Title: Fuel Planning and Management **IA No:** DfT00460 **RPC Reference No:** xxx **Lead department or agency:** Department for Transport **Other departments or agencies:** Civil Aviation Authority	**Impact Assessment (IA)** **Date:** 09/03/2023 **Stage: Consultation** **Source of intervention: Domestic** **Type of measure: Secondary Legislation** **Contact for enquiries:** aviationsafety@dft.gov.uk

Summary: Intervention and Options

RPC Opinion: RPC Opinion Status

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**
£431.7m	£372.1m	£-43.2m	Qualifying Provision

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

Civil Aviation Authority (CAA) legislation regarding fuel planning and management is not aligned with International Civil Aviation Organisation's (ICAO) Standards and Recommended Practices (SARPs). As a result, CAA registered aircraft and operators are not permitted to use more advanced fuel schemes, nor alternative forms of propulsion. This prevents UK operators from achieving fuel savings (which would contribute to reducing carbon emissions aims) and safety benefits associated with more advanced fuel schemes. As operators would use more advanced fuel schemes if permitted, a market failure occurs through government failure. Therefore, government intervention is required to realign CAA legislation with ICAO SARPs; without intervention, UK operators will continue to be overly restricted in their fuel planning and management practices.

What are the policy objectives and the intended effects?

This policy introduces a package of changes in the legislation considering fuel planning and management. The primary objectives are to align CAA legislation with ICAO SARPs, ensure compliance with International Treaty obligations, and to permit advanced fuel schemes. We expect that uptake of more advanced fuel schemes will be high and the extent to which operators benefit will depend upon their operational maturity and sophistication. We also expect the CAA to take on some additional monitoring purpose to ensure the safety of schemes. However, there are minor risks that the efficacy of the policy at achieving efficiency and safety benefits and agent behaviour may not be as intended.

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

Option 0: In this option, we assume no additional government action further to existing legislation concerning fuel planning and management. UK aircraft and air operators will be subject to existing CAA legislation, and ICAO regulations will not be followed.

Option 1: In this option, existing CAA legislation will be updated and amended to align with the latest ICAO SARPs concerning fuel planning and management. Commercial Air Transport (CAT) operators will be free to determine if they wish to take advantage of the new regulations and adopt a fuel scheme suited to their specific operation. We anticipate that doing so will allow operators to achieve both efficiency and potential environmental benefits by reducing the fuel load required without endangering safety in addition to a reduction in fuel burn because of the reduced weight. Alternatively, further operational efficiencies may be gained by converting the reduction in fuel load to increased payload capacity by carrying more passengers and/or cargo. For these reasons, **this is the preferred option**.

Without regulatory changes, it would not be possible for operators to adopt fuel schemes or implement other best-practice fuel planning and management regulations outlined by ICAO. For this reason, it is considered that regulation is the only feasible approach.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 11/2028

Does implementation go beyond minimum EU requirements?		No		
Is this measure likely to impact on international trade and investment?		Yes		
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:** 0	**Non-traded:** 0	

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 1

Description: align UK legislation with international standards.

FULL ECONOMIC ASSESSMENT

Price Base Year 2024	PV Base Year 2024	Time Period Years 10	Net Benefit (Present Value (PV)) (£m)		
			Low: 296.2	**High:** 653.7	**Best Estimate:** 431.7

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0.02	1	0.49	**4.18**
High	0.03		1.94	**16.73**
Best Estimate	0.02		0.97	**8.37**

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

We expect Air Operator's Certificate (AOC) holders to experience transition costs through familiarisation costs and operations administration and management costs. Familiarisation costs are the costs to business of reading, interpreting, and disseminating the regulation within an organisation, whilst operators that choose to implement fuel schemes, as permitted by the regulation, will face additional costs associated with updating internal documentation and collating evidence to demonstrate their ability to implement fuel schemes safely. On an on-going basis, it is anticipated that CAA will recruit and train additional staff to ensure organisations are meeting the safety requirements set out in the regulation, whilst operators will recruit additional staff to manage an on-going uptake of fuel schemes.

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

We do not anticipate there to be any non-monetised costs. It is expected that the operators that choose to implement individual fuel schemes will already be using the technology required, and that this regulation will enable them to use this existing technology to the maximum extent of its potential.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0.0	1	34.0	**285.9**
High	0.0		78.5	**657.9**
Best Estimate	0.0		52.7	**440.1**

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

We expect operators who choose to implement a Basic Scheme with Variations or an Individual Fuel Scheme to gain a one-off benefit through fuel load savings. As aircraft will be lighter and become more economical with fuel, there will be an additional on-going fuel burn saving; this will also present a carbon saving benefit to society (supporting wider government decarbonisation aims). We expect operators of planes operating short haul flights to benefit from a reduction in fuel costs. However, we expect operators of larger aircraft operating long haul flights to carry more payload in response to a weight reduction, generating greater revenue.

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

We expect safety, harmonisation, and innovation benefits to occur. We have deemed these benefits to be non-monetised due to the data required to provide estimates not being available. Safety benefits are expected to arise from the additional monitoring involved with fuel schemes both by operators and the CAA which could reduce fuel related incidents. Further benefits should arise from harmonising CAA legislation with ICAO SARPs thus ensuring the UK is meeting its International Treaty obligations. In doing so, UK based operators should have a greater scope to innovate new fuel management and planning options.

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

A significant number of assumptions are used in the estimation of benefits. The key assumption is that the value of fuel burn savings are at least equivalent to the value of additional payload operators can carry in equilibrium. Sensitivities provide a high and low estimate for benefits. These are based on a high and low uptake of Individual Fuel Schemes by the largest operators. A significant unintended consequence and risk is that the carbon benefits from fuel savings are not realised because of operators carrying additional payload. There are also marginal risks considering efficacy, agent behaviour and safety (but these are not assumed to outweigh the wider policy benefits).

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			Score for Business Impact Target (qualifying provisions only) £m:
Costs: 0.7	**Benefits:** 44.0	**Net:** -43.2	-216.2

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1.0 Policy Rationale

Policy Background

1. When determining how much fuel is required to safely conduct air operations and minimise the risk of fuel related incidents, operators are required to abide by fuel planning and management legislation. This legislation requires operators to consider the amount of fuel required to reach their intended destination, in addition to considering the amount of fuel required in the event of unforeseen circumstances, e.g. a missed approach at the destination aerodrome, a diversion to an alternate aerodrome and other considerations. This policy proposes amendments to this fuel planning and management legislation.
2. The amendments this policy proposes aims to align Civil Aviation Authority (CAA) legislation with the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs)[1]. ICAO SARPs are recognised as industry best-practice, and the UK is obliged to adhere to these regulations in domestic legislation.
3. The most significant proposal this policy introduces is the concept of fuel schemes. These policies seek to ensure that aircraft always have enough fuel to reach their destinations, including in the event of unforeseen circumstances which lead to a deviation from the original flight plan. Within this impact assessment we use the term “fuel scheme” to refer to the amount of fuel carried by an aircraft determined by fuel planning policies, in-flight fuel management policies, and the selection of aerodromes[2].
4. The relationship between these three elements was first considered when studying incidents where aircraft landed with less than Final Reserve Fuel (FRF) – the minimum amount of fuel an aircraft should land with for the operation to be deemed safe. The resulting analysis[3] established that an integrated approach to fuel management, using an advanced fuel scheme, would be most effective at fuel related incidents, such as breaching FRF.

Problem Under Consideration

5. At current, CAA legislation regarding fuel planning and management is not aligned with ICAO’s SARPs. The divergence between each set of regulations has occurred because of updates to ICAO SARPs which have not yet been incorporated into CAA legislation; this policy aims to resolve this divergence. The changes to legislation explored in this impact assessment reflect the current differences between CAA legislation and ICAO SARPs.
6. Aircraft and operators under the CAA’s jurisdiction are not currently permitted to use performance-based compliance for flight planning and fuel management. With performance-based compliance, operators have greater flexibility in planning their fuel management practices but must prove that safety requirements have been met in historic performance. This policy enables operators to utilise a performance-based approach to fuel management through Basic Fuel Schemes with Variations or Individual Fuel Schemes.
7. The policy seeks to recognise that different Commercial Air Transport (CAT) operators have different capabilities and resources at their disposal and to introduce flexibility in fuel schemes to take account of these differing capabilities. Current fuel requirements have not been updated to reflect the operational maturity and sophistication of modern flight operations and this policy seeks to ensure that these requirements are more reflective of real-world performance than previously.
8. The policy provides for operators to implement the following fuel or energy schemes:

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[1] Annex 6 Part I via Amendment 38 and subsequent updates to ICAO Doc 9976 Flight Planning and Fuel Management (FPFM) Manual’ (1st Edition, 2015). ICAO documents available through ICAO eLibrary. Accessible at: https://elibrary.icao.int/home

[2] An aerodrome is term used for a place where air operators start and end from. It is a broader term than “airport”.

[3] CAA AWO and Fuel Planning Opinion and Instruction Document.

a. **Basic Fuel Scheme.** This represents the current prescriptive requirement which does not allow for fuel efficiency gains at any point of a journey.
b. **Basic Fuel Scheme with Variations.** This will allow operators to make incremental savings with regards to fuel requirements for contingency and discretionary reserves.
c. **Individual Fuel Scheme.** Operators will be permitted to reduce fuel requirements for all aspects of their fuel planning policy, provided they are able to demonstrate to the CAA that they can do so safely. Operators will be required to have suitable planning tools, aircraft equipment, real-time operational data gathering and control in place to meet specified safety Key Performance Indicators (KPIs).

9. To demonstrate compliance with the safety KPIs required to implement Individual Fuel Schemes, it is expected that operators will use flight following, flight monitoring and flight watch systems. As outlined by the European Union Aviation Safety Agency (EASA)[4], these systems are defined as:
    a. Flight following – the recording in real time of departure and arrival messages by operational personnel to ensure that a flight is operating and has arrived at destination aerodrome.
    b. Flight monitoring – in addition to the requirements of flight following, monitoring includes:
        i. operational monitoring of flights by suitably qualified operational control personnel from the point of departure throughout all phases of the flight;
        ii. communication of all available and relevant safety information between the operational control personnel on the ground and the flight crew; and
        iii. provision of critical assistance to the flight crew in the event of an in-flight emergency or security issue, or at the request of the flight crew.
    c. Flight watch – incorporates the elements required for flight following and monitoring but also includes the active tracking of a flight by suitably qualified operational control personnel throughout all phases of the flight to ensure that the flight is following its prescribed route, without unplanned deviation, diversion, or delay.
10. It is expected that the airlines that will choose to implement Individual Fuel Schemes have a mature and effective Safety Management Systems (SMS) and are currently prevented from realising the benefits of a reduction in fuel loads due to the limitations of the existing regulations.
11. This proposal also introduces the concept of alternative fuel or energy sources other than hydrocarbon-based fuels. Without this change, UK operators will not be able to take advantage of technological advances in the production of alternative propulsion sources for aviation.

Rationale for Intervention

12. The primary rationale for intervention is to align UK legislation with ICAO SARPs regarding fuel planning and management, thus ensuring compliance with International Treaty obligations.
13. Under existing legislation, aircraft operators are not able to utilise new fuel planning and management practices, preventing them from realising safety and efficiency benefits associated with their use. Because operators would implement advanced fuel schemes should legislation allow, the current regulations are the sole reason why the benefits of implementing them are not realised. This puts UK operators at a competitive disadvantage compared to international competitors whilst UK regulations prevent the use of advanced fuel schemes.
14. Both these factors represent government failures – situations where existing government intervention or legislation creates inefficiency. These government failures can be resolved by the proposed legislation, which will align UK regulations with international best practice. This will alleviate the competitive disadvantage levied on UK operators by misaligned legislation and allow them to benefit from the full use of new fuel planning and management practices.

[4] EASA Notice of Proposed Amendment 2016-06 (A), Fuel Planning and Management (15/07/2016)

15. Without government intervention, the existing government failure will remain unresolved and operators will be prevented by regulations from changing their fuel planning and management practices.

Policy Objective

16. The primary objective is to align CAA legislation with ICAO SARPs, thus ensuring that the UK is meeting its International Treaty obligations, whilst also allowing fuel efficiency and safety benefits to be realised across the sector. To achieve this objective, the policy introduces a package of changes in the legislation considering fuel planning and management.
17. In doing so, the policy also ensures that fuel requirements are more reflective of actual operational requirements and are based upon real-world performance rather than arbitrarily determined levels. Ensuring this will lead to fuel savings for CAT operators or potentially allow them to increase profits by increasing the amount of cargo and/or number of passengers that can be carried on commercial flights.
18. As mentioned , another part of the package is legislation allowing for alternative means of propulsion in aircraft, enabling the use of electric propulsion and hydrogen for future energy provision in aircraft. The objective of this part of the legislation is to allow UK operators and original equipment manufacturers to explore and benefit from potential innovative sources of clean energy in aircraft propulsion in line with UK policy aspirations such as those in the Jet Zero strategy[5].
19. Finally, this package addresses fuel issues that are specific to helicopter operations. These changes to regulation are less extensive than the changes to aircraft regulations, therefore have less economic impact. The changes to regulations include:
    a. Clarifying and simplifying the rules for helicopter fuel planning.
    b. Providing more robust regulations for the practice of refuelling.
    c. Harmonisation with ICAO SARPs[6].

Options Considered

Option 0 – Do Nothing

20. In this option, we assume no additional government action further to existing legislation concerning fuel planning and management. UK aircraft and air operators will be subject to existing CAA legislation, and a difference to ICAO Standards will be filed.
21. The prescriptive regulations for general aviation (including helicopters/helicopter operators) will remain; and the introduction of the concept to enable alternative means of propulsion will not be incorporated into the aviation safety regulations.

Option 1 – Adopting ICAO Standards *(preferred option)*

22. In this option, we assume that existing CAA legislation will be updated to reflect the latest ICAO SARPs concerning fuel planning and management. This option would align UK legislation with ICAO, thus ensuring the UK remains compliant with ICAO SARPs as per the CAA's International Treaty obligations.
23. Operators will be free to choose whether to take advantage of the new regulations and adopt a fuel scheme suited to their specific operation. It may be that operators choose to take no action in response to this policy. However, we anticipate that responding to legislator changes will allow airlines to achieve both efficiency benefits by reducing the fuel load required without endangering safety, in addition to a reduction in fuel burn because of the reduced mass of fuel onboard.

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[5] Jet Zero strategy: delivering net zero aviation by 2050. Available at: https://www.gov.uk/government/publications/jet-zero-strategy-delivering-net-zero-aviation-by-2050

[6] ICAO SARPs Annex 6 Part III Amendment 22. ICAO documents available through ICAO eLibrary. Accessible at: https://elibrary.icao.int/home

Alternatively, further operational efficiencies may be gained by converting the reduction in fuel load to increased payload capacity either by carrying more passengers and/or cargo.

24. If aircraft are operated at reduced weights, less fuel is burnt which has a potential benefit for the environment. Further marginal benefits are expected from the wider package of legislation changes. For these reasons, **this is the preferred option**.

Alternatives to Regulation

25. Without regulatory changes, it would not be possible for operators to adopt fuel schemes or implement other best-practice fuel planning and management Standards outlined by ICAO. Thus, the UK would not be fulfilling its International Treaty obligations. Additionally, UK operators will not be able to take advantage of advances in alternative means of propulsion and the general aviation community will not be able to take advantage of the less prescriptive regulations for fuel planning and management for recreational aviation (including for helicopter operators). For this reason, it is considered that regulation is the only feasible approach.

2.0 Costs and Benefits

Summary

26. The following section delineates the methodologies we have used to estimate the impacts of the proposed policy on businesses, consumers, and government. In addition to providing a description of the methodology we have used; this section details the data sources that have been used in our analysis and any assumptions that have been made. We note significant uncertainty in some of our data and assumptions. To mitigate, we invite comments on these through specific questions in this assessment, but also welcome more general comments where required.
27. To estimate the impacts of the proposed policy, we have estimated the ongoing costs and benefits of a continuation of the current situation (Option 0) and compared these with the proposed changes (Option 1). The costs and benefits of the proposed change in policy are summarised below and described in detail in the following section of this document.
28. Unless otherwise stated, monetary values throughout this document are expressed in terms of **2024 prices**.

Option 0 – Do Nothing

29. In this option, we assume no additional government action further to existing legislation concerning fuel planning and management. UK aircraft and air operators will be subject to existing CAA legislation, and ICAO regulations will not be followed.
30. To estimate the impacts of the proposed policy, we have estimated the ongoing costs and benefits of a continuation of current regulations and use this a baseline against which to compare the costs and benefits of Option 1. The analysis, assumptions and data used to estimate the costs and benefits associated with the baseline are included in the section detailing the costs and benefits of Option 1.
31. In the analysis for Option 1, the behaviour of firms under Option 0 is assumed to be as if they are following a Basic Fuel Scheme.

Option 1 – Fuel Planning

32. In this option, we assume that existing CAA legislation will be updated and added to with the latest ICAO Standards concerning fuel planning and management. This option would align UK legislation with ICAO SARPs, - allowing UK air transport operators to compete on the same basis as those of other nations. Most prominently, air operators will be permitted to use fuel schemes, which we expect to provide the greatest benefits during the appraisal period.
33. Below are listed the costs and benefits we analyse during this section.

Monetised Costs

a. Familiarisation costs – expected to directly impact businesses.
b. Administration costs – expected to directly impact businesses.
c. Monitoring costs (CAA) – expected to directly impact government.
d. Monitoring costs (operators) – expected to directly impact businesses.

Monetised Benefits

e. Fuel cost savings – expected to directly impact businesses.
f. Fuel burn savings – expected to directly impact businesses.
g. Realised carbon savings – expected to directly impact society.

Non-monetised Benefits

h. Safety benefits – expected to indirectly impact consumers.
i. Harmonisation benefits – expected to directly impact businesses.

j. Innovation benefits – expected to indirectly impact businesses.
k. Fuel benefits to general aviation – expected to directly impact businesses.

34. Figure 1 provides a summary of the monetised costs and benefits associated with the proposed policy. The estimates represent the additional (or reduction in) monetised cost and benefits of Option 1, relative to the Option 0 baseline.

Figure 1 Summary of Monetised Costs and Benefits (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
One-off Costs											
Best Estimate	**Training Costs**	0.0									
Low		0.0									
High		0.0									
Best Estimate	**Administration Costs**	0.0									
Low		0.0									
High		0.0									
On-going Costs											
Best Estimate	**CAA Oversight**	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Low		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
High		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Best Estimate	**Operator Oversight**	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Low		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
High		1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Overall Costs											
Best Estimate	**Overall Costs**	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Low		0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
High		2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
On-going Benefits											
Best Estimate	**Fuel Load Savings**	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Low		0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High		0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Best Estimate	**Fuel Burn Savings**	30.9	36.7	42.6	48.9	55.3	61.7	68.7	76.9	83.8	92.7
Low		26.9	29.6	32.6	35.6	38.8	42.0	45.5	49.8	53.1	57.8
High		52.0	58.9	66.1	73.7	81.6	89.4	98.0	108.4	116.7	127.9
Best Estimate	**Realised Carbon Benefit**	6.4	7.1	7.7	8.4	9.1	9.9	10.7	11.6	12.4	13.4
Low		2.8	3.0	3.1	3.3	3.5	3.6	3.8	4.1	4.3	4.5
High		11.3	12.2	13.2	14.2	15.2	16.3	17.5	19.0	20.2	21.7
Overall Benefits											
Best Estimate	**Overall Benefits**	37.6	43.8	50.4	57.3	64.4	71.6	79.4	88.6	96.2	106.2
Low		29.9	32.6	35.7	38.9	42.3	45.6	49.3	53.9	57.4	62.3
High		63.7	71.2	79.4	88.0	96.9	105.8	115.6	127.4	137.0	149.7

Values are in 2024 prices and do not account for discounting. Values of 0.0 imply a value of less than £50,000, whilst greyed out boxes imply a true zero value.

Number of Affected Businesses

35. To calculate the potential impacts of the policy, it is necessary to estimate the number of businesses that will be required to become familiar with the new legislation. As this is permissive legislation (i.e., legislation which allows, but does not force, businesses to implement sophisticated fuel planning), it is also necessary to estimate the number of businesses that will choose to take advantage of the regulation.
36. Primarily, it is anticipated that holders of Air Operator's Certificates (AOCs) will be required to become familiar with the regulation, understand its implications for their operations and to determine if they wish to take advantage of the regulation; this will result in a one-off cost to

AOCs. An AOC is the approval granted by the CAA to aircraft operators which enables them to use aircraft for commercial air transport (CAT) purposes.

37. According to CAA records[7], there are 71 fixed wing CAT operators in the UK, including commercial airlines, business aviation providers and specialist air service providers. It is assumed that all these operators will be required to become familiar with the regulations.

Uptake rate

38. The application of uptake rates is limited to the analysis of monetised benefits. These benefits solely consider the fuel scheme section of the proposed policy and uptake rates have been estimated for this purpose only. As such, uptake rates are not a reflection of the uptake of policy for non-monetised impacts.

39. The proposed regulation considering fuel schemes can be broadly broken down into two parts for which there will be different uptake rates. Each part reflects an option for an operator as to how they can apply fuel schemes to their operations.

Basic Fuel Scheme with Variations

40. The first part of the fuel scheme legislation allows operators to adopt a Basic Fuel Scheme with Variations which have a relatively small associated monetised benefit. These benefits arise primarily from aligning CAA with ICAO Standards across all operators, which allows operators to make incremental fuel savings. It is assumed that all air operators act rationally and choose to adopt the opportunity granted by the new permissive legislation by implementing Basic Fuel Schemes with Variations immediately, given there is little upfront or no cost of doing so. This implies that 100% of flights will accrue the associated benefits in any scenario.

Individual Fuel Scheme

41. The legislation allows operators to adopt Individual Fuel Schemes which have a larger monetised benefit. However, only the largest operators will have the operational capability and maturity to provide sufficient evidence to the CAA to justify that their individual scheme is valid and robust and will then be able to implement such schemes.

42. We do not explicitly know which operators will look to adopt Individual Fuel Schemes and look to explore this during consultation. In this analysis, we assume the scope of Individual Fuel Schemes applies to the flights and aircraft operated by the five most active in 2019 ranked by seat kilometres used. These airlines account for 66% of short-haul (SH) flights, and 90% of long-haul (LH) flights in 2019[8], which will be used as a base year for subsequent analysis given the impact of the Covid-19 pandemic on flight activity during recent years. This SH/LH breakdown assumes any aircraft with an average flight duration greater than 6 hours is classed as a LH aircraft.

43. A more accurate scope for Individual Fuel Schemes will be established during consultation, subject to airline response. The flight and fleet data associated with the largest airlines reflects the magnitude of scope we expect for Individual Fuel Schemes, rather than acting as a specific identifier of beneficiaries.

44. However, unlike uptake for Basic Fuel Scheme with Variations, we do not anticipate that large airlines will implement Individual Fuel Schemes for all flights they operate. As a result, we have assumed that a maximum of 50%[9] of flights in scope will be subject to an Individual Fuel Scheme and the subsequent monetised economic benefit. The low and high scenarios adjust this probability to 25% and 75%[10] respectively.

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[7] CAA Complexity Matrix (Version 6.1 30/01/2020)

[8] CAA UK Airline Data 2019, Tables 0.1.6, 1.11.1 & 1.11.2. Available at: https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airlines/uk-airline-data/uk-airline-data-2019/annual-2019/

[9] This is an estimated value motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. A more precise value will be sought through consultation.

[10] These are estimated values motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy.

45. A further difference is we do not expect the full uptake of Individual Fuel Schemes to be achieved immediately. This is because operators will take time to digest the new legislation and then implement, design and evidence new fuel schemes for routes they deem Individual Fuel Schemes to be most suitable. To account for this, we assume an uptake of only 10% of flights in scope in the first year. We assume that the maximum uptake rate [50%] will be attained by the end of the 10-year appraisal period, and that growth will be linear.

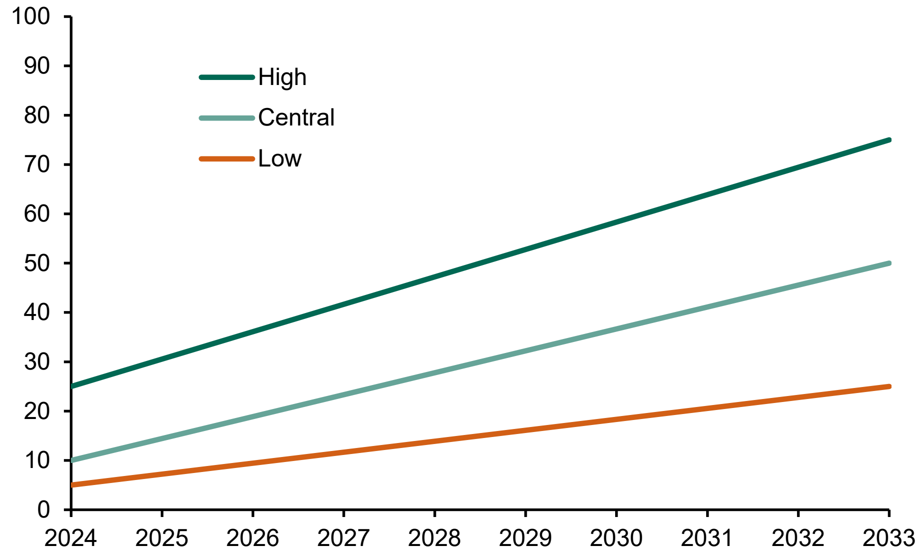
46. The maximum and initial uptake rates are detailed in Figure 2. Rather than reflecting uptake for a certain fuel scheme across the fleet, uptake rates should be interpreted as the uptake within flights in the scope outlined above for each fuel scheme. This approach has been taken to prevent the double counting of benefits derived from the Basic Fuel Schemes with Variations for flights where an Individual Fuel Scheme is utilised.

Figure 2 Initial and Maximum Uptake Rates

% of flights in scope	**Basic Fuel Schemes with Variations**						**Individual Fuel Scheme**					
	Central		**Low**		**High**		**Central**		**Low**		**High**	
	Init.	Max.	Init.	Max.	Init.	Max.	Init.	Max.	Init.	Max.	Init.	Max.
SH Flights	100	100	100	100	100	100	10	50	5	25	25	75
LH Flights	100	100	100	100	100	100	10	50	5	25	25	75

47. The progression of uptake rates over the appraisal period is illustrated in Figure 3.

Figure 3 Individual Fuel Scheme Uptake Rates (%)



48. In this analysis we assume that uptake will not vary depending on whether a flight is LH or SH. Again, we will look to explore this during consultation.

Costs

Monetised Costs

49. The estimated one-off and ongoing costs of the policy are estimated in the section below. A high and low-cost scenario to reflect the uncertainty in these estimates is presented in a subsequent Sensitivity Analysis section.

Transition Costs – Familiarisation

50. This section sets out how familiarisation costs are calculated. Familiarisation costs are the costs to business of reading, interpreting, and disseminating the regulation within an organisation.

51. Data provided by the CAA[11], indicates that there were 71 registered fixed-wing CAT operators on 30th January 2020. It is assumed that all 71 of these operators will be required to become familiar with the regulations, irrespective of whether they choose to take advantage of them or not. In addition, our estimate of familiarisation costs therefore incorporates the estimated staff time required to discuss and determine whether each organisation wishes to proceed with implementing Individual Fuel Schemes.
52. It is not known with certainty how long familiarisation will take within each organisation, and we have therefore assumed a value of 3 hours per organisation[12]. As above, we seek feedback from those responding to the consultation as to whether this is a reasonable estimate or not.

Question 1
a) To what extent do you agree or disagree that the calculated familiarisation costs represent an accurate estimate of the true costs facing CAT operators?
b) Can you provide any information to enable us to refine this estimate?

53. Hourly staff costs are estimated based on the mean hourly wage of employees within Standard Industrial Classification (SIC) 5110 – Passenger Air Transport.
54. Data from the Office for National Statistics (ONS) Annual Survey of Hours and Earnings (ASHE) 2022 has been used to estimate this mean hourly wage, which has subsequently been uplifted to account for non-wage costs and inflation. Expressed in 2024 prices, it is estimated that the hourly staff associated with familiarisation is £28.23[13].
55. Using the staff costs (£28.23) and time requirements (3 hours per organisation) outlined above, in addition to the expected number of businesses required to familiarise themselves with the regulation (71 businesses), we estimate a total familiarisation cost of £6,013, as shown in Figure 4.

Figure 4 Training Costs (£, mn)

	Description	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Best Estimate	**Training Costs**	0.01									

Values are in 2024 prices and do not account for discounting.

[11] CAA Complexity Matrix (Version 6.1 30/01/2020)
[12] This is an estimated value motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. A more precise value will be sought through consultation.
[13] This was derived from the mean hourly wage of employees within the sectors from Table 16.5a of the Annual Survey of Hours and Earnings from 2021. The starting point of £21.24 was inflated by one year to bring the value to 2024 prices, then increased by 26.5%, per Transport Appraisal Guidance Unit A4.1, Paragraph 2.2.4 to account for non-wage costs, resulting in a total hourly cost of £27.71.

Transition Costs – Operator Administration and Management Costs

56. Operators that choose to take advantage of the regulations by implementing Individual Fuel Schemes or Basic Schemes with Variations will face additional administration and management costs associated with this activity.
57. These organisations must meet a series of requirements in planning tools used, aircraft equipment, operational data gathering and operational control and will initially be required to collate evidence for submission to the CAA to demonstrate that they can meet these requirements.
58. In addition, changes will need to be made to training, internal documentation, and handbooks to provide employees with the correct guidance regarding the organisation's fuel planning and management approach. This will imply a one-off cost to businesses.
59. It is not known with any certainty how many hours of staff time will be required within each organisation to undertake this activity; however, it is expected that the time requirement for CAT operators wishing to utilise Individual Fuel Schemes will be considerably greater than the time requirement for operators wishing to utilise Basic Fuel Schemes with Variations.
60. An assumed value of 30 hours[14] per organisation has been used for the purposes of this impact assessment regarding the time required for operators to demonstrate the capability to use Individual Fuel Schemes. For those wishing to use Basic Schemes with Variations, we use an assumed value of 6 hours per organisation[15].
61. At an hourly staff cost of £28.23, this leads to an estimated cost per organisation of £846.86 relating to Individual Fuel Schemes and £169.37 per organisation with regards to Basic Schemes with Variations. Through CAA engagement with industry and desktop assessment of the complexity of operators' flight operations, we expect that approximately 5 organisations will adopt Individual Fuel Schemes[16] and the remainder to adopt a Basic Scheme with Variations, this leads to a total estimated administration and management cost of £15,413, as shown in Figure 5.

Figure 5 Administration Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Administration Costs**	0.02									

Values are in 2024 prices and do not account for discounting.

Question 2
a) To what extent do you agree or disagree that the calculated administrated costs represent an accurate estimate of the true costs associated with demonstrating to the CAA that an operator is capable of meeting the standards required to implement Individual Fuel Schemes?
b) Can you provide any information to enable us to refine this estimate?

62. As mentioned previously, it is expected that operators choosing to implement Individual Fuel Schemes already have the technology, software, processes and systems in place (e.g. flight following, flight monitoring and flight watch) to enable them to do so. Therefore, we assume that operators will face no costs associated with investing in new technologies and systems to allow them to meet the safety requirements of implementing Individual Fuel Schemes.

[14] This is an estimated value motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. A more precise value will be sought through consultation.
[15] This is an estimated value motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. A more precise value will be sought through consultation.
[16] This is motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy.

Question 3
a) Do you anticipate that operators will face any additional costs associated with investing in new technologies and systems to enable them to meet the safety requirements of the regulation?
b) If yes, can you provide any information to enable us to estimate the aggregate cost of this technology?

On-going Costs – CAA Oversight

63. To facilitate the ongoing oversight of fuel schemes, it is anticipated that the CAA will be required to recruit additional staff to ensure that organisations are meeting the safety KPIs set out in the regulation. The CAA estimate that 4[17] additional fulltime employees will be required at a total cost of £82,000 per employee per annum. This is based on an estimate provided by the CAA and accounts for the wage and non-wage costs, i.e. national insurance and pension contributions, IT equipment, office space costs, of the employees providing this oversight. This leads to an estimated cost of CAA oversight of £328,000 per year throughout the 10-year appraisal period, as shown in Figure 6.

Figure 6 CAA Oversight Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**CAA Oversight Costs**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33

Values are in 2024 prices and do not account for discounting.

On-going Costs – Operator Oversight

64. To facilitate the ongoing oversight of fuel schemes, it is anticipated operators will be required to recruit additional staff to ensure safety KPIs are adhered to and to manage which routes utilise Individual Fuel Schemes.
65. It is estimated that 1[18] additional employee will be required at operators intending to implement Individual Fuel Schemes at a total cost (including non-wage costs) of £82,000 per employee per annum. This cost estimate is based on the CAA figure previously used as it is assumed oversight employees at the CAA and operators are sufficiently similar in their required experience and skillset. On the basis we expect 5[19] organisations to adopt Individual Fuel Schemes, this leads to an estimated oversight cost of £410,000 per year throughout the 10-year appraisal period.
66. Furthermore, it is estimated that 0.10[20] additional employees will be required to complete the oversight function at organisation which only intend to implement Basic with Variations Fuel Schemes. Assuming an annual total cost of £82,000 per employee across the remaining 66 operators, this leads to an estimated oversight cost of £541,200 per year. In total, the estimated oversight cost amounts to £951,200 per year throughout the 10-year appraisal period, as shown in Figure 7.

Figure 7 Operator Oversight Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Operator Oversight Costs**	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95

[17] This is an estimated value motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. A more precise value will be sought through consultation.
[18] This is an estimated value motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. A more precise value will be sought through consultation.
[19] This is motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy.
[20] This is an estimated value motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. A more precise value will be sought through consultation.

Values are in 2024 prices and do not account for discounting.

Question 4
a) How many employees are likely to be required by an operator for oversight in adopting Basic with Variations Fuel Schemes?
b) How many employees are likely to be required by an operator for oversight in adopting Individual Fuel Schemes?

Sensitivity Analysis

Transition Costs – Familiarisation

67. Given the uncertainty in our estimate regarding the time required for organisations to become familiar with the regulations, high and low-cost estimates are produced.
68. Previously, we estimated each organisation is required to spend 3 hours becoming familiar with the regulations. In the low-cost scenario, this value reduces to 1.5 hours[21]. Using the same hourly wage cost and number of organisations as before, this reduces familiarisation costs to £3,006. Meanwhile, in the high-cost scenario, the time requirement increases to 6 hours[22]. This increases familiarisation costs to £12,025, as shown in Figure 8.

Figure 8 Training Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Training Costs**	0.01									
Low		0.00									
High		0.01									

Values are in 2024 prices and do not account for discounting.

Transition Costs – Operator Administration and Management Costs

69. There is also significant uncertainty in our estimate of the time required for organisations to undertake additional administration and management tasks. These tasks include demonstrating to the CAA that Individual Fuel Schemes and Basic Schemes Variations can be implemented safely.
70. Previously, we estimated organisations looking to implement Individual Fuel Schemes are required to spend 30 hours on admin purposes, whilst organisations only looking to implement Basic with Variations Fuel Schemes require 6 hours for this purpose. In the low-cost scenario, these values reduce to 15 and 3 hours[23], respectively. Using the same hourly wage cost and number of organisations as before, this reduces admin costs to £7,706. Meanwhile, in the high-cost scenario, the time requirements increase to 60 and 12 hours[24]. This increases admin costs to £30,826, as shown in Figure 9.

Figure 9 Administration Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Administration Costs**	0.02									
Low		0.01									
High		0.03									

Values are in 2024 prices and do not account for discounting.

On-going Costs – CAA Oversight

71. There is significant uncertainty in our estimate regarding the number of employees required to provide operators suitable CAA oversight when implementing Basic with Variations and Individual Fuel Schemes.
72. Previously, we have estimated a requirement of 4 additional employees[25]. In the low-cost scenario, this value reduces to 2 employees[26]. Using the same cost per employee as before, this reduces total operator oversight costs to £164,000 per annum. Meanwhile, in the high-cost

[21] This is an estimated value calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.
[22] This is an estimated value calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.
[23] These are estimated values calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.
[24] These are estimated values calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.
[25] This is an estimated value calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.
[26] This is an estimated value calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.

scenario, the number of additional employees increases to 8 employees[27]. This increases annual operator oversight costs to £656,000, as shown in Figure 9.

Figure 10 CAA Oversight Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**CAA Oversight Costs**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Low		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
High		0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66

Values are in 2024 prices and do not account for discounting.

On-going Costs – Operator Oversight

73. Furthermore, there is significant uncertainty in our estimate regarding the number of employees required to provide operators suitable oversight when implementing Basic with Variations and Individual Fuel Schemes.
74. Previously, we have estimated 1 additional employee for operators intending to implement Individual Fuel Schemes, and 0.10 additional employees for operators only intending to implement Basic with Variations Fuel Schemes. In the low-cost scenario, these values reduce to 0.50 and 0.05 employees[28], respectively. Using the same cost per employee as before, this reduces total operator oversight costs to £475,600 per annum. Meanwhile, in the high-cost scenario, the number of additional employees increases to 2 and 0.20 employees[29], respectively. This increases annual operator oversight costs to £1,902,400, as shown in Figure 11.

Figure 11 Operator Oversight Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Operator Oversight Costs**	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Low		0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
High		1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90

Values are in 2024 prices and do not account for discounting.

Overall Monetised Benefits

75. In total, the central scenario estimates costs of £1.29m in 2024, reducing to £1.28m per annum in subsequent years. These values decrease to £0.66m and £0.64m respectively in the low-cost scenario, whilst they increase to £2.60m and £2.56m in the high-cost scenario. Annual costs are shown in Figure 12 and Figure 13.

Figure 12 Overall Costs (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Overall Costs**	1.30	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Low		0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
High		2.60	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56

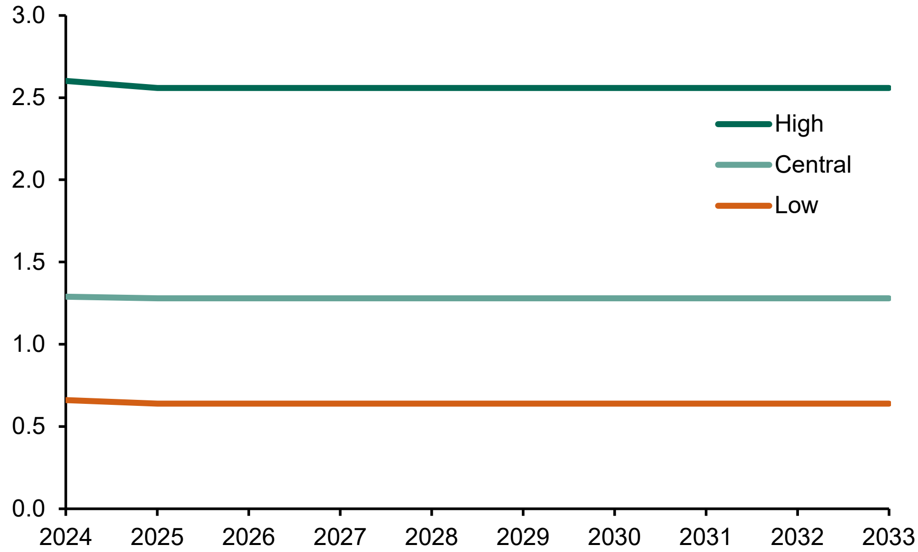
Values are in 2024 prices and do not account for discounting.

[27] This is an estimated value calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.

[28] These are estimated values calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.

[29] These are estimated values calculated by halving the central estimate in the low-cost scenario and doubling in the high-cost scenario.

Figure 13 Annual Overall Costs (£mn, 2024 prices)



Values are in 2024 prices and do not account for discounting.

Benefits

Monetised Benefits

76. This analysis uses fleet and flight data from 2019 as a forecast for the first appraisal year, 2024. 2019 was chosen as a base year due to the downturn in commercial flying activity during the pandemic on data from more recent years.
77. The values used in this section are the best estimates determined by analysis unless stated otherwise. Sensitivity analysis is provided separately including high and low estimates.
78. Please note Fuel Load Savings and Fuel Burn Savings are different monetised impact despite similarity in their name. It is the case that Fuel Burn Savings are a consequence of Fuel Load Savings.

On-going Benefits – Fuel Load Savings

79. This section outlines how the benefit to airlines from a reduction in the fuel load requirement for an aircraft is estimated. We considered this impact to be a direct impact to business. Benefits are estimated by assessing the change from using a basic fuel scheme to a Basic Fuel Scheme with Variations or an Individual Fuel Scheme.
80. A breakdown of the quantity of fuel saved by the proposed legislation is outlined in Figure 14, as suggested by EASA[30]. The fuel schemes illustrated are based on 2-hour and 13-hour durations for SH and LH flights respectively. Given the flight time these management schemes are based on are longer than the average flight time of UK LH flights, the following estimates should be considered an upper bound for potential fuel savings.

Figure 14 EASA Example Fuel Management Schemes (kg, mins)

Fuel Schemes		**Basic**	**Basic w/ Var.**	**Individual**	**Unit**
SH	**Total**	**7,300**	**7,200**	**6,807**	kg
	Taxi	250	250	200	kg
	Trip	4,000	4,000	3,960	kg
	Contingency	200	200	69	kg
	Alternate (go-around)	500	450	428	kg
	Alternate (airport)	1,050	1,050	1,010	kg
	Discretionary fuel	300	250	140	kg

[30] EASA Notice of Proposed Amendment 2016-06 (A), Fuel Planning and Management (15/07/2016)

	Final reserve fuel	1,000	1,000	1,000	kg
	Duration	120	120	120	mins
LH	**Total**	**112,846**	**112,446**	**108,087**	kg
	Taxi	600	500	500	kg
	Trip	99,854	99,854	99,554	kg
	Contingency	4,993	4,993	1,424	kg
	Alternate (go-around)	800	700	665	kg
	Alternate (airport)	2,638	2,638	2,543	kg
	Discretionary fuel	1000	800	440	kg
	Final reserve fuel	2,961	2,961	2,961	kg
	Duration	780	780	780	mins

Basic w/ Var. = Basic Fuel Schemes with Variations

81. It has not been possible to attain more accurate estimates of fuel load savings following the legislation. Therefore, the fuel load values from the EASA example flights are used during the analysis.

Question 5
a) To what extent do you agree or disagree that the fuel load savings detailed above represent an accurate estimate of the true fuel load savings that would be realised by operators using each type of fuel scheme on a short haul flight?
b) To what extent do you agree or disagree that the fuel load savings detailed above represent an accurate estimate of the true fuel load savings that would be realised by operators using each type of fuel scheme on a short haul flight?

82. As previously described, the first part of the legislation harmonises UK legislation with ICAO Standards, allowing airlines to make small fuel load savings through a Basic Fuel Scheme with Variations. Indeed, EASA's estimates in Figure 14 suggests that a SH flight will save 100kg (1.4%) of fuel because of this change, whilst a LH flight will save 400kg (0.4%) compared to a Basic Fuel Scheme.
83. Meanwhile, the second part of the legislation permits airlines greater flexibility with their fuel management and schedules if any decision to reduce aircraft fuel loads is supported by sufficient analysis and monitoring. As a result, EASA estimates in Figure 14 suggest that a SH flight will save 493kg (6.8%) of fuel with an Individual Fuel Scheme, whilst a LH flight will save 4,759kg (4.2%) compared to a Basic Fuel Scheme, as shown in Figure 15.

Figure 15 EASA Example Fuel Management Schemes Fuel Savings (kg)

	SH		**LH**	
	Basic w/ Var.	**Individual**	**Basic w/ Var.**	**Individual**
Fuel Requirement	7,200	6,807	112,446	108,087
Basic Requirement	7,300	7,300	112,846	112,846
Saving	100	493	400	4,759

84. Fuel load savings will only be experienced once per aircraft. A saving only occurs once as aircraft do not use the entirety of their fuel load on any given flight. This is due to the inclusion of items such as alternates and reserves on a fuel scheme, which are only expected to be used in extraordinary circumstances, such as a flight being diverted.
85. Assuming that remaining fuel after the last flight before the policy is enacted is kept loaded for the next flight of the aircraft, an airline benefits from a one-off saving of not having to refuel that aircraft the full amount of fuel which was used in the trip. Clearly, for subsequent flights, the entire refuelling will be required to adhere with the new fuel scheme.

86. Given that the first part of the legislation allows all airlines to achieve a small fuel load saving through implementing a Basic Fuel Scheme with Variations, we assume that all airlines will experience the associated fuel load saving. This implies that every aircraft in the UK commercial fleet will experience at least a small fuel load saving.
87. Initially this will provide a large one-off benefit as airlines respond to the legislation permitting Basic Fuel Schemes with Variations and Individual Fuel Schemes. Subsequently, an on-going benefit will be realised as new aircraft enter the fleet. Furthermore, as aircraft transition from a Basic Fuel Scheme with Variations to an Individual Fuel Scheme as the uptake of the latter increases, an additional fuel load benefit will be realised.
88. According to data from the CAA[31], the size of the UK commercial fleet is 974 aircraft, consisting of 753 SH aircraft, and 221 LH aircraft. This breakdown assumes any aircraft with an average flight duration greater than 6 hours is classed as a LH aircraft. Subsequently, any flights operated by those aircraft is considered a LH flight. A caveat of this assumption is medium-haul flights are classed as SH flights.
89. Our illustrative analysis of CAA fleet data[32] suggests approximately 636 (439 SH, and 197 LH) aircraft operated by the largest carriers will be in scope for Individual Fuel Schemes. This implies the remaining 338 aircraft (314 SH, 24 LH) operated by smaller operators will only be in scope for the benefits from the Basic Fuel Scheme with Variations. These values are illustrated in Figure 16.

Figure 16 Number of Aircraft in Scope

Year = 2019	**Total**	**Largest Airlines**	**Smaller Airlines**
SH	753	439	314
LH	221	197	24
Total	974	636	338

The largest airlines consider those whose operations are in scope for Individual Fuel Schemes and Basic Fuel Scheme with Variations. The smaller airlines consider those whose operations are in scope only for Basic Fuel Scheme with Variations. Values show number of aircraft.

90. Taking our assumed 2019 fleet composition as an estimate for 2024, we then apply a growth rate in line with DfT's Jet Zero Scenario 1 Air Traffic Movement (ATM) forecast[33]. In using this growth rate, as we assume that the ATM to fleet ratio remains constant over time. We further assume that the growth in fleet size does not vary between smaller and larger airlines, but the applied growth rate does differ for SH and LH aircraft. The forecast for fleet growth is shown in Figure 17.

Figure 17 Number of Aircraft in Scope Forecast

	Smaller Airlines		**Largest Airlines**		**Total**
	SH	LH	SH	LH	
2024	314	24	439	197	974
2025	314	24	439	197	973
2026	315	24	440	197	976
2027	314	24	439	199	977
2028	314	25	440	202	980
2029	316	25	441	203	985
2030	318	25	444	206	993
2031	322	26	451	213	1012
2032	324	26	453	214	1017
2033	328	27	459	221	1035

[31] CAA UK Airline Data 2019, Tables 0.1.6, 1.11.1 & 1.11.2. Available at: https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airlines/uk-airline-data/uk-airline-data-2019/annual-2019/
[32] CAA UK Airline Data 2019, Tables 0.1.6, 1.11.1 & 1.11.2. Available at: https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airlines/uk-airline-data/uk-airline-data-2019/annual-2019/
[33] Jet Zero strategy: delivering net zero aviation by 2050. Available at: https://www.gov.uk/government/publications/jet-zero-strategy-delivering-net-zero-aviation-by-2050

Values show number of aircraft.

91. Considering the uptake rate of each fuel scheme, we expect the largest carriers to implement Individual Fuel Schemes up to a maximum 50% uptake rate in 2033, whilst the remainder of their aircraft operate a Basic Fuel Scheme with Variations. Initially, we expect only a 10% uptake rate for Individual Fuel Schemes by aircraft in scope. The forecast for uptake rates over the appraisal period is shown in Figure 18.

Figure 18 Uptake Rates Forecast (%)

	Basic Fuel Scheme with Variations		**Individual Fuel Scheme**	
	SH	LH	SH	LH
2024	100	100	10	10
2025	100	100	14	14
2026	100	100	19	19
2027	100	100	23	23
2028	100	100	28	28
2029	100	100	32	32
2030	100	100	37	37
2031	100	100	41	41
2032	100	100	46	46
2033	100	100	50	50

This uptake rates apply only to the aircraft in scope for each scheme – those in Figure 17.

92. Applying the uptake rates in Figure 18 to the forecast for aircraft in scope in Figure 17 provides a forecast for the actual number of aircraft which are utilising a Basic Fuel Scheme with Variations or an Individual Fuel Scheme throughout the appraisal period. In this forecast, we assume that any aircraft in scope for an Individual Fuel Scheme that has not implemented one instead utilises a Basic Fuel Scheme with Variations.

Figure 19 Fleet Uptake Forecast

	Basic w. Variations Fuel Scheme		**Individual Fuel Scheme**		**Total**
	SH	LH	SH	LH	
2024	709	201	44	20	974
2025	689	192	63	28	973
2026	672	184	83	37	976
2027	651	177	102	47	977
2028	632	170	122	56	980
2029	615	163	142	65	985
2030	599	156	163	76	993
2031	588	151	185	88	1012
2032	570	143	206	98	1017
2033	557	138	229	111	1035

Values in this Figure are rounded to the nearest integer. Values show number of aircraft.

93. In the first year of the policy, we expect 910 aircraft to utilise Basic Fuel Schemes with Variations, and an additional 64 to utilise Individual Fuel Schemes. The LH/SH breakdown of these flights is shown in the first row of Figure 19. This amounts to a fuel saving of 266,824kg of fuel valued at £251,596 (2024 prices), using the fuel load savings previously described. This assumes International Air Transport Association's (IATA) average 2022 cost of jet fuel of $141.20/barrel[34], equivalent to £0.94/kg[35] (2024 prices), as shown in Figure 20.

[34] IATA Jet Fuel Price Monitor (accessed 02/12/2022). Available at: https://www.iata.org/en/publications/economics/fuel-monitor/

[35] Assumes jet fuel density of 0.8kg/l, 158.987 litres per oil barrel, £1 = $1.2387. Exchange rate is a YTD value (accessed 02/12/2022). Available at: ExchangeRates.org.uk.

Figure 20 Jet Fuel Cost

	Value	**Unit**
Jet Fuel Cost	141.20	$/barrel, 2022 prices
Litre per Barrel	158.987	l
Jet Fuel Cost	0.89	$/l, 2022 prices
Jet Fuel Density	0.8	kg
Jet Fuel Cost	1.11	$/kg, 2022 prices
GBP/USD Exchange Rate	1.2369	$, 2022 average
Jet Fuel Cost	0.90	£, 2022 prices
Jet Fuel Cost	0.94	£, 2024 prices

94. In subsequent years, we expect fuel load savings to occur through two avenues. The first is from new aircraft entering the fleet as airlines offer more flights to meet demand. We assume that the new aircraft of smaller airlines are enrolled on a Basic Fuel Scheme with Variations, generating the associated fuel load benefit.
95. As for the second avenue, we assume that the new aircraft of larger airlines are enrolled on Individual Fuel Schemes. This is a simplifying assumption; the lifetime fuel load savings are identical irrespective of whether new aircraft are enrolled on individual fuel schemes or not. In the case of a lower enrolment of new aircraft onto Individual Fuel Schemes, a forecasted increase in uptake will be compensated by a greater transfer of aircraft from Basic Fuel Scheme with Variations to an Individual Fuel Scheme.
96. The second avenue sees larger airlines move aircraft which are operating on a Basic Fuel Scheme with Variations onto an Individual Fuel Scheme. This is estimated as the difference between the growth in the fleet uptake forecast (see Figure 19), and the aircraft in scope forecast (see Figure 17). Figure 21 details when we expect increases in fleet uptake to occur through these two avenues. Note that negative values are assumed to be zero as an airline cannot de-benefit from a one-off fuel load saving on an aircraft.

Figure 21 Increases in Fleet Uptake Forecast

	Basic with Variations		**Individual**		**Basic w. Var. to Individual**	
	SH	LH	SH	LH	SH	LH
2024	709	201	44	20	0	0
2025	0	0	0	0	19	9
2026	1	0	1	1	18	8
2027	0	0	0	2	19	7
2028	0	0	1	2	19	7
2029	1	0	2	2	19	8
2030	2	0	3	3	18	7
2031	5	1	7	6	16	5
2032	1	0	2	2	19	9
2033	4	1	6	7	17	6

Taking the sum of the Basic with Variations and Individual columns equals the Total column in Figure 17 and Figure 19. Values in this Figure are rounded to the nearest integer. Values show number of aircraft.

97. The associated fuel saving from the behaviours described in Figure 21 are shown in Figure 22. The fuel load savings are as previously described for new aircraft adopting Basic Fuel Scheme with Variations and Individual Fuel Schemes. However, those aircraft transferring to an Individual Fuel Schemes from a Basic Fuel Scheme with Variations have a smaller fuel load saving (393kg for SH flights, 4,359kg for LH flights) as they have already previously experienced a fuel load saving when initially adopting a Basic Fuel Scheme with Variations. Total fuel savings are detailed in Figure 22.

Figure 22 Total Fuel Load Savings (kg)

kg	**Basic with Variations**		**Individual**		**Basic w. Var. to Individual**		**Total**
	SH	LH	SH	LH	SH	LH	
2024	70910	80520	21651	93743	-	-	266824
2025	-	-	-	-	7645	37915	45559
2026	105	39	727	3773	7193	35282	47120
2027	-	99	-	9631	7603	31476	48809
2028	40	104	278	10140	7512	31923	49998
2029	108	83	745	8093	7280	34020	50329
2030	200	152	1382	14877	7011	30743	54366
2031	485	315	3345	30753	6188	23391	64477
2032	132	77	913	7550	7480	37466	53619
2033	441	326	3038	31855	6698	26949	69307

No new aircraft fuel load savings are expected in 2025 due to the negative growth in ATMs forecasted in this year. A true zero value is assumed as a negative fuel load saving is nonsensical.

98. The associated value of the fuel load savings in Figure 22 is detailed in Figure 23. This assumes the cost of fuel to be £0.94/kg.

Figure 23 Fuel Load Savings Benefit (£, mn)

	Description	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Best Estimate	**Fuel Load Savings**	0.25	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.05	0.07

Values are in 2024 prices and do not account for discounting.

On-going Benefits – Fuel Burn Savings

99. A further fuel benefit is derived from the fuel load savings. According to EASA[36], an amount of fuel equivalent to 3% of the fuel load saving will not be burned per hour as the aircraft has become lighter, and therefore more fuel efficient. We consider this to be a direct impact to business.

100. However, given that a lesser fuelled aircraft with no change in payload would be under the optimal aircraft weight (as determined by the market), airlines have an incentive to increase the payload of the aircraft assuming they can generate a revenue stream from the additional payload which is greater than the cost of the fuel saving. CAA engagement suggests that this effect will only be observed in LH aircraft due to the marginal fuel weight saving possible in smaller SH aircraft. This implies that the operators of SH aircraft will benefit only from fuel burn saving, rather than an increased payload benefit.

101. In LH aircraft, any increase in payload would require an increase in fuel, but in any situation the value of the additional cargo less the fuel required to carry it would be at least greater than the cost saving. The optimal ratio between the weight of additional payload and amount of fuel required for that weight is unknown and will be addressed in consultation.

Question 6
a) In the event of fuel load savings, do you anticipate that operators will choose to carry additional payload (and associated additional fuel) to maximise revenue from each aircraft movement?
b) If yes, can you provide any information to enable us to the value of this additional payload?

102. In our analysis, we assume that the market that airlines operates in (i.e., a market where airlines are not maximising for social welfare, therefore ignoring public goods such as the environment) is in equilibrium. This implies that the value of additional payload to the airline will be equivalent to the fuel cost saving. Therefore, this analysis uses the monetised value of fuel burn savings as a

[36] EASA Notice of Proposed Amendment 2016-06 (A), Fuel Planning and Management (15/07/2016)

proxy for the likely behaviour of an airline to increase payload for LH aircraft, as the value of additional payload is non-monetizable. The true value of payload and whether this hypothesised logic chain holds will be explored in consultation. To prevent confusion, this benefit will continue to be referred to as a fuel burn saving.

103. In the short-term, before the long-run equilibrium is realised, the value of additional cargo/passenger payload in LH aircraft will be greater than the value of fuel burn savings. Therefore, the fuel burn savings monetised benefit is likely to be an underestimate of the true economic benefit to airlines.

104. EASA suggest that fuel burn savings will be equivalent to 3% of the weight of the fuel load saved per hour. Using the fuel load savings previously calculated, using a Basic Fuel Scheme with Variations airlines can expect a 3.0kg/hr saving for SH flights, and a 12.0kg/hr saving for LH flights. Under the second part of the legislation and by using an Individual Fuel Scheme, airlines can expect a 14.8kg/hr saving for SH flights, and a 142.8kg/hr saving for LH flights.

105. CAA data[37] indicates that there were 1.06m flights by CAA registered commercial aircraft in 2019, of which 0.94m we consider SH, and 0.12m LH. We have assumed a LH flight to be greater than six hours in duration. Considering these flights, an average SH flight had a duration of 126 minutes, whilst a LH flight lasts an expected 528 minutes.

106. We have also assumed that the number of flights per aircraft remains constant over time. Using the flight data mentioned in the previous paragraph, and the fleet data previously outlined, we assume that a SH aircraft completes 1250 flights per year, whilst a LH aircraft completes 554 per year, as shown in Figure 24.

Figure 24 Flight Details

	SH	LH	Unit
Average Duration	126	528	mins
Flights per Year	1250	554	no. flights

107. Using these assumptions and applying them to the fleet uptake forecast detailed in Figure 19 provides an estimate for the number of minutes of flying expected under each fuel scheme. This is outlined in Figure 25.

Figure 25 Flight Duration Forecast (mins)

mins	Basic w. Variations Fuel Scheme		Individual Fuel Scheme		Total
	SH	LH	SH	LH	
2024	111,530,536	58,883,540	6,904,796	5,762,572	183,081,444
2025	108,343,689	56,210,436	9,962,738	8,307,169	182,824,032
2026	105,632,061	53,870,757	13,071,983	10,907,029	183,481,830
2027	102,337,692	51,830,428	16,113,323	13,611,533	183,892,976
2028	99,396,126	49,763,878	19,207,192	16,377,354	184,744,550
2029	96,654,003	47,541,296	22,356,912	19,158,032	185,710,244
2030	94,164,668	45,589,429	25,602,229	22,135,849	187,492,175
2031	92,452,367	44,249,876	29,144,018	25,596,170	191,442,430
2032	89,668,634	41,791,931	32,427,433	28,574,742	192,462,740
2033	87,682,273	40,221,815	36,075,462	32,341,623	196,321,173

108. Applying the fuel burn assumptions previously outlined allows the fuel burn saving to be estimated under each fuel scheme, as shown in Figure 26.

Figure 26 Fuel Burn Saving (kg)

37 CAA UK Airline Data 2019, Tables 0.1.6, 1.11.1 & 1.11.2. Available at: https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airlines/uk-airline-data/uk-airline-data-2019/annual-2019/

kg	Basic w. Variations Fuel Scheme		Individual Fuel Scheme		Total
	SH	LH	SH	LH	
2024	5,576,527	11,776,708	1,702,723	13,710,660	32,766,617
2025	5,417,184	11,242,087	2,456,811	19,764,918	38,881,001
2026	5,281,603	10,774,151	3,223,551	25,950,663	45,229,969
2027	5,116,885	10,366,086	3,973,545	32,385,383	51,841,899
2028	4,969,806	9,952,776	4,736,494	38,965,991	58,625,067
2029	4,832,700	9,508,259	5,513,215	45,581,950	65,436,124
2030	4,708,233	9,117,886	6,313,510	52,666,951	72,806,579
2031	4,622,618	8,849,975	7,186,915	60,899,958	81,559,466
2032	4,483,432	8,358,386	7,996,605	67,986,755	88,825,178
2033	4,384,114	8,044,363	8,896,209	76,949,146	98,273,832

109. The associated value of the fuel load savings in Figure 26 is detailed in Figure 27. Once again, this assumes the cost of fuel to be £0.94/kg.

Figure 27 Fuel Burn Savings Benefit (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Fuel Burn Savings**	30.9	36.7	42.6	48.9	55.3	61.7	68.7	76.9	83.8	92.7

Values are in 2024 prices and do not account for discounting.

On-going Benefits – Realised Carbon Savings

110. As discussed, in SH aircraft, we do not expect operators to increase payload in response to a reduction in the weight of fuel load. Instead, we expect the full quantity fuel savings to be made in these aircraft, which implies that carbon savings will be derived from reduced fuel burn.

111. As shown in Figure 26, we expect 7.3m kg of fuel to be saved in 2024 by SH aircraft. Using BEIS emissions factors[38], this would equate to a saving of 23.2m kg of carbon dioxide emissions (CO2e, see Figure 28).

112. Using central forecasts for carbon values from DfT TAG Data Book[39], the economic value of this carbon saving would be £6.4m (2024 prices). These values increase to 13.3m kg fuel, 42.4m kg of CO2e, and a value of £13.4m (2024 prices) in 2033.

Figure 28 CO2e Savings from SH Aircraft (kg, £)

SH Aircraft Only	Fuel Saving (kg)	CO2e Saving (kg)	Value (£, 2024 prices)
2024	7,279,249	23,240,896	6,427,663
2025	7,873,996	25,139,779	7,058,712
2026	8,505,154	27,154,916	7,740,628
2027	9,090,430	29,023,562	8,399,283
2028	9,706,300	30,989,886	9,104,902
2029	10,345,915	33,032,023	9,852,677
2030	11,021,743	35,189,780	10,656,127
2031	11,809,533	37,705,005	11,591,659
2032	12,480,037	39,845,762	12,436,338
2033	13,280,323	42,400,883	13,435,352

Values are in 2024 prices and do not account for discounting.

38 BEIS Greenhouse Gas Reporting: Conversion Factors 2022, Full-Set (accessed 07/12/2022). Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022

39 DfT TAG Data Book, Sheet A3.4 (accessed 07/12/2022). Available at: https://www.gov.uk/government/publications/tag-data-book

Non-monetised Benefits

113. This section outlines those benefits which have not been monetised. The following impacts have not been monetised as the data required to provide estimates is not widely available and the nature of the benefits does not lend themselves to monetisation. Any analysis would likely provide low quality estimates; therefore, it is not considered proportionate to do so.

Safety Benefits

114. As previously described, the introduction of Individual Fuel Schemes will require airlines to provide additional attention to their fuel schemes. This will be matched by an additional monitoring requirement for the CAA. Increases in scrutiny will be aided by advances in technologies which become legislated for use in air operations by this policy. This impact is considered to be an indirect impact to business.
115. As a result of increased planning and management efforts and abilities by operators and regulators, the number of diversions which result in a flight landing with less than the final reserve fuel will be expected to reduce. Landing with less fuel than the final reserve is considered by the CAA as an incident with safety consequences. Therefore, the introduction of fuel schemes is expected to accrue a marginal safety benefit.

Harmonisation Benefits

116. As stressed throughout this assessment, a major benefit of the policy is that CAA legislation will be aligned with ICAO Standards and thus complying with our International Treaty obligations. This impact is considered to be a direct impact to business, and true for the fuel management and planning legislation concerning both aircraft and helicopters. Enacting this policy will allow CAA registered operators and aircraft to implement effective fuel management policies and remove discrepancies between legislation issued by the CAA and other national and international aviation authorities.

Innovation Benefits

117. There are several avenues through which the policy can stimulate innovation. These innovation benefits are considered to be indirect impacts to business.
118. Firstly, the policy includes legislation which allows the latest technology to be used to their full potential for fuel planning and management activities. Permitting the use of more advanced technologies signals to the market that future innovations in fuel planning and management technology will be welcomed by policymakers and regulators, reducing potential barriers to further technological advances.
119. Secondly, the permissive legalisation surrounding fuel schemes allows for innovative improvements in the fuel working practices of operators. If operators have sufficient evidence to prove that an Individual Fuel Scheme is safe, regulators will be more willing to accept those schemes.
120. Finally, the policy introduces the use of alternative means of propulsion to be used for operations, such as hydrogen and electric propulsion. This provides a significant opportunity to industry to progress research into alternative energy sources. Against the backdrop of a wider decarbonisation agenda, this benefit is likely to be especially valuable.
121. This regulation is a necessary requirement to enable the use of alternative energy sources, such as hydrogen or electric propulsion, for commercial air travel. However, some regulatory changes and significant technological advancements will be required before these energy sources can be used. The costs and benefits of these regulations will themselves be subject to the regulatory impact assessment process.

Fuel Benefits for General Aviation

122. We expect a limited benefit to business jet operators from implementing Basic Fuel Schemes with Variations. This benefit will be small because operators are required to have an effective fuel

management system in place which may be unrealistic due to the nature of business jet operations (i.e., operating out of many aerodromes and flying various routes). It is also only applicable to business jet operators engaged in CAT operations, rather than privately owned and operated aircraft.

123. The primary benefit for large General Aviation (GA) aircraft and helicopter operators is the simplification of regulations regarding fuel reserves. In these aircraft, there is often no scope for a Basic Fuel Scheme with Variations or Individual Fuel Scheme to be adopted. Furthermore, light recreational aircraft operators will benefit from the removal of the prescriptive final reserve fuel requirement which have been replaced with more proportionate requirements.

Sensitivity Analysis

On-going Benefits – Fuel Load Savings

124. High and low estimates are provided based on varying uptake rates of the policy, given the uncertainty surrounding the central estimated uptake rate. As discussed, the uptake of Basic Fuel Scheme with Variations is expected to be 100% in our central scenario, both for initial and maximum values, across the segment of the fleet not in scope for Individual Fuel Schemes. We do not change this assumption during our sensitivity analysis, as shown in Figure 29.

125. In our central scenario, we expect a maximum uptake rate of 50% to apply to the largest operators who implement Individual Fuel Schemes. In the low scenario, this portion decreases to 25%, whilst it increases to 75% in the high scenario. As for initial rates, we expect uptakes of 10%, 5% and 25% for the central, low, and high scenarios, respectively[40]. The portion of the fleet which are in scope for Individual Fuel Schemes, but do not utilise them, are assumed to utilise the Basic Fuel Scheme with Variations – this assumption does not change between scenarios.

Figure 29 Initial and Maximum Uptake Rates (%)

%	**Basic Fuel Scheme with Variations**						**Individual Fuel Scheme**					
	Central		**Low**		**High**		**Central**		**Low**		**High**	
	Init.	Max.	Init.	Max.	Init.	Max.	Init.	Max.	Init.	Max.	Init.	Max.
SH Flights	100	100	100	100	100	100	10	50	5	25	25	75
LH Flights	100	100	100	100	100	100	10	50	5	25	25	75

126. As discussed, we expect uptake rate of Individual Fuel Schemes to grow linearly from the initial rate in the first appraisal year to the maximum rate in the final appraisal year. Figure 30 details the year-by-year uptake rate used across each scenario.

Figure 30 Individual Fuel Scheme Uptake Rates by Scenario (%)

%	**Central Scenario**		**Low Scenario**		**High Scenario**	
	SH	**LH**	**SH**	**LH**	**SH**	**LH**
2024	10	10	5	5	25	25
2025	14	14	7	7	31	31
2026	19	19	9	9	36	36
2027	23	23	12	12	42	42
2028	28	28	14	14	47	47
2029	32	32	16	16	53	53
2030	37	37	18	18	58	58
2031	41	41	21	21	64	64
2032	46	46	23	23	69	69
2033	50	50	25	25	75	75

[40] These are estimated values motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy.

127. Other than a change in uptake rate, no other changes are made to estimation when constructing a high and low scenario. The fuel load benefits from each scenario are shown in Figure 31. Using 2024 data for comparison, in the low scenario, a reduced uptake rate of Individual Fuel Schemes reduces fuel load benefits from £0.25m in the central scenario, to £0.20m. Meanwhile, in the high scenario, an increased uptake rate of Individual Fuel Schemes increases fuel load benefits to £0.40m.

Figure 31 Fuel Load Savings (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Fuel Load Savings**	0.25	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.05	0.07
Low		0.20	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04
High		0.40	0.05	0.06	0.06	0.06	0.06	0.07	0.08	0.06	0.08

Values are in 2024 prices and do not account for discounting.

On-going Benefits – Fuel Burn Savings

128. The same methodology used for fuel load benefits sensitivity analysis is used to provide high and low estimates for fuel burn benefits. The uptake rates in Figure 30 are applied to the calculation of 2024 fuel burn benefits. Although this is not explicitly detailed in our calculations, uptake rates are incorporated into the fleet uptake forecast used to estimate fuel burn savings which is then subsequently used.

129. Using 2024 data as a comparison, a reduced uptake rate of Individual Fuel Schemes reduces fuel burn benefits from £30.9m in 2024, in the central scenario, to £26.9m, in the low scenario. Meanwhile, an increased uptake of Individual Fuel Schemes increases fuel burn benefits to £52.0m in the high scenario (see Figure 32).

Figure 32 Fuel Burn Savings (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Fuel Burn Savings**	30.9	36.7	42.6	48.9	55.3	61.7	68.7	76.9	83.8	92.7
Low		26.9	29.6	32.6	35.6	38.8	42.0	45.5	49.8	53.1	57.8
High		52.0	58.9	66.1	73.7	81.6	89.4	98.0	108.4	116.7	127.9

Values are in 2024 prices and do not account for discounting.

On-going Benefits – Realised Carbon Savings

130. The high and low estimates for carbon savings consider two areas of sensitivity. Firstly, the volume of fuel burn saved in the high and low estimates outlined above are used. Secondly, high, and low versions series of DfT TAG carbon values[41] are used. This implies the low scenario for realised carbon savings assumes a low fuel burn saving, and a low value of carbon, whilst the high scenario uses the high values for each.

131. Using 2024 data as a comparison, fuel carbon savings are reduced from £6.4m in 2024, in the central scenario, to £2.8m, in the low scenario. Meanwhile, carbon benefits increase to £11.3m in the high scenario (see Figure 33).

Figure 33 Realised Carbon Savings (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Realised Carbon Savings**	6.4	7.1	7.7	8.4	9.1	9.9	10.7	11.6	12.4	13.4
Low		2.8	3.0	3.1	3.3	3.5	3.6	3.8	4.1	4.3	4.5
High		11.3	12.2	13.2	14.2	15.2	16.3	17.5	19.0	20.2	21.7

Values are in 2024 prices and do not account for discounting.

[41] DfT TAG Data Book, Sheet A3.4 (accessed 07/12/2022). Available at: https://www.gov.uk/government/publications/tag-data-book

Overall Monetised Benefits

132. Considering the sum of monetised benefits and using 2024 data as a comparison, overall benefits reduce from £37.6m in 2024, in the central scenario, to £29.9m, in the low scenario. Meanwhile, overall benefits increase to £63.7m in the high scenario (see Figure 34).

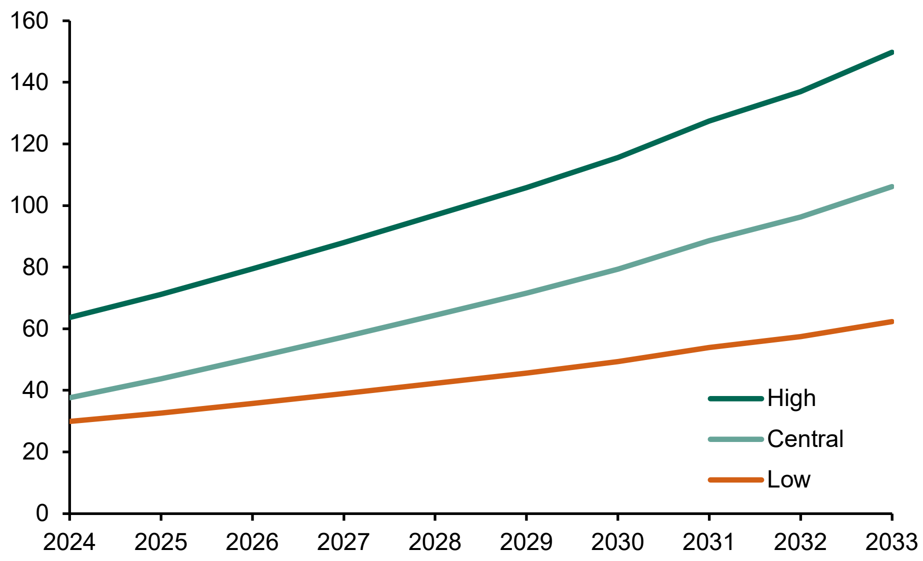
Figure 34 Overall Benefits (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate		37.6	43.8	50.4	57.3	64.4	71.6	79.4	88.6	96.2	106.2
Low	**Overall Benefits**	29.9	32.6	35.7	38.9	42.3	45.6	49.3	53.9	57.4	62.3
High		63.7	71.2	79.4	88.0	96.9	105.8	115.6	127.4	137.0	149.7

Values are in 2024 prices and do not account for discounting.

133. Overall benefits are also shown in Figure 35.

Figure 35 Annual Overall Benefits (£mn, 2024 prices)



Values are in 2024 prices and do not account for discounting.

134. It has not been deemed necessary to conduct a switching values analysis. This is due to the relatively small additional expected impact of non-monetised impacts compared to the large impacts which have already been monetised in this analysis. In addition, given the magnitude of monetised impacts is much greater than the magnitude of monetised costs, it has also been deemed unnecessary to undertake a break-even analysis.

Small and Large Operators

135. When assessing the impact on the largest operators and the smaller ones, the economic benefit is distributed unequally. Inequality greatens in the high scenario and lessens in the low scenario, driven by the varying uptake of Individual Fuel Schemes by large operators.
136. In any scenario, the inequality associated with the policy grows over time. Considering the central scenario, in 2024, large operators receive a large majority (88.0%) of the overall benefits to businesses[42]; this is roughly in line with the 85.1% market share (according to our definition of large operators) they command. But by 2033, large operators receive a majority (95.4%) which significantly outpaces their market share (85.1%, assuming market share remains constant). This divergence is driven by large operators benefitting from increasing uptake of Individual Fuel Schemes over time, which small operators are not in scope for.
137. The full breakdown of benefits is shown in Figure 36 and illustrated in Figure 37.

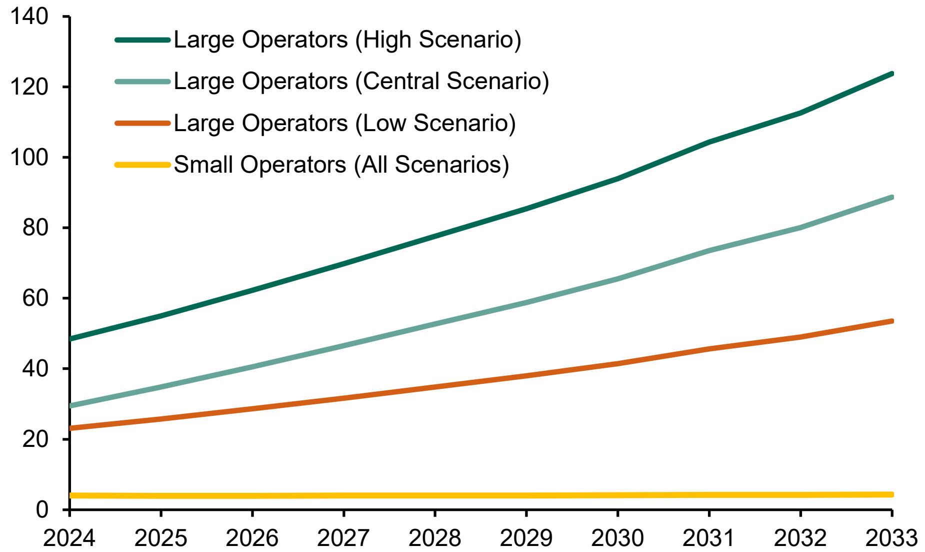
[42] Realised Carbon Benefits are a benefit to society and not to business, therefore are excluded from this part of the analysis.

Figure 36 Monetised Benefits by Small/Large Operators (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
On-going Benefits											
Best Estimate	**Fuel Load Savings (large operators)**	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Low		0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High		0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Best Estimate	**Fuel Load Savings (small operators)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Best Estimate	**Fuel Burn Savings (large operators)**	29.2	34.7	40.5	46.5	52.6	58.8	65.5	73.4	80.0	88.6
Low		22.9	25.7	28.6	31.6	34.8	37.9	41.4	45.6	49.0	53.5
High		48.1	54.9	62.2	69.8	77.6	85.4	93.9	104.2	112.5	123.7
Best Estimate	**Fuel Burn Savings (small operators)**	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.2	4.3
Low		4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.2	4.3
High		4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.2	4.3
Overall Benefits											
Best Estimate	**Overall Benefits (large operators)**	29.4	34.8	40.5	46.5	52.7	58.8	65.5	73.5	80.0	88.6
Low		23.1	25.7	28.6	31.7	34.8	38.0	41.4	45.6	49.0	53.5
High		48.4	55.0	62.2	69.8	77.6	85.4	94.0	104.3	112.6	123.7
Best Estimate	**Overall Benefits (small operators)**	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.2	4.3
Low		4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.2	4.3
High		4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.2	4.3

Values are in 2024 prices and do not account for discounting.

Figure 37 Annual Overall Benefits by Small/Large Operators (£mn, 2024 prices)



Values are in 2024 prices and do not account for discounting.

Business Impact Target Calculations

138. Utilising a Price Base Year of 2019, a Present Value Base Year of 2020, and a discount rate of 3.5%, Option 1 has been estimated to have an Equivalent Annual Net Direct Cost to Business (EANDCB) of -£43.2m and a Business Impact Target (BIT) score of -216.2.

3.0 Risks and Unintended Consequences

Risks

139. No significant risks have been identified from this policy. It is expected that the regulation will be straightforward to enforce using existing CAA enforcement mechanisms and that fuel schemes and other changes in fuel planning and management legislation will be implemented by the organisations required to do so (given its uptake will have benefits to industry). Nevertheless, potential sources of risks are discussed below.

Efficacy

140. This policy considers permissive legislation. This implies air operators could choose to make no changes to their working practices or operations. In this case, the primary objective of harmonising legislation with ICAO standards will still be achieved, but the full economic benefits of the policy would not be realised.
141. However, we expect the policy, in particular the permission of using Basic Fuel Schemes with Variations and Individual Fuel Schemes, to be effective and for uptake to be within the high-low range outlined in the analysis section of this assessment. We expect the potentially large economic benefits to operators to provide sufficient incentive for them to act as envisaged in response to legislation.

Agent Behaviour

142. The monetised benefits associated with this policy require agents to act in a certain way to derive such impacts, i.e., to introduce fuel schemes. Our analysis assumes that operators will act rationally and act in response to the legislation. Although this assumption rarely completely holds in practice, we expect enough operators to act to achieve the estimated economic benefits. This is due to the significant positive economic benefit to business from doing so and the relatively small cost.
143. Furthermore, some potential long-term innovation benefits are heavily dependent on research and development activities occurring in response to the policy. The extent to which this will occur depends on the technologies impacted; we expect innovation in fuel schemes to occur in the short-term, but innovation in alternative aviation fuel/energy to require a longer time span. Nevertheless, we expect short-term operational innovations to be stimulated by economic incentives, whilst long-term projects would need to be supported by other more focused policies.

Legal Challenge

144. We do not anticipate the policy to present any legal challenge.

Safety

145. The Basic Fuel Schemes with Variations and Individual Fuel Schemes permitted by this legislation allow operators to carry a lesser load of fuel on their aircraft during flights. This suggests that less fuel would be available for diversions and other safety related flying activities and reasons. As a result, there is a risk that the number of aircraft which land with less than the FRF, therefore inciting an incident, will increase rather than decrease as intended.
146. However, the design of the legislation mitigates this risk. Air operators who wish to implement an individual scheme must provide sufficient evidence to the CAA that there is no safety compromise deriving from the operators' choice of fuel scheme. The CAA will be required to conduct additional monitoring sufficiently assure the safety of fuel schemes.

Unintended Consequences

Unrealised Carbon Impacts

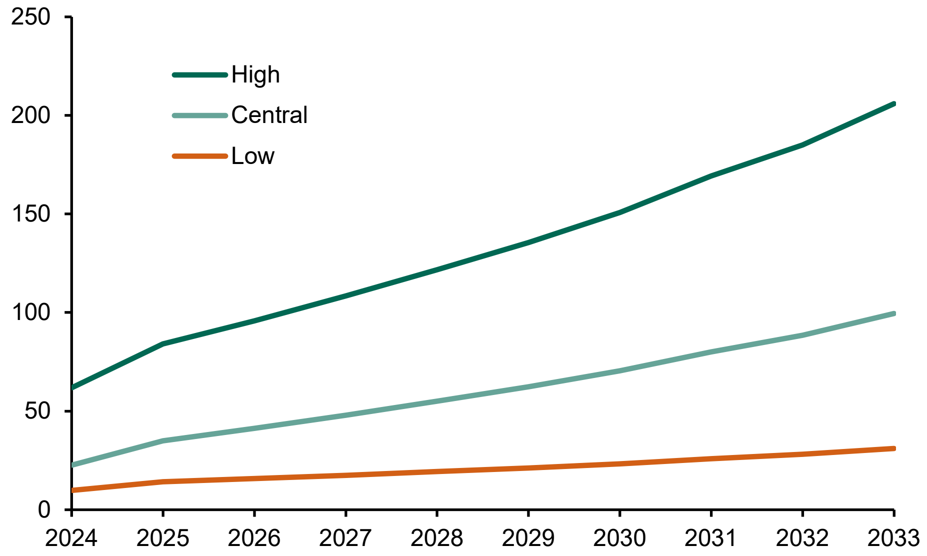
147. As previously discussed, in LH aircraft, we expect operators to increase payload in response to the reduction in weight associated with fuel load, rather than utilising the fuel burn savings. As a result, we do not expect the full quantity of fuel savings to be made, as operators will have to readjust their fuel load to compensate for the additional payload weight. This implies that the carbon benefits derived from reduced fuel burn in LH aircraft will not be realised.
148. Hypothetically, should airlines choose not to increase payload in LH aircraft and only utilise the fuel burn savings, we expect that 25.5m kg of fuel would be saved in 2024 in our central scenario. Using BEIS emissions factors[43], this would equate to a saving of 81.3m kg of carbon dioxide emissions (CO2e). Using central forecasts for carbon values from DfT TAG Data Book[44], the economic value of this carbon saving would be £22.5m (2024 prices). These values increase to 85.0m kg fuel, 271.4m kg of CO2e, and a value of £86.0m (2024 prices) in 2033.
149. In the low scenario utilising low uptake rates of the policy and a low carbon value scenario, the value of carbon savings would decrease to £9.8m in 2024 and £26.5m in 2033 (2024 prices). Meanwhile, in the high scenario utilising high uptake rates and a high carbon value scenario, the value of carbon savings would increase to £61.8m in 2024 and £184.2m in 2033 (2024 prices).

Figure 38 Unrealised Carbon Savings (£, mn)

	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Best Estimate	**Unrealised Carbon Savings**	22.5	34.9	41.2	47.9	55.0	62.3	70.4	80.1	88.5	99.4
Low		9.8	14.1	15.7	17.5	19.3	21.2	23.3	25.9	28.1	31.0
High		61.8	84.0	95.7	108.4	121.7	135.4	150.7	169.2	185.0	205.9

Values are in 2024 prices and do not account for discounting.

Figure 39 Unrealised Carbon Benefits (£mn, 2024 prices)



Values are in 2024 prices and do not account for discounting.

150. Air operators are firms which, assuming rationality, aim to maximise their profits by maximising revenue and minimising costs. The release of carbon emissions does not enter their profit maximisation problem, since the cost of emitting carbon dioxide is borne by society rather than

[43] BEIS Greenhouse Gas Reporting: Conversion Factors 2022, Full-Set (accessed 07/12/2022). Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022

[44] DfT TAG Data Book, Sheet A3.4 (accessed 07/12/2022). Available at: https://www.gov.uk/government/publications/tag-data-book

the emitter, therefore creating a divergence between the socially optimum equilibrium (decided by a social planner who accounts for the cost of carbon). This is an example of a market failure.

151. The divergence generates a negative consumption externality in markets concerning air operators and their operations. Should air operators choose to reduce fuel burn, the policy has the unintended benefit of reducing the size of the carbon externality and realising a large benefit to society. However, if air operators choose to increase payload rather than fly at a lower maximum take-off mass (MTOM), the unintended benefit is not realised, which generates an unintended consequence itself.
152. This analysis assesses the benefit as the difference between two ends of a fuel burn savings in LH aircraft scale – full fuel burn savings (by not carrying additional payload), versus no fuel burn savings (by carrying additional payload). However, this is an oversimplification and operators will likely do some combination of both. This implies that our estimates for potential carbon savings are likely maximum estimates.

Competition

153. We expect the policy is likely to have an adverse impact on competition within the air operators market. As established in the analysis, only large operators will be able to implement Individual Fuel Schemes and experience the benefits to business associated with them. This implies large operators will gain a competitive advantage over smaller operators due to this legislation. This unintended consequence is expanded on in the competition assessment and equality analysis.

4.0 Wider Impacts

Innovation Test

154. Many of the technologies and processes required to demonstrate the ability to carry significantly reduced fuel loads, e.g., Flight Monitoring and Flight Watch, are already part of the operating capabilities of several airlines. The legislation is non-prescriptive in that it does not specify the technology or processes that operators must implement to demonstrate their ability to reduce fuel load safely.
155. On that basis, we assess that the regulation does not prevent or reduce innovation as it is does not prescribe specific technologies and instead provides a non-prescriptive means through which operators may demonstrate their ability to meet the stated safety requirements.
156. The regulation also promotes innovation through changing definitions and specifying the use of the term “energy” rather than “fuel”, in recognition of the likely use of different energy sources for propulsion in the future. Again, this is a deliberate non-prescriptive description which is intended to support, rather than preclude, future innovation by allowing a technology agnostic approach to meeting the sector’s needs.

Small and Micro Business Assessment

157. This Small and Micro Business Assessment has been prepared in accordance with the latest guidance and considers the likely impacts of the policy on small and micro businesses, in addition to businesses with between 50 and 499 employees.
158. Data provided by the CAA[45] has been used to determine the size of the organisations that will be affected by the policy. It should be noted that there are some differences at the margins between the CAA’s method of categorising organisation size and those that are typically used, e.g. the CAA data defines a micro business as those with 10 employees or fewer, rather than the more typical definition of 9 employees or fewer.
159. This dataset indicates that there are 14 micro businesses (10 or fewer employees), 26 small businesses (11-50 employees), 15 medium businesses (51 to 200 employees), 9 large businesses (201 to 500 employees) and 6 very large businesses (501 or more employees).
160. We expect businesses of all sizes will choose to take advantage of the regulation by implementing at least Basic Fuel Schemes with Variations and that the benefits of doing so will generate fuel savings with a value more than the estimated familiarisation costs.
161. However, CAA understand, based on engagement with industry, that only the largest CAT operators (i.e. with over 501 employees) will choose, or indeed be able, to implement Individual Fuel Schemes. It is anticipated that these operators will only choose to implement Individual Fuel Schemes if they determine that the benefits of doing so are likely to outweigh the costs.
162. The decision by some operators to implement Individual Fuel Schemes may have a negative impact on other operators, many of which are likely to be classified as “large” (201 to 500 employees), by placing them at a competitive disadvantage relative to the largest operators who may be benefiting from lower fuel costs or offsetting additional revenue from increased payload. However, the risk of this is thought to be low, since this disadvantage would only be realised in a situation where two operators are flying the same route[46], one using a Basic Fuel Scheme or a Basic Fuel Scheme with Variations and the other using an Individual Fuel Scheme.

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[45] CAA Complexity Matrix (Version 6.1 30/01/2020)

[46] This motivated by CAA policymaking teams and their engagement with industry regarding fuel planning and management policy. It is not considered proportionate to seek further evidence.

Equalities Impact Assessment

163. An equalities impact assessment has not been completed as there will be no impact on those groups with a protected characteristic.

Justice Impact Test

164. A justice impact test has not been completed as no criminal offence is being introduced, and there will therefore be no impact on the justice system.

Trade Impact

165. These measures have already been implemented by European Union Aviation Safety Agency (EASA) member states and other national aviation authorities. At present, this puts UK airlines at a competitive disadvantage relative to international rivals. The implementation of this policy is therefore expected to restore the competitive advantage of UK businesses, leading to greater exports and an improvement in the UK's trade balance.

Competition Assessment

166. As highlighted previously, it is our understanding that Individual Fuel Schemes will only be taken up by the largest operators within the aviation market, who already have systems in place to demonstrate that they are able to safely operate with smaller fuel reserves. Some operators will not have these systems in place and will therefore not be able to benefit fully from the policy through the implementation of Individual Fuel Schemes.
167. Operators who implement Individual Fuel Schemes will either benefit through reduced fuel costs, because of lower overall aircraft weight leading to less fuel burn, or through increasing revenue by using the additional weight allowance to carry more cargo/passengers. As a result, their operating margins will increase relative to the margins of smaller rivals.
168. This is likely to have a negative impact on smaller operators within the sector, who will not be able to benefit in the same way unless they choose to invest in costly Flight Watch, Flight Monitoring, or similar systems. Equally, new incumbents to the market will face higher upfront costs if they wish to compete on an equal footing with the largest operators.
169. However, smaller operators will be able to benefit from implementing Basic Fuel Schemes with Variations. Whilst the fuel load and fuel burn savings associated with these fuel schemes are smaller than for Individual Fuel Schemes, they still offer an economic benefit to operators compared to the do-nothing scenario. This limits the adverse competition impact on smaller operators; indeed, we assess the overall policy impacts to outweigh this impact.

Greenhouse Gases Impact Test/Wider Environmental

170. We do not expect this policy to impact the emissions of greenhouse gases. It is our expectation that operators will use the additional weight allowance to carry more cargo, rather than benefiting from reduced fuel costs because of decreased fuel burn.

5.0 Post Implementation Review

1. **Review status:** Please classify with an ‘x’ and provide any explanations below.

	Sunset clause		Other review clause	X	Political commitment		Other reason		No plan to review

Regulations to be reviewed every five years to ensure continued suitability.

2. **Expected review date** (month and year, xx/xx):

1	1	/	2	8	Five years from when the Regulations come into force

3. **Rationale for PIR approach:**

Circle the level of evidence and resourcing that will be adopted for this PIR (see Guidance for Conducting PIRs):

We have determined that a medium level of evidence and resourcing would be a proportionate approach for conducting a PIR. The estimated monetised costs of this permissive policy are comparatively small and primarily will be experienced primarily by businesses choosing to implement Individual Fuel Schemes. However, a medium level of evidence and resources is justified by the large estimated benefits and the risk of competitive disadvantage to those unwilling or unable to take advantage of the regulations.

Monitoring data will be gathered through a mixed approach of primary data collection and expert analysis of existing data/information. The CAA’s oversight role will provide a means for gathering data on an ongoing basis regarding uptake of differing approaches to fuel planning within the sector. This will be used to understand how many, and which, organisations are using each approach. Engagement with industry will be conducted to understand how these organisations have been impacted by the introduction of these approaches and to identify and estimate the costs and benefits of doing so.

Additionally, the PIR will assess the extent to which the potential Risks and Unintended Consequences have been realised. Specifically, data will be gathered to determine uptake of the policy, the impacts of the policy on safety levels and the extent to which the policy has led to environmental benefits.

Given the in-depth and technical nature of the topics that would need to be explored, and the likely need to ask follow up questions, it is anticipated that this engagement would need to be qualitative rather than quantitative. Figure 40 provides an overview of the topics to be explored and the key research questions.

Figure 40 Key Objectives, Research Questions and Evidence collection plans

Key objectives of the regulation(s)	Key research questions to measure success of objective	Existing evidence/data	Any plans to collect primary data to answer questions?
Align UK regulations with ICAO SARPs	Did this measure bring UK regulations in line international best practice, as represented by ICAO SARPs? Have ICAO SARPs changed since the introduction of this policy? If so, have UK regulations been amended to account for this?	ICAO SARPs	No. ICAO SARPs and relevant UK regulations to be reviewed by DfT/CAA staff
Enable CAT operators to tailor fuel policies/schemes to their specific operational requirements	What has the uptake of the policy been. How many CAT operators are using: a. Basic Scheme, with Variations? b. Individual Fuel Schemes? What have the benefits been to those choosing to take up either of these options? Specifically, have operators chosen to increase payload in response to the reduction in weight? Alternatively, have they utilised fuel burn savings, thus realising reductions in carbon dioxide emissions? What have the costs been to those choosing to take up either of these options?	Yes – CAA data	Engagement with industry
Enable the use of alternative means of propulsion e.g. electric and hydrogen for energy provision	Has the policy been adopted by industry to allow for alternative means of propulsion?	No	Engagement with industry
Enhance safety	Has the introduction of the policy improved/decreased safety, specifically the number of declared fuel incidents?	Yes – CAA records	No

Annex A: List of Abbreviations

Abbreviation	Definition
AOC	Air Operator’s Certificate
ASHE	Annual Survey of Hours and Earnings
ATM	Air Traffic Movement
BIT	Business Impact Target
CAA	Civil Aviation Authority
CAT	Commercial Air Transport
CO2e	Carbon Dioxide Emissions Equivalent
EANDCB	Equivalent Annual Net Direct Cost to Business
EASA	European Union Aviation Safety Agency
FRF	Final Reserve Fuel
GA	General Aviation
IA	Impact Assessment
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
KPI	Key Performance Indicators
LH	Long Haul
MTOM	Maximum Take-Off Mass
ONS	Office for National Statistics
PIR	Post Implementation Review
PV	Present Value
SARP	Standards and Recommended Practices
SMS	Safety Management Systems
SH	Short Haul
SIC	Standard Industrial Classification