA and the UK ETS would result in AOs being double charged on these flights for emissions above the CORSIA baseline (i.e. they would face obligations under both CORSIA and the UK ETS for these emissions). This would be expected to arise from 2024 when global aviation emissions are predicted to exceed the CORSIA baseline for the first time.[14]

1.3 Rationale for Intervention

1.3.1 Rationale for implementing CORSIA in the UK

31. The primary rationale for the introduction of CORSIA is the failure of the market to account for the social and environmental costs that result from the carbon dioxide (CO_2) emitted from international aviation.[15] While some national carbon pricing schemes do exist, such as the UK ETS, these are not enough alone to combat the market failure from international aviation.
32. Placing a price on carbon creates the incentive for emissions to be reduced in a cost effective and technology-neutral way, while mobilising the private sector to invest in emissions reduction technologies and measures. CORSIA is designed to help achieve ICAO's medium-term goal of carbon-neutral growth from 2020, by ensuring that the growth in emissions above the baseline is offset by an equivalent reduction in emissions in other sectors meaning net emissions remain at the baseline level.
33. While the aviation sector provides significant economic and social benefits, CO_2 emissions generated by flying causes costs to society, or negative externalities. Negative externalities arise as those emitting CO_2 do not face the full societal cost of their CO_2 emissions and the resultant effects, and therefore produce a higher level of CO_2 emissions than the socially optimal level. Government intervention is required to address this market failure. At present

[9] Final UK greenhouse gas emissions national statistics: 1990 to 2019

[10] Statistics for international aviation are estimated from refuelling from bunkers at UK airports

[11] Final UK greenhouse gas emissions national statistics: 1990 to 2019 - GOV.UK (www.gov.uk)

[12] 2019 UK Greenhouse Gas Emissions, Final Figures (publishing.service.gov.uk)

[13] Joint Research Centre, European Commission, Fossil CO_2 emissions of all word countries – 2020 report, available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC121460

[14] DfT aviation decarbonisation modelling suggests that market demand will return to pre-covid levels by 2030. According to DfT analysis of CAA airports data, a month-to-month comparison of UK airport data suggests PAX demand in December 2022 was 83% of December 2019 levels.

[15] For a summary of the social and environmental consequences of increased atmospheric concentration of greenhouse gas emissions, please see https://www.theccc.org.uk/the-science-of-climate-change/how-a-changing-climate-affects-us/.

CORSIA is the primary coordinated international action that seeks to address the negative externality of CO_2 emissions from international aviation.

34. Government intervention is necessary to ensure that AOs will comply with their offsetting obligations under CORSIA. In the absence of intervention, the UK would not have effective enforcement mechanisms in place to ensure compliance. In the absence of intervention, the UK would also be exposed to a high risk of challenge from other states (through ICAO), industry or environmental groups as it would be in breach of the Chicago Convention.[16] This would also mean that the externality described above is not addressed, as CORSIA seeks to do on emissions above the CORSIA baseline.

1.3.2 Rationale for options to address the interaction of CORSIA with the UK ETS

35. The implementation of CORSIA's offsetting requirements in the UK will need to take into account the UK ETS as flights from the UK to the EEA and Switzerland are in scope of both schemes. Legislation will therefore also need to address how CORSIA and UK ETS will interact.
36. Without further consideration as to how the two schemes should interact, airlines would face obligations under both CORSIA and the UK ETS for some emissions on flights from the UK to the EEA and Switzerland - 'double-charging'.

1.4 Policy Objective

37. The key purpose of government intervention is to facilitate the effective implementation of CORSIA by implementing the CORSIA offsetting provisions into UK law and to ensure that UK AOs comply with them. Market-based measures, like CORSIA and the UK ETS, are an important measure for supporting decarbonisation of the aviation sector.
38. By seeking to ensure consistency with the Standards and Recommended Practices (SARPs), the Government will provide clarity and legal certainty for regulators, AOs, and other relevant stakeholders. This is important for providing certainty to industry and for ensuring ease of compliance.
39. Government intervention is also needed to facilitate CORSIA's interaction with the UK ETS, as legislated for through the UK ETS Order. Implementation of CORSIA without further consideration of the interaction between CORSIA and the UK ETS would result in AOs facing obligations under both schemes for emissions above the CORSIA baseline on flights from the UK to EEA and Switzerland. In considering options for how CORSIA should be implemented alongside the UK ETS, we have sought to ensure we can best uphold both our international commitments to implement and participate fully in CORSIA and our domestic climate ambition, as well as maintaining a well-functioning carbon market in the UK.

1.5 Options Considered

1.5.1 Option 0 – Do Nothing

40. Under the "Do Nothing" scenario, CORSIA's offsetting requirements would not be implemented in UK law.
41. In practice, given the scope of CORSIA legislation is restricted to UK-attributed operators, this would mean that the UK would have no power to enforce CORSIA for UK-attributed AOs, and in the absence of UK legislation we assume that these operators will not offset their emissions under CORSIA. Under the Do Nothing scenario, the UK would be required to file differences against the relevant ICAO SARPs and provide justification for any differences. Non-implementation of CORSIA by the UK is judged to have serious political consequences for the UK's international reputation and could risk undermining the agreement on CORSIA and further

[16] The Chicago Convention, signed in 1944, established the core principles permitting international transport by air, and led to the creation of the International Civil Aviation Organization (ICAO). The CORSIA Standards and Recommended Practices (SARPs) were adopted as an Annex to the Chicago Convention (Annex 16 Volume IV).

global progress on reducing international aviation emissions. Non-UK operators would continue to be subject to CORSIA on flights to and from the UK as they are not in scope of UK legislation for CORSIA and will be administered by their own state. There is a risk, however, that in response to the UK not implementing CORSIA, other states take similar action and do not implement the scheme, meaning non-UK operators will similarly not offset their emissions under CORSIA. This risk is most significant in relation to flights operating to and from the UK given the likelihood that other states would be concerned that applying CORSIA on such routes would put their operators at a competitive disadvantage relative to UK operators.[17]

42. Further, focusing narrowly on UK operators only would risk underestimating the impact of CORSIA on the UK economy more widely (Section 0). We have therefore constructed a precautionary baseline where there is no offsetting under CORSIA on flights to and from the UK by operators of any nationality.
43. In the Do Nothing, the UK ETS would be the only carbon pricing policy for aviation in the UK having been in force since 2021. It is considered in its current design as described in Section 1.1.2, and is not included in the legislation being proposed in this analysis.
44. Whilst we do not consider this option to be viable, it remains fully assessed as the counterfactual in this analysis.

1.5.2 Long-List Options

45. In considering options for how CORSIA should be implemented alongside the UK ETS, we have sought to ensure we can best uphold both our international commitments to implement and participate fully in CORSIA and our domestic climate ambition, as well as maintaining a well-functioning carbon market in the UK.
46. We have also considered the extent to which AOs would be required both to cancel CORSIA emissions units and surrender UK ETS allowances for some emissions on flights from the UK to the EEA and Switzerland, resulting in double charging. The high-level policy options listed below consider a range of approaches for how CORSIA and the UK ETS could interact on these flights.
47. In all high-level policy options presented below, apart from the Do Nothing, AOs would be required to comply with CORSIA for all international flights outside the scope of the UK ETS, where the other state is also a participant in the scheme.[18] The options therefore differ only in the approach taken to applying CORSIA and the UK ETS on flights from the UK to EEA and Switzerland.
48. **Option 1: UK ETS and CORSIA:** The UK ETS and CORSIA would be implemented independently. Operators flying UK to EEA and Switzerland routes would be required to comply with both schemes for emissions above the CORSIA baseline and therefore have overlapping obligations for these emissions.
49. **Option 2: UK ETS only:** Only the UK ETS would apply on UK to EEA and Switzerland flights. UK to EEA and Switzerland flights would not be subject to CORSIA obligations.
50. **Option 3: Price-based hybrid:** Both CORSIA and the UK ETS would apply to UK to EEA and Switzerland flights. Operators would be compensated for the additional cost of complying with CORSIA on these flights. Compensation could be via various means, for example financial compensation or a reduction in UK ETS obligations to the equivalent value.
51. **Option 4: Emissions-based hybrid:** An aeroplane operator's UK ETS obligations would be adjusted by an amount equivalent to their CORSIA obligations on flights from the UK to the EEA

[17] There is also a risk that non implementation of CORSIA in the UK could have wider impacts on flights outside of the UK though this is not the focus of our analysis.

[18] The EU have confirmed that CORSIA will apply for extra-European flights to and from third countries participating in CORSIA. CORSIA will not be applied to flights in the EU ETS scope (intra-EEA and from the EEA to UK and Switzerland. For more details see: ETS_Aviation-Agreed_text_EN.pdf (europa.eu) We are currently considering this issue and impacts for UK-attributed operators flying these routes. The impact of this, and any action taken by the UK in response, will be discussed qualitatively in the final stage impact assessment.

and Switzerland. The supply of UK ETS allowances could also be reduced by an equivalent amount to avoid an over-supply of the UK ETS market.

1.5.3 Qualitative assessment of Long-List Options

52. A multi-criteria type approach was applied to each option using the assessment criteria (see below) to inform the options to take forward to quantitative analysis. Consideration has also been given to the recommendations of the Climate Change Committee who have advised that the approach to interaction between the schemes should be sufficiently environmentally stringent, that no credits from CORSIA should be used for flights currently covered by the UK ETS unless and until they can satisfy strict eligibility criteria (equivalence, additionality, permanence, sustainability) and that double compliance should be avoided.[19]
53. The criteria considered is as follows:
54. **Consistency with the UK's international commitments**: The UK has committed to implementing CORSIA as an ICAO Member State and has participated in the scheme since the start of the Pilot Phase.[20] Some options would apply CORSIA to all applicable flights (1, 3, 4), consistent with the CORSIA SARPs, whilst Option 2 would not apply CORSIA to UK to EEA and Switzerland flights. We also recognise also the intention of ICAO Assembly Resolutions on CORSIA to avoid CO2 emissions from international aviation being addressed more than once, and we have taken this into account in developing the interaction options.
55. **Emissions savings:** The UK Government has committed to decarbonising the UK economy to meet the target of net zero by 2050.[21] CORSIA implementation will result in AOs being required to offset their emissions above the CORSIA baseline, through purchasing eligible emissions units generated by projects which reduce emissions in other sectors. Emissions savings are estimated to be highest under Options 1 and 3, due to the wider application of CORSIA. Under Option 4, emissions savings delivered under the UK ETS would be maintained if a corresponding supply-adjustment is made. If not, emissions savings would be lower overall, with the lack of supply adjustment mechanism risking an oversupply of UK ETS allowances (UKAs) in the market for other sectors to emit. Emissions savings from CORSIA are understood to be lower under Option 2 due to the restricted application of the scheme. Under Option 2 abatement on UK to EEA and Switzerland flights would be delivered solely within aviation or other ETS sectors, rather than out-of-sector reductions that occur elsewhere in the global economy.
56. **Cost to business:** CORSIA implementation will require AOs to purchase CORSIA Emission Units (CEUs) on emissions above the CORSIA baseline. The greatest cost to AOs would arise under Option 1, where AOs would face obligations under both schemes for all emissions above the CORSIA baseline on flights from the UK to the EEA and Switzerland. In Options 2 and 3, AOs will face an additional cost from the application of CORSIA to flights outside of UK ETS scope, but their costs on UK to EEA and Switzerland flights would remain the same as the Do-Nothing. Option 4 would have the lowest cost to AOs. This is because AOs would be required to purchase CORSIA Emissions Units instead of UK ETS allowances on UK to EEA and Switzerland flights. Although uncertain, it is expected that the price of CORSIA units will remain lower than the price of UK ETS allowances for the duration of CORSIA. There is expected to be additional costs to other UK ETS participants under Options 3 and 4 when supply-adjustment occurs, where reduced application of UK ETS to aviation requires additional abatement to be delivered by remaining sectors. The impact on medium, small and micro business under all options will be proportionate to their emissions, and is considered further in Section 4.1.
57. **Abatement incentives:** All options will introduce an emissions abatement incentive, equivalent to the CORSIA carbon price, on flights outside of UK ETS scope. Under Option 1, the abatement incentive on UK to EEA and Switzerland flights would be the highest, due to the

[19] https://www.theccc.org.uk/publication/2023-progress-report-to-parliament/

[20] As committed to in the European Civil Aviation Conference (ECAC) Bratislava Declaration of September 2016 and reconfirmed in writing to ICAO in June 2020.

[21] Government policy on reaching Net Zero by 2050 - House of Commons Library (parliament.uk)

increased carbon costs faced by AOs. Under Option 4, we expect AOs would face a lower incentive to reduce their emissions as they would face lower CORSIA Emissions Unit prices on some emissions on UK to EEA and Switzerland routes, rather than higher UKA prices, resulting in lower levels of in-sector abatement being cost-effective. Under Options 2 and 3, we would expect abatement incentives on UK to EEA and Switzerland routes to remain the same as the Do-Nothing.

58. **Competitiveness impacts:** For this impact assessment, competitiveness impacts are defined as those which could affect an AOs ability to compete with its rivals.
59. The overall competitiveness impacts of each policy option depend on the level of interaction with the UK ETS, and in particular whether AOs will be required to comply with obligations under both schemes for flights from the UK to EEA and Switzerland. Option 1 would have the greatest impact on competition, as AOs with comparatively more flights on UK to EEA and Switzerland routes would face higher costs and a competitive disadvantage. Under Option 2, there is potential for UK-attributed AOs to face lower carbon costs on flights from the UK to the EEA and Switzerland, as responsibility for enforcing CORSIA sits with the operator's administering state. However, we would expect other administering states to avoid this competitiveness impact by applying Option 2 to AOs they administer. There may be a competitive risk for Option 3 subject to when operators are compensated for the cost of CORSIA. Under Option 4, competitiveness impacts may arise due to the potential small reduction in effective carbon prices once global emissions rise above CORSIA baseline levels.
60. There is potential for competitiveness impacts to occur from the EU approach of applying only the EU ETS and not CORSIA to flights in scope of the EU ETS (international intra-EEA and EEA to UK and Switzerland flights), and any discrepancies between the UK and EU approach.[22]
61. Should options which change the UK ETS (3, 4) have an impact on the UK ETS carbon price, this could affect compliance costs for other UK ETS participating sectors. These changes to compliance costs could lead to competitiveness impacts if some firms in those sectors are affected to differing extents.
62. **Operational delivery**: This criterion considers the complexity required to facilitate the delivery of each of the policy options. The hybrid options (3, 4) will require some action by Government and Regulators to amend the UK ETS and would be complex to implement, likely with greater administrative burden. The consideration of carbon prices in Option 3 would add additional complexity. Options 1 and 2 would be simpler to deliver as they maintain the UK ETS in its current form.
63. **Integrity of the UK ETS**: This consideration accounts for any changes to the UK ETS which could present risks to the integrity of the scheme. Options 1 and 2 maintain the UK ETS in its current form. Reducing AO demand for the UK ETS allowances, without an equivalent adjustment in supply, could contribute to a build-up of surplus allowances. If Options 3 and 4 include a supply-adjustment mechanism where demand for allowances is reduced, this would help mitigate this risk by maintaining the environmental ambition of the UK ETS. However, where reduced application of UK ETS to aviation requires additional abatement to be delivered by remaining sectors, this would be expected to lead to a change in UK ETS price. These impacts would be larger under Option 4 due to the greater potential changes in demand for UKAs. This could also be exacerbated by the lower abatement incentive in Option 4.
64. **Revenue**: Government revenue will be impacted where the policy options influence the demand for UKAs or supply of UKAs auctioned under the UK ETS. Options 1 and 2 make no adjustments to the UK ETS and therefore do not impact government revenue. Option 3 may have limited impacts on government revenue where compensation is delivered via, supply adjustment, free allowances, or direct reimbursement. With a supply adjustment mechanism, the hybrid options would reduce the supply of allowances, and government revenue. They could

[22] The EU have confirmed that CORSIA will apply for extra-European flights to and from third countries participating in CORSIA. CORSIA will not be applied to flights in the EU ETS scope (intra-EEA and from the EEA to UK and Switzerland. For more details see: ETS_Aviation-Agreed_text_EN.pdf (europa.eu)

however potentially increase the price of UKAs if more expensive abatement had to occur among remaining participants to retain the level of emissions savings delivered in the counterfactual. The impact on revenue is expected to be greater under Option 4.

65. The following options were discounted after assessment against the criteria and are not carried forward to the short-list:
    - **Option 1**: Under this option, AOs would be double charged on flights from the UK to the EEA and Switzerland for all emissions above the CORSIA baseline (i.e., they would face obligations under both CORSIA and the UK ETS for these emissions). It would introduce the greatest costs to AOs and have the greatest competitiveness impact, as AOs with comparatively more flights on UK to EEA and Switzerland routes would face higher costs and a competitive disadvantage.
    - **Option 4**: As AOs would be subject to CORSIA, and a lower carbon price, for some of their emissions on UK to EEA and Switzerland flights, we expect there would be a lower incentive to reduce emissions. It is likely to have impacts on the UK ETS, such as on the cap, market and allowance price. This option would also reduce government revenues. These impacts are expected to be greater than when the carbon price is accounted for in the design of a hybrid scheme (Option 3). As a hybrid scheme, it would be complex to implement.

66. As such, this analysis takes forward Option 2 (UK ETS only), and Option 3 (price-based hybrid), referred to as Option A and Option B respectively for the rest of this document.

Design options for a price-based hybrid (Option B)

67. The UK ETS Authority[23] has explored various designs of the price-based hybrid scheme, recognising that practically it could function in a variety of ways and would need to account for a number of factors. Through the consultation, the Authority is seeking views on how these considerations should be addressed in the design of a price-based hybrid, should this approach be decided on. The key considerations and how they are addressed in this IA are discussed below.
    i. Establishing a delivery mechanism to compensate aeroplane operators for the costs of compliance with CORSIA offsetting. We have considered adjusting UK ETS surrender obligations, reimbursing operators with UK ETS allowances and financial compensation. These design options do not produce substantively different quantified costs and benefits. However, there would be differences to non-monetised impacts, depending on the option design chosen, such as changes to the UK ETS. These design options are collectively assessed under Option B.
    ii. The frequency of compensation, accounting for the annual UK ETS and three-year CORSIA compliance cycles. For the purposes of the IA, we assume that AOs would comply annually with their UK ETS obligations in line with current requirements and are then compensated retrospectively for the cost of compliance with CORSIA offsetting on flights from the UK to EEA and Switzerland following the CORSIA compliance deadline. This is consistent with the policy approach proposed in the consultation.
    iii. Where UK ETS obligations are adjusted, determining whether and how the overall supply of UK ETS allowances should also be adjusted. Monetised impacts of the price-based hybrid assume that where UK ETS obligations are reduced, supply of UK ETS allowances is also reduced by an equivalent amount. Impacts should this not occur are discussed qualitatively.
68. Determining the prices of CORSIA Eligible Emissions Units and, where equating the carbon prices of the two schemes, UK ETS allowances used to calculate the value of compensation. In this IA, CORSIA carbon price assumptions are taken from DfT aviation decarbonisation

[23] The UK Government, Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland together make up the UK ETS Authority.

modelling[24] and UK ETS carbon price assumptions are taken from DESNZ traded carbon prices for appraisal. [25]

2.0 Costs and Benefits

2.1 Option 0 – Do Nothing

69. The Do Nothing scenario, which all options presented in this analysis are assessed against, is based on a number of assumptions, linked to the consequences of the UK not implementing CORSIA into domestic law (Section 1.5.1). As a result, we assume that under this scenario:
    i. UK-attributed AOs would not offset their emissions on any of their flights for the purpose of CORSIA.
    ii. AOs attributed to other ICAO member states would not offset their emissions on any routes involving the UK.
70. In assessing the impact of the alternative policy options against the Do Nothing scenario we do not confine the scope of our assessment to the impact on UK-attributed operators alone. This is to recognise that for all operators, the additional costs associated with CORSIA implementation could be passed through onto passengers. Passengers on all flights departing from and arriving in the UK are likely to be a mix of non-UK and UK nationals.
71. There are also data constraints and modelling limitations that would mean assessing the impact of the options on UK-attributed AOs only would be complex, time-consuming and disproportionate. To give an indication of scale, in 2022, 48% of international flights departing UK airports were ran by airlines with air operator certificates issued by the UK, according to DfT analysis of CAA airport data.[26]
72. The quantified modelling only assesses the impact of CORSIA on UK departing flights. This is because the CO_2 emissions forecasts come from DfT's aviation model[27], which currently only estimates CO_2 emissions for UK departing flights. The modelling captures all passenger and freighter air traffic movements departing from all UK commercial airports.
73. The impact of the policy options on flights other than those departing the UK are therefore not quantified, due to limitations in our modelling. These limitations include data constraints, and therefore attempts to capture this impact would be complex, time-consuming and disproportionate. These impacts are instead referred to qualitatively throughout the document.

2.2 Cost and Benefit summary

74. Figure 1 contains a list of the costs and benefits we have assessed for each option, whether they are monetised/non-monetised, and the section where the detailed analysis can be found. All the costs and benefits listed are treated equally in the assessment of the policy options presented in this document.
75. The appraisal period we have used is 2023-2035. This is because 2035 is when CORSIA is currently agreed to continue until in its current form.

Figure 1 Summary of costs and benefits included this analysis

	Detail	Approach	Section	Key uncertainties / Sensitivities tested

[24] Jet zero: further technical consultation (publishing.service.gov.uk)

[25] Traded carbon values used for modelling purposes, 2023 - GOV.UK (www.gov.uk)

[26] Data includes direct scheduled and charter passenger and cargo-only Air Transport Movements as reported by UK and UK Crown Dependency reporting airports and recorded in CAA Airport Data. International departures are defined as commercial flights departing a UK or UK Crown Dependency airport where the next step is outside of the UK and UK Crown Dependencies. Domestic departures, movements to oil rigs and all arrival flights are excluded.

[27] Raw CO_2 data from DfT's aviation model, consistent with the DfT aviation decarbonisation modelling 'Continuation of current trends' scenario, and updated macroeconomic assumptions as of Jan 2023. This is consistent with the SAF Mandate Cost Benefit Analysis published in March 2023..

Costs	Purchasing CORSIA Emissions Units (CEUs)	Monetised	2.4.1	**Key sensitivity tested**: Quantity of CEUs demanded
	Fiscal impacts (transfer)	Monetised	2.6.2	**Key sensitivity tested:** Quantity of CEUs demanded and the price of UKAs (Section 2.7.2)
	Abatement costs for remaining UK ETS participants (partial transfer)	Non-monetised	2.8.1	**Key uncertainties**: Whether the UKA price does not differentiate from the Do Nothing.
	Familiarisation costs to AOs	Non-monetised	2.8.2	N/A
	Administrative costs to the regulator and government	Non-monetised	2.8.3	N/A
Benefits	Emissions savings from CEUs	Monetised	2.5.1	**Key uncertainties**: CEUs are fully additional. **Key sensitivity tested**: Quantity of CEUs demanded and value of emissions savings to society (Section 2.7.2)
	Reduction in costs to AOs (transfer)	Monetised	2.6.1	**Key sensitivity tested:** Quantity of CEUs demanded and the price of UKAs (Section 2.7.3)
	Emissions savings from the UK ETS	Monetised	2.3.3.2	**Key uncertainties**: Emissions savings remain the same as the Do Nothing under all options. (Section 3.5.1)
	Positive spillovers	Non-monetised	2.9.1	N/A
Indirect impacts	Impact on carbon leakage and competitive disadvantage	Non-monetised	2.10.1	
	Consumer impacts	Non-monetised	2.10.2	
	Demand impacts	Non-monetised	2.10.3	

76. Figure 2**Error! Reference source not found.** shows a summary of monetised costs and benefits for Option A and B. Figure 3 shows a more detailed analysis of the impacts (i.e. including economic transfers which do not feed into the NPV). Figure 4 shows a summary of the non-monetised impacts which do not feed into the NPV, but are equally important when comparing options. Monetised costs and benefits estimated for Option B are necessarily based on a stylised illustration of a price-based hybrid. This includes, where relevant, an assumption that supply can be accurately reduced in a timely fashion by a quantity equal to demand reduction. Furthermore, non-monetised costs to remaining traded sector businesses is uncertain, and greater NPV figures for the hybrid option should be understood in the context of uncertain risks to UK ETS market integrity.

Figure 2 Summary of Monetised Costs and Benefits, excluding transfers (£bn, 2023 prices, central scenario only)

	Costs	**Benefits**	**Net Present Value**
Option A– UK ETS only	0.33	14.01	**13.68**
Option B – Price-based hybrid	0.45	18.95	**18.50**

The values in this table are the discounted sum of impacts over the appraisal period, 2023 to 2035. The costs reflect the cost of purchasing CORSIA Emissions Units. The benefits reflect the CO_2 emissions savings attributable to CORSIA.

Figure 3 Summary of Analysis, including transfers (£bn, 2023 prices, central scenario only)

	Costs		**Benefits**		
	Purchasing CORSIA Emission units	Fiscal impact*	Reduction in purchasing UK ETS allowances*	CO_2 savings (CORSIA)	CO_2 savings (UK ETS)
Option A – UK ETS only	0.33	0	0	14.01	0
Option B – Price-based hybrid	0.45	1.59	1.59	18.95	0

The values in this table are relative to the counterfactual and represent the discounted sum of impacts over the appraisal period.
*Impacts are social transfers that benefit the recipient and are a cost to the donor and therefore do not make society better or worse off.

Figure 4 Summary of non-monetised costs and benefits

	Non-monetised costs			**Benefits**	**Indirect impacts**		
	Abatement costs for remaining UK ETS participants (Section 2.8.1)	**Familiarisation costs to AOs (Section 2.8.2)**	**Administrative costs to the regulator and government (Section 2.8.3)**	**Positive Spillovers (Section 2.9.1)**	**Impact on carbon leakage and competitive disadvantage (Section 2.10.1)**	**Airfare impacts (Section 2.10.2)**	**Demand impacts (Section 2.10.3)**
A	N/A	Small cost, relative to monetised impacts, associated with familiarisation with legislation.	Low cost to regulator as no additional burden expected for calculating CORSIA offsetting obligations and insignificant enforcement costs. Negligible costs to government.	Decarbonisation of the aviation sector may lead to a small reduction in non-CO_2 climate and air quality impacts.	Low risk of carbon leakage and competitive distortion. Small risk of competitive distortion between UK registered operators and non-UK registered operators flying from the UK to EEA and Switzerland.	No impact on UK to EEA and Switzerland flights. Small increase in average airfares on flights outside of UK ETS scope, due to the introduction of a carbon price.	No demand impact on UK to EEA and Switzerland flights. Increase in airfares on international flights outside of UK ETS scope would likely reduce demand for flights, resulting in a reduction in flights and a small decrease in emissions.
B	For designs involving supply-adjustment, costs to business may increase for remaining UK ETS participants. This is exacerbated by the speed at which global aviation grows. The magnitude of costs are small due to small supply-adjustments.	Small cost, relative to monetised impacts, associated with familiarisation with legislation. Costs will be greater if changes to the UK ETS are made.	Small cost to regulator for enforcement costs. No additional burden expected from calculating offsetting obligations. Admin cost from additionally calculating CORSIA obligations on UK to EEA and Switzerland flights for all in-scope UK ETS operators. Small cost to government from implementing UK ETS changes if required.	Decarbonisation of the aviation sector may lead to a small reduction in non-CO_2 climate and air quality impacts.	Low risk of carbon leakage and competitive distortion.	No impact on UK to EEA and Switzerland flights. Small increase in average airfares on flights outside of UK ETS scope, due to the introduction of a carbon price.	No demand impact on UK to EEA and Switzerland flights Increase in airfares on international flights outside of UK ETS scope would likely reduce demand for flights, resulting in a reduction in flights and a small decrease in emissions.

2.3 CBA Methodology

2.3.1 Estimating CO_2 Emissions

77. The cost-benefit analysis presented in this document is based on estimates of CO_2 emissions of UK international departing flights.[28] These estimated CO_2 emissions are then used to estimate level of CORSIA Emission Unit demand, which in turn is used to estimate the cost to AOs and the emissions savings.
78. As stated in Section 2.1, the CO_2 emissions forecasts for UK departing flights used in this analysis come from DfT's aviation model.[29] These forecasts do not fully account for the impacts of the Covid-19 pandemic on emissions. However, they take account of the latest GDP figures which reflect the impact of Covid-19 to some extent.
79. The DfT aviation model splits the international flights departing from UK airports into a number of 'zones'. These zones can either cover flights between the UK and a city, a country or a region.
80. We have aggregated or disaggregated the estimated CO_2 emissions attributed to flights between the UK and cities or regions to the country level based on historical passenger data from the CAA.[30] For a more detailed explanation of this methodology, please see Annex A. This approach allows us to estimate CO_2 emissions by country destination for UK departing flights.

2.3.2 Estimating CORSIA Emission Unit Demand

2.3.2.1 Methodology

81. The number of CORSIA Emissions Units demanded in respect to UK departing flights varies depending on the policy option. Under Option B CORSIA Emission Unit demand is calculated based on emissions from all UK departing flights (including UK to EEA and Switzerland flights and all other international flights in scope of CORSIA). However, under Option A, demand for CORSIA Emission Units is lower as flights from UK to EEA and Switzerland would not be subject to CORSIA offsetting requirements.
82. As outlined in Section 1.1.1, CORSIA obligations will be calculated based on a dynamic approach, involving a combination of a Sectoral Growth Factor (SGF) and the Individual Growth Factor (IGF) of the AO in question.
83. In this analysis, we have not attempted to calculate the IGF of individual AOs who would be operating on routes covered by CORSIA for proportionality reasons. As discussed in Section 1.1.1, the IGF will not be used to calculate CORSIA offsetting requirements until 2033, where it will only comprise 15% of the overall growth factor. Therefore, calculating the IGFs would be disproportionate as it would be subject to significant uncertainty concerning individual AO emission projections, as there is limited data which could be used to assess the future behaviour of individual AOs. It is also unlikely to materially influence the assessment of costs and benefits.
84. Therefore, we have estimated CORSIA Emission Unit demand based on the SGF alone for the full appraisal period. The calculation for Emission Unit demand used in this analysis is therefore the estimated CO_2 emissions from UK departing flights on CORSIA eligible routes multiplied by the SGF in a given year.[31] However, as in reality the IGF will be used to calculate offsetting requirements from 2033 onwards, it should be acknowledged that the estimates for CORSIA Emission Unit demand 2033-2035 will be subject to a slightly higher level of uncertainty. We would expect that this assumption may on average slightly overstate offsetting requirements for

[28] The analysis focuses on international flights as domestic flights are outside the scope of CORSIA.

[29] Raw CO_2 data from DfT's aviation model, consistent with the 'Continuation of current trends' scenario used in DfT aviation decarbonisation modelling, and updated macroeconomic assumptions as of Jan 2023. This is consistent with the recently published SAF Mandate Cost Benefit Analysis.

[30] DfT analysis of CAA airports data

[31] SGF calculation- (Total CO_2 emissions covered by CORSIA in the given year - average of total emissions covered by CORSIA in reference year) / Total CO_2 emissions covered by CORSIA in the given year.

this period. This is because it is likely that IGFs for AOs operating in the UK market will be lower than the global average, due to the relative maturity of the UK aviation market and the higher projected economic growth in other parts of the world.

85. The route level CO_2 emission data used for calculating the global SGFs, were provided by Manchester Metropolitan University (MMU) and are based on ICAO's 'optimistic' fuel scenario. This is a technology scenario where fleet migrates to the latest operational initiatives, as well as an optimistic fuel burn improvement (1.53% per annum) for all aircraft entering the fleet after 2010 out to 2050. The estimated SGFs are presented in Figure 5.
86. The CORSIA baseline used to calculate offsetting requirements in this analysis is 85% of 2019 emissions for the majority of the appraisal period (2024-2035). This is in line with the agreement of the 41st Session of the ICAO Assembly (Section 1.1.1). For 2023, the baseline used is 2019 emissions, as this is the baseline for the Pilot Phase (2021-2023).

2.3.2.2 Accounting for Covid-19

87. The Covid-19 pandemic has had a major impact on demand for air travel. International travel restrictions and national lockdowns have meant demand for air travel has drastically reduced since the start of 2020.
88. We have accounted for impact of Covid-19 in our analysis through the Sectoral Growth Factor (SGF), which represents the international aviation sector's global average growth of emissions in a given year. To inform this, we have used estimates of international CO_2 emissions provided by Manchester Metropolitan University (MMU), consistent with Committee on Aviation and Environmental Protection (CAEP)/12 GHG Trends. DfT analysis has applied several Covid-19 recovery scenarios consistent with CAEP/12 Covid-19 scenarios.[32]
89. The three Covid-19 recovery scenarios are described below:
    i. High - returns to 2019 demand for air travel in 2024.
    ii. Mid - returns to 2019 demand for air travel in 2026.
    iii. Low - returns to 2019 demand in 2031.
90. A more detailed description of these scenarios is found in Annex B.
91. An adjustment factor calculated from these recovery trajectories has been applied to route level data for all international flights globally to calculate our SGF estimates. To note this implicitly assumes the same pace of recovery from the pandemic for all international routes globally, e.g. including long haul vs short haul, routes between more developed vs less developed countries, and countries well recovered from the Covid-19 pandemic vs those less well recovered.
92. The estimated SGFs are shown in Figure 5 below. These growth factors represent the growth in global sectoral emissions, relative to the CORSIA emissions baseline of 2019 emissions from 2021-2023 and 85% of 2019 emissions from 2024, not an annual year-on-year growth rate.

Figure 5 Estimated Sectoral Growth Factors (%)

Covid-19 Scenario	23	24	25	26	27	28	29	30	31	32	33	34	35
Quick recovery	0	24	25	26	28	28	30	32	34	36	38	40	41
Mid recovery	0	10	13	15	17	19	21	24	26	28	30	31	33
Slow recovery	0	0	0	0	0	4	6	8	11	13	14	16	18

93. For the purposes of this analysis, we have used the 'Mid' recovery scenario developed by MMU in our central analysis as this is the middle of the three scenarios and seems most consistent with recent evidence of recovery; and the Quick & Slow recovery scenarios as sensitivity analysis. However, it should be recognised that there is considerable uncertainty surrounding how the international aviation sector will recover from Covid-19; and that these scenarios should

[32] https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2022/ENVReport2022_Art7.pdf

therefore be interpreted as possible scenarios for how the sector may potentially recover, rather than firm forecasts for how the sector will recover.

2.3.2.3 CORSIA Eligible Fuels

94. As highlighted in Section 2.3.2.1, in this analysis CORSIA Emission Unit demand is estimated using UK departing flight emissions and the SGF only. In reality, an AO can use CORSIA Eligible Fuels (CEFs) to reduce its offsetting obligations and therefore the number of CORSIA Emissions Units it is required to purchase (Section 1.1.1).
95. In this analysis, the use of CORSIA Eligible Fuels has not been quantified due to the high levels of uncertainty surrounding the extent to which AOs will claim CEFs against their offsetting obligations. Therefore, the impact of CEF has not been assessed in central estimates due to the additional uncertainty that would come with monetising the impact. However, a detailed sensitivity analysis to assess the impact the use of CORSIA Eligible Fuels would have on the overall costs and benefits outlined in this analysis was conducted in Section 2.7.5.

2.3.2.4 CORSIA Emission Unit demand and emissions savings

96. We have assumed for all policy options except the Do Nothing, that other states will enforce CORSIA robustly and all operators will comply fully with their CORSIA obligations on UK departing flights, in line with the global agreement on CORSIA.
97. In this analysis, the use of CORSIA Emissions Units for CORSIA compliance is assumed to represent genuine and verifiable emissions reductions. In order to become eligible to sell into CORSIA, carbon market programmes must demonstrate ongoing compliance with criteria and must apply for assessment by responding to the Technical Advisory Body's (TAB) call for applications. The TAB consists of a group of experts who then review programme applications against the CORSIA Emissions Unit Eligibility Criteria (EUC).[33] The EUC were agreed by ICAO member states; the UK and others negotiated for their high environmental integrity, which was largely reflected in the EUC adopted in 2018. The criteria include ensuring that credits are additional, permanent, do no net harm and are only counted once towards a mitigation obligation. The assessment process also includes a public comment period through which external organisations and individuals can submit views on programme applications. The TAB makes recommendations to the ICAO Council based on their programme assessments, and the Council then makes the final decisions on CORSIA eligibility. There are therefore safeguards in place to help ensure the integrity of emissions reductions used for CORSIA compliance. The risks with this assumption are discussed further in Section 3.4.

2.3.3 UK ETS Changes

2.3.3.1 Context: Changes to the UK ETS

98. All analysis within this document has been carried out relative to the Do Nothing scenario of the UK ETS remaining the only carbon pricing scheme applying to the UK aviation sector.
99. Emissions savings under the UK ETS are defined as the difference between the actual emissions in scope of the UK ETS and the UK ETS cap.
100. It is assumed that all UK ETS allowances reach the market in any given year, either through free allocation or auction, i.e., realised emissions within the UK ETS are equal to the UK ETS cap. However, in reality, some pots of allowances such as the Flexible Share and the New Entrants Reserve (NER), may never reach the market. This assumption ensures simplicity as the focus of this analysis is CORSIA implementation and attempting to estimate the number of UK ETS allowances reaching the market each year would be disproportionate.
101. There would be no changes to the UK ETS under Option A, as the UK ETS remains the only carbon pricing scheme on UK to EEA and Switzerland flights.

[33] ICAO: *CORSIA Emissions Unit Eligibility Criteria* (March 2019), here

102. In contrast, depending on the design mechanisms chosen, described in Section 1.5.3, Option B may result in changes to the UK ETS:
    i. Reducing obligations: AOs surrender fewer UKAs as their obligations are reduced based on the cost of CORSIA Emissions Units relative to UK ETS allowances. An equivalent change in the supply of UKAs may be required either by keeping the market under review and adjusting as necessary or by adjusting the supply of allowances dynamically.
    ii. Reimburse with allowances: AO demand for UKAs purchased at auction or on the secondary market would fall due to receipt of allowances. Overall supply and demand for UKAs would be unaffected.
    iii. Financial reimbursement: AOs would be provided separately with financial compensation. There would be no change to AO demand for UKAs and therefore to the UK ETS.
103. Furthermore, the way the hybrid scheme is designed may impact AO behaviour. Generally, economic actors prefer to receive financial compensation, as opposed to 'in kind' compensation, such as reimbursement through allowances or obligations. This is because rational AOs would prefer the freedom associated with financial reimbursement, as opposed to in kind payments, which are restricted in the way they can be used. This preference is likely to be exacerbated as all forms of reimbursement will be made retrospectively after the CORSIA compliance cycle has completed.
104. The consultation also seeks views on whether there are any alternative ways AOs could be compensated for the costs of compliance with CORSIA offsetting. Any changes to policy as a result of consultation will be reflected in the final stage impact assessment.

2.3.3.2 The impact of changes on the UKA price and emissions savings within the UK ETS

105. In this analysis, UK ETS allowance price assumptions are derived from DESNZ's Traded carbon values[34]. The Market Carbon Values series has informed the central scenario in this analysis with the low and high series used for sensitivity analysis.
106. There are assumed to be no deviations from this price series as a result of Option A and Option B, where AOs are compensated with UK ETS Allowances or financially,[35], as no change is made to demand for or supply of allowances in the UK ETS. Section 2.8.1 addresses non-monetised impacts on the UKA price where reduced application of the UK ETS to aviation requires additional abatement delivered by remaining sectors at an increased cost.
107. **For Option B design involving reducing AOs' UK ETS obligations,** as AO surrendering obligations fall, an equal reduction in the supply of UKAs would aim to prevent an oversupply of allowances and hence prevent the UKA price and abatement levels within the UK ETS from dropping. The following impacts are anticipated to increase the UKA price, increasing costs to business, and are discussed in detail in Section 2.8.1.[36]
    i. **Additional abatement from remaining sectors**: where reduced application of the UK ETS to aviation requires additional abatement to be delivered by remaining sectors, the UKA price can be expected to rise as cheaper abatement options are replaced by more expensive options, increasing costs to business for remaining participants.
    ii. **Market dynamics and the timing of any supply adjustment (if required)**: The relative weight of demand and supply for UKAs will inevitably influence the price for which they trade on the secondary market and sell for at auction.

[34] https://www.gov.uk/government/publications/traded-carbon-values-used-for-modelling-purposes-2023

[35] The analysis assumes that there will be no deviation from the price series, however in reality we realise is a possibility for fluctuations in the UK ETS price. This is discussed in Section 2.8.1 and Section 3.5

[36] Increased costs to business from higher UK ETS compliance costs can be understood as a transfer. Where firms passthrough costs to consumers and make no further changes to production, higher compliance costs result in higher government revenues. However, where higher UK ETS compliance costs result in abatement action that would otherwise not take place, these impacts involve the consumption of resources and hence are not defined as a transfer.

108. Figure 6 shows the compensation under Option B, as an equivalent change in the number of UKAs, compared to the overall UK ETS cap[37] (for all participating sectors). This demonstrates the likely small impacts of a price-based hybrid on the UKA price.

Figure 6 Equivalent change in number of UKAs under Option B (in tonnes, mn)

		2023	2024	2025	2026	2027	2028	2029	2030
Develop ETS Cap Scenario: NZS Central Pathway +10Mt		147.2	92.1	86.7	79.1	70.1	53.5	50.9	49.3
High CORSIA Unit demand	**Option B**	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
	% of total Develop cap	0.00%	0.00%	0.00%	0.00%	0.00%	0.56%	0.00%	0.00%
Central CORSIA Unit demand	**Option B**	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
	% of total Develop cap	0.00%	0.00%	0.00%	0.00%	0.00%	0.31%	0.00%	0.00%
Low CORSIA Unit demand	**Option B**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	% of total Develop cap	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

109. Despite the potential for these deviations, for all Option B designs, the analysis concludes there are no changes to emissions savings delivered by the UK ETS, relative to the Do Nothing. We have qualitatively assessed the risk of higher costs to business in Section 2.8.1 & 3.5, however due to the uncertainties described, it has not been possible to quantify these impacts.

2.3.4 Behavioural Response of AOs

2.3.4.1 Context

110. CORSIA implementation will result in the introduction of a carbon price on flights that are outside the scope of the UK ETS. Where the UK ETS already applies a carbon price to emissions, the approach to implementation of CORSIA and resulting impact on the effective carbon price, varies by policy option. The CORSIA Emission Unit prices assumed in this analysis are presented in Figure 7.
111. It is expected that CORSIA Emission Unit prices will be lower than UK ETS allowance prices (Section 2.3.5).

2.3.4.2 Marginal Abatement Incentive (MAI)

112. In all policy options, the incentive AOs face to take action to reduce their emissions – their Marginal Abatement Incentive (MAI) - on flights outside of UK ETS scope will be the price of CORSIA Emissions Units. The MAI on flights from the UK to the EEA and Switzerland may vary depending on the policy option for interaction between CORSIA and the UK ETS.
113. Under Option A, there will be no change in the cost of compliance or the MAI on flights from UK to EEA and Switzerland, relative to the Do Nothing scenario. This is because only the UK ETS would continue to apply to emissions on these flights, as per the Do Nothing.
114. For Option B, we expect the MAI on UK to EEA and Switzerland flights would remain at the UK ETS price, as in the Do Nothing. This can be illustrated by considering an AO incurring UK ETS and CORSIA obligations for a given quantity of emissions on routes from the UK to the EEA and Switzerland. During the three-year CORSIA compliance period, the AO is subject to UK ETS and CORSIA obligations, which increases the MAI above the UK ETS price. At the end of the three-year compliance period the AO receives compensation, through a reduction in UK ETS obligations, allowances or via financial reimbursement. The compensation is equivalent to the

[37] To note this follows the cap trajectory as set out in the Developing the UK Emissions Trading Scheme: main response here Developing the UK Emissions Trading Scheme (UK ETS) - GOV.UK (www.gov.uk)

monetary value of the additional CORSIA obligations charged during the compliance period, and causes the MAI to fall. The AO's total costs over the compliance period are equal to its UK ETS obligations only. Across the three-year compliance period, the AO therefore faces an MAI equal to the UK ETS price, as abatement decisions are assumed to be influenced by the MAI over the compliance period rather than the MAI in a given year. It is important to note that where the value of compensation does not precisely equal the monetary value of the additional CORSIA obligations, the MAI may be lower or higher than the UK ETS price.

2.3.5 Sensitivity Analysis Approach

115. The quantified elements of the cost-benefit analysis are subject to 4 key sources of uncertainty: the growth and trajectory of UK departing flight emissions, the level of Covid-19 recovery and the growth in international CO_2 emissions, carbon price uncertainty and the uncertainty relating to the value of GHG emissions to society.
116. The impacts of these 4 sources of uncertainty are shown with their own sensitivities in each of the corresponding sections of the document (Section 2.7.1 for factors affecting costs, and Section 2.7.2 for factors affecting benefits). An overall sensitivity approach is then taken to assess the impact of these uncertainties on the overall value for money. In the overall low sensitivity, the low Covid-19 recovery scenarios are paired with the relevant low-price assumption and vice versa for the high sensitivity.
117. **The growth and trajectory of UK departing flight emissions:** There is inherent uncertainty surrounding the UK aviation sector's growth and trajectory of emissions over time. Emissions will vary as a result of several factors affecting demand, including macroeconomic conditions and Covid-19 recovery. As such, in this analysis, two sensitivities are presented, alongside the central emission scenario, to represent a higher and lower growth in emissions. The key drivers of the differences between these scenarios are UK GDP growth rates, UK consumption expenditure growth rates, foreign GDP growth rates and oil prices. This is equivalent to the sensitivities conducted for the SAF Mandate Cost Benefit Analysis.[38]
118. **Pace of Covid-19 recovery and growth in international CO_2 emissions**: CORSIA offsetting obligations are driven by the growth in international aviation CO_2 emissions. As such, the growth of international aviation demand and therefore the level of international emissions assumed is a crucial driver of the level of costs and benefits attributed to CORSIA. There is an inherent uncertainty surrounding the aviation sector's recovery from Covid-19 and the growth in international CO_2 emissions more generally, and how these vary across different routes. In this analysis, three different Covid-19 recovery scenarios for international aviation emissions have been tested. These scenarios are described in more detail in Section Methodology above and are consistent with CAEP/12 Covid-19 recovery scenarios.
119. **Carbon prices:** CORSIA and the UK ETS place a carbon price on aviation emissions. The exact carbon prices over the appraisal period will be influenced by factors including: overall market supply and demand, activity type, project location, and costs associated with carbon accounting to ensure units are not double counted.
120. The illustrative CORSIA Emissions Unit prices used in this analysis are taken from DfT's published aviation decarbonisation modelling[39]. They have been converted into 2023 prices to align with the rest of our analysis and are shown in Figure 7.
121. It has not been possible to reflect the uncertainty regarding future prices of CORSIA Emissions Units in the cost-benefit analysis. This is because CORSIA price assumptions do not vary between 2023-2035 for the Low and Mid series. The High price series assumes a significant change in the design of CORSIA from 2030. Whilst this is appropriate for modelling of feasible long-term decarbonisation trajectories, it is not appropriate in the context of this analysis, which is assessing the impacts of UK implementation of CORSIA under its current design. As a result,

[38] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147351/uk-sustainable-aviation-fuel-mandate-consultation-stage-cost-benefit-analysis.pdf

[39] Illustrative CORSIA price series can be found on Page 40 of the Jet zero: further technical consultation (publishing.service.gov.uk)

this analysis does not consider any uncertainty in the CORSIA price in the period to 2035. The government intends to explore the evidence concerning CORSIA prices ahead of the final stage impact assessment, with a view to reflecting uncertainty regarding future CORSIA prices in the final stage impact assessment.

Figure 7 CORSIA Emission Unit Price (£ per tonne of CO_2, 2023 prices)

	23	24	25	26	27	28	29	30	31	32	33	34	35
Central	3.2	4.3	4.3	4.3	5.4	5.4	6.5	6.5	7.6	7.6	8.6	9.7	10.8

122. UK ETS allowance prices are assessed as a sensitivity in the cost-benefit analysis. The price series used for UK ETS allowance prices reflect those published by the Department for Energy Security and Net Zero,[40] and reflect the recent move towards a net-zero consistent cap. These are presented in Figure *8*. The Market Carbon Values UK ETS price series has been used in the central scenario in this analysis, with the low and high series used for sensitivity analysis.

Figure 8 UK ETS allowance price (£ per tonne of CO_2, 2023 prices)

	23	24	25	26	27	28	29	30	31	32	33	34	35
High	64.0	84.0	100.0	114.0	116.0	124.0	118.0	118.0	128.0	131.0	136.0	139.0	149.0
Central	70.0	72.0	79.0	91.0	97.0	98.0	89.0	87.0	94.0	101.0	108.0	111.0	121.0
Low	51.0	63.0	71.0	77.0	73.0	69.0	58.0	56.0	60.0	67.0	70.0	72.0	80.0

123. **Value of GHG emissions to society**: Green Book guidance suggests there is an intrinsic uncertainty over the value of GHG reductions to society.[41] Given GHG savings are the key monetised benefit in this cost-benefit analysis, this is a key sensitivity.
124. The valuation placed on an emissions reduction in this analysis is assumed to be the cross-government central carbon value series for policy appraisal.[42] However, to account for the inherent uncertainty surrounding carbon values, the low and high carbon value series are used as sensitivities in Section 2.7.2 CORSIA Emissions Savings.We have conducted an additional sensitivity analysis, derived from the uncertainty around the volume of CORSIA Eligible Fuels airlines will claim against their offsetting obligations (Section 2.7.5).

2.3.6 Appraisal Assumptions

125. **Appraisal period**: The appraisal period is 2023-2035. This is because 2035 is when CORSIA is currently due to continue in its current form. Legislation to implement CORSIA will also cover any offsetting requirements in respect of the 2022 scheme year.[43] [44] However, AOs have not accrued CORSIA offsetting obligations for the 2022 scheme year as global emissions remained below the CORSIA baseline. As such, extending the appraisal period to 2022 would add no costs and benefits, but would have implications for discounting.
126. **Discount rate**: As per Green Book guidance, the discount rate used in this appraisal is the standard rate of 3.5%.
127. **Discount and price base year**: per the Green Book guidance, the base year for discount and price base values is 2023 (for appraisal metrics).
128. **Social transfers**: Economic transfers pass purchasing power from one group in society to another and do not involve the consumption of resources. According to the Green Book,

[40] Traded carbon values used for modelling purposes, 2023 - GOV.UK (www.gov.uk)

[41] The Green Book (2022) - GOV.UK (www.gov.uk)

[42] Valuation of greenhouse gas emissions: for policy appraisal and evaluation - GOV.UK (www.gov.uk)

[43] Offsetting requirements for the 2021 scheme year were covered in an amendment to the Air Navigation (CORSIA) Order in 2022. https://www.legislation.gov.uk/uksi/2022/1050/contents/made

[44] The requirement for the Regulator to notify aeroplane operators of their 2022 offsetting obligations is contained in the draft SI published alongside this consultation. As legislation was not in place in 2023, the Regulator engaged voluntarily with aeroplane operators to communicate their 2022 offsetting obligations by 30 November 2023, consistent with the CORSIA SARPs.

transfers should not be included in the cost-benefit analysis as they do not make society as a whole better or worse off. In this policy, the changes in the cost to operators of purchasing UK ETS allowances and in government revenues generated from auctioning UK ETS allowances are considered transfers (Section 2.6).

129. **Optimism bias**: Optimism bias is not applied in this appraisal. The main costs of CORSIA implementation are the cost of purchasing CORSIA Emissions Units and the sensitivity on costs is a more appropriate method to capture uncertainty.

2.4 Monetised Costs

2.4.1 Purchasing CORSIA Emission Units

130. Under all the policy options analysed in this analysis, relative to the Do Nothing scenario, AOs will be required to purchase a quantity of CORSIA Emission Units (CEUs) on international flights.
131. The methodology followed to estimate the volume of CEUs demanded is described in Section 2.3.2 above. In summary, CEU demand is calculated by multiplying the estimated CO_2 emissions from UK departing flights, taken from DfT's aviation model, by the estimated sectoral growth factor outlined in Section 2.3.2. Figure 9 shows the number of CEUs demanded under the different policy options analysed in this document, based on the central Covid-19 recovery trajectory.
132. In this analysis we necessarily make an assumption about the behaviour of AOs when purchasing CEUs. We assume that AOs purchase CEUs in the year they accrue those offsetting obligations, due to a lack of evidence about when AOs will make these purchases. In reality, AOs can purchase CEUs at any point over the compliance cycle or for future compliance (providing the units are eligible for that period) to meet their expected obligations.

Figure 9 CORSIA Emission Unit Demand on UK departing flights (tonnes, mn)

Option	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum
A	0	1.7	2.3	2.8	4.0	4.4	5.0	5.5	6.0	6.5	6.8	7.2	7.4	**59.6**
B	0	2.5	3.3	4.0	5.4	5.9	6.7	7.4	8.0	8.6	9.1	9.6	9.9	**80.5**

Values detail the number of CORSIA Emissions Units demanded on UK departing flights under each policy option. The central Covid-19 recovery trajectory scenario is used.

133. Figure 9 shows the number of CEUs demanded on UK ETS routes only (UK to EEA and Switzerland). These values are a subset of the values in Figure 10.

Figure 10 CORSIA Emission Unit Demand on UK ETS Routes (tonnes, mn)

Option	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum
A	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
B	0	0.8	1.0	1.2	1.4	1.5	1.7	1.9	2.0	2.1	2.3	2.4	2.5	**20.9**

Values detail the number of CORSIA Emission Units demanded on UK ETS routes under each policy option. The central Covid-19 recovery trajectory scenario is used.

134. CEU demand would be lower under Option A, as UK to EEA and Switzerland flights would not be subject to CORSIA offsetting obligations. In contrast, the volume of CEUs demanded for Option B include all UK international departing flights (both routes included in the UK ETS and all other international routes in scope of CORSIA).
135. The total cost of purchasing CEUs is determined by the volume of CEUs demanded by AOs (Figure 9) and the price of CEUs (Figure 7).
136. The central estimate of the cost to AOs of purchasing CEUs is shown in Figure 11 below. As CEU demand is lower under Option A, the costs to AOs of purchasing CEUs is lower than

Option B. Sensitivity analysis to account for the inherent uncertainty around the volume of CEUs demanded is presented in Section 2.7.1.

137. As discussed in Section 2.3.2.1, the quantified cost estimates presented in Figure 11 represent estimates of the costs on UK departing flights only. CORSIA will also impose costs on flights by UK and non-UK registered airlines on flights arriving into the UK, as well as on other flights conducted by UK-registered operators between CORSIA participating countries other than the UK, that have not been quantified in this analysis.
138. Costs of purchasing CEUs on flights arriving in the UK are likely to be of a similar magnitude to departing flights. Flights arriving in the UK from other states are not in scope of the UK ETS and so the options for interaction between CORSIA and UK ETS do not affect costs on these flights. However, flights departing from the EEA and arriving in the UK are also in scope of the EU Emissions Trading System (EU ETS), and flights departing Switzerland and arriving in the UK are in scope of the Swiss ETS. As part of changes to the Aviation ETS Directive, the EU has decided to not apply CORSIA on flights in scope of the EU ETS for EU operators on these routes.[45] We are currently considering this issue and impacts for UK-attributed operators flying these routes. The impact of this, and any action taken by the UK in response, will be discussed qualitatively in the final stage impact assessment.
139. There is also likely to be a limited number of flights conducted by UK registered airlines between CORSIA participating states that do not involve the UK, as such the costs associated with this are likely to be small.

Figure 11 CORSIA Emission Unit Cost on UK departing flights (£bn, 2023 prices)

Opt.	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
A	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08	**0.45**	**0.33**
B	0.00	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	**0.60**	**0.45**

The NPV value displays the total discounted cost over the appraisal period.

140. Figure 12 shows the cost of purchasing CEUs on UK ETS routes (a subset of Figure 11 above).

Figure 12 CORSIA Emission Unit Cost on UK ETS Routes (£bn, 2023 prices)

Opt.	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
A	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
B	0	0	0	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	**0.15**	**0.12**

The NPV value displays the total discounted cost over the appraisal period. There is zero offsetting in 2023, and costs in 2024 and 2025 are so low they round to zero.

2.5 Monetised Benefits

141. The benefits monetised in this analysis are the impact on emissions savings from the different policy options.

2.5.1 Emissions Savings

2.5.1.1 Emissions savings under the UK ETS

142. As highlighted in Section 2.3.3, this analysis assumes that under Options A and B there is no change to emissions savings from the UK ETS.[46]

2.5.1.2 Emissions savings from CORSIA implementation

[45] The EU have confirmed that CORSIA will apply for extra-European flights to and from third countries participating in CORSIA. CORSIA will not be applied to flights in the EU ETS scope (intra-EEA and from the EEA to UK and Switzerland. For more details see: ETS_Aviation-Agreed_text_EN.pdf (europa.eu)

[46] While there will be no change to the overall level of emissions savings from the UK ETS there will be a change in distribution of emissions savings between sectors within the UK ETS (Section 2.8.1).

143. In this analysis each tonne of emissions reported as reduced or removed through a CORSIA-eligible programme is appraised as a tonne of emissions reduced or removed. This assumes that all CORSIA Emissions Units are additional in the sense that the activity producing the emissions savings would not have occurred in the absence of carbon finance. In order to supply units through CORSIA, carbon market programmes must demonstrate ongoing compliance with ICAO's criteria including additionality, permanence, no net harm, independent verification and the avoidance of double counting, which are set out in Section 2.3.2.3. The UK successfully negotiated to help ensure these criteria support overall environmental integrity by limiting the uncertainty inherent when emissions reductions are credited against a counterfactual scenario (however stringent) and providing a quality threshold which some programmes partially exceed. For the government response and final stage impact assessment, the government intends to strengthen our evidence base on CORSIA, and associated emissions savings.
144. For all options the volume of emissions savings from applying CORSIA are the number of CORSIA Emission Units purchased. The demand for CORSIA Emission Units for each option, in the central scenario, is shown above in Figure 9.
145. The valuation of emissions reductions in this analysis is consistent with government guidance on valuing greenhouse gas emissions in policy appraisal.[47] The central estimate of emissions savings from CORSIA Emission Units is shown in Figure 13. Sensitivity analysis relating to the inherent uncertainties surrounding carbon values and the quantity of CEUs demanded is presented in Section 2.7.2. These figures also should be read in the context of the qualitative uncertainties relating to additionality highlighted above and in Section 2.3.2.4.

Figure 13 CORSIA Emissions Savings (£bn, 2023 prices)

Opt.	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
A	-	0.48	0.65	0.80	1.16	1.29	1.48	1.66	1.84	2.02	2.17	2.31	2.43	**18.30**	**14.01**
B	-	0.7	0.93	1.16	1.57	1.75	1.99	2.23	2.46	2.69	2.89	3.08	3.24	**24.69**	**18.95**

The NPV value displays the total discounted cost over the appraisal period. The central scenario shown assumes the central Covid-19 recovery scenario and applies the central carbon values.

146. Figure 14 shows emissions savings from CORSIA Emission Units on UK to EEA and Switzerland routes, and is a subset of those shown in Figure 13.

Figure 14 CORSIA Emissions savings on UK ETS Routes (£bn, 2023 prices)

Opt.	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
A	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**-**
B	-	0.22	0.29	0.35	0.41	0.45	0.51	0.57	0.62	0.67	0.72	0.77	0.81	**6.39**	**4.93**

147. Under Option A, abatement on UK to EEA and Switzerland flights would be delivered solely within aviation or other ETS sectors, rather than carbon offsets.
148. The emissions savings delivered by CORSIA, highlighted in Figure 13 and Figure 14, represent realised emissions which are then offset through emissions reductions elsewhere in the global economy under CORSIA. For Option B, the emissions savings are higher than under Option A as the scope of CORSIA is greater and because territorial emissions savings delivered under the UK ETS remain at the same level as the Do Nothing, due to the additional effort from other traded sectors (Section 2.3.4).
149. As discussed in Section 2.3.2.1, the quantified emissions savings presented in Figure 13 represent estimates on UK departing flights. There will be an impact on emissions savings for UK and non-UK registered airlines on flights arriving into the UK, and other flights conducted by

[47] Valuation of greenhouse gas emissions: for policy appraisal and evaluation - GOV.UK (www.gov.uk)

UK registered operators between CORSIA participating countries other than the UK, that have not been quantified in this analysis.

150. For flights arriving into the UK from other international destinations, there will be emissions savings of a similar magnitude for both options.
151. There is also likely to a limited number of flights conducted by UK registered airlines between CORSIA participating states that do not involve the UK, as such the emissions savings associated with this are likely to be small.

Emissions savings from the introduction of a carbon price

152. In addition to the emissions savings derived from CORSIA Emissions Units, the implementation of CORSIA by the UK should incentivise AOs operating to and from the UK to decarbonise at a faster rate than in the Do Nothing scenario. This is because it places a carbon price on some international flights that are currently subject to no form of carbon pricing. In theory, the addition of a carbon price on international emissions should make in-sector decarbonisation more cost effective. AOs could for example decarbonise through operational and technical efficiencies or through the use of sustainable aviation fuel (SAF).
153. The extent to which this occurs has not been monetised due to difficulties in predicting how individual AOs or the sector as a whole will behave. However, these impacts are expected to be small in comparison to the monetised benefits, due to the relatively low cost of CORSIA Emissions Units, relative to the cost of decarbonisation for the aviation sector.

2.6 Monetised Social Transfer Impacts

2.6.1 Purchasing UK ETS Allowances

154. For Option A, there are no changes to the UK ETS, and so no changes to the cost of purchasing allowances for AOs. As discussed in Section 2.3.3, changes to the UK ETS would occur under some variations of Option B, namely where AOs are compensated for the cost of CORSIA offsetting through a reduction in UK ETS obligations or reimbursement of UK ETS Allowances.
155. The cost to AOs of purchasing UK ETS Allowances (UKAs) is determined by the price of traded UKAs (as sold within the market) and the volume purchased by AOs.
156. Depending on the design of Option B, the cost to AOs of purchasing UKAs may change or AOs may receive financial compensation. For simplicity, we refer to this impact as a reduction in the cost of purchasing of UKAs, however, the same conclusions apply to a financial compensation design.
157. The change in cost to AOs of purchasing UKAs, shown in Figure 15**Error! Reference source not found.**, is equal to the cost of purchasing CORSIA Emission Units on UK to EEA and Switzerland routes over the CORSIA compliance period. For simplicity, we calculate the value of compensation based on the cost of purchasing CORSIA Emissions Units on UK to EEA and Switzerland routes on an annual basis within a CORSIA compliance period. AOs are assumed to be compensated in the year of compliance with CORSIA, for example 2028 for the 2024-2026 compliance period. In reality, how the value of compensation is calculated is subject to final policy design, for example which years' carbon prices are used in the calculation.

Figure 15 Value of Compensation to AOs under Option B (£bn, 2023 prices)

Opt	Adjustment	23	24	25	26	27	28	29	30	31	32	33	34	35	(36)	(37)	Sum	NPV
B	3-yearly	0	0	0	0	0	0.01	0	0	0.03	0	0	0.04	0	0	0.07	**0.15**	**0.10**

All numbers are negative. Figures show the value of the reduction in demand for UK ETS allowances under Option B. The NPV value displays the total discounted cost over the appraisal period.

158. We also assessed this impact as a change in demand for UK ETS allowances. The change in demand for UK ETS allowances was calculated by summing the total cost of CORSIA

Emissions Units over the CORSIA compliance period and dividing by the average UK ETS Allowance price over the same period. This estimates a reduction in UK ETS obligations equal to the monetary value of the demand for CORSIA Emissions Units on UK to EEA and Switzerland flights. The resulting values based on our central estimates of the reduction in demand for UKAs and central UK ETS allowance price assumption is shown in Figure 16 below.

Figure 16 Volume of change in demand for UK ETS Allowances (mn)

Opt.	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Sum
B	0	0	0	0	0	-0.16	0	0	-0.29	0	0	-0.46	0	0	-0.61	**-1.53**

Values detail the change in volume of UK ETS allowances purchased by AOs under Option B, compared to Do Nothing.

159. This change to costs for AOs counts as a social transfer from government to firms. In this case, the revenues generated from auctioning allowances under the UK ETS will be reduced and transferred to AOs in the form of reduced costs. As these transfers do not make society as a whole better or worse off, they are not included in the monetised costs and Net Present Value calculations. Note that both UK and non-UK residents will benefit from reduced UK ETS costs, however for the purpose of this analysis the full impact is treated as a social transfer.

2.6.2 Fiscal impacts

160. Under Option A, there will be no fiscal impact.
161. For Option B, there would be fiscal impacts where there are reduced government revenues from reduced supply of UK ETS Allowances to auction, or increased government spending to an equivalent value from financial reimbursements. As previously mentioned, it is assumed in this analysis that government sells all its available auctioned UK ETS Allowances every year.
162. The fiscal impact is assumed to be equal to the value of the compensation paid to AOs for the cost of CORSIA obligations under Option B as shown in Figure 16 and **Error! Reference s ource not found.** above.[48] As above, subject to final policy design, the value of the fiscal impact could differ, depending on whether compensation is based on CORSIA costs in-year or at the end of the compliance period.
163. This represents an economic transfer and so is not included in the monetised costs and Net Present Value calculations.

2.7 Sensitivity Analysis

164. The approach taken to sensitivities is set out in Section 2.3.5. Sensitivity analysis on individual sources of uncertainty costs and benefits has been included, alongside a combined scenario-based approach.

2.7.1 Costs of purchasing CORSIA Emission Units

165. The sensitivity test carried out on the cost of purchasing CORSIA Emission Units relate to the growth of emissions from the UK aviation sector and the recovery of the global aviation sector from the Covid-19 pandemic.
166. Demand for CORSIA Emission Units varies depending on the assumed level of UK emissions and recovery of the global aviation sector from the Covid-19 pandemic. Figure 17 below shows the demand for CORSIA Emissions Units using the high and low bounds of the different UK emissions and Covid-19 recovery scenarios for the different options.
167. Full results of the sensitivity tests performed to test the impact of assumptions relating to 1) the growth of emissions from the UK aviation sector and 2) the recovery of the global aviation sector

[48] This assumption has been made for simplicity. In reality, AOs can purchase UKAs from other scheme participants. However, this would also be classed as a transfer.

from the Covid-19 pandemic are shown in Annex D. They are combined here to present the extreme bounds of CORSIA Emission Unit demand.

Figure 17 CORSIA Emissions Unit demand by Emission and Recovery Scenario (tonnes, mn)

Opt.	Emissions	23	24	25	26	27	28	29	30	31	32	33	34	35	Total
A	High	0.0	4.7	5.1	5.6	7.2	7.5	8.2	8.8	9.4	10.1	10.5	10.8	11.1	**99.0**
	Mid	0.0	1.7	2.3	2.8	4.0	4.4	5.0	5.5	6.0	6.5	6.8	7.2	7.4	**59.6**
	Low	0.0	0.0	0.0	0.0	0.0	0.8	1.3	1.8	2.2	2.7	3.0	3.4	3.7	**18.9**
B	High	0.0	6.8	7.4	8.0	9.8	10.2	11.0	11.8	12.6	13.4	13.9	14.4	14.7	**134.1**
	Mid	0.0	2.5	3.3	4.0	5.4	5.9	6.7	7.4	8.0	8.6	9.1	9.6	9.9	**80.5**
	Low	0.0	0.0	0.0	0.0	0.0	1.1	1.7	2.4	3.0	3.6	4.1	4.5	4.9	**25.3**

Values show the number of CORSIA Emission Units required under each Covid-19 recovery scenario. High assumes high UK departing flight emissions alongside a quick Covid-19 recovery, mid shows the central estimate for UK departing flights with the mid Covid-19 recovery scenario, and the low shows the low estimate for UK departing flight emissions, with a pessimistic global recovery from Covid-19.

168. The cost of purchasing CORSIA Emission Units under varying CORSIA Emission Unit demand, depending on UK emission levels and global Covid-19 recovery scenarios, with a central CORSIA Emission Unit price assumed, is shown in Figure 18 below. It shows that the cost of purchasing CORSIA Emission Units does not vary significantly based on the emissions level or recovery scenario used.
169. There is no variation in CORSIA prices assessed in this analysis, for reasons outlined in Section 2.3.5.

Figure 18 Cost of CORSIA Emissions Units by Emission and Recovery Scenario (£bn, 2023 prices)

Opt.	Emissions	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
A	High	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	**0.5**
	Mid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	**0.3**
	Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	**0.1**
B	High	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	1.0	**0.7**
	Mid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.6	**0.4**
	Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	**0.2**

Values show the cost of CORSIA Emission Units required under each Covid-19 recovery scenario. High assumes high UK departing flight emissions alongside a quick Covid-19 recovery, mid shows the central estimate for UK departing flights with the mid Covid-19 recovery scenario, and the low shows the low estimate for UK departing flight emissions, with a pessimistic global recovery from Covid-19. Costs are positive for High and Mid scenarios from 2024, but estimates are low and round to 0.0.

2.7.2 CORSIA Emissions Savings

170. Sensitivity tests carried out on emissions savings for CORSIA are:
    i. On the growth of emissions from the UK aviation sector and on the recovery of the global aviation sector from the Covid-19 pandemic.
    ii. Different carbon value series to value emissions reductions
171. The figures presented in this section should be read in the context of the uncertainties relating to the additionality of emissions savings highlighted in Section 2.3.2.4.
172. Figure 17 above shows the CORSIA Emission Units demanded on all UK departing flights under different assumptions around UK aviation emissions and the sectoral growth factor because of Covid-19 recovery. The quantity of CORSIA Emission Units demanded also represents the level of emissions savings. Using the central estimate of carbon values, the benefits of emissions savings from CORSIA using the high and low bounds of different UK emissions and global Covid-19 recovery scenarios are therefore shown in Figure 19 below.
173. Full results of the sensitivity tests performed to test the impact of assumptions relating to 1) the growth of emissions from the UK aviation sector and 2) the recovery of the global aviation sector

from the Covid-19 pandemic on emissions savings are shown in Annex C. They are combined here to present the extreme bounds of CORSIA Emission Unit demand, and therefore the level of emissions savings.

174. As would be expected, emissions savings vary depending on the level of recovery and growth in the airline sector. The quicker the sector recovers, the more emissions exceed the CORSIA baseline, leading to greater demand for CORSIA Emission Units, and subsequently greater emissions savings.
175. As highlighted in Section 2.5.1, all the emissions savings delivered by CORSIA shown in Figure 19 represent realised emissions which are then offset elsewhere in the global economy. For Option B, the emissions savings are higher than under Option A as the scope of CORSIA is greater and because territorial emissions savings delivered under the UK ETS remain at the same level as the Do Nothing, due to the additional effort from other traded sectors.

Figure 19 CORSIA Emissions Savings by Emissions Scenario (£bn, 2023 prices)

Opt.	Rec.	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
A	Quick	0.0	1.3	1.4	1.6	2.1	2.2	2.4	2.7	2.9	3.2	3.3	3.5	3.6	**30.2**	**23.4**
	Mid	0.0	0.5	0.6	0.8	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.4	**18.3**	**14.0**
	Slow	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.5	0.7	0.8	1.0	1.1	1.2	**6.0**	**5.3**
B	Quick	0.0	1.9	2.1	2.3	2.8	3.0	3.3	3.6	3.9	4.2	4.4	4.6	4.8	**40.9**	**31.8**
	Mid	0.0	0.7	0.9	1.2	1.6	1.7	2.0	2.2	2.5	2.7	2.9	3.1	3.2	**24.7**	**18.9**
	Slow	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.6	**7.9**	**5.7**

Values show the benefit from CORSIA emissions savings under each Covid-19 recovery and UK emission scenario, using the central carbon price. High assumes high UK departing flight emissions alongside a quick Covid-19 recovery, mid shows the central estimate for UK departing flights with the mid Covid-19 recovery scenario, and the low shows the low estimate for UK departing flight emissions, with a pessimistic global recovery from Covid-19.

176. The carbon values used are consistent with the latest guidance on valuing greenhouse gas emissions in UK policy appraisal.[49] The value society places on carbon is uncertain (Section 2.3.5). The value of the emissions saving benefits in this analysis vary substantially depending on the value placed on carbon.
177. Sensitivity analysis assessing the impact of an all-round lower or higher emissions savings benefit from CORSIA is shown in Figure 20 below. In this table, the low sensitivity assumed low carbon values and a low UK emissions level and low Covid-19 recovery scenario, and vice versa for the high sensitivity.

Figure 20 CORSIA Emissions Savings by Combined Approach (£bn, 2023 prices)

Opt.	Carbon	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
A	High	0.0	1.9	2.2	2.4	3.1	3.3	3.7	4.0	4.4	4.7	5.0	5.2	5.4	**45.3**	**35.2**
	Central	0.0	0.5	0.6	0.8	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.4	**18.3**	**14.0**
	Low	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	**3.0**	**2.2**
B	High	0.0	2.8	3.1	3.4	4.3	4.5	4.9	5.4	5.8	6.3	6.6	7.0	7.2	**61.3**	**47.7**
	Central	0.0	0.7	0.9	1.2	1.6	1.7	2.0	2.2	2.5	2.7	2.9	3.1	3.2	**24.7**	**18.9**
	Low	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	**4.0**	**2.9**

Values show the benefit from CORSIA emissions savings under each combined sensitivity approach.

[49] Valuation of greenhouse gas emissions: for policy appraisal and evaluation - GOV.UK (www.gov.uk)

2.7.3 Cost of UK ETS Allowances

178. This impact is referred to as the reduction in costs of the purchase of UK ETS allowances. However, depending on the final design, it could be realised through financial compensation to the equivalent value.
179. Sensitivity tests carried out on the cost of purchasing UK ETS allowances are:
    i. On the growth of emissions from the UK aviation sector and on the recovery of the global aviation sector from the Covid-19 pandemic.
    ii. The price of UK ETS allowances
180. The price of UK ETS allowances is subject to uncertainty as they are driven by market forces (Section 2.3.5). DESNZ UK ETS price assumptions have been used to construct this sensitivity.[50] The results of this sensitivity analysis are presented in Figure 21 below.

Figure 21 Reduction in cost of UK ETS Allowances by Combined Sensitivity Approach (£bn, 2023 prices)

Opt	Sens.	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Sum	NPV
B	High	0	0	0	0	0	0.03	0	0	0.05	0	0	0.07	0	0	0.10	**0.25**	**0.17**
	Central	0	0	0	0	0	0.01	0	0	0.03	0	0	0.04	0	0	0.07	**0.15**	**0.10**
	Low	0	0	0	0	0	0	0	0	0	0	0	0.02	0	0	0.03	**0.05**	**0.03**

All numbers are negative as they represent a reduction in cost relative to the Do Nothing.

Values the costs to AOs of purchasing UK ETS allowances under different UK ETS price assumptions and different UK and global emissions and Covid-19 recovery scenarios. For Option B, we model compensation to AOs occurring in the year of the CORSIA compliance deadline. In years where the change in costs is listed as 0, AOs face UK ETS obligations consistent with the Do Nothing.

2.7.4 Fiscal impact

181. As explained in Section 2.6.2, the fiscal impact associated with Option B represents an economic transfer. The implications of the sensitivity analysis for the estimated fiscal impacts are therefore the same as the implications for the reduced cost to AOs of purchasing UK Allowances shown in Figure 21 above.

[50] Traded carbon values used for modelling purposes, 2023 - GOV.UK (www.gov.uk)

2.7.5 CORSIA Eligible Fuels

182. This analysis does not account for the use of CORSIA Eligible Fuels (CEF) in reducing demand for CORSIA Emissions Units. The impact of CEF has not been assessed in central estimates due to uncertainty concerning the use of CEF to reduce CORSIA obligations. This sensitivity analysis considers the implications for those estimates of assuming an upper bound for the impact of CEF on CORSIA Emissions Unit demand.

2.7.5.1 Limitations of the Analysis

183. Emissions projections used in this analysis are consistent with the "continuation of current trends" scenario from previous DfT aviation decarbonisation modelling.[51] In this scenario, sustainable aviation fuel (SAF) comprises 2% of the fuel mix by 2030, 4% by 2040, and 10% by 2050.
184. The core analysis presented above implicitly assumes that the CORSIA offsetting requirements are calculated based on emission projections that take account of any emissions reductions associated with the use of SAF. This is not how CEF are formally accounted for in CORSIA. Initial CORSIA offsetting requirements for a given compliance period are calculated based on all emissions from aviation activity, including those emissions released by SAF and other CEF in combustion, effectively assuming all fuel used is kerosene. Lifecycle emissions reductions from CEF are subsequently deducted from initial offsetting requirements to provide final CORSIA offsetting requirements (see equation below) for a given compliance period. Because our emissions projections already include the impact of SAF on emissions, the methodology used to estimate offsetting requirements in this IA is inconsistent with the way in which they are calculated in practice.

$$\text{Initial Offsetting Requirements} - \text{Emissions Reductions from CEF} = \text{Final Offsetting Requirements}$$

185. To correct this inaccuracy in emissions projections would require a rerun of the DfT Aviation Model or an adjustment to be made to the CEU demand estimates used in this IA. Neither option is proportionate, given the resources required to undertake a model rerun, and the additional uncertainty introduced by estimating the appropriate adjustment to CEU demand.
186. In any case, the inaccuracy generated is likely to be very small. The use of SAF in the "continuation of current trends" is very low (2% in 2030). The following sensitivity analysis considers the implications for the analysis of assuming AOs claim high levels of CEF use against their CORSIA offsetting requirements, thereby reducing their demand for CEUs.

2.7.5.2 Comparing SAF and CEF

187. The definition and scope of CEF is wider than that of SAF in the UK SAF Mandate.[52] For example, CEF also includes lower-carbon aviation fuel (LCAF)[53] which is not recognised in the SAF Mandate. Because the wider definition of CEF is not considered in UK domestic policymaking, the DfT Aviation Model does not forecast its uptake. Therefore, the estimates in this analysis are likely to be conservative, as AOs may choose to use LCAF in addition to SAF to further reduce their CORSIA offsetting requirements.
188. However, it is unlikely UK-based AOs, who are those flying most on UK departing routes, will choose to utilise fuels which are outside the scope of SAF as defined by the SAF Mandate. This is because AOs will choose their fuels in response to the suite of decarbonisation policies in place, including the SAF Mandate and the UK ETS. Since UK policy utilises a definition of SAF consistent with the SAF Mandate, there is little incentive for UK AOs to prioritise the uptake of

[51] Jet Zero strategy: delivering net zero aviation by 2050. Available at gov.uk.

[52] Pathway to net zero aviation: developing the UK sustainable aviation fuel mandate - GOV.UK (www.gov.uk)

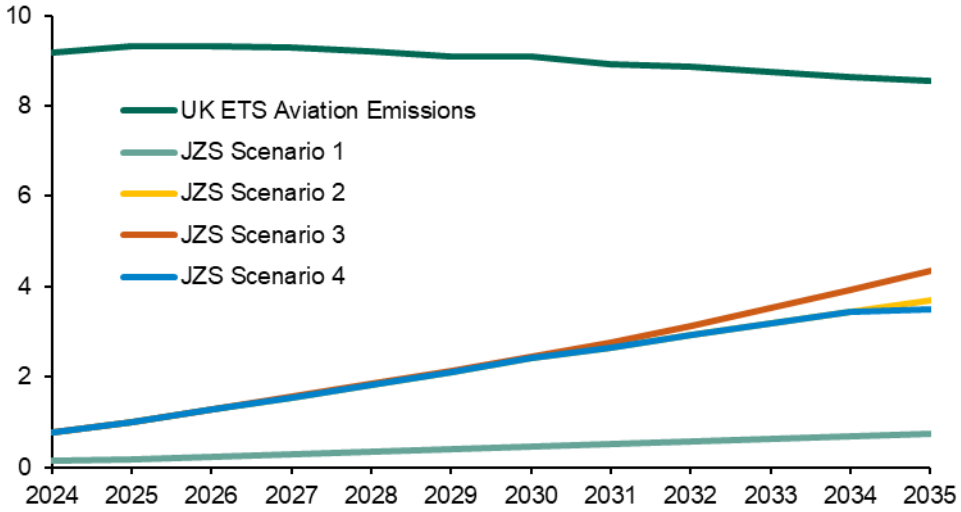
[53] CORSIA Sustainability Criteria for CORSIA Eligible Fuels. Available from icao.int.

alternative fuels, such as LCAF. This minimises the risk that there will be impacts associated with LCAF uptake that are not accounted for in this analysis.

2.7.5.3 AO Behaviour

189. AOs can only claim a unit of emissions reductions from SAF once, under either CORSIA or UK ETS, and not both schemes.[54] There are no geographical restrictions on the supply, delivery or use of the SAF, so it does not have to be purchased or delivered in the UK, or used specifically on flights covered by either scheme. The price of UK Allowances (UKAs) is expected to be higher than the projected CORSIA Emissions Units (CEUs) price assumptions throughout the appraisal period. Therefore, AOs that have both UK ETS obligations and CORSIA offsetting obligations have a greater incentive to claim SAF use against their UK ETS obligations, because the subsequent financial saving on UKAs would be greater. SAF is also currently 'zero rated' (assumed to produce zero emissions) under the UK ETS, as opposed to the calculation of emissions from SAF on a lifecycle basis under CORSIA, further increasing the incentive for AOs to claim under the UK ETS.
190. In the case that AOs claim enough SAF against their UK ETS obligations to reduce them to zero, AOs would likely claim remaining SAF against CORSIA offsetting requirements. This is not expected to occur on an aggregate level during the appraisal period, with emissions in scope of the UK ETS far exceeding the forecasted emissions reductions from SAF, even in the most ambitious DfT aviation decarbonisation modelling scenarios (see Figure 28).[55]

Figure 22 Emissions Savings from SAF (Mt)



191. However, not all AOs flying to and from the UK have UK ETS obligations, since they may not operate flights from the UK to the EEA or Switzerland. In this case, it is expected any SAF or LCAF use will be claimed against the AO's CORSIA offsetting requirements. Due to a lack of evidence, has not been possible to estimate what portion of airlines this applies to, and the corresponding portion of emissions. Therefore, this sensitivity analysis assesses the maximum possible impact of claiming SAF against CORSIA offsetting requirements.

2.7.5.4 Impact on CORSIA Emission Unit Demand

192. This sensitivity test uses the DfT aviation decarbonisation modelling scenario with the greatest emissions savings from SAF - the 'High Ambition with SAF breakthrough' scenario 3 (Figure 22)

[54] Paragraph 2.3.3.2 of the CORSIA SARPs requires that an aeroplane operator shall provide a declaration that it has not made claims for the same batches of CEF under other GHG schemes it participates in.

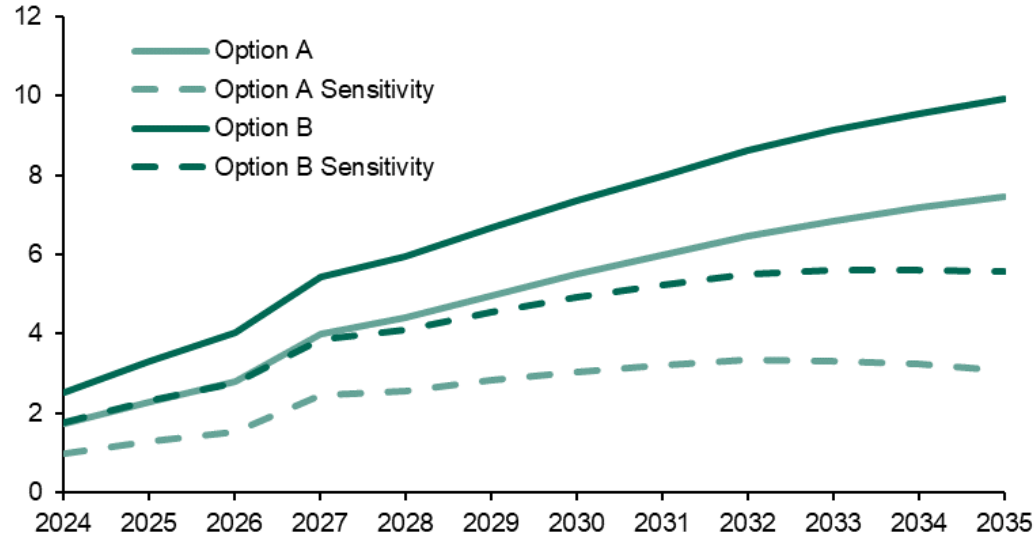
[55] The emissions savings from SAF presented in Figure 22 assume a proportional emissions savings from SAF equal to 70%. In reality, SAF is zero rated under the UK ETS, meaning that SAF emissions savings, as treated under the UK ETS, could exceed those presented in DfT aviation decarbonisation modelling scenarios. The government is looking at ways to mitigate this risk and will publish a consultation shortly.

- to show the largest possible impact of AOs claiming SAF against their CORSIA offsetting requirements.

193. Assuming UK operators do not use alternative aviation fuels, such as LCAF, lifecycle emissions savings estimated for reductions under CORSIA are likely to be close to the 70% reduction assumed in DfT aviation decarbonisation modelling.

194. For this sensitivity, we assume that in Options A and B, CEU demand decreases by the total emissions saving from SAF, modelled for DfT aviation decarbonisation modelling 'High Ambition with SAF breakthrough' scenario. This reduces total CEU demand by 28.7Mt between 2023 and 2035, from 59.6Mt to 30.9Mt in Option A, and from 80.5Mt to 51.8Mt in Option B. The annual impacts are shown in Figure 23.

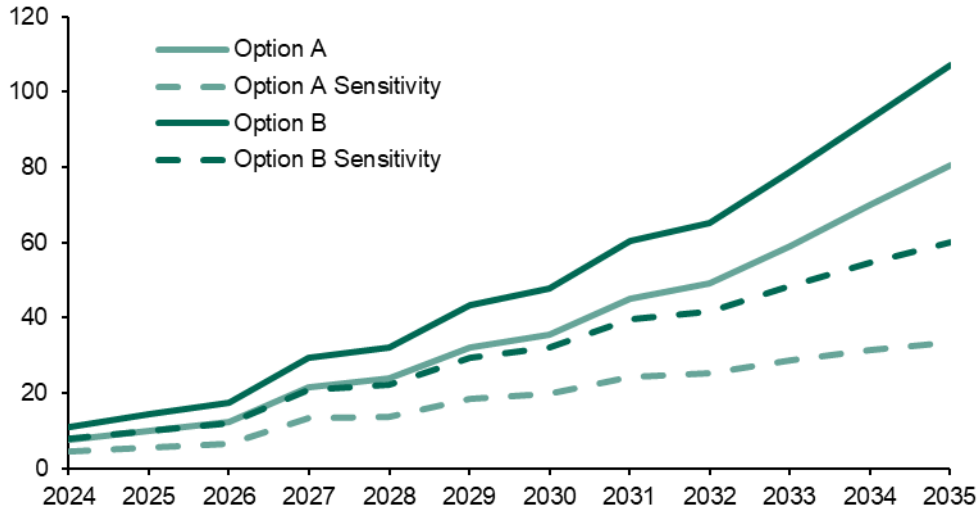
Figure 23 CORSIA Emissions Unit Demand Sensitivity (Mt)



2.7.5.5 Impact on Purchasing CORSIA Emissions Units

195. Following on from a decrease in CEU demand, the cost to AOs of purchasing CEUs decreases by a nominal total of £221.8m (2023 prices) in each option over the appraisal period. In Option A, expenditure on CEUs decreases from £446.5m to £224.7m. Meanwhile, in Option B, spending decreases from £600.0m to £378.2m. The annual impacts are presented in Figure 24.

Figure 24 Cost of Purchasing CORSIA Emissions Units Sensitivity (£m, 2023 prices)



2.7.5.6 Impact on Emissions Savings

196. When an AO chooses to claim a tonne of carbon saved from using CEF against its CORSIA offsetting requirements, the AO is no longer required to purchase a CEU. However overall emissions savings under the sensitivity test do not change compared to the main analysis, because the reduction in emission savings from reduced CEUs is exactly outweighed by the emissions savings associated with greater CEF use (Figures 25-26).

Figure 25 Emissions Savings Sensitivity Distribution (Mt)

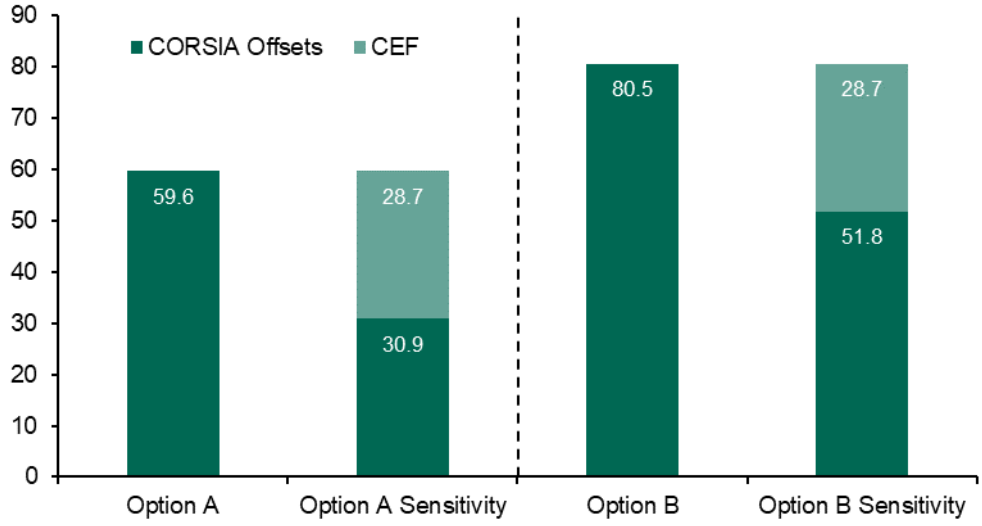
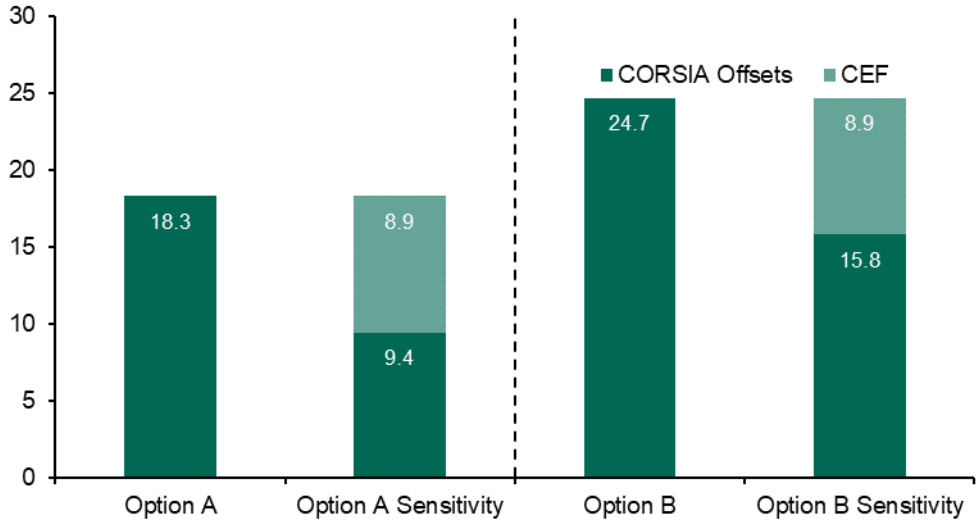


Figure 26 Emissions Savings Benefit Sensitivity Distribution (£bn, 2023 prices)



2.7.6 Combined Scenario-Based Analysis

197. An overall scenario-based approach has been used to assess the impact of different assumptions to test its robustness to differences in conditions and context. The impact of CEF has not been considered in this combined sensitivity analysis as the aim of the combined scenario is to test the impact of CORSIA under the various uncertainties around aviation sector growth. However, any use of CEF would result in lower costs and benefits attributed to CEUs (Section 2.7.5).
198. The overall scenarios combined the different sensitivities for both cost and emissions savings. For cost, the high scenario considers the highest volume of CEUs demanded due to an optimistic global Covid-19 recovery and high UK emissions scenario. For benefits, the high scenario considers the highest level of global Covid-19 recovery and high UK emissions scenario, combined with the highest cost of carbon. The opposite applies for the low sensitivity.

199. The low and high sensitivity ranges, shown in Figure 27 below, always indicate value for money. In all scenarios, the benefits substantially outweigh the costs. However, there are a number of other key uncertainties and non-monetised costs highlighted in Figure 1, that should be considered when interpreting the NPVs.

Figure 27 Sensitivity Scenarios (£bn, 2023 prices)

Scenario	Option	Cost of CORSIA Emission Units	Emissions Savings	NPV
High	A	0.54	35.16	**34.61**
	B	0.73	47.71	**46.98**
Central	A	0.33	14.01	**13.68**
	B	0.45	18.95	**18.5**
Low	A	0.12	2.15	**2.04**
	B	0.15	2.87	**2.72**

Values show the costs and benefits of different options under the overall sensitivity scenarios. All values are discounted totals over the appraisal period.

2.8 Non-Monetised Costs

2.8.1 Abatement costs for remaining UK ETS sectors

2.8.1.1 Abatement costs under Option A and Option B delivered by reimbursements

200. For Option A and where Option B is delivered via reimbursements, there is no change in UK ETS supply and hence no change in abatement for traded sectors.

2.8.1.2 Abatement costs under Option B delivered by a reduction in UK ETS obligations and corresponding supply-adjustment

201. Where Option B is delivered via a reduction in UK ETS obligations and a corresponding adjustment to supply, this represents an effective reduction in the scope of the UK ETS. The reduction in scope inherently moves some abatement options, which may have been cost effective, out of the scope of the UK ETS. Additional abatement is delivered by remaining sectors, such that the UKA price can be expected to rise as cheaper abatement options are replaced by more expensive options, increasing costs to business for remaining participants. The scale of the UKA price increase is dependent on the cost-effectiveness and quantity of CO_2 reduced by abatement options available to UK ETS sectors over time. Due to high uncertainty and a lack of available evidence this impact is not quantified in the cost-benefit analysis. However, the overall magnitude of these impacts is likely to be small. This is because CORSIA obligations are expected to make up a small proportion of the total UK ETS cap. Furthermore, the cost of compensation based on the price of CEUs relative to the comparatively high price of UKAs is low, meaning the size of the reduction to UK ETS obligations is expected to be small.
202. This impact could be influenced by the speed at which global aviation emissions grow. As global aviation emissions grow, UK AOs' CORSIA obligations as a proportion of combined UK ETS and CORSIA obligations on UK to EEA and Switzerland routes increase. For any design that involves reducing AOs' UK ETS obligations, as global aviation demand grows, the more the UK ETS supply must be adjusted, increasing UKA prices.

2.8.2 Familiarisation Costs

203. Under both options, there will be costs to AOs of familiarisation with CORSIA legislation and the resulting compliance. It is not possible to monetise the cost to AOs of familiarisation with the proposed legislation under either option due to uncertainty about the exact level of familiarisation required, as CORSIA is an international obligation for which information is already

publicly available. To give a sense of scale, the UK currently regulates ~25 aeroplane operators for CORSIA. The exact number of operators in scope of CORSIA varies depending on annual emissions. However, it is expected that these costs will be very small in comparison to the monetised costs, therefore, it is unlikely to influence the Business Impact Target. A qualitative assessment is provided instead.

204. We anticipate the cost of familiarisation with CORSIA related documents across the two policy options to be similar. However, under Option B there would be an additional level of familiarisation required, as there may also be changes to the UK ETS. This is expected to result in a greater administrative burden for AOs due to the additional complexity, however it is expected that the majority of the administrative burden under this option would fall to regulators and to government. Furthermore, the detailed policy design of Option B is subject to consultation and so the exact nature of any required changes to UK ETS legislation would still need to be finalised.

2.8.3 Administrative Costs

2.8.3.1 Cost to the UK Regulator

205. There will be an administrative cost to the CORSIA Regulators[56] associated with calculating and reporting offsetting obligations to ICAO for UK attributed AOs under both options, which is recoverable though their respective charging schemes. Informing AOs of offsetting obligations is delivered as part of ongoing communication between the regulator and the AO.
206. The administrative cost to the regulator will be greater in Option B. This is because, under all potential designs, the regulator would be required to additionally calculate the cost of CORSIA obligations on UK to EEA and Switzerland flights for all in-scope UK ETS operators, not just those operators attributed to the UK under CORSIA. Where UK ETS obligations are reduced, the Regulator would be responsible for any action relating to the adjustment of the UK ETS obligations, with the approval of the UK ETS Authority. Reimbursement with allowances would fall under the remit of the Authority.

2.8.3.2 Cost to Government

207. Under Option A, no changes will be made to the UK ETS and therefore any administrative costs to government would be negligible.
208. There will be a small administrative cost to government under Option B as the government will play a role in implementing changes to the UK ETS if required, such as any supply adjustment, or in providing separate financial compensation. However, we do not expect these costs to be significant and have not monetised these costs for the purposes of this analysis, due to a lack of data and given no similar changes have been made in the past.

2.9 Non-Monetised Benefits

2.9.1 Positive Spillovers

209. As discussed in Section 2.5.1.2, the implementation of CORSIA by the UK should incentivise AOs operating to and from the UK to decarbonise at a faster rate than in the Do Nothing scenario, as it places a carbon price on some international flights that are currently subject to no form of carbon pricing.
210. Any decarbonisation of the aviation sector which results from CORSIA could lead to positive spillover effects such as a reduction in non-CO_2 climate and air quality impacts.
211. Currently, CORSIA only covers CO_2 emissions, though aviation also affects the climate through non-CO_2 impacts. Emissions from nitrogen oxides (NOx) and the formation of contrail cirrus

[56] The CORSIA Regulators are the Environment Agency, Natural Resources Wales, Scottish Environment Protection Agency and the chief inspector in Northern Ireland. The Environment Agency regulate the majority of UK-attributed AOs under CORSIA.

clouds are understood to represent a large magnitude of aviation's non-CO_2 climate impact. Evidence on these non-CO_2 impacts and the extent to which they can be reduced is still being developed. However, the use of more efficient aircraft or reduction in demand, resulting from the application of a carbon price, may have a corresponding positive impact on reducing non-CO_2 impacts.

212. However, any impact on air quality and non-carbon climate impacts will only occur to the extent to which CORSIA incentivises wider decarbonisation within the aviation sector. Furthermore, there is uncertainty regarding the impact different actions to reduce CO_2 emissions will have on non-CO_2 climate impacts.

2.10 Indirect Impacts

2.10.1 Carbon Leakage and Competitive Disadvantage

213. The impacts CORSIA implementation will have on carbon leakage and competitive disadvantage are considered twofold: the impacts of implementing CORSIA itself and the approach to interaction between CORSIA and the UK ETS. These impacts have not been monetised due to complexities and data constraints associated with predicting airline behaviour. Furthermore, the competitive impacts will vary by airline, depending on their relative route networks, and their exposure to the carbon price on UK to EEA and Switzerland and other international routes.
214. In summary, CORSIA has been designed to avoid competitiveness and carbon leakage impacts through its 'route-based approach', which ensures that all airlines face obligations on the same route, regardless of the nationality of the airline. In addition, there is strong global participation in CORSIA, with 126 States participating from 2024, meaning routes without coverage are minimal, which limits the scope for competitive and carbon leakage impacts.
215. The cost of purchasing CORSIA Emissions Units will affect the level of carbon leakage and competitiveness impacts of the application of CORSIA.
216. The independent economic research presented in Box 1[57] assessed the impact of carbon leakage in the context of UK ETS reform, including interaction with CORSIA.

Box 1: Economic Research on the impacts of carbon pricing in the UK aviation sector
The UK Government's Department for Transport and the Department for Business, Energy and Industrial Strategy jointly commissioned an external economic research study to develop a robust evidence base on the extent to which potential aviation carbon pricing policies applied to UK departing flights could lead to carbon leakage and competitive disadvantage.

The research defined carbon leakage and competitive disadvantage:

- **Carbon leakage**: Where a carbon mitigation policy implemented in one area leads to a change in emissions outside of the policy area. It can be both positive and negative. Positive leakage would refer to a climate policy leading to an increase in emissions outside the policy area, whilst negative carbon leakage would refer to a decrease. Carbon leakage can occur through customer reactions (changes to demand) and airline reactions (changes in capacity or decarbonisation).
- **Competitive disadvantage**: where a carbon mitigation policy increases costs for operations within the policy area, and the business in the policy area experience a significant adverse impact on their ability to compete. This disadvantages companies with a larger share of operations in the policy area compared to those with a smaller share of operations in the policy area.

217. The study outlined in Box 1 found that there was minimal risk of carbon leakage from carbon pricing of the aviation sector, within the modelled scenarios. The impact of CORSIA

[57] www.frontier-economics.com

implementation, on routes outside the UK ETS scope, was not considered as part of the study outlined in Box 1. However, the framework used for assessing carbon leakage in report, has been used here to assess the impact of carbon leakage from the scheme as a whole. As such, the definition of carbon leakage used in this analysis is consistent with the report in Box 1 and may differ from other definitions used across government.[58]

218. On the demand side, carbon leakage from implementation of CORSIA may occur where passengers:
    i. Reduce their demand for air transport and do not shift this demand elsewhere (no-substitution).
    ii. Take an alternative mode of transport (e.g., surface transport).
    iii. Substitute to a different aviation route (i.e. switching to a flight where carbon pricing does not apply or an itinerary avoiding a carbon price).
219. On the supply side, carbon leakage from implementation of CORSIA may occur where airlines:
    i. Change capacity on specific routes in response to lower demand.
    ii. Reallocate aircraft between routes or replace high-emissions aircraft (e.g., where an airline assigns or invests in low emissions aircraft for CORSIA routes)
220. The magnitude of the passenger reaction depends on the degree of cost pass through onto ticket prices (Section 2.10.2). However, at any level of cost pass through, carbon leakage via passengers switching to alternative transport modes is found to be minimal where viable alternative transport methods for international flights and different aviation routes outside the scope of CORSIA are likely to be limited.
221. Carbon leakage via passengers switching to alternative routes will be minimal as a large proportion of states are subject to CORSIA, and as the low projected CORSIA Emission Units prices mean CORSIA carbon pricing is anticipated to compose a small proportion of overall journey costs. Likewise, competitive disadvantage would occur if CORSIA increases costs to the extent that AOs experience an adverse impact on their ability to compete. However, all airlines operating on CORSIA routes will face the same incentives to decarbonise, as all operators on a given 'CORSIA route' will face CORSIA offsetting obligations. Furthermore, CORSIA is likely to only lead to a small impact in air fares (Section 2.10.2).
222. Despite the competitive impacts at a route-level being minimal, in theory, AOs who have more routes outside the scope of CORSIA will have a competitive advantage over those who have more. However, given the wide scope of CORSIA there are limited routes upon which this competition distortion can occur. From an airline reaction perspective, carbon leakage will also be limited by the degree of CORSIA coverage.
223. New entrants are exempt from CORSIA offsetting requirements for the first 3 years, or until the new entrant's annual emissions exceed 0.1% of total 2019 CO_2 emissions from international flights. This means that new entrants will have lower costs than other AOs participating on the same routes, until they are required to offset emissions, giving them a slight competitive advantage.

2.10.1.1 Competitiveness impacts and carbon leakage on UK to EEA and Switzerland flights

224. The study described in Box 2 found that the policy options assessed for the interaction between CORSIA and the UK ETS on flights from the UK to the EEA and Switzerland were found to have minimal impacts on carbon leakage.[59]
225. The precise impact on competitive disadvantage and carbon leakage may vary by policy option and is explored further below. Overall, we expect the impacts to be minimal under both options.

[58] His Majesty's Treasury and the Department for Business, Energy and Industry Strategy published a consultation on carbon leakage which uses a slightly narrower definition, which excludes internal carbon leakage. Addressing carbon leakage risk to support decarbonisation - GOV.UK (www.gov.uk)

[59] The options for interaction between CORSIA and the UK ETS assessed in the study reflect Options 1, 2 and 4 from the longlist in this analysis. The options were numbered differently in the study.

226. The risk of adverse competitiveness impacts differs under each option. However, under Option A and B, the extent of adverse competitiveness impacts depend on the extent to which UK-based carriers compete with non-UK based carriers over similar route networks.
227. Under Option A, there is potential for competitive distortion to occur between operators flying from the UK to the EEA and Switzerland as responsibility for enforcing CORSIA sits with the operators' attributed state (Section 3.2).
228. Under Option B, there will be a different application of carbon pricing schemes to certain operators or flights, for example, application to helicopters which are in scope of CORSIA, but not the UK ETS. However, we do not anticipate there to be any impacts resulting from these discrepancies, as the MAI for Option B for flights to the UK to EEA and Switzerland, described in Section 2.3.4, is expected to be equal to the UK ETS price over the course of the CORSIA compliance period.
229. For Option B, as compensation would be provided retrospectively following CORSIA compliance there may be an additional competitive risk for airlines with a greater proportion of UK to EEA and Switzerland routes, as AOs would comply with both schemes temporarily before the compensation for the costs of CORSIA offsetting were provided. For the period in which AOs effectively faced two carbon prices on the same emissions, these airlines would be comparatively worse off. However, airlines would be compensated at the end of the compliance period, the aim of which would be to negate any long-term risks to competitiveness.
230. The precise design of Option B is still to be decided. The mechanism for compensation, whether via the UK ETS or financial compensation, and how the compensation is calculated, will influence the value to AOs. The implications of the final design for competitiveness will be considered in the final stage IA.

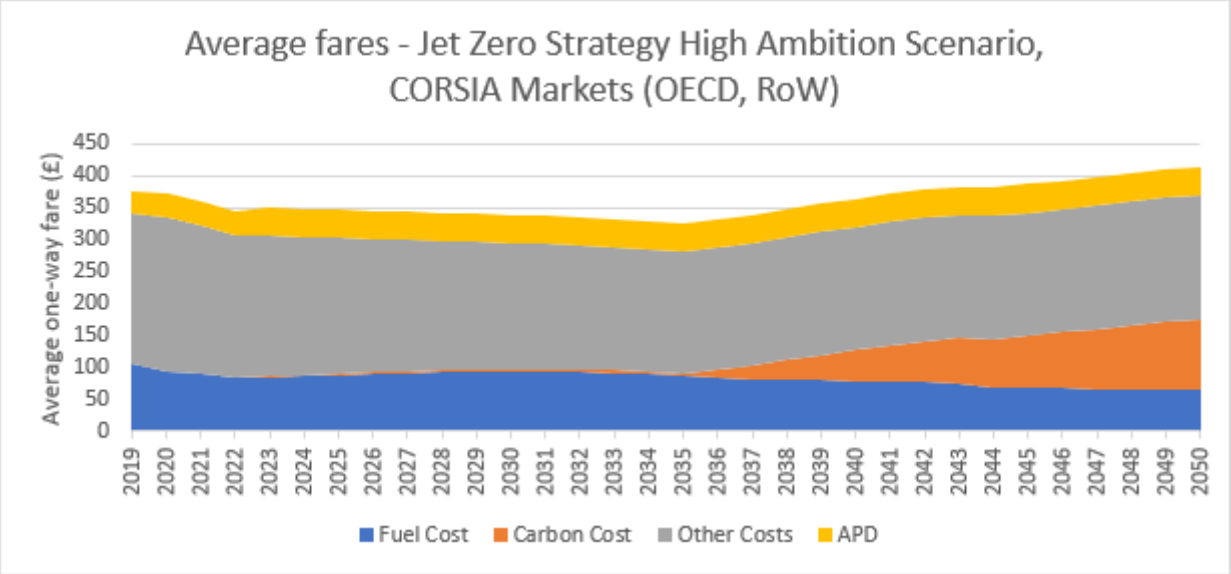
2.10.2 Airfare Impact

231. We assume that carbon costs are passed through to consumers, all else being equal. Our assumptions on carbon cost passthrough are informed by the study referenced in Box 2.
232. The introduction of a CORSIA Emission Unit price is a change in direct marginal cost. This is because the carbon price affects the cost of fuel consumption, which affects the cost of adding capacity. If marginal costs increase, then direct costs increase, which will result in airlines reducing capacity on a route, investing in decarbonisation technologies or purchasing offsets and allowances, which on average results in higher prices.
233. As a result, we have assumed that the carbon costs would be likely passed onto consumers in the form of higher air fares on average. In reality, it is not possible to know how airlines will recuperate these costs, and the approach will likely vary by airline.
234. The overall level of passthrough will depend on a range of factors:
    i. The number of airlines competing in a market: The higher the level of competition, the closer prices will be to marginal costs, and so it is more likely that airlines will be forced to pass any changes in costs through to the consumer.
    ii. Airport capacity: At congested airports, where ticket prices may be based more on willingness to pay rather than cost, we might see less cost passthrough. The extent to which this occurs is not strongly impacted by carbon price, but in practice, passthrough may be higher if carbon prices rise beyond airlines ability to absorb them.
235. This analysis does not attempt to quantify the impact on air fares, as the policy options are only expected to have a small impact on individual ticket prices, compared to the Do Nothing and quantitative analysis would not be proportional. Despite the fact CORSIA will apply to a significant proportion of flights that to date have not yet been subject to carbon pricing, the CORSIA price is relatively low, accounting for a very small fraction of overall airline costs, as such, we expect the impact on ticket prices to be low. Furthermore, DfT aviation decarbonisation modelling, shown in Figure 28, found that carbon costs, including the UK ETS

and CORSIA, account for a relatively small proportion of total airfares, especially before 2035 – the time horizon of the analysis presented in this analysis.[60]

236. In both options, AOs would face increased costs on all other international flights in scope of CORSIA (non-UK to EEA and Switzerland routes), due to the introduction of a new carbon price, and are likely to pass these costs onto consumers, leading to higher air fares on average.

Figure 28 Average airfares – DfT high ambition scenario, central carbon market



Consumer impact on UK to EEA and Switzerland flights

237. Under both options, the overall cost to AOs and marginal abatement incentive would be the same as the Do Nothing option for flights from the UK to EEA and Switzerland, and therefore we would not expect an impact on ticket prices.

2.10.4 Demand Impacts

238. The impact of CORSIA on ticket prices could then lead to an impact on passenger demand. As outlined above, for all applicable international flights departing the UK that are currently not subject to a carbon price (i.e. outside of UK ETS scope) the introduction of a carbon price under CORSIA is expected to be passed through to ticket prices.
239. Any increase in air fares resulting from the application of CORSIA will likely lead to a reduction in demand for flights. It follows that there would also be a small reduction in emissions, to the extent to which demand falls. However, as CORSIA Emission Unit prices are relatively low, this impact is likely to be small.
240. For UK to EEA and Switzerland flights, for both options, as we expect no impact on ticket prices, there would be no demand effect on these flights. This is because these flights would continue to be subject to the UK ETS price only as CORSIA would not be applied (Option A), or the marginal abatement incentive faced by airlines would remain equal to the UK ETS price over the CORSIA compliance period (Option B).

3.0 Risks and Unintended Consequences

3.1 An Untested Scheme

241. CORSIA is a new international scheme, and its implementation is untested. A risk therefore exists that the scheme presents unanticipated complexities for AOs when implementing. These risks would be mitigated centrally through ICAO as far as possible, through triennial reviews of

[60] Jet zero: modelling framework (publishing.service.gov.uk)

the scheme. Further AOs have been successfully monitoring, reporting and verifying their emissions under CORSIA since 2018. The scheme has been developed over several years, and subject to significant scrutiny and input from industry and governments across the world. The SARPs establish a detailed framework for its implementation, accompanied by guidance and technical manuals, which are updated and refined to address any small issues identified during CORSIA's operation. The Environment Agency also publishes detailed guidance for UK AOs complying with CORSIA.[61]

3.2 CORSIA Enforcement

242. Routes between participating states in CORSIA are subject to offsetting requirements - so as both the UK and EU Member States have committed to participating in CORSIA, flights between them are defined by the ICAO SARPs as subject to offsetting requirements, regardless of the nationality of the operators flying these routes. Under Option A, we assume that CORSIA offsetting obligations are not applied in any form on flights from the UK to the EEA and Switzerland, despite those flights being between CORSIA participating states.
243. However, in reality, non-UK operators are administered by their own state for the purposes of CORSIA. While the UK may choose not to apply CORSIA for UK-attributed operators on flights from the UK to the EEA and Switzerland, it is for other administering states to determine whether to take similar action should they have responsibility for operators with CORSIA obligations on these flights. If other administering states do not take action, there is a risk that non-UK operators could be subject to both CORSIA and UK ETS obligations on these flights, which could put them at a small disadvantage compared to their UK competitors.[62] However, other states would have an economic incentive to take action to address the risk of competitive disadvantage. As a result, we have assumed in this analysis that for Option A other states would act similarly to the UK and exempt their registered airlines from CORSIA on flights from the UK to the EEA and Switzerland.

3.3 Non-Compliance

244. There is a risk that under Option A, where CORSIA would not apply for UK-attributed airlines on flights in scope of the UK ETS, that there could be a knock-on impact on compliance with the UK ETS from non-UK registered AOs. If the attributed states of non-UK AOs do not exempt them from CORSIA obligations on UK ETS routes, there is a risk that these AOs could fail to comply with one, or both, schemes, in order to reduce their exposure to double charging. It may be particularly likely that they do not comply with UK ETS, as this is an obligation to a foreign government. This risk has been mitigated as far as possible due to the robust enforcement regime of the UK ETS in UK legislation, where penalties exist for non-compliance.

3.4. Additionality of CORSIA Emissions Units

245. In this analysis each tonne of emissions reported as reduced or removed through a CORSIA-eligible programme is appraised as a tonne of emissions reduced or removed. This assumes that all CORSIA Emissions Units (offsets) are additional in the sense that the activity producing the emissions savings would not have occurred in the absence of carbon finance. In order to supply units through CORSIA, carbon market programmes must demonstrate ongoing compliance with criteria including additionality, permanence, no net harm, independent verification and the avoidance of double counting, as set out in section 2.5.1.
246. The UK successfully negotiated to help ensure these criteria support overall environmental integrity by limiting the uncertainty inherent when emissions reductions are credited against a

[61] https://www.gov.uk/guidance/corsia-how-to-comply

[62] The extent of this competitive disadvantage is expected to be small, given the low additional cost of CORSIA Emissions Units, relative to the cost of UK Allowances on these routes.

counterfactual scenario (however stringent) and providing a quality threshold which some programmes partially exceed.

247. For the government response and final stage impact assessment, the government intends to strengthen our evidence base on CORSIA, and associated CORSIA emissions savings.

3.5 Risks associated with a supply-adjustment mechanism

3.5.1. Impact of misaligned supply / demand adjustments in UK ETS

248. Some designs of Option B would see a corresponding reduction to UK ETS supply equivalent to the reduction in AOs' UK ETS obligations. There is a risk that a supply-adjustment is delivered imperfectly. This could occur if AOs' UK ETS obligations were reduced, without a corresponding and simultaneous equal reduction to the supply of UKAs. If the supply of UKAs is not reduced at the same time as the decrease in surrender obligations, then this could lead to shocks to the UK ETS market. There would be a period of time where more UKAs were available to purchase than in the Do Nothing, UK ETS participants could benefit from being able to emit more. The decrease in demand could also put downward pressure on the UKA price, making less forms of abatement affordable than in the Do Nothing. This risk would be most prevalent with a design that reduced obligations, without a fixed date to reduce the supply of UKAs or adjust the cap, for example where the approach to supply adjustment was kept under review. However, as the overall change in demand for UKAs would be small under Option B, this impact is likely to be limited.
249. Some design mechanisms for Option B alleviate this risk as they would not reduce demand for UKAs from aviation i.e., designs based on reimbursement.

3.5.2 Equity risks within the UK ETS

250. Another risk with Option B where there is a supply-adjustment is the increased costs to participating sectors in the UK ETS. This risk is explained in more detail in Section 2.8.1.

3.5.3 Extending approach to other UK ETS sectors

251. The assessment of impacts on the UK ETS from making adjustments to account for CORSIA under Option B in this analysis is relative to the financial value of CORSIA obligations on flights from the UK to EEA and Switzerland. Any adjustments to the UK ETS's application to other participating sectors, either in part or in full, in similar ways would risk significantly increased impacts given those sectors' larger scale within the UK ETS. It should be noted that international aviation, like maritime, is a unique sector where emissions are international and not produced within states. ICAO exists as an international body under the UN to coordinate and regulate the air transport sector, including the responsibility for international aviation emissions under the Kyoto Protocol. International action is especially important for aviation emissions given the interconnected global nature of the sector. The UK is fully committed to global action on aviation emissions through international processes, including supporting collective action through ICAO.

3.5.4 The UK's net zero goal

252. The UK has committed to reaching net zero emissions across the economy by 2050. As the result the UK ETS cap is adapted to be consistent with this goal.[63]
253. Some designs of Option B require an adjustment to the UK ETS cap, which would retain emissions savings under the UK ETS. As we get to net zero in 2050, it's likely that the UK ETS

[63] The net zero-consistent UK ETS cap has been set up to 2030: https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets

cap would be equal to zero. Where this is the case, an adjustment may not be possible. If an adjustment could not be made, then emissions savings under the UK ETS would be lower than the Do Nothing scenario. However, CORSIA is only currently agreed until 2035, and as such, we do not expect the number of CORSIA units on UK to EEA and Switzerland routes to exceed the volume of auctioned allowances in the time horizon assessed in this analysis.

3.5.5 Non-implementation of a supply adjustment

254. Total monetised emissions savings assume that the emissions savings under the UK ETS remain the same. Where Option B is delivered via a reduction in UK ETS obligations, this conclusion holds if the supply of UKAs is reduced equivalent to AOs' reduction in UK ETS obligations. There may be circumstances where the supply is not reduced to this extent, for example if such a reduction was deemed to place unacceptable costs on remaining UK ETS participants. In such instances, emissions savings delivered by the UK ETS would decrease relative to the Do Nothing scenario, and the NPV of Option B would be lower.

4.0 Wider Impacts

4.1 Small and Medium Business Impacts

255. It is estimated that there were 115 micro businesses (1-9 employees) and 60 small businesses (10-49 employees), 25 businesses with 50-249 employees and 15 with 250+ employees in the passenger air transport sector in the UK at the start of 2023. In addition, there were 185 micro businesses and 10 small businesses, and 5 businesses with 250+ employees in the freight air transport and space transport sector in the UK at the start of 2023.[64]
256. CORSIA includes exemptions agreed by ICAO to reduce the impact on small businesses. One exemption is from monitoring, reporting and verification of emissions for AOs emitting less than 10,000 metric tonnes of CO_2 emissions from international aviation per year.
257. In addition, it was agreed at the 41st ICAO Assembly that if an AO's offsetting requirements in a given compliance period are less than 3,000 tonnes of CO_2, then that AO will face no offsetting requirements for that compliance period. This is intended to reduce the exposure of small businesses to disproportionate costs of sourcing and purchasing CORSIA Emissions Units.
258. However, small, micro and medium businesses are not explicitly exempted. So, it is theoretically possible that small and micro businesses could be required to comply with CORSIA, and the provisions for the monitoring, reporting and verification of emissions.
259. Further, new entrants are exempt from CORSIA offsetting until the earliest of the following applies:
    a. Three years from commencing aviation activities within the scope of CORSIA.
    b. The year when new entrants' annual emissions exceed 0.1% of total emissions in 2019.
260. As the UK is required to implement these provisions in UK law due to an international obligation, no scope to further reduce any burdens on small and micro businesses has been identified.
261. DfT has no information on the average number of metric tonnes emitted by small and micro businesses, however due to the 3,000 metric tonne exclusion, we can expect that where proportionate to the level of harm caused, small polluters will be excluded from administrative and offsetting burdens.

4.2 Innovation Impacts

262. CORSIA was designed to help achieve ICAO's global aspirational goal of keeping net CO_2 emissions from international aviation from 2020 at the same level. CORSIA was designed to complement emissions reductions from non-market-based measures, while further advancements in key technologies (e.g. engines, fuels) may result in further CO_2 reductions in

[64] Business population estimates for the UK and regions 2023: statistical release - GOV.UK (www.gov.uk)

the future. The growth against the baseline level of emissions, over which CORSIA offsetting applies, can be reduced by any method which reduces emissions. As such, CORSIA is technology neutral as the reduction in emissions could be driven by a general reduction in capacity, technological or operational efficiencies or the development of new fuels.

263. The requirement to purchase CORSIA Emission Units is placed on AOs, however the demand for new technology to reduce emissions could drive innovation in the wider aviation manufacturing sector, fuel supplier or at airports.
264. In addition, CORSIA creates demand for eligible emissions units to offset the growth in international aviation emissions. The emissions units are generated when emissions from a specific project or programme are reduced, compared to the Do Nothing case, through the implementation of emissions reductions techniques / technologies. The projects can be implemented in various sectors and there is no prescribed way for a project to be conducted, allowing space for innovation in the future.
265. The extent to which CORSIA will influence innovation will depend on several factors including:
    a. The level of Covid-19 recovery and the subsequent demand for growth in international aviation activity (and therefore emissions)
    b. The marginal abatement incentive faced by AOs resulting from the carbon price applied through CORSIA (Section 2.3.4.2)

4.3 Impact on protected groups

266. The measures proposed are not expected to have any disproportionate impact on protected groups as the impacts fall on AOs.

4.4 Trade Impacts

267. The trade impacts of implementing CORSIA will be negligible. It is an international measure which will ensure all airlines worldwide will face the same rules for addressing their emissions. In addition, given the wide scope of CORSIA there will be limited scope for trade impacts (Section 1.1.1).
268. CORSIA applies to all AOs on the same routes between states, regardless of the state of the operator (a route-based approach). Emissions from international flights where both the origin and destination states participate in CORSIA are included and therefore all flights on these routes, regardless of the AOs registered state, are subject to offsetting requirements. As a result, we do not expect barriers to trade will result from the implementation of CORSIA, as all AOs on a given route are subject to the same requirements.

5.0 Monitoring and evaluation

269. CORSIA will be reviewed by ICAO every three years from 2022. The outcome of the first review was confirmed at the ICAO Assembly in Autumn 2022. This confirmed changes to CORSIA's design including the future baseline and calculation of the growth factor (Section 1.1.1). Changes to the CORSIA SARPs to reflect these changes have been agreed by ICAO and will be reflected in UK CORSIA legislation to ensure consistency with international standards.
270. UK regulations will be reviewed at least every three years to ensure continued compatibility with international standards and other domestic policies.

Annex A: DfT's Aviation Model Methodology

A.1 Background

271. The methodology used in this document is designed to calculate outputs of emissions savings, costs, and revenues of different market-based measures for aviation, namely the UK ETS and CORSIA. The model assesses this over the period 2020-2050, however only the period up to 2035 is used in this analysis.

272. The modelling in this analysis is based on emissions forecasts from the Department for Transport's Aviation Model.[65]

273. The Aviation model forecasts CO_2 emissions produced by all flights departing UK airports up to 2050. The modelling covers passenger and freighter ATMs departing all the UK airports included in the DfT's model, but does not quantify CO_2 emissions at overseas hubs or flights to the UK. The forecasts therefore include CO_2 emitted from all domestic flights within the UK, and all international flights which depart UK airports, irrespective of nationality of passengers or carriers. Emissions from UK airports not included in the forecasts are unlikely to be significant as they are small and only offer short range services.

274. The model uses historical passenger data from the Civil Aviation Authority (CAA). The CAA records the number of passengers and the number of aircraft take-offs and landings at UK airports each year.

A.2 Methodology

275. The steps this model takes to output expected emissions by route are:

i. DfT's aviation model forecasts carbon emissions on UK departing flights split by 'zone' out to 2050. These zones can be countries, regions or airports.

ii. For any zones which are regions encompassing multiple countries, these have been disaggregated to country level using historical passenger data.

- The proxy used is average passenger numbers for the period 2013-2018.
- For example, the zone 'Iberian Peninsula' covers Gibraltar, Portugal & Madeira. If the historical passenger split was 10:85:5 respectively, 85% of emissions would be attributed to Portugal, etc.

iii. For any zones which are an airport or city, i.e. smaller than a country, these passenger numbers are subtracted from the country that they are in so that they aren't double counted.

- For example, if emissions for routes UK to Spain in 2023 from the model were 100Mt, and for the route from UK to Barcelona in the same year was 20Mt, the output of expected emissions to Spain would be 80Mt in 2023 (100-20)

iv. There is then an adjustment made for freight. DfT models freight as its own 'zone' for domestic and international freight. Given all domestic flights are covered by the UK ETS there is no need to make an adjustment as the whole 'zone' would be covered in the UK ETS and wouldn't be covered by CORSIA.

- For international freight, a scaling factor is calculated of all international emissions (freight + passenger journeys) to all international passenger journeys.
- This scaling factor is then applied to the country level outputs (described in steps X above) to account for airfreight emissions to countries modelled.

[65] UK aviation forecasts 2017 (publishing.service.gov.uk)

Annex B: International aviation emissions projections

B.1 October 2022 Scenarios

276. The analysis adopts two international aviation emissions projections from 2018-2050. These projections labelled FS1 and FS4 reflect the upper and lower bound of international aviation emissions projections consistent with CAEP/12 GHG trends which informed CAEP's 2022 assessment of the emissions savings and costs of CORSIA.[66]
    i. FS1 reflects a 'Baseline' scenario where efficiency improvements are frozen
    ii. FS4 reflects an 'Optimistic' scenario where efficiency improvements are equal to Independent Expert Integrated Review (IEIR) Technology and CAEP/12 WG2 High Operational Improvements.
277. DfT applied a further sensitivity to these scenarios to reflect the uncertainty concerning demand recovery from Covid-19. These in turn are consistent with CAEP/12 Trends Covid-19 scenarios.[67]
    i. High – returns to 2019 demand for air travel in 2024.
    ii. Mid – returns to 2019 demand for air travel in 2026.
    iii. Low – returns to 2019 demand in 2031.
278. A factor has been calculated for the years 2023-2050 to scale the FS1 and FS4 projections in line with each of the Covid-19 demand recovery scenarios.

[66] Microsoft PowerPoint - 1_CAEP_CORSIA Periodic Review (C225)_Focus on Covid19 Impacts.pptx (icao.int)

[67] ENVReport2022_Art7.pdf (icao.int)

Annex C: Sensitivity analysis

279. The sensitivity analysis in this document focuses on the combined impact of the level of UK emissions growth and the global aviation sectors recovery from Covid-19s impact on CORSIA Emission Unit demand. This level of CORSIA Emission Unit demand is a key driving factor for the estimates of the cost of CORSIA Emission Units and the level of emissions savings. This annex separates out the impact of UK emissions level and global Covid-19 recovery on CORSIA costs and emissions savings.
280. Figure 32 shows the annual cost of CORSIA Emission Units under varying levels of global recovery and UK emissions, using the central estimate for the CORSIA Emission Unit price.
281. The high numbers represent the highest UK emissions level combined with the optimistic global recovery. The low numbers represent the lowest UK emissions level with the pessimistic global recovery. These are represented by Asterisks in Figure 32.

Figure 29 The cost of CORSIA Emission Units under varying UK emissions and global recovery from Covid-19 scenarios, central CORSIA Emission Unit price, £bn, 2023 prices

Opt.	Global recovery	UK emission level	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
		High*	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**0.7**	**0.5**
		Mid	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	**0.6**	**0.5**
	Optimistic	Low	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	**0.6**	**0.4**
		High	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	**0.5**	**0.4**
		Mid	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	**0.4**	**0.3**
	Mid	Low	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	**0.4**	**0.3**
		High	0	0	0	0	0	0	0	0	0	0	0	0	0.1	**0.2**	**0.2**
		Mid	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.2**	**0.1**
A	Pessimistic	Low*	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.2**	**0.1**
		High*	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	**1.0**	**0.7**
		Mid	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**0.8**	**0.6**
	Optimistic	Low	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**0.7**	**0.6**
		High	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**0.7**	**0.5**
		Mid	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	**0.6**	**0.4**
	Mid	Low	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	**0.5**	**0.4**
		High	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	**0.3**	**0.2**
		Mid	0	0	0	0	0	0	0	0	0	0	0	0	0.1	**0.2**	**0.2**
B	Pessimistic	Low*	0	0	0	0	0	0	0	0	0	0	0	0	0.1	**0.2**	**0.2**

282. Figure 32 shows the annual monetised emissions savings from CORSIA, under varying levels of global recovery and UK emissions, using the central carbon price.
283. The high numbers shown in Figures 31 and 32 represent the highest UK emissions level combined with the optimistic global recovery. The low numbers represent the lowest UK emissions level with the pessimistic global recovery.

Figure 30 Monetised emissions savings under CORSIA by varying UK emissions level and global recovery from Covid-19, central carbon price, £bn, 2023 prices

Opt	Global recovery	UK emission level	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum	NPV
		High*	0	1.3	1.4	1.6	2.1	2.2	2.4	2.7	2.9	3.2	3.3	3.5	3.6	**30.2**	**23.4**
		Mid	0	1.2	1.3	1.4	1.8	1.9	2.1	2.3	2.4	2.6	2.8	2.9	3.0	**25.7**	**20.0**
	Optimistic	Low	0	1.1	1.2	1.3	1.7	1.8	1.9	2.1	2.2	2.4	2.5	2.6	2.7	**23.5**	**18.3**
		High	0	0.5	0.7	0.9	1.3	1.5	1.7	1.9	2.2	2.4	2.6	2.8	2.9	**21.5**	**16.5**
		Mid	0	0.5	0.6	0.8	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.4	**18.3**	**14.0**
	Mid	Low	0	0.4	0.6	0.7	1.1	1.2	1.3	1.5	1.7	1.8	2.0	2.1	2.2	**16.7**	**12.8**
		High	0	0	0	0	0	0.3	0.5	0.7	0.9	1.1	1.3	1.4	1.6	**7.8**	**5.6**
		Mid	0	0	0	0	0	0.3	0.4	0.6	0.8	0.9	1.1	1.2	1.3	**6.5**	**4.7**
A	Pessimistic	Low*	0	0	0	0	0	0.2	0.4	0.5	0.7	0.8	1.0	1.1	1.2	**6.0**	**4.3**
		High*	0	1.9	2.1	2.3	2.8	3.0	3.3	3.6	3.9	4.2	4.4	4.6	4.8	**40.9**	**31.8**
		Mid	0	1.7	1.9	2.0	2.5	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.0	**34.9**	**27.2**
	Optimistic	Low	0	1.5	1.7	1.9	2.3	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.6	**31.8**	**24.8**
		High	0	0.8	1.0	1.3	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.7	3.9	**29.0**	**22.2**
		Mid	0	0.7	0.9	1.2	1.6	1.7	2.0	2.2	2.5	2.7	2.9	3.1	3.2	**24.7**	**18.9**
	Mid	Low	0	0.6	0.9	1.1	1.4	1.6	1.8	2.0	2.2	2.5	2.6	2.8	2.9	**22.5**	**17.3**
		High	0	0	0	0	0	0.4	0.7	0.9	1.2	1.5	1.7	1.9	2.1	**10.4**	**7.5**
		Mid	0	0	0	0	0	0.3	0.6	0.8	1.0	1.2	1.4	1.6	1.8	**8.7**	**6.3**
B	Pessimistic	Low*	0	0	0	0	0	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.6	**7.9**	**5.7**