Title: Developing the UK Emissions Trading Scheme (UK ETS)	**Impact Assessment (IA)**
IA No: DESNZ027(F)-23-IDET	**Date:** 31/03/2023
RPC Reference No: N/A	**Stage:** Final
Lead department or agency: Department for Energy Security and Net Zero	**Source of intervention:** Domestic
Other departments or agencies: HMT, DfT, DAs	**Type of measure:** Secondary legislation
	Contact for enquiries: alexei.mulko@beis.gov.uk

Summary: Intervention and Options

RPC Opinion: Not Applicable

Cost of Preferred (or more likely) Option (in 2023 prices)

Total Net Present Social Value	Business Net Present Value	Net cost to business per year	Business Impact Target Status
£10.1bn	N/A	£2.4b	Not a regulatory provision

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

The Authority Response sets out amendments to the existing UK Emissions Trading Scheme (UK ETS), not whether to continue with the UK ETS. The ETS is a UK wide scheme implemented by the UK Government, Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland. In order to meet legally binding UK climate targets, several parts of the ETS need to be updated.

When the UK ETS was established in January 2021 the Authority's goal was to make it the World's first net zero consistent cap and trade market. This document sets out the important structural changes to the scheme that will deliver on this goal.

What are the policy objectives of the action or intervention and the intended effects?

Policy Objectives:

1. Setting the UK ETS cap to be consistent with net zero and doing this at the top of the net zero consistent range.
2. Smoothing the transition to the net zero cap through releasing 53.5 million additional allowances from the reserve pots to the market between 2024-2027
3. Setting the Industry Cap at 40% of the overall cap.
4. Putting aside 29.5 million allowances for future market management. This is equivalent to approximately 3% of the overall cap.
5. Phasing-out of aviation free allocation.

There are other policy positions laid out in the AR that will not be implemented in legislation in 2023 and will be subject to further consultation. An impact assessment on those positions will be produced alongside the response to those consultations when they occur.

It should be noted that the parts of the scheme covered in the annexes may have other sub-objectives. As a result of the intervention, the ETS will be a more effective scheme which incentivises investment in decarbonisation technologies and abates emissions.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

The longlist is split into two sections: the longlist for the cap and the longlist for the use of unallocated allowances.

From there are three key dimensions that we considered for assessing the shortlist of policy options. Those three dimensions are:

- Cap: Whether to set the cap anywhere in between the consultation range.
- Industry Cap: What percentage of the cap to set aside for free allocation use.
- Unallocated Allowances (UnAs): How to use the unallocated wedge and flexible share of allowances. Either to auction, to be used to mitigate the Cross Sectoral Correction Factor (CSCF, a process in which all free allocation is reduced) in 2024-25 (the consultation set out a guarantee to maintain current stationary free allocations in 2024-25) or put into a reserve pot.

The final option is the following:

- Cap: top of the range (936 million allowances in phase 1, 2021-2030)
- Industry cap: 40%
- Percentage of unallocated allowances auctioned: 62.4%
- Reserve: 29.5 million allowances

Note that no non regulatory option is considered as this is an IA about updating UK ETS legislation.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 12/2028				
Is this measure likely to impact on international trade and investment?		Yes		
Are any of these organisations in scope?	**Micro**No	**Small** Yes	**Medium** Yes	**Large**Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Traded:** 54.7	**Non-traded:**	

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

Signed by the responsible Minister: Graham Stuart

Date 12 July 2023

Summary: Analysis & Evidence

Preferred Option

Description:

FULL ECONOMIC ASSESSMENT

Price Base Year 2023	PV Base Year 2023	Time Period Years 7	Net Benefit (Present Value (PV)) (£m)		
			Low: 846	**High: 17, 096**	**Best Estimate:** 10,109

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	-	7	841	**5,044**
High	-		96	**573**
Best Estimate	-		278	**1,671**

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

- All monetised costs are borne by participants in the UK ETS. These are the abatement costs.
- Another quantified cost is the cost of purchasing allowances which arises from the trading aspect of the UK ETS. If firms need more allowances, then they can buy them at auction. The revenue from this is counted as a social transfer from firms to government.

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

- Administrative costs: in this IA, the *net change* in administrative costs is zero by assumption as this IA concerns updating UK ETS legislation.
- Market engagement: Reduction in free allowances, and greater abatement means there may be more operator engagement in primary and secondary allowance markets. This could include operators engaging for the first time (extensive margin changes) or increasing the level of engagement (intensive margin).

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	-	7	982	**5,890**
High	-		2,945	**17,670**
Best Estimate	-		1,963	**11,780**

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

The primary benefit of an ETS is the benefit to society of emissions reductions (abatement) that are achieved as a result of the policy. Relative to the counterfactual of remaining with the current legislated cap, we expect a significant reduction in traded sector emissions under all cap options considered.

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

- Investment in decarbonisation technologies and processes
- Spillover benefits in the green economy
- Energy Savings and associated air quality improvements due to energy efficiency

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

Key assumptions:

- Appraisal period: The appraisal period is 2023 – 2030. These are the years that the changes detailed are in scope for the appraisal.
- Additionality: two "high" and "low" policy baselines are examined, which effectively constitute different assumptions on the levels of additionality.
- Discount and Price base year: per the Green Book guidance, the base year for discount and price base values is 2023.

Key sensitivities: There are three sources of uncertainty in the analysis: counterfactual emissions, the value of emissions, and abatement costs. These have diverging assumptions to cover a range of scenarios.

Key risks/ limitations:

- Carbon Values and Prices
- Cost timings
- Competitiveness
- Carbon Leakage
- Technology risk correlation

BUSINESS ASSESSMENT (Preferred Option)

Direct impact on business (Equivalent Annual) £b: 2.4			**Score for Business Impact Target (qualifying provisions only) £m:**
Costs: 2.4	**Benefits:** 0	**Net:** -2.4	

Structure of IA

1. This IA provides supporting evidence to the "Developing the UK Emissions Trading Scheme" (UK ETS): Authority Response (henceforth "the AR"). However, as the AR sets out multiple proposals affecting various aspects of the scheme, and various levels of policy development, it is not appropriate to have a single assessment covering all proposals. Hence, this impact assessment will be divided into **sections covering separate proposals.**

2. These sections **broadly correspond to the chapters of the consultation. However, in some cases we have grouped or divided policy proposals differently, to ensure the analysis of impacts is holistic, coherent, and proportionate.**

3. Table 1 summarises the structure of the IA.

Table 1 - structure of IA

IA Section	Corresponding Consultation Chapter	IA Coverage
1, Annexes 1-3	1	Cap and Unallocated Allowances
Annex 4	4	Aviation

Annex 5	2,8	Technical (& expedited) changes to Stationary Free Allowances
Annex 6	5	Oil and Gas venting/flaring
Annex 7	N/A	UK ETS Theory of Change

Section 1: Revisions to the Cap

4. This section covers the following proposals:
    a. The amendment of the UK ETS Cap
    b. The amendment of the Industry Cap
    c. The use of the unallocated stationary free allowances and flexible share
5. In order to analyse these interventions, consideration is also given to other aspects of the consultation. However, these will be covered individually in other sections:
    a. Amendments to Aviation free allocations (scheme level impacts are included here. Further analysis in Annex 4).
    b. Technical Changes in Annex 5.
    c. Oil and Gas venting in Annex 6.
6. UK ETS is a UK-wide scheme. All impacts are assessed at the level of the UK.

Problem under consideration and rationale for intervention

7. The AR sets out *amendments* to the existing UK ETS, not whether to continue with the UK ETS. Hence, this impact assessment does not re-assess the original rationale for intervention of the UK ETS, and carbon pricing more broadly. These issues were considered in the original Future of UK Carbon Pricing package[1] and associated impact assessment and were reiterated in the analytical annex to the Developing the UK ETS consultation[2].
8. **Cap:** The current UK ETS cap was not intended to be retained for the entirety of Phase 1 of the UK ETS (2021-2030). It was set to give sufficient continuity, clarity, and foresight to participants to ensure a smooth transition at the launch of the UK ETS, while retaining the environmental ambition. It was intended that there would be a subsequent consultation on an appropriate trajectory for the UK ETS cap with any changes implemented no later than January 2024.[3]
9. The original rationale for intervention of the UK ETS as a new scheme:
    a. To address the failure of the market to account for the social and environmental costs associated with greenhouse gas (GHG) emissions from the power, industry, and aviation sectors[4], due to the negative externality.
    b. To address the failure of the market to account for the associated benefits (knowledge & productivity spillovers and reduced deployment costs) associated with investment in innovation and deployment of clean technologies, due to positive externalities.
10. The need to reduce the cap to deliver on this rationale is also highlighted by considering UK government climate targets, which are set out in detail in chapter 1 of AR. Setting an appropriate traded sector[5] cap will be an important part of delivering those targets. The Net Zero Strategy (NZS)

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[1] https://www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing

[2] https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets

[3] *ibid*

[4] For a summary of the social and environmental consequences of increased atmospheric concentration of greenhouse gas emissions see: https://www.theccc.org.uk/what-is-climate-change/

[5] Traded Sector: sectors covered by the UK ETS

sets out clear policies and proposals for keeping us on track for our coming carbon budgets, our ambitious Nationally Determined Contribution (NDC)[6] and the UK's legally binding net zero target. To note, the Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland have, or are in the process of setting their own carbon budgets. Wales has their own National Carbon budget[7] while Scotland has yearly emission reduction targets as set out in the 2019 Climate Change Act[8] and in their latest Climate Change Plan[9]. Northern Ireland is in the process of developing its own carbon budget, under the Climate Change Act (NI) 2022.

11. The cap must be set appropriately to ensure the carbon price signal[10] provided by the UK ETS is consistent with the level of traded sector ambition set out in our targets and strategies. If the cap is set too high (i.e.: allows a greater number of emission allowances to enter the market), it is less likely the UK ETS price will be sufficient to incentivise appropriate decarbonisation. Similarly, if it is set too low, it risks sending a decarbonisation investment signal which is inconsistent with a feasible, least-cost UK decarbonisation pathway.

12. The rationale for bringing the unallocated allowances to market is primarily smooth the transition to the net zero cap, to ensure that there is no sudden drop in allowance supply between 2023 and 2024. The mechanism by which these allowances are brought to market has implications for the timings and distribution of costs and emissions reductions.

13. The industry cap sets an upper bound on the quantity of free allocations that can be issued each scheme year. Under current scheme rules the industry cap is set at the UK's notional share of the EU ETS industry cap for Phase IV of the EU ETS. To avoid any unintended impacts to market functioning, stability or liquidity which could arise if free allocations made up the majority of allowances under the cap, the Authority proposed resetting the industry cap to make up a percentage of the overall cap rather than being set as fixed numbers, as in current legislation.

Rationale and evidence to justify the level of analysis used in the IA

14. Given the scale of the intervention we have undertaken a full final stage impact assessment including modelling, cost-benefit analysis (CBA), sensitivity analysis and qualitative analysis.

15. The evidence used in the impact assessment comes from 4 main sources[11].

    a. BEIS modelling of how amendments cumulatively impact the supply of allowances through the UK ETS system's mechanisms.

    b. BEIS modelling of the emissions, abatement, and carbon values under a revised UK ETS.

    c. BEIS evidence on to support identification and assessment of wider impacts.

    d. Consultation responses

16. Modelling evidence is discussed in annex 1. Wider BEIS evidence is discussed in the wider impacts section. Consultation responses are set out in the authority response document. The limitations of the data and modelling assumptions are considered in annex 1. The implications of these limitations are considered in the sensitivity analysis section of the CBA.

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[6] https://www.gov.uk/government/publications/net-zero-strategy

[7] https://www.gov.wales/net-zero-wales-carbon-budget-2-2021-2025

[8] 2019 Climate Change Act

[9] Climate Change Plan

[10] Under an ETS, the externality is internalised by determining the appropriate level of emissions and allowing the ETS mechanism to determine the price signal necessary to deliver that ambition. For further details on how the UK ETS incentivises decarbonisation, see the analytical annex to the consultation https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets

[11] Please note that some modelling may still refer to BEIS due to governance.

Policy objectives[12]

17. Align the UK ETS to the legally binding 2050 net zero target by implementing a revised net zero consistent cap trajectory from 2024. The net zero consistent cap will reset the total cap for the first phase of the UK ETS (2021 – 2030).

18. Review the approach to free allocation to improve the scheme's approach to carbon leakage, ensuring the most appropriate and equitable approach to free allocation in the context of UK specific environment (including a net zero cap)

Longlist

19. This longlist is split into two sections: the longlist for the cap and the longlist for the use of UAs. These options are the component parts of the shortlist options A-E in table 3. Firstly, the longlist for the cap. Broadly there are three longlist options for the cap for this policy: do nothing, make the cap consistent with the Net Zero Strategy, and making the cap consistent with the CCC's (Climate Change Committee) recommendation. The preferred option is to set a cap consistent with the Net Zero Strategy. The shortlist sets out details on how these caps could be structured, including the industry cap, providing a sensible set of combinations of the different elements.

20. Do Nothing: the "do nothing" option would be to retain the current cap, industry cap and related mechanisms as currently legislated. This is set out in further detail in the counterfactual section. As discussed above, failing to implement the proposed amendments (or similar alternatives) would leave the UK ETS inconsistent with the UK ETS objectives and broader strategic goals and targets.

21. A Net Zero Strategy consistent cap: this would mean the total cap for the entire first Phase (2021-2030) between 887 million allowances and 936 million allowances, as set out in the consultation. Compared to the current legislated cap for the whole phase, 1365 million allowances, this would equate to a reduction of between around 30-35% over the course of the phase. This is the preferred longlist option as it allows the changes to achieve the objectives of aligning with the Net Zero Strategy.

22. The CCC's recommendation: The CCC set out their recommendation for the ETS cap in 2020. However, when compared to the Net Zero Strategy pathway, it requires not as many emissions reductions in the traded sector. This difference reflects differences in the pathways set out for UK approach to decarbonisation such as the balance of technology deployment and behavioural change - these affect the decarbonisation pathway of each sector.

23. As discussed in the Consultation the Authority considered the CCC's advice carefully. However, given that the subsequent Net Zero Strategy provides the UK Government's assessment of the pace of emissions reductions needed across different parts of the economy to deliver UK economy-wide climate targets, it is appropriate that the cap trajectory is based on the Net Zero Strategy. Setting a cap at the CCC's original pre-Net Zero Strategy path for emissions for the traded sector would permit more emissions in the traded sector compared to the Net Zero Strategy pathway. This could place additional pressure for emissions reduction on the non-traded sector.

24. Secondly, the longlist for using the unallocated wedge of allowances (set out in chapter 1 of the AR). There are three options. 1) 'do nothing' would mean leaving the legislation unchanged, meaning unallocated allowances continue to build up and are unlikely to be deployed. 2) Auction them to smooth the transition to the net zero cap. 3) Hold them in specific reserve pots for use later.

25. Both options 2) and 3) are considered in the shortlist in various combinations. They would both be expected to redistribute these allowances over the course of the phase. In general, proposals which make more allowances available earlier in the phase could allow for higher emissions in those earlier years, offset by lower emissions in subsequent years. The impacts of these options will differ depending on the magnitude and timing of any allowances brought to market, the compliance strategies of market participants, as well as the mechanism(s) used. Generally, an increase in the

[12] The authority response covers considerations of how the preferred option will be given effect.

supply of allowances relative to demand would be expected to reduce prices in those earlier years and increase prices later where allowance supply relative to demand is tighter.

26. Option 1) was dismissed as this would leave an increasing volume of shares with no clarity on how many, if any, of the allowances would reach the market, or when. This would be confusing for participants and hinder the functioning of the UK ETS with the new cap being introduced.

Costs and Benefits

Identifying costs and benefits

27. This section identifies the main expected costs and benefits of the policy, who these are likely to impact, and summarises the approach to analysing them.
28. **The main driver of benefits is UK ETS allowance prices:** setting a tighter cap is expected to generally be associated with higher prices for UK ETS allowances ('carbon prices'). This drives greater abatement, allowing emissions fall in a way consistent with the cap. For further details see section 1.1 of the analytical annex to the consultation[13]. Paragraph 108 of this IA discusses impacts on carbon prices.

Benefits:

29. **GHG emission reduction** (monetised): The primary benefit of an ETS is the benefit to society of emissions reductions (abatement) that are achieved as a result of the policy. Relative to the counterfactual we expect a significant reduction in traded sector emissions under all cap options considered.
30. **Investment in decarbonisation technologies and processes** (non-monetised): Higher allowance prices increase the incentive to invest in *developing* clean technologies & processes, as well as *deploying* them, by making them better value for money than higher emissions alternatives. These benefits will also depend on concurrent decarbonisation policies but are expected to be significant[14].
31. **Spillover benefits in the green economy** (non-monetized): The increased investment mentioned above could lead to positive spillovers in the long term, reducing the cost (and accelerating uptake) of future abatement. Additionally, this decarbonisation will support jobs and investment in the green economy across the UK. As noted in the Green Jobs Taskforce report [15], decarbonisation schemes like ETS and CCUS have the largest potential for growing job opportunities in the green sector. Given the wide and long-term scale of the UK ETS reforms it is not feasible to estimate the spillover impacts associated quantitatively.
32. **Energy Savings and associated air quality improvements due to energy efficiency** (non-monetized): The ETS incentivises firms to reduce their emissions intensity. This is expected to include driving improvements to energy efficiency, as using less fuel inputs per unit output will reduce their exposure to the carbon price. Reducing energy use through energy efficiency has social benefits, as the production and distribution of fuels uses scarce resources, as set out in the Green Book annexes on valuing energy savings. Additionally, saving fossil fuels and other fuels such as biofuels can yield improvements to air quality, which also yields social benefits. However, in this impact assessment the benefits associated with energy efficiency are not quantified, and hence not monetised. This is because the underlying UK ETS modelling (see modelling annex) does not include fuel-use change as an output. The modelling outlines possible assessments of least-cost technology pathways. However, one of the key benefits of using an ETS is that the price signal incentivises least-

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067127/developing-uk-ets-consultation-analytical-annex.pdf

[14] For further discussion on the literature on the potential benefits of an increase in decarbonisation technology investment see:

https://www.gov.uk/government/publications/business-competitiveness-in-industrial-sectors-and-the-role-of-carbon-pricing-policy-in-the-uk

[15] https://www.gov.uk/government/publications/green-jobs-taskforce-report

cost deployment of abatement, hence there is fundamental uncertainty over what technologies will be deployed, and so specifying expected fuel-use change is beyond the scope of this analysis. This means two potentially substantive sources of net benefit are excluded from our monetized analysis but should be borne in mind in our overall assessment.

Costs:

33. **Abatement costs** (monetized): The UK ETS gives flexibility over the timing and nature of any investment into abatement. However, all cap options which drive net emissions reductions will require this investment, and the costs to firms of investing in decarbonising technologies will represent the key cost of the policy. Higher UK ETS allowance prices increase the cost to firms of unabated emissions, and in theory we would expect abatement to occur up to point where the (marginal) cost is less than or equal to the carbon price in the system. Paragraph 48 sets out how abatement costs are estimated.

34. **Purchasing allowances**[16] (quantified – social transfer): This cost arises from the trading aspect of the UK ETS. If firms need more allowances, then they can buy them at auction. The revenue from this is counted as a social transfer from firms to government. This transfer is assessed in section on revenues, however it can be interpreted as the cost of businesses of purchasing allowances. Operators can also buy allowances on the secondary market. These trades constitute social transfers between market participants. These transfers are not quantified as it is not feasible to assess likely potential future trades.

35. **Administrative costs** (non-monetized): in this IA, administrative costs refer to the costs to businesses of fulfilling their legal requirements under the UK ETS. This includes the monitoring and verification of their emissions, engagement with their regulator and engagement with annual mechanisms such as free allowance issuance, activity level changes and the surrendering of allowances. The proposed amendments to the cap, industry cap and unallocated allowances do not generate any change in these administrative costs to businesses. Hence, the *net change* in administrative costs is zero by assumption. As an extension of this, familiarisation costs are not monetised which could affect aircraft operators. The bottom-up data needed was not available and this cost would be comparatively lower to the monetised ones listed here so would not affect the CBA.

36. **Market engagement**[17] (non-monetized): Reduction in free allowances, and greater abatement means there may be more operator engagement in primary and secondary allowance markets. This could include operators engaging for the first time (extensive margin changes) or increasing the level of engagement (intensive margin). Changes in engagement may also require greater expertise and therefore resource from operators. Such engagement changes could include the volume of allowances purchased, the timing of purchases, or the development of new strategies for market engagement such as hedging.

Quantification Approach

37. The quantification approach uses two key analytical frameworks. The **cap composition** modelling and the **BEIS Carbon Pricing Model framework (BCPM).**

Cap composition

[16] These costs are **both** sometimes referred to as "compliance costs", however we do not use this term to avoid confusion between the cost of purchasing allowances to cover UK ETS emissions, sometimes referred to as 'compliance', and the administrative costs necessitated by the UK ETS (monitoring, verification etc…) which are also sometimes referred to as "compliance costs".

38. The cap composition modelling was used to estimate the combined impact of the proposals for amending the UK ETS, various mechanisms of the system. Each policy option constitutes setting values for several key parameters in the UK ETS, such as the: cap, industry cap, use of unallocated allowances, aviation free allowances, flexible share, and new entrants' reserve. The cap composition modelling takes these inputs, and estimates the final structure of the cap, including assessing the cross sectoral correction factor (CSCF, explained further in Annex 1), checking no allowances are "double counted" or unaccounted-for, and estimates the volume of allowances issued through auctions, stationary FAs (Free Allowances), this is explained further in Annex 1, aviation FAs, or held in reserves. It does this on an annual basis. This provides a key input to the BCPM analysis, counterfactual, cost-benefit analysis, assessment of social transfers and wider impacts analysis. Annex 3 sets out the cap composition assumptions of the options.

BEIS Carbon Pricing Model framework (BCPM).

39. The quantification approach in this IA is based on modelling of the UK ETS using the BEIS Carbon Pricing Model framework (BCPM). For details, see the modelling annex 1. The BCPM is a fundamentals-based model which determines the required emissions reduction needed to meet the cap on an annual basis. This model uses marginal abatement cost curves (MACCs) to then determine the cost of the last marginal reduction of GHGs and the resulting cost at which firms will choose to abate emissions. This determines the equilibrium value of a UK ETS allowance in the model. Abatement activities below this cost level are acted upon, and any unabated emissions would purchase allowances to comply with the UK ETS.

40. **Emissions baselines:** The modelling begins by assessing the level of traded sector emissions we expect based on current economic and market trends, as well as decarbonisation policies. This baseline does not include the impact of the UK-ETS. It identified two baseline scenarios. We refer to these as the **"high policy"** and **"low policy"** baselines. Our "low policy" baseline assumes a lower level of government decarbonisation funding and thus a higher level of baseline emissions in the traded sector. This requires more abatement to be delivered by the UK ETS. The "high policy" baseline assumes greater level of government funded decarbonisation so a lower level of emissions are in the traded sector baseline. As a result, less abatement is delivered by the UK ETS.

41. **MACC adjustment:** As part of these two baselines, we had to adjust the Marginal Abatement Cost Curves (MACCs) to account for the deployment of abatement technologies by other government policies. If we did not adjust them, then we could **double count** abatement technologies by removing emissions from the baseline, attributed to those technologies, and then also leaving them available to be deployed in response to the UK ETS in the modelling. Further detail on the MACC adjustment is included in Annex 1.

42. The modelling then uses these baseline emissions and adjusted MACCs to estimate the demand for allowances in the UK ETS. This is augmented by key UK ETS behavioural assumptions such as participants' foresight, cost of carry and hedging behaviour, based on observed evidence. It combines this with assumptions on allowance supply from the cap composition modelling. The BCPM then estimates the timing of when abatement would occur and estimates annual carbon values (the marginal cost of abatement) and final emission levels.

43. **Carbon values and market-adjusted carbon values:** carbon values reflect the expected annual marginal cost of abatement delivered, reflecting basic supply and demand conditions in the ETS. We expect the carbon price trajectory observed in the secondary market to differ in some ways from carbon values for theoretical and practical reasons. Firstly, our modelling is subject to uncertainty, as discussed in the annex. Further, short-term market conditions not reflected in our carbon value modelling will influence the market price of UK ETS allowances. For example, prevailing macroeconomic conditions could influence output and hence emissions & UKA demand. Alternatively, global energy market conditions may impact derived demand for fuels and hence UK ETS allowances from the power sector. For this reason, our modelling also includes estimates of **market-adjusted carbon values,** to support work where short-term allowance prices are more directly relevant. The methodology is discussed in the modelling annex 1.

44. **Abatement costs:** We can estimate the total cost of deploying abatement technologies by estimating the "area" under the MAC curve. For each unit of emissions, if we know the cost of that abatement, we can add up these costs *for each unit,* which is equivalent to estimating the "area under the curve". This forms the basis of our estimate of annual costs. The MACCs capture the aggregate cost of achieving a lower level of emissions, rather than the costs of specific abatement decisions. Hence, they are suitable as an estimate of total social costs, but they abstract away from some of the challenges of the time profile of costs. See annex 2 for details.

Sensitivity analysis approach

45. The quantified elements of the cost-benefit analysis are subject to three key sources of uncertainty. Given the scheme has a very large scope, we address this uncertainty through a **scenario-based approach[18].** This means we generally focus on analysing distinct states of the world holistically and assessing their impact on the value-for-money case of the UK ETS reforms. This contrasts with a more granular "sensitivity" approach, which may focus on more specific assumptions/data in the analysis and their impact on results.

46. **First, the level of policy ambition, and hence emissions in the counterfactual.** Higher emissions reductions in the counterfactual means the UK ETS cap needs to drive less abatement. Hence, the emissions reductions attributable to the UK ETS reforms are lower (lower additionality). Costs would also be lower, including marginal abatement costs, leading to lower carbon values.

47. We reflect this by making use of **two of the baseline emissions scenarios from the underlying modelling work.** For details see annex 1.
    a. A **high policy** baseline where **more** emissions reductions are delivered by supporting policies, so **less** is driven-by and attributed to the ETS.
    b. A **low policy** baseline where **fewer** emissions reductions are delivered by supporting policies, so **more** is driven-by and attributed to the ETS.

48. **Second, abatement costs.** The amount of abatement available is dependent on the amount of emissions in the business as usual (BAU) scenario. Whether there are more or less emissions in the BAU scenario means for the same carbon value there will be more/ less abatement available at that price. Our MACCs considered a number of different uncertainties such as different levels of economic growth and different levels of fossil fuel prices. High economic growth and low fossil fuel prices will lead to higher BAU emissions and thus more available abatement and vice versa. These uncertainties are applied across all sectors of the economy.

49. The **value to society of GHG reductions** is subject to uncertainty, and the Green Book sets ranges for these values. Given GHG savings are the key monetised benefit in the CBA, this is a key sensitivity. This sensitivity is a more traditional sensitivity, rather than a "scenario approach", however, given the importance of carbon emissions in the appraisal we include it as well.

Appraisal Assumptions and Social Transfers

50. Appraisal period: The appraisal period is 2023 – 2030. These are the years that the policy is active, and the changes detailed are in scope of the analysis. Although the cap is not changed until 2024, our evidence and modelling suggest impacts will begin from 2023 (and may have impacted historic years, though these are out of scope of a forward-looking Impact Assessment) as the market will "price in" the amendments to the scheme, causing changes in behaviour such as abatement before the cap is

[18]For discussion on sensitivity and scenario approaches see the Aqua Book: https://www.gov.uk/government/publications/the-aqua-book-guidance-on-producing-quality-analysis-for-government.

adjusted. It is not appropriate to go beyond 2030 as the policy is undefined beyond this point, with the cap, industry cap and other mechanisms not yet defined for the next phase. Appraising beyond 2030 risks double counting costs and benefits for any further changes. Further, this also means beyond 2030 it is not feasible to estimate carbon values and abatement, limiting our capacity to quantitatively model impacts.

51. Additionality: two “high” and “low” policy baselines are examined, which effectively constitute different assumptions on the levels of additionality. For the high policy baseline scenario, emissions are already being saved due to concurrent policies (for details see modelling annex), this means that less emission reductions are attributed to the ETS, so the additionality is lower. For the low policy scenario more emissions savings are attributable to the ETS (as fewer concurrent policies are in place), resulting in a higher additionality. The differences in additionality are discussed in the emissions results section.

52. Discount rate: Throughout the appraisal the standard Green Book discount assumption of 3.5% has been used.

53. Discount and Price base year: per the Green Book guidance, the base year for discount and price base values is 2023 (for appraisal metrics). This is the first year that the policy is active and affects the impacted groups.

54. Optimism Bias: Optimism Bias is not applied in this appraisal. The supplementary guidance of the Green Book on optimism bias applies to marginal change projects. This is a transformational project. The main costs in this policy are the abatement costs and, in this case, the sensitivity on costs is a more appropriate method to capture uncertainty. In sensitivity analysis, the ‘high cost’ scenario applies a 300% uplift to the central cost assumption.

55. Social Transfers: Economic Transfers pass purchasing power from one person to another and do not involve the consumption of resources. In this policy, the revenues generated from auctioning allowances are counted as transfers. According to the Green Book, transfers should not be included in the CBA. They are presented separately as part of the overall impact assessment, starting from paragraph 84 onwards.

Counterfactual approach and results

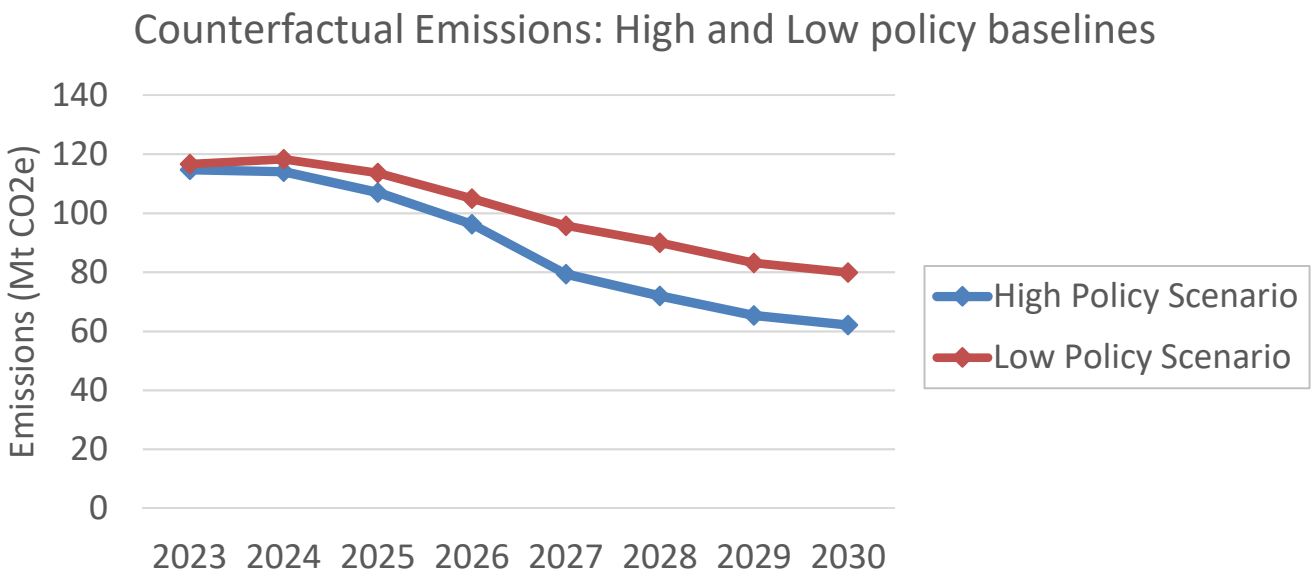
56. For this analysis, we have assumed the counterfactual is a “do nothing” option, which would be to retain the current cap, industry cap and related mechanisms as they are currently legislated and makes the assumption that no future policy changes are made to the scheme during the appraisal years. As discussed above, failing to implement the proposed amendments (or similar alternatives) would leave the UK ETS inconsistent with the UK ETS objectives and broader strategic goals and targets.

57. The assumptions for the counterfactual fall into two groups: non-UK ETS policy assumptions *which impact participants in the UK ETS* (and hence traded sector emission) and UK ETS Policy assumptions.

58. The main non-UKETS policy assumptions are the assumptions on supporting decarbonisation policies and the baseline level of emissions. Under the “low policy” baseline, traded sector emissions are *still expected to reduce* over time in the counterfactual, by approximately 1/3 by 2030 on 2021 levels. This is due to economic and sector trends, and the estimated impact of other policies. Under the “high policy” baseline, emissions are expected to reduce faster, by approx. 44%. This accelerated reduction comes from assuming greater reductions delivered by an expanded suite of policies (for details see Annex 1). The Low Policy Baseline was based on currently funded policies and proposals as set out in the Spending Review 2021. The High Policy baselines was based on additional policies

set out in the Net Zero Strategy (2021)[19]. How our baselines compare to the UK Government's Carbon Budget Delivery Plan (2023), is set out in more detail in Annex 1.

Figure 1 Traded sector emissions counterfactual (no UK ETS Cap revision).



59. We had to make several assumptions about UK ETS policy mechanisms to produce the counterfactual. In line with Green Book guidance, we assessed the "business as usual" for the policy. As far as possible we assumed legislation defaults for UK ETS mechanisms. Where legislation is undefined (e.g.: future stationary free allocation benchmarks are not yet defined) or where an implicit policy choice is needed (unallocated allowances) we judged to best reflect "current policy intent".

60. Table 2 summarises the key UK ETS assumptions in the counterfactual. The key observation is that the cap (and total allowances issued annually) is *consistently significantly higher than the level of counterfactual emissions.* Given the scale of over-supply our evidence indicates that factors such as hedging demand would not be sufficient to increase demand for allowances to meet supply. Hence, the cap would not bind, and constrain emissions. We would expect prices to fall to the auction reserve price (ARP of £22/allowance). **Overall, in the counterfactual we expect that the UK ETS would act as a flat carbon price of £22/allowance.**

Table 2 Key UK ETS assumptions

Mechanism	Assumption
Stationary FAs	2021-2025: allocation table (as of Oct 2022)

[19] https://www.gov.uk/government/publications/net-zero-strategy

	2026-2030: estimated total stationary FAs fall by approx. 15%, due to benchmark updates, updated activity, falling carbon leakage exposure factors (CLEFs) and reduction factors[20]. This is broadly in line with 2020-2021 magnitude.
Aviation FAs	The current status quo in legislation, projected forward indefinitely. 2020 allocation starting point, reduced by 2.2% of the 2020 allocation in each year (rounded to the nearest integer).
Hospital and Small Emitters (HSE), and Ultra-Small Emitter (USE) Opt-outs	2021-2025: current operation. 2026-2030: Assume the share of HSE/USE adjustment is the same as for 2021-2025
Auction Reserve Price (ARP)	We assume the ARP remains at its currently legislated value of £22/t.
Unallocated Allowances (UnAs)	In the counterfactual, stationary FAs are consistently below the industry cap. To minimise complexity, we assume the UnAs is auctioned each year in the year it is created. This **does mean assuming it was auctioned in 2021 and 2022,** which while not the case, creates a more reasonable description of "business as usual". This assumption has no impact as demand for allowances is below the cap (see paragraph 60).
Auction pot	The auction is calculated using the same method. Annually: Cap – (industry cap + aviation FA +adjustments + UnAs). Adjustments include normal adjustments for NER, Flex share & HSE/USE.
Multiple mechanisms:	Maintained Legislation Defaults: Cap, Industry Cap, Hospital & Small Emitter & Ultra-small emitter opt-outs; Flexible share; New Entrants' Reserve;

61. For the purposes of estimating the net change in social transfers (such as revenues) we need an additional assumption about *which* allowances are issued when demand is insufficient. We assume free allocations (stationary and aviation) are issued as normal, as there is no reason to believe the volume of free allowances would reduce substantially. Hence, it is auction demand which is reduced by the lack of demand. Therefore, although the auction pot is much larger in the counterfactual, the total amount sold is lower. The results section on social transfers discusses this further.

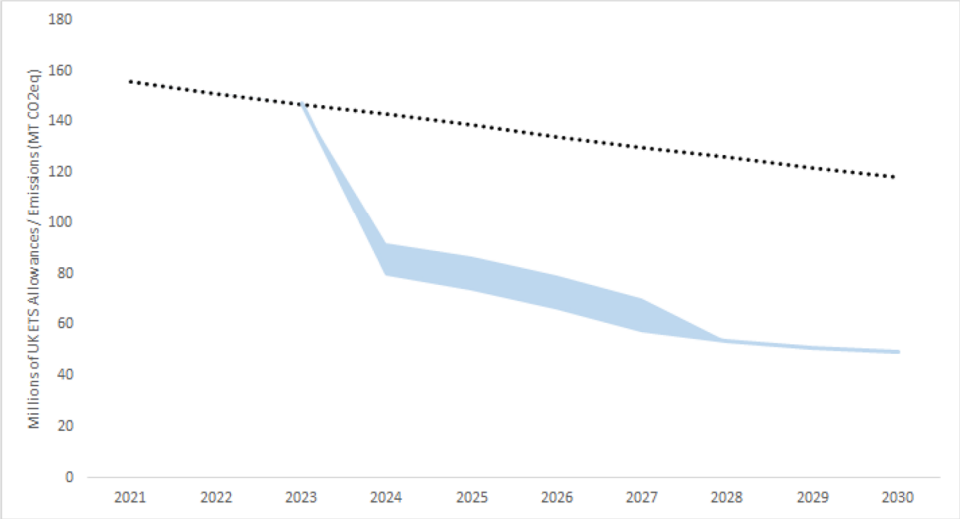
Short-list Options

62. The range of cap options was set out in figure 1.2 of the consultation and is reproduced below in figure 2.

Figure 2 Range of cap options

[20] See Commission Delegated Regulation (EU) 2019/331 of 19 December 2018 and Commission Implementing Regulation (EU) 2019/1842 of 31 October 2019 as amended by the Greenhouse Gas Emissions Trading Scheme (Amendment) Order 2020/1557 and the Greenhouse Gas Emissions Trading Scheme (Amendment) (No. 2) Order 2022/1173 https://www.legislation.gov.uk/uksi/2020/1557/contents/made; https://www.legislation.gov.uk/uksi/2022/1173/contents/made.

Figure 1.2: The currently legislated cap (dotted line), which is not consistent with delivering net zero, will remain in place until end 2023. The illustrative trajectory below, represented as a range, is shaded in blue.



63. As described in the long list scenario section there are three key dimensions that we considered for assessing the shortlist of policy options. Those three dimensions are:

    a) Cap: Whether to set the cap anywhere in between the consultation range.
    b) Industry Cap (IC): What percentage of the cap to set aside for free allocation use.
    c) Unallocated Allowances (UAs): How to use the unallocated wedge and flexible share of allowances. Either to auction, to be used to mitigate the Cross Sectoral Correction Factor (CSCF) in 2024-25 (the consultation set out a guarantee to maintain current stationary free allocations in 2024-5) or put into a reserve pot.

64. Reserve pot: this contingency was to be used as allowances for CSCF mitigation over 2026-2030 or as a source of allowances for the market stability mechanisms pot. The reserve is a residual pot determined by the number of unallocated allowances created and by the number of allowances used for free allocation and auctioning.

65. Several options of different combinations of these mechanisms were developed and considered. These options were developed using the Cap Composition modelling (see quantification section, paragraph 38), to ensure the scheme-wide interactions between mechanisms were reflected. In this IA we have identified five key options which reflect the range of options considered. Some minor variations of these options were variously considered which are not detailed in this IA as they are sufficiently similar to the four options below. These are summarised in table 3. Regardless of the option for the cap within the period all options have the same level of emissions in 2030.

Table 3 Shortlist of options

Option	Cap (Consultation range) (2021-2030 allowance volume)	Industry cap (2024-2030)	Percentage of the Unallocated Allowances	Reserve (UAs not auctioned, or for 2024/5 CSCF mitigation)

			(UAs) Auctioned[21]	
A	Bottom of the range (887 million allowances)	37%	67%	11 million allowances
B	Top of the range (936 million allowances)	37%	73%	15 million allowances
C	Top of the range (936 million allowances)	40%	67%	26 million allowances
D	Top of the range (936 million allowances)	37%	50%	35 million allowances
E	Top of the range (936 million allowances)	40%	62.4%	29.5 million allowances

66. In all options A-D, we assumed **aviation FAs** were phased-out on trajectory 2A[22]; a linear reduction over 2024-2028 (see annex 4 for details). Aviation FAs have an impact on the total volume of allowances auctioned. However, they do not impact the availability or use of unallocated allowances from the stationary free allocation system. Hence, option 2A was chosen as a **middle ground** option for developing the cap options A-D between faster and slower phase-out options and does not reflect a preferred position. The impact of changing AFA phase-out options on total auction volumes is generally relatively small, compared to the total volume of allowances auctioned. This also does not have a significant effect on the Net Present Value (NPV[23]). More detail on the final aviation FA phase-out option can be found within paragraphs 216 to 226. For details on the composition of policy options, see annex 3.

67. The preferred option is option E which assumes aviation FAs were phased out on trajectory 1D where aviation free allowances are not provided for beyond 2025. This leads to a slight increase in the volume of allowances auctioned.

68. The UK ETS Authority considered the responses to the consultation, alongside updated assessments of emissions abatement progress in order to decide on the preferred option. They also considered the objectives of the ETS when deciding on the preferred option. This is covered in more detail in the AR.

Results

Emissions Reductions

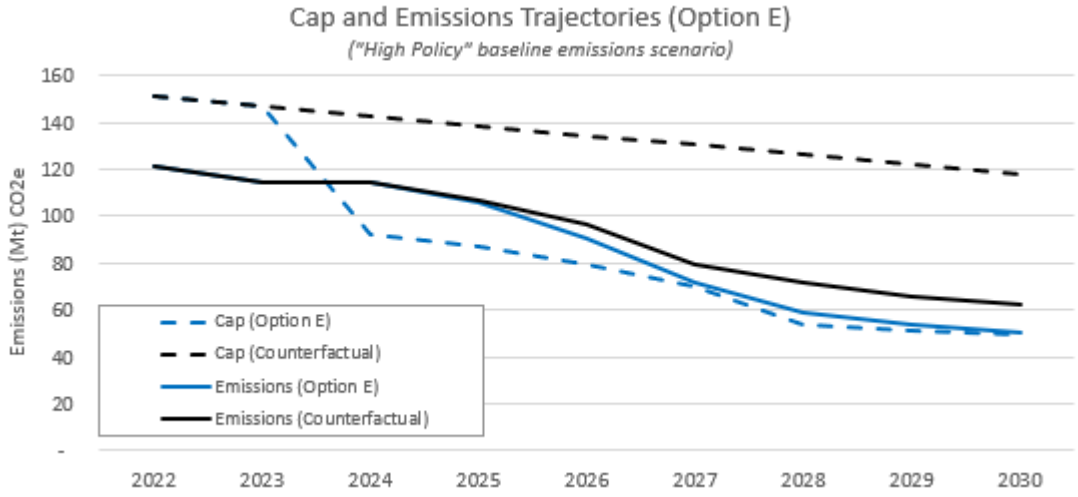
[21] This is estimated to be about 85 million allowances under option C. However, the exact number will vary depending on the option.

[22] AFA entitlement decreases by a constant amount every year between 2024 to 2028 by when AFA's are fully phased out.

[23] The Net Present Value is the sum of future costs and benefits that have been discounted to bring them to a present value.

69. Figure 3 shows Option E against the 'high policy' baseline emissions to illustrate the relative size of the caps and emissions trajectories. It shows the reduction in the net zero cap below baseline emissions from 2024, and the corresponding reduction in emissions. Note, *annual* emissions remain above the *annual* cap for the first few years as unallocated allowances from 2021-2023 are made available in the system, as well as existing hedged/banked allowances. Emissions then begin to fall below counterfactual emissions.

Figure 3 Preferred option cap and emissions trajectories



70. Figure 3 is broadly representative of the other options and baseline scenario. Table 4 shows the emissions reduction figures for all options & high/low baseline emissions. Between options, generally options B, C, D, & E have similar profiles as they have the same cap, and mostly differ in how allowances reach market & when (which drive slight differences in the timings of abatement). Option A has consistently higher savings than the other three, due to the tighter cap. Across scenarios, savings attributed to the UK ETS in the low policy baseline are consistently higher and start earlier than the high policy baseline. In the chart, this would look like the solid black line being higher, as shown in figure 3. In both the high and low policy baselines, savings begin earlier as the market has foresight of the changes, so our modelling and evidence suggests we should expect prices to rise before 2024, with corresponding increases in abatement earlier.

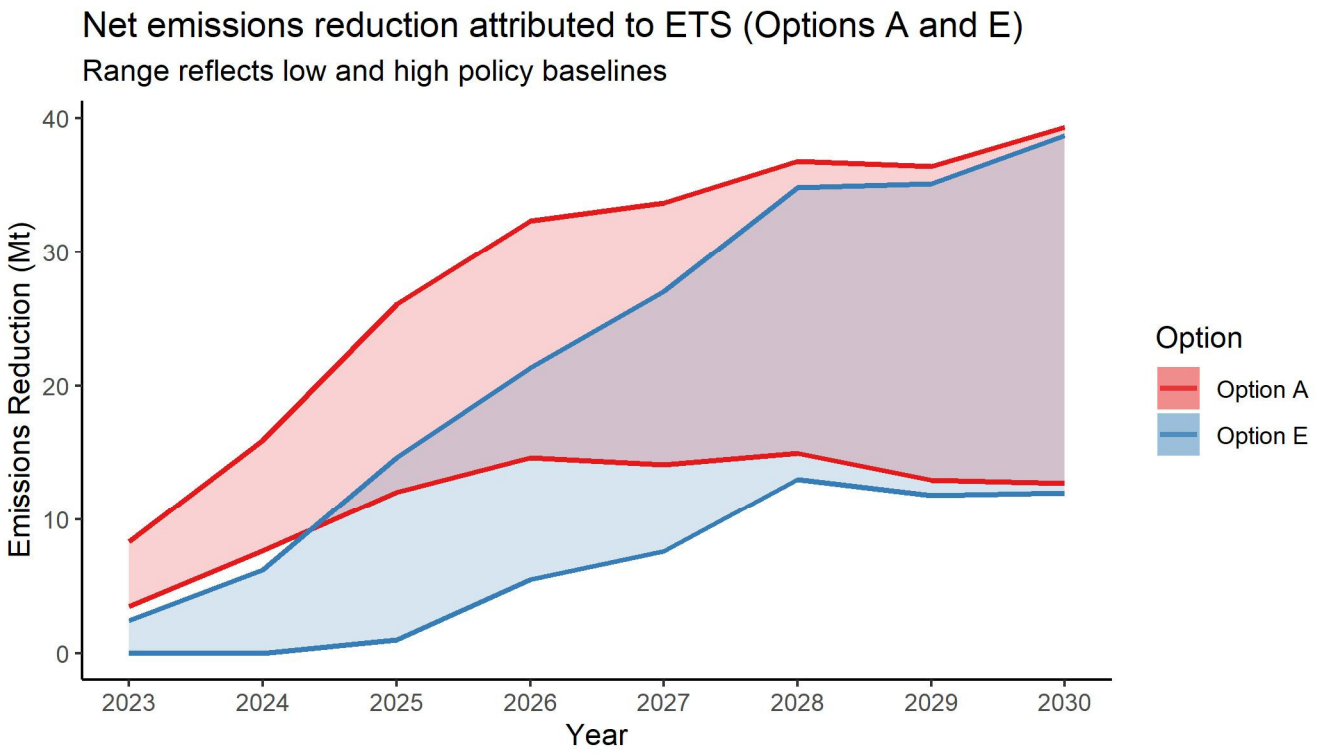
Table 4 Emission reduction figures for shortlisted options

MtCO2e		2023	2024	2025	2026	2027	2028	2029	2030
Option A	High Policy	3.5	7.6	12.0	14.6	14.1	15.0	13.0	12.7
	Low Policy	8.3	15.9	26.1	32.3	33.7	36.8	36.4	39.3
Option B	High Policy	-	-	1.1	7.3	10.1	15.0	13.0	12.7
	Low Policy	0.6	4.3	14.6	23.5	29.4	36.6	36.3	39.3
Option C	High Policy	-	-	0.9	6.2	8.9	14.2	12.4	12.2
	Low Policy	1.5	5.2	14.6	22.4	28.3	35.9	35.8	39.0
Option D	High Policy	-	-	0.9	6.2	8.4	13.5	12.0	12.0
	Low Policy	2.0	5.8	14.6	22.4	27.8	35.2	35.4	38.8
Option E	High Policy	-	-	1.0	5.5	7.6	13.0	11.8	12.0
	Low Policy	2.4	6.2	14.6	21.3	27.0	34.8	35.1	38.7

71. We note that in the high policy baseline, (essentially) the same emissions reductions over time are delivered across the portfolio of policies, however they are not attributed to the UK ETS in this analysis, hence both the costs and benefits are not covered here.

72. Figure 4 shows the results from Table 4 for options A and E to aid visualisation. Options B, C and D look similar to Option E. In the early years (2023-2025) the main driver of emissions differences is the option chosen, with option A driving approximately 10Mt additional savings (roughly equal to the differences in annual cap). However, by the end of the phase, where the two caps are aligned for these options, the difference in emissions between the two policy baselines, is greater in magnitude than the difference in emissions between the options. The primary determinant of net attributable emissions savings is the level of other policies, rather than the exact cap chosen, within the shortlist range of options.

Figure 4 Net emission reductions for options A and C



Cost Benefit Analysis (CBA)

73. Figure 5 summarises the Net Present Value (NPV) of options A – E. **All central scenarios show Value for Money.** Highest is £40 billion and lowest £10 billion. The preferred option has a central NPV of £10.10bn and Benefit to Cost Ratio (BCR) of 7.1 for the "high policy baseline". This demonstrates Value for Money with significantly high NPV and BCR. When comparing the shortlist options, **option A has higher NPV than B, C, D & E.** NPV is driven by scale of emissions (drives benefits and abatement costs). Lower cap in option A means gross benefits and costs are larger, i.e., the higher level of abatement generates a higher NPV. **Options B, C, D, E have very similar NPVs.** Per above, the key driver of the costs and benefits is gross emissions reductions. Since the caps are the same, the emissions trajectories are very similar (though distributional considerations change) the overall VfM is similar. **The "low policy baseline" NPVs are significantly larger than the "high policy baselines."** This is because the counterfactual emissions are much higher in the low policy baseline (less supporting policy is delivered and so emissions reductions driven by the cap in the analysis are much larger). Hence the gross magnitude of both costs and benefits are significantly larger, and the NPV is also larger.

Figure 5 Central NPV values for shortlisted options

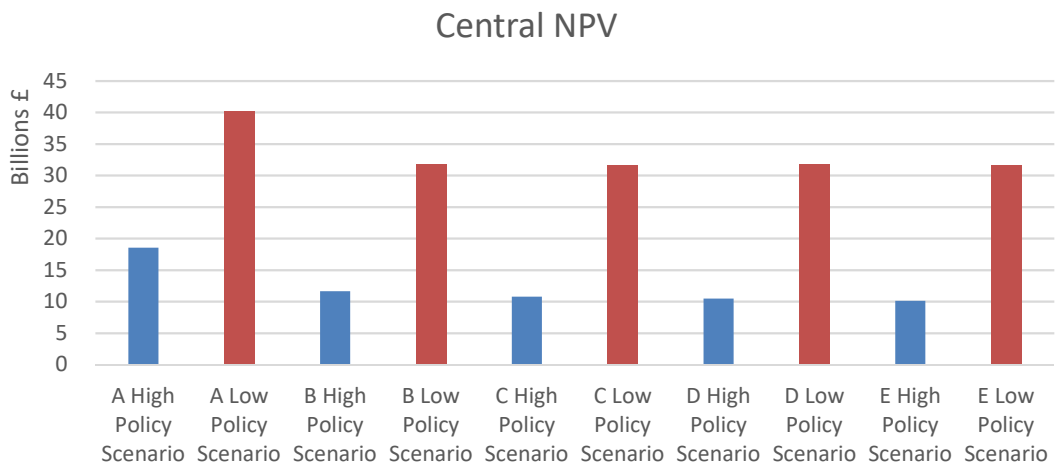
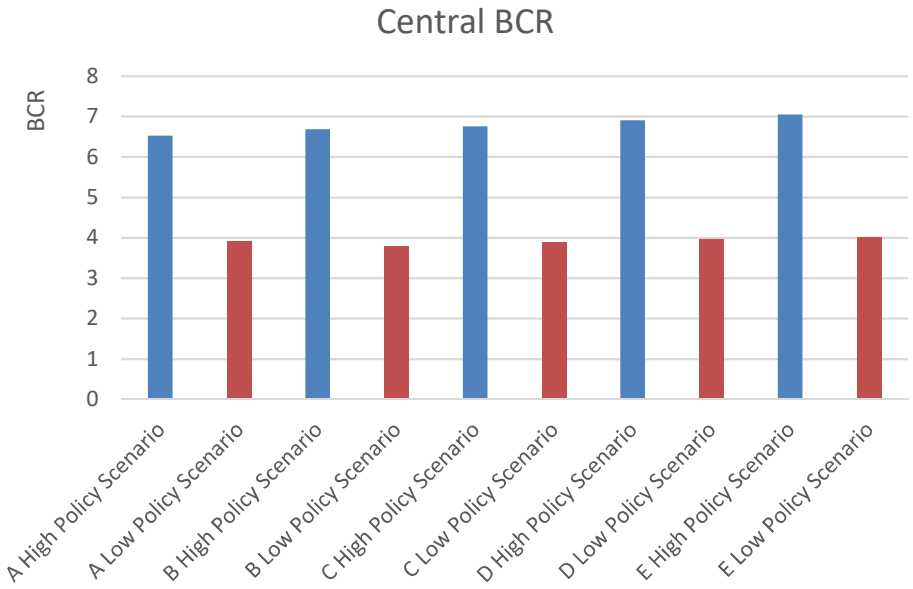


Figure 6 Central BCR values for shortlisted options



74. **The shortlisted options all have BCRs are above 1, showing Value for Money[24].** However, any BCRs of 4-7 would be considered very high[25] by most standards, strengthening the value for money case. For a given baseline, the four options are much more similar than different. As mentioned in paragraph 28, this is driven by ETS allowance prices.

75. **BCRs for "low policy baseline" are smaller, despite the NPVs being larger.** This is because, although more emission savings are attributed to the ETS in the low policy baseline, those savings are (at the margin) more expensive, as more expensive technologies must be deployed to realise them.

76. **Option A has similar BCRs to options B, C, D, E despite having larger NPV.** This is likely because, although slightly more emissions reductions are attributed to option A, the marginal cost of

[24] BCR>1 and NPV>0 are mathematically equivalent.

[25] For example, see: DfT VfM Guidance

those extra savings is not radically different to the average cost of the savings in B, C, D, E so the benefits per unit cost do not change appreciably.

Sensitivity Analysis

77. The approach to sensitivities uses a scenario-based approach[26]. Hence, we assess the VfM case for the UK ETS under wide ranging assumptions, to test its robustness to systematic differences in conditions & context. See Annex 2 for quantified details on sensitivities and the approach.

78. Table 5 below shows how the parameters are varied for the sensitivity scenarios.

Table 5 Explanation of sensitivity scenarios

Sensitivity Scenario	Value of Emissions (values are varied using Green Book Appraisal Guidance)	Carbon Values	Costs
Central	Central	Central	Central
High	High	Central	Low (3 times lower than central)
Low	Low	Central	High (3 times higher than central)

79. High policy baseline sensitivity ranges always indicate VfM. In the low sensitivity analysis scenario, NPVs are close to zero and BCRs are approximately 1, indicating benefits and costs are comparable in size. In the low sensitivity scenario, the NPV remains positive.

80. The sensitivity analysis results for the low policy baseline have a wider range, and the worst case has a negative NPV. This occurs when carbon emission savings are worth around half and costs are three times higher than the central. The wider range is driven by the larger magnitude of both costs and benefits. Additionally, the impact of higher costs is particularly significant as the marginal costs are so much higher. The BCRs are approx. 0.6 which, while less than 1 (i.e., costs exceed benefits), is not exceedingly low. Additionally, as discussed, this represents a worst-case scenario.

81. For the preferred option, for the high policy baseline, the NPVs range from £0.85bn in the low scenario to £17.10bn in the high scenario. The corresponding BCRs are 1.2 and 30.8. For the low policy baseline the NPVs range from £-10.51bn in the low scenario to £59.43bn in the high scenario. The corresponding BCRs are 0.7 and 17.6.

82. The low sensitivity scenario for the low policy baseline for the preferred option does have a negative NPV, however as detailed above, this scenario seems unlikely with a 300% uplift on costs.

83. This can also be interpreted as indicating the scale of downside risk that must materialise to result in poor VfM from the ETS reforms, noting that the key source of risk to VfM is the policy risk associated with supporting policies, rather than the uncertainty around costs.

Social Transfers

Note on Allowance Prices

[26] For discussion on sensitivity and scenario approaches see the Aqua Book: https://www.gov.uk/government/publications/the-aqua-book-guidance-on-producing-quality-analysis-for-government

84. The modelling that underpins the analysis in this IA (see annex 2 for more details and limitations) includes an assessment of "carbon values" which reflect the expected annual marginal cost of abatement delivered, reflecting basic supply and demand conditions in the ETS.

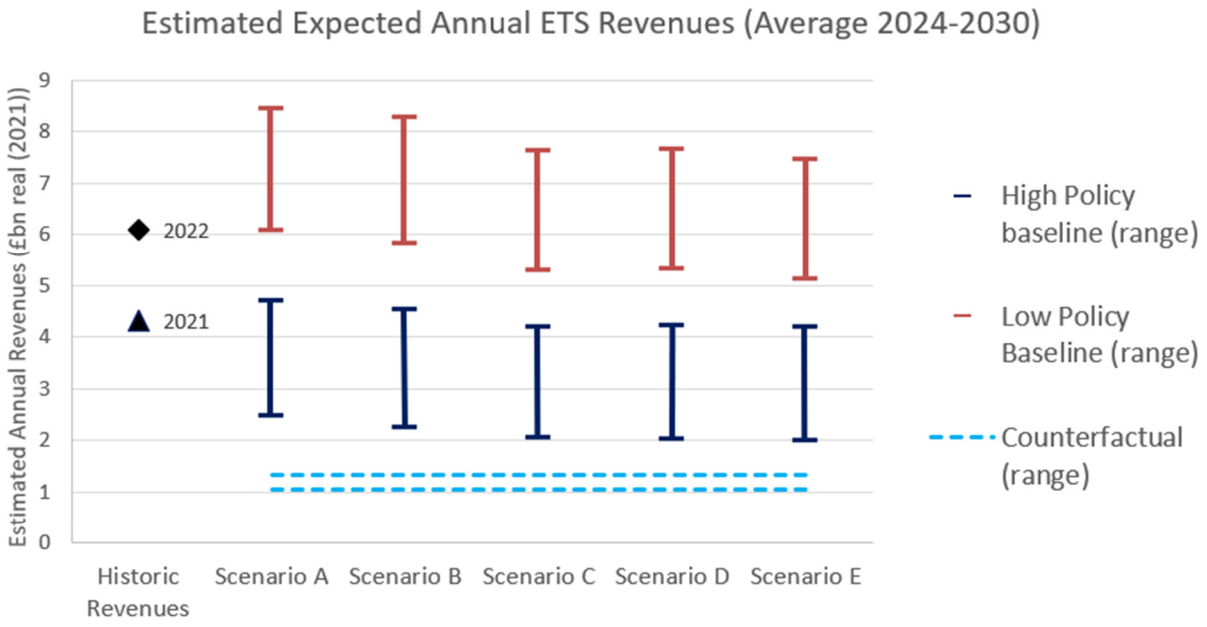
85. For this reason, our modelling also includes estimates of market-adjusted carbon values, to support work where short-term allowance prices are more directly relevant. The methodology is discussed in annex 1. We judged that assessing social transfers should be done using the market-adjusted carbon values as these are designed to reflect the short/medium term cost of purchasing allowances more closely.

86. **However, to avoid undue risk of influencing the market, or undermining the price determination process, we have not included these price series in this IA. For the same reason, we have also not included any annual figures for revenues or business cost from which is possible to derive the price assumptions in combination with other information (for example auction volumes & revenues). These are not financial forecasts but analysis to allow for comparison of policy options.** Hence, we include only average annual figures, using a top-down view across the whole ETS when assessing social transfers. For projections of UK ETS auction revenues, please see the Office for Budgetary Responsibility (OBR) projections.

Revenue

87. Revenues to government from the ETS constitute a social transfer from firms to the government. Figure 7 shows estimated expected annual revenues (2024-2030), with the low values reflecting the bottom of our market carbon value range estimates high values reflecting the top. In all cases and across all options revenues exceed the counterfactual. This is because, although auction volumes are smaller, prices are higher, with prices in the counterfactual only being non-zero due to the auction-reserve price.

Figure 7 Estimated expected annual revenues for shortlisted options



These figures are presented to compare the average differences between options and do not constitute a forecast of annual revenues. *Figures calculated from internal BEIS assessments of market carbon value ranges. The range of values for the low and high policy baselines are presented. Auction volumes, and the market price of UKAs are subject to uncertainty, and would be expected to vary within and between years. Counterfactual range reflects high/low policy baseline emissions, as this constrains demand for allowances 2021-2022 revenues are nominal and refer to the average auction clearing price (per unit)*

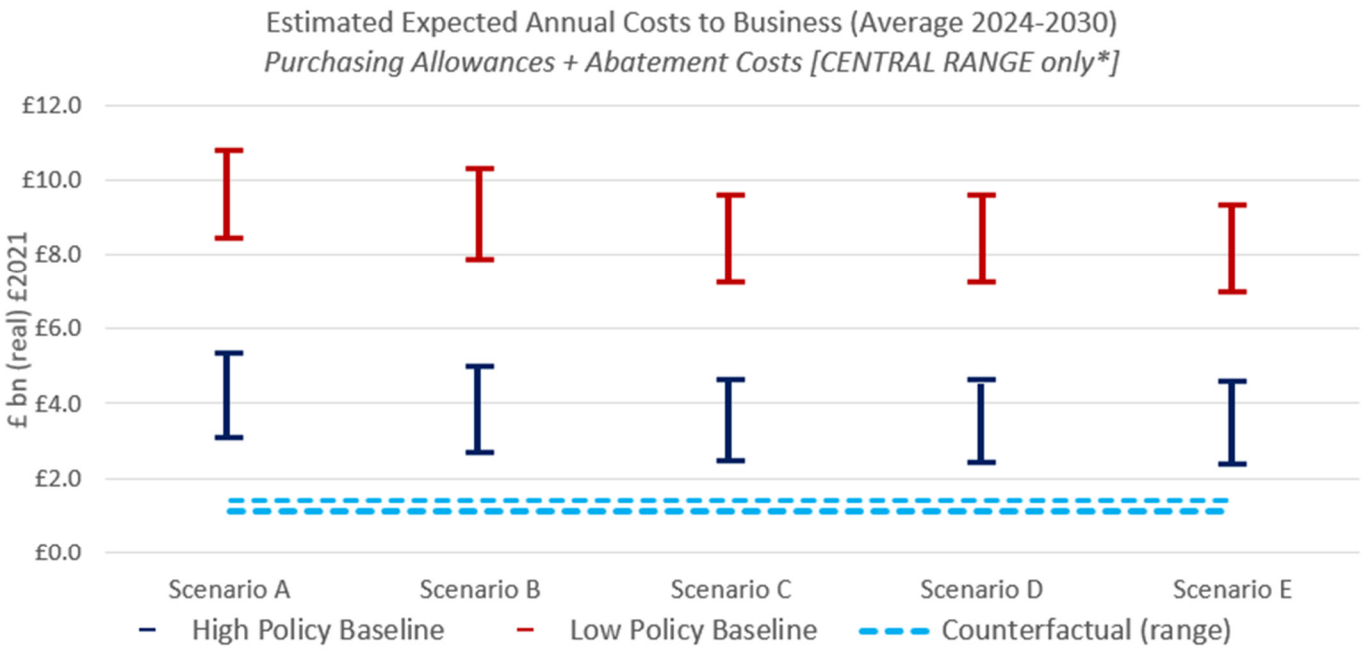
88. Option A has slightly higher revenues than B, C, D, and E as the tighter cap drives higher prices which offset the impact of the implied lower auction volume. However, the difference is relatively small. The difference in revenues across the sensitivities is larger, with average market-adjusted

carbon values being approximately double the low policy baseline, and slightly higher at the end of the phase. Hence, the expected annual gross revenue ranges are approx. 2.5 times higher[27].

Direct costs and benefits to business[28] calculations

89. Figure 8 shows the estimated expected annual costs to business from the changes. These are cost of purchasing allowances plus abatement costs. Note here counterfactual costs are **just** cost of allowance purchases + abatement costs, and do not include the non-covered costs of the ETS (administrative, monitoring, verification enforcement); these are not estimated in this IA as the provisions do not change them directly so they would just additively shift the chart results.

Figure 8 Estimated expected annual costs to businesses for shortlisted options



These figures are presented to compare the average differences between options and do not constitute a forecast of annual costs. *Figures calculated from internal BEIS assessments of market carbon value ranges. The central value for the low and high policy baseline are presented. Auction volumes, and the market price of UKAs are subject to uncertainty, and would be expected to vary within and between years.*
Counterfactual range reflects high/low policy baseline emissions, as this constrains demand for allowances
Central gross real abatement costs from the cost-benefit analysis are used.
** uncertainty reflects baseline emissions scenarios, and carbon price uncertainty. Abatement cost uncertainty (high/low sensitivities) are not included.*

90. Across the different options, in the high policy baseline, the large majority of costs are from purchasing allowances (estimated using revenues), with abatement costs constituting approx. £500m p/a. In the low policy baseline abatement costs are a larger share of business costs, rising to approx. £2bn p/a over the options, alongside higher revenues from higher prices.

91. These costs will be distributed differently across installations and firms, depending on a variety of factors (these factors are discussed in more detail in the wider impacts sections):

[27] We note, this is just UK ETS revenues, as we do not adjust for the estimated costs or revenues associated with the differences between the high/low policy baselines.

[28] Given its scope covers large sale combustion and industrial process emissions, we do not expect voluntary & community bodies to be specifically impacted. Where they are, it is like to only if they have large onsite combustion for heating or CHP, in which case the ETS has provisions to reduce the burden on small emitters, ultra-small emitters a hospitals, as well as offering fee allowances where these is carbon risk & in the instance of eligible high efficiency cogeneration.

a. Scale: larger firms with larger emissions will have largest costs, both to purchase allowance and/or to engage in abatement.

b. Marginal abatement: firms will engage in different levels of marginal abatement in response to the same carbon price signal, depending on the costs they face. One of the primary benefits of using an ETS to determine a price signal is to provide a mechanism for achieving the lowest overall cost of this decarbonisation[29]. This means the split of abatement and allowance purchasing costs will vary by firm.

c. Deep decarbonisation: the ETS will also be part of the incentive to deploy deep decarbonisation such as fuel switching to new fuels (such as green hydrogen), electrification or CCUS. In these instances, firms will likely face zero/minimal costs of purchasing allowances (to cover any residual emissions) but much higher abatement costs. In this instance costs may also be more front-loaded (see risks and assumptions discussion below).

d. Free Allowances: the provision of free allowances often dramatically reduces the costs to business of purchasing allowances. Many stationary sectors receive free allowances covering 80-100% of their emissions. For further discussion see the aviation and industry impacts section.

e. Cost pass through rates are dictated by market conditions and will differ significantly by sector. Cost pass through is a key part of the overall competitiveness implications of the proposals, which are discussed in the authority response, and the sector impacts section of the IA.

f. Sector: sectoral differences are likely to be related to the availability of abatement technologies, deep decarbonisation options, free allowance eligibility, and cost pass through. Hence, it provides one lens through which to assess the overall distribution of impacts.

Risks, limitations, and assumptions

92. Counterfactual assumptions are set out above. Modelling assumptions and cap composition assumptions are discussed in their respective annexes (Annex 1).

93. **Carbon Values and Prices:** our assessment of the marginal cost of abatement, and how this would drive changes in carbon prices is subject to uncertainty, as discussed throughout. This is a key source of risk for the analysis, with higher costs being associated, we expect, with lower levels of net social benefit, and higher costs to business. However, we have mitigated the risks to our analytical conclusions through our scenario-based approach, which considers a wide range of counterfactual emissions and decarbonisation cost scenarios. As discussed, in general the value-for-money conclusions are robust to the realisation of all but the worst-case scenarios.

94. **Cost timings:** our modelling reflects aggregated costs of achieving different levels of abatement. This aggregation also smooths costs on an annual basis. In reality, some decarbonisation technologies will require up-front investments, with lower operational costs over their lifetime. This change in the distribution of costs over time could have some minor impacts on the CBA, however this is mitigated though the use of a 7-year appraisal period, which limits the scope for changes in the time-distribution of costs (and hence the changes to discounting) to change the substantive results.

95. **Competitiveness & Carbon Leakage:** our modelling does not include large-scale changes to business competitiveness. This is largely determined by free allocation policy rather than the cap, and hence will be considered further during the Free Allocation Review. Similarly, our emissions modelling does not account for changes in carbon leakage (see authority response for definitions and discussion). Similarly, the approach to mitigating carbon leakage risk is discussed in the authority response.

[29] Discussed further in the analytical annex to the consultation.

96. **Technology risk correlation:** Given the scale of this analysis, it is possible that systematic risks could manifest which are not reflected in our modelling. For example, if some technical barrier emerges which makes a key technology (e.g.: carbon capture utilisation and storage (CCUS)) substantially more expensive, or significantly delays/constrains deployment across a wide range of sectors/cases, or there are differences in regional access to technologies. Then, this could make the emissions reductions needed to meet the cap harder to deliver. The UK ETS cannot directly mitigate this risk, however as a technology-agnostic mechanism we would expect it to be well placed to drive deployment in whatever the least-cost, scalable abatement technologies are available. We have investigated the risk that abatement costs are up to approximately three times higher than our central scenario and found our VfM case is robust to this uncertainty. Hence, although this risk remains, we feel the case for the proposed ETS changes is generally robust to it.

97. **Cap composition:** our cap composition modelling (see Annex 3) is only an initial approximation of the impact of the multiple mechanisms on the final distribution of allowances. It is subject to some uncertainty. Future FAs are subject to uncertainty depending on changes in activity levels, and as a result, CSCF, Unallocated allowances and New Entrants' Reserve (NER) figures use are estimates only. Updated HSE/USE (hospital small emitter / ultra-small emitter) information may also change results slightly. Lastly, the precise implementation of some mechanisms may mean that the final numbers will likely differ moderately from this analysis. However, we would expect most of these uncertainties to impact the options in very similar ways, so the differences *between options* are expected to be inherently well represented by the analysis. We generally expect any overall differences to the final figures to be relatively small. For details on the cap composition assumptions see annex 3.

Impact on small and micro businesses (SaMBA)

98. The UK ETS does not collect data on business size directly. However, it has multiple thresholds to limit its coverage to large emitters, and mechanisms to address impacts on smaller emitters. This impact assessment uses related datasets to estimate the potential coverage of small businesses. Note this SaMBA is assessing the impacts of the *revisions* of the scheme on small businesses, not re-assessing the provisions of the UK ETS for smaller businesses. This SaMBA only deals with the stationary sectors, for aviation SaMBA see paragraph 241. This SaMBA is set out as:
    a. UK ETS thresholds and mechanisms
    b. Contextualising thresholds
    c. Costs for low emitters
    d. Assessment of the impacts of changes

99. Currently, there is a minimum threshold for participation in the UK ETS on the basis of certain activities. Under the Greenhouse Gas Emissions Trading Scheme Order 2020 ("the Order"), the threshold for combustion has been set such that only installations where the combustion of fuels in units with a total rated thermal input exceeding 20 megawatts are required to participate in the UK ETS.[30]

100. For firms who are low emitters there are different provisions on them, and it may be that these firms are also smaller in labour size. There are simplified provisions for hospitals and installations with emissions lower than 25,000t CO2e per annum, and where the installation carrying out the activity of combustion has rated thermal capacity below 35MW[31]. These firms are allowed to opt out of buying allowances. Instead, they monitor and verify their emissions and are given an

[30] https://www.legislation.gov.uk/uksi/2020/1265/schedule/2

[31] https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#simplified-provisions-for-hospitals-small-emitters-and-ultra-small-emitters

emissions target which reduces in line with the cap. They pay a price based on the year's average carbon price for their emissions over that target each year.

101. Similarly, there are special provisions for ultra-small emitters (which again, may be smaller in organisation size). If eligible, installations with emissions lower than 2,500t CO2e per annum may obtain ultra-small emitter status. They would not be required to hold a permit but are still required to monitor their emissions and must notify their regulator if they exceed the threshold. For firms which opt-out from the UK ETS via this scheme, no data is collected on them.[32]

102. The first and highest level of SaMBA analysis done was to look at average costs just to give an indication as to whether the average SME could be disproportionately burdened. This seeks to convert the ETS thresholds to gas bills, assuming that all emissions are associated with the combustion of natural gas. Using 2022 estimates of retail energy prices from BEIS supplementary guidance tables[33] gives an idea business sizes within the thresholds. The 25,000 tCO2 per annum threshold for small emitters would be equivalent to an annual gas bill of approximately £133,500. And for ultra-small emitters, 2500 tCO2 has an equivalent annual gas bill of £13,350. The average gas bill for a micro and small business is £3,138 and £6,941 respectively according to 2022 data[34]. The distribution of figures is not given but the mean is appropriate for this initial high-level look.

103. From these initial figures it is highly unlikely that the cost for small and ultra-small emitters are disproportionate in any case, firms in these thresholds do not surrender their allowances or receive free allowances so do not face allowance trading costs. The administrative burden is also quite low.

104. However, given the sector coverage of the UK ETS is focussed on more energy intensive activities, it is unlikely that the average SME energy use is representative of the small firms which may be in scope of the UK ETS. Hence, we looked at more granular distributional data. Filtering the Non-domestic National Energy Efficiency Data Framework (ND – NEED) for factories with fewer than 50 employees that are involved in manufacturing was used as a proxy for (industry sector) firms who could be in the ETS. When gas consumption for 2019 and 2020 were looked at, only 0.25% of small and micro firms were over the 25,000 tCO2 threshold. More detail on this analysis can be found in the Modelling Annex (annex 2).

105. From this high-level analysis, it can be inferred that it is unlikely that a substantial number of small or micro enterprises are participating in the UKETS scheme. And for those that could be, it is unlikely that they are disproportionately burdened.

106. The cost of purchasing allowances to cover emissions under the UK ETS scales with emissions, rather than organisation size, hence would not be expected to be disproportionate for smaller firms. Further, the changes proposed in this IA are not expected to drive any changes in administrative costs (see SaMBA for more info), so should not place a disproportionate burden on SMEs.

Wider Impacts

107. Power Sector: In the GB power sector, the balance of emissions reductions and increasing prices on compliance costs will differ across sites and over time. However, in general we expect UK ETS compliance costs in the power sector to be passed on to end users of electricity[35].

108. Increases in the carbon price could also impact the generation mix of technologies in the UK electricity system. An increased carbon price is expected to increase the marginal cost of electricity

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[32] https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#simplified-provisions-for-hospitals-small-emitters-and-ultra-small-emitters

[33] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[34] https://bionic.co.uk/business-energy/guides/average-energy-usage-for-businesses/

[35] Only GB is in scope of this impact as Northern Ireland electricity generators participate in the EU ETS by virtue of the Ireland / Northern Ireland Protocol.

generation from fossil fuel generators (e.g., coal and gas) relative to other technologies (e.g., nuclear and renewables), promoting the displacement of fossil fuel generators with other lower carbon technologies. Increases in the carbon price feed through to wholesale prices. Higher wholesale prices should attract more electricity imports and displace some domestic generation. If electricity generated in these markets is relatively more carbon intensive than domestic generation, this could result in carbon leakage. However, this risk would also depend on the policies in interconnected jurisdictions, such as the EU which has the EU ETS covering power generation. Further, this is very dependent on future prices, including the relevant jurisdiction's carbon prices, in interconnected markets and the UK's future carbon leakage policy. The scale of this impact depends on these factors but is likely to increase over time alongside other net zero policies.

109. The ETS revisions sit alongside a wider suite of policies, including those set out in the UK Government's Net Zero Strategy and the net zero plans of the Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland. As such, it is difficult to determine the exact impact of the changes listed in this IA on energy bills. In general, a higher carbon price would be expected to increase the marginal cost of electricity generation from fossil fuel generators. In the short run, these higher costs may be passed onto consumers' energy bills. However, the medium/long run, energy bills may be decreased where the ETS contributes to faster power sector decarbonisation. It is possible that any short-term pressure is outweighed by wholesale price changes.

110. Aviation impacts: Aviation is recognised as a hard to decarbonise sector relative to other UK ETS participants. Aircraft operators are likely to respond to a higher carbon price by investing in sustainable aviation fuel, technological and operational efficiencies. Higher marginal costs are likely to be passed through to consumers in the form of higher airfares. The Department for Transport's Jet Zero Strategy provides further detail on how we will reach net zero aviation by 2050[36].

111. Fuel switching impacts: ETS modelling does not provide insights into whether abatement options lead to fuel switching. A higher carbon price could incentivise firms to shift their fuel mix to more renewable sources to lower costs. This could then have impacts on air quality.

112. Carbon Leakage Impacts: The UK Government has consulted on a range of carbon leakage mitigation options[37], including on whether measures such as a carbon border adjustment mechanism (CBAM) and product standards could be appropriate tools in the UK's policy mix. Any measures would be designed to work alongside the UK ETS Authority's decisions on the future of free allocations, with the aim of ensuring that carbon leakage risks are mitigated at all stages of the UK's net zero transition.

113. ETS market impacts: The impacts on the market will be both in terms of supply and demand and also in terms of participants' expectations. With few allowances in circulation (the combination of free allocation and auctioned allowances) the scarcity of them increases. Projected traded carbon values increase as the cap decreases. Also, as few allowances are auctioned this will result in either smaller primary auctions, or less frequent primary auctions. As noted above, the reduction in free allocation may also lead to greater participation of operators who currently receive the majority of their allowances from free allocation. There will be a further consultation on market stability mechanisms later in 2023 which will consider the changes detailed here and whether further changes should be made to the operation of the market, for example whether to introduce a supply adjustment mechanism.

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[36] https://www.gov.uk/government/publications/jet-zero-strategy-delivering-net-zero-aviation-by-2050

[37] https://www.gov.uk/government/consultations/addressing-carbon-leakage-risk-to-support-decarbonisation

Table 6 Market impacts explanation

Liquidity in the UK ETS

Liquidity refers to the efficiency or ease with which an asset or security can be converted into ready cash without affecting its market price. Market liquidity refers to the extent to which a market, such as a country's stock market or a city's real estate market, allows assets to be bought and sold at stable, transparent prices. For the UK ETS this means that liquidity refers to how easily UKAs can be bought and sold quickly at low cost, and at a price close to the observed price.

Liquidity, as defined above, is not a discrete state, rather it is comparative. This means that a market is generally compared to other markets, or other timepoints, when assessing whether it is liquid.

The benefits of a liquid market

Traders want liquidity in a market because it means buying and selling is smooth and efficient. In a liquid market the price is little affected by individual trades, meaning there is reduced volatility[1] and increased certainty.

The UK ETS Authority wants a functioning market for its traders in order to decarbonise the UK. The Authority's interest in the market being liquid is indirect. The Authority wants emitters to have increased certainty of price because it means cost-effective abatement will take place. Therefore, the Authority favours a liquid market because it increases price certainty for the emitters who trade in that market.

However, a market which has liquidity can still fail or perform poorly. This can occur for a range of reasons including lack of information about the market, lack of confidence in the market and credit constraints.

The effect of allowance supply and demand on liquidity

Markets operate on supply and demand. For an ETS the supply is the number of allowances in circulation through auctions and free allocation and the demand is the need for those allowances either for compliance (current or future) or as an asset.

Considering supply and demand in terms of changing liquidity means looking at the effect in terms of trades. Changes to supply or demand may increase the potential for trades to be made more or less smoothly, but do not automatically do so.

In theory, increasing the number of allowances in circulation increases the potential for an increased number of trades. In turn, an increased number of trades potentially means traders have more information. More information can mean greater certainty about the price at which they can buy or sell allowances leading to less volatility and smaller price changes.

Therefore, theoretically, a larger market has the potential to be more liquid. But this does not always hold in practice as many other elements – such as traders' views on future policies and cash flow to buy allowances – also impact trading behaviour.

Changes to the UK ETS and liquidity

Changes to the structure of the UK ETS similarly have the potential to change liquidity. Possible structural changes include changing the number of allowances in the scheme or the route by which they arrive in circulation by changes to auction share, to free allocation or by cancelling allowances.

Also, changing the nature of the market has the potential to affect liquidity as it may affect participant behaviour. For example, a participant who receives less free allocation and needs to purchase more

allowances may choose to trade more often in the year or may choose to trade larger volumes but with the same frequency of trades as before.

Measuring liquidity
Dimensions of market liquidity can be distinguished. These include: the ability of the market to absorb large transactions / trade volumes, the divergence of transaction prices, and how temporary any price movements are when they take place. Also, there are other factors that influence liquidity such as whether there are "market makers"[2] present.

The Authority is commissioning work to look at liquidity in the UK ETS in more detail. Results from this will be reported as part of the ongoing Monitoring and Evaluation of the UK ETS.

114. Public Sector Equalities Duty (PSED): The changes listed in this IA do not have any direct impact in respect of disability, race, age, sex, sexual orientation, gender reassignment, pregnancy and maternity, marriage or civil partnership, religion, or belief. These changes do not target persons, but large companies or groups of companies. In addition, these changes will be of general benefit to everyone in the UK, regardless of whether they have one or more protected characteristics via the reduction in GHG emissions. Equally, these changes should not hinder such actions or give rise to, or create an increased risk of, discrimination, harassment, victimisation, or any other conduct prohibited by or under the Equality Act 2010. Therefore, we expect these changes to have a neutral impact in this area. We conclude that these changes should have no adverse or disproportionate negative impact on persons or groups with a protected characteristic and no steps need to be taken to advance equality of opportunity and foster good relations because of or in relation to them.

Regional Impacts[38]

115. By design, the UK ETS is a pan-UK system which is industry, regional, and sector agnostic. However, this does not mean homogeny of effects across regions; industry and sectors are not distributed uniformly. Abatement due to the UK ETS depends partly on key technological and infrastructure solutions. These solutions will not be delivered symmetrically across the UK and therefore the rate of decarbonisation will differ across UK nations. Compliance data from 2021[39] shows that England had 578 installations with aggregated total emissions of approximately 68MtCO2e, Wales had 51 installations with aggregated emissions of 16.6MtCO2e, Scotland had 97 installations with aggregated total emissions 7.7MtCO2e, and Northern Ireland had 18 installations with aggregated total emissions of 0.6MtCO2e[40].

116. Whilst the analysis in this IA is done at a UK level, the level of overall impact for the individual UK nations should also remain high and positive. This is because the same mechanisms that drive the overall NPV and BCR would also apply to the DAs, see paragraphs 27-36 for more detail on these mechanisms. The following sections look at the Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland in turn.

Scotland

[38] Details of specific site emissions are based off of the following UK ETS reports: https://reports.view-emissions-trading-registry.service.gov.uk/ets-reports.html

[39] From UK Emissions Trading Registry Data

[40] Note that these figures may differ from the regional paragraphs due to differing classifications

117. In 2021 there were 7.7MtCO2e emissions from Scottish traded sector participants, representing around 7% of the total traded sector emissions in the UK. Free allowances equivalent to 3.3MtCO2e were provided to Scottish installations covering 44% of verified Scottish emissions and 8% of the overall UK free allowances[41].

118. Emissions from the Scottish traded sector in 2021 were concentrated in three sectors: power (27%), oil and gas (27%) and chemicals (20%). The Grangemouth industrial complex and Peterhead Power station alone accounted for 52% of Scotland's traded sector emissions, while the top ten sites accounted for 73% of Scotland's traded sector emissions in 2021. Scotland's different sectoral composition and concentration of sites means that the overall sectoral impacts will differ for Scotland than the UK as whole. With Scotland's emissions trajectory being determined by the availability of wider technological and infrastructure solutions in conjunction with ETS policy settings.

Wales

119. As a share of total territorial regional emissions, Wales has a greater share of emissions within the traded sector than any other UK nation (45.5% of Welsh emissions in 2020)[42]. Verified emissions from Welsh traded sector participants (excluding aviation) in 2021 were 16.6MtCO2e, which represented approximately 15% of total traded sector emissions in the UK for that year; free allowances equivalent to 8.7MtCO2e were provided to Welsh installations (53% of verified Welsh emissions).

120. The composition of the traded sector in Wales is such that over two thirds (70%) of emissions from the stationary installations in 2021 were derived from just two sites, the steel works in Neath Port Talbot and a CCGT power station in Pembrokeshire; the top six sites in Wales represented over 90% of emissions. As a result, the emissions trajectory of the traded sector in Wales will be determined by the abatement opportunities available to these sites.

121. Due to the high concentration of emissions within the traded sector in Wales, changes to the UK ETS will play a particularly important role in enabling the Welsh Government to meet its legislated carbon budgets and targets. Using evidence gathered from both stakeholder engagement and analysis shared with the Authority, the Welsh Government assesses that the pace of abatement by 2030 in Wales will be slightly slower than that of the UK as a whole, due to the profile of installations within the region and access to technology (for estimated UK emissions trajectory, see paragraph 69).[43] Despite this, the Develop UK ETS policies are judged to be sufficiently ambitious to enable the WG to meet their own climate ambitions.

Northern Ireland[44]

122. In 2021, verified traded sector emissions in Northern Ireland (NI) were 3.7MtCO2e across both the UK and EU ETS. Under the terms of Article 9 and Annex 4 of the NI Protocol[45]the 5 installations in NI which are defined as electricity generators will remain in the EU ETS following EU Exit, to maintain the effective operation of the all-Ireland Single Electricity Market (SEM) by ensuring a common carbon price across the island of Ireland. Verified emissions within the UK ETS from traded sector

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[41] This excludes those participating under the hospitals and small emitters guidance

[42] National Atmospheric Emissions Inventory (2020) Report: Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2020. Available online at: https://naei.beis.gov.uk/reports/reports?report_id=1080

[43] Note that it is judged to be inappropriate to publish emission trajectories for the traded sector in Wales as it could include disclosive, market sensitive information.

[44] Northern Ireland electricity generators are out of scope of the IA as they participate in the EU ETS by virtue of the Ireland / Northern Ireland Protocol.

[45] Revised_Protocol_to_the_Withdrawal_Agreement.pdf (publishing.service.gov.uk)

participants in NI in 2021 were 0.6MtCO2e[46], accounting for approximately 0.5% of the total traded sector emissions in the UK and 15% of traded sector emissions in NI. Verified emissions within the EU ETS from traded sector participants in NI in 2021 were 3.1MtCO2e[47], representing 85% of traded sector emissions in NI.

123. Free Allowances (FA) equivalent to 0.4MtCO2e were provided to NI installations in 2021, covering 64% of verified NI UK ETS emissions and 1% of the overall UK FA. The proportion of FAs received by installations compared to total NI UK ETS traded sector emissions is particularly high in comparison to the other DAs due to electricity installations in NI (which are not considered at risk of carbon leakage and therefore don't receive any FAs) remaining under EU ETS.

124. The regions all have different compositions of industry within the traded sector. From Northern Ireland's perspective, in 2020 there was a much larger % of total economy emissions than England, Scotland and Wales from agriculture (27% in NI, compared to 9% in England, 19% in Scotland and 16% in Wales) and Land Use Change (11% in NI, compared to 0% in England, 1% in Scotland and -2% in Wales). Emissions from Agriculture and Land Use Change sectors in Northern Ireland account for almost 40% of 2020 total emissions, these sectors are not currently part of any ETS scheme. It follows therefore that relative to the other regions, NI has a smaller percentage of total economy emissions that are captured within an ETS.

125. The Energy Supply sector accounts for the majority of traded sector emissions in NI. In 2020, there were 2.8mtCO2e total emissions in this sector, 98% of which were traded sector emissions. However, as mentioned above, these installations now remain under the EU ETS and as such do not participate in the UK ETS. There were a higher number of total emissions in the Business sector, organisations within this sector emitted 3 mtCO2e, however, in comparison to the Energy sector, a much lower proportion of these were from the traded sector at 0.6 mtCO2e (approximately 19% of total business sector emissions). Installations in NI (within the traded sector) carry out a range of business activities including but not limited to: manufacture of air and spacecraft and related machinery; manufacture of hollow glass; manufacture of cement; operation of dairies and cheese making; and processing and preserving of poultry meat – there will be variation in the pace at which these sectors will decarbonise which will influence NI's emissions trajectory.

Monitoring and Evaluation

126. A programme of evaluation is planned for the years 2022-2026. This will look retrospectively at the UK ETS and aims to: evaluate the implementation of the scheme and possible impacts that it might have on delivery; assess the impacts of the scheme and inform the first whole system review of the UK ETS (scheduled for 2023). The purpose of the evaluation is:

    a. to evaluate the implementation of the scheme and possible impacts that it might have on delivery (process evaluation).

    b. to assess the operation of the UK ETS allowance market, and the extent to which it is effective in facilitating the scheme's ultimate goal of enabling firms to cost-effectively abate their emissions (outcomes evaluation).

    c. to evaluate the impact of the scheme on GHG abatement and carbon leakage; to provide insight on how and why targeted impacts were (or were not) achieved; and to assess the role of scheme design in achieving (or not) those impacts (impact evaluation).

127. The evaluation includes a review of the cap, free allocation, and market stability mechanisms. Data will be collected from both primary and secondary sources, with interviews and surveys of stakeholders taking place for the primary data collection. As the different elements - cap, free allocation - are interdependent, monitoring the scheme cannot be broken down into its components; instead, it requires observing as a whole. A Theory of Change has been devised, with the

[46] UK Emissions Trading Registry - GOV.UK (view-emissions-trading-registry.service.gov.uk)

[47] https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/union-registry_en

assumptions of this being tested in the evaluation, this is shown in annex 7. Future changes to the scheme will be considered in line with the 2028 statutory review and stakeholder engagement in the form of interviews and surveys will be used as the primary means of evaluating future changes, building on the evaluation programme, to be completed in 2026.

128. Different aspects of the scheme are monitored on regular basis to ensure that the market is operating efficiently. Emissions data and records of free allocations are collected yearly in the registry. If an auction fails, then there are processes to feedback and re-release those allowances. In addition, the market is also regulated and monitored by the Financial Conduct Authority (FCA).

Annex 1: Modelling

SaMBA

129. Small and Micro Business (impact) Analysis (SaMBA): the goal of this analysis was to show a high-level indication that the current UK ETS opt-outs do not disproportionately affect SMEs. This would be done using gas consumption and whether that is greater than the ETS threshold.

130. The SaMBA Analysis Data Sources: The anonymised version of the 2022 National Energy Efficiency Data Framework (ND – NEED) and The Green Book Supplementary Guidance: valuation of energy use and greenhouse gas emissions for appraisal.

131. The methodology behind the analysis is as follows:

a. Use Supplementary guidance to convert ETS thresholds from tCO2 to KWh.

b. Filter framework so only factories, manufacturing firms with less than 50 employees are being examined.

c. Refine List to see whether any firms would not be in the UK ETS

d. Calculate results. Using the filter function gives how many firms are over the ETS threshold and from there, proportions can be calculated.

132. The main assumption used in this modelling is that gas consumption is comparable to emissions. Another assumption is about which SIC groups to include. Inclusion in the UK ETS depends on activities, not sectors so assumptions have been made that the SIC groups filtering will return firms that could be covered in the ETS.

133. Limitations. It should be noted that none of these limitations are significant:

a. Only gas consumption is used, this does not consider non gas fuel use. We lack wide-coverage data on non-gas use. Any combustion of non-gas fuels, or process emissions from small/micro enterprises are not covered.

b. There is no 'ETS' tag in the ND-NEED Framework so some firms and sectors may have been missed. At this time, we do not have matched ND-NEED & UK ETS data so the fields cannot be cross checked.

c. The data is anonymous so some firms may have been included but are not part of the ETS. Without having names, this data cannot be cross checked.

Cap Composition

134. The UK ETS is designed so that the cap it established and then it is divided into all the allowance "pots" – auction share, stationary free allocation, and others. This means they sum to the overall allowance cap for each year. However, not all these elements are pre-set at the start of the phase or defined from a "top down" approach. For example, free allocation is calculated from a "bottom up" approach focussed on characteristics relating to the efficiency and likelihood of carbon leakage of emitters. Given the complexity of the scheme, and the interrelated choices – a single tool, the Cap Composition Calculator, was developed which could be used to consistently calculate "basic" figures about pots in the scheme allowances. It was also used to explore interactions between the allowance pots and to help to build and explore scenarios.

135. In terms of risks and limitations, the Cap Composition Calculator cannot provide exact allocations for all the elements of the cap across the time frame. This is because some components, such as free allocation, are calculated and adjusted yearly for each installation. Other elements, such as the hospital and small emitters adjustment to the cap, are calculated for each allocation period. The tool is instead designed to approximate these allocations and uses appropriate assumptions. So, it cannot produce exact answers to how much free allocation is used, or how many unallocated allowances will remain, but instead indicates the approximate sizes.

136. The model is based on a set of fixed values and a number of levers. The fixed values are the constants in the model either because they will not vary, or because the variation will be small compared to the other elements. These elements are:

a. The hospital and small emitters adjustment,

b. Aviation free allocation

c. Free allocation

d. New entrants' reserve and

e. The flexible share percentage of the cap

137. The levers are:

a. the cap,
b. the industry cap,
c. flexible share volume and
d. the use of the unallocated allowances, such as potential auctioning and the years in which they are auctioned.

138. The Cap Composition Calculator used the numbers for the fixed elements and then applies the chosen sets of assumptions in the levers. There are a number of checks throughout the model to ensure that the combination is feasible, for example, placement of a larger number of the unallocated allowances than would actually exist is flagged. Similarly, the calculations are checked that they sum to the chosen Net Zero cap trajectory in all years.

139. The outputs from the calculator are:

a. The yearly auction volume,
b. the free allocation (including new entrants' reserve and flexible share use),

c. the unallocated allowances and, consequently,
d. the cap breakdown for each year.

As stated above, because some elements will be approximate, these are broad indications of the allocation and not exact numbers.

Annex 1 Table 1: The assumptions for the five options and the calculator outputs

Assumptions	Option A	Option B	Option C	Option D	Option E
Cap	Bottom of cap range	Top of cap range	Top of cap range	Top of cap range	Top of cap range
Free Allocation (FA) (Stationary)	Current Allocation Table (AT) until 2025 Equal to IC post 2026	Current (AT) until 2025 Equal to IC post 2026	Current (AT) until 2025 Equal to IC post 2026	Current (AT) until 2025 Equal to IC post 2026	Current (AT) until 2025 Equal to IC post 2026
Industry Cap (IC) as a percentage of the total cap	37% from 2024-30	37% from 2024-30	40% from 2024-30	37% from 2024-30	40% from 2024-30
Percentage of the unallocated allowances auctioned	67%	73%	67%	50%	62%
Free Allocation (Aviation) [48]	Phase out by 2028	Phase out by 2028	Phase out by 2028	Phase out by 2028	Phase out by 2026
Flexible Share	Maintain at 3%	Maintain at 3%	Maintain at 3%	Maintain at 3%	Maintain at 3%
New Entrants' Reserve (percentage of the cap)	Maintain at 2.2%	Maintain at 2.2%	Maintain at 2.2%	Maintain at 2.2%	Maintain at 2.2%
Small Emitted Adjustment	Maintain at current quantities	Maintain at current quantities	Maintain at current quantities	Maintain at current quantities	Maintain at current quantities
Forecasted remaining reserve (nearest million)	11 million allowances	15 million allowances	26 million allowances	35 million allowances	29.5 million allowances

Background to the carbon price model

140. The UK BEIS Carbon Price Model (UK BCPM) was first developed in 2018 for the purpose of supporting policy development on the design of a UK ETS from its launch in 2021. It was initially designed using the older BEIS Carbon Price Model (BCPM) as a template; the BCPM was used to project carbon values in the EU ETS.

141. The UK BCPM underwent substantial development in 2019, consistent with BEIS's standard for quality assurance and modelling best practice. The 2019 update added new functionality, allowing the modelling of an auction reserve price (ARP), and updated hedging assumptions in line with the new 2019 'business as usual' (BAU) emissions trajectories. It has since been updated on a roughly annual basis with appropriate updated data. The most recent update was in 2021, when the BAUs and Marginal Abatement Cost Curves (MACCs) were updated to reflect the most recent UK decarbonisation policy announcements.

[48] This assumption was made as aviation free allocation was considered separately. Please see paragraphs 66-67 and the aviation section for more details.

142. The following sections provide more detail on the methodology used, the key inputs assumptions that influence the model outputs, and some of the risks and limitations of the model.

Modelling methodology

143. Carbon values are estimated in the UK BCPM, as the equilibrium point where demand for abatement (the required effort) is matched by the supply of abatement through use of carbon abatement technologies.

144. To determine the amount of abatement effort required to achieve the ETS cap under each policy option, we compare the cap on emissions in each of the options against BAU emissions. For the counterfactual the current legislated UK cap is used.

145. On the supply of abatement, this is given by the marginal abatement cost curves (MACCs) to identify what abatement measures are undertaken to achieve the level of effort required. It is assumed that participants are rational, i.e., the cheapest abatement opportunities are taken up first, and participants abate up to the point at which their marginal abatement costs equal the prevailing market price. There is a MACC curve for each technology in each year and shows the amount of abatement (for a given BAU), will be achieved by that technology, in that year, at varying carbon values.

146. Therefore, the carbon value estimate reflects the cost of the last additional unit of abatement required to meet the emissions cap in the system. All else constant, the tighter the cap relative to BAU emissions the more abatement effort undertaken and the higher the carbon value required to incentivise that abatement.

Assumptions

147. Table 2 shows a summary of the key assumptions contained within the BEIS Carbon Pricing Model (BCPM). In the next few sections, we will cover the key assumptions in more detail.

Annex 1 Table 2. Summary of key UK BCPM input assumptions and sources

Input	UK CPM
Fundamental Assumptions	
BAU emissions	Enerdata POLES [49]model outputs adjusted to UK emissions projections from the UK's Energy and Emission projections and Dynamic Dispatch Model for the power sector.
MACCs	Enerdata POLES model outputs reviewed against UK Authority data for sectors. Also adjusted to reflect interconnector flows.
Cost of carry	This is the opportunity cost of holding allowances instead of using the capital for other uses. It has been set at 3.25% in scenarios following peer review. [32]
Behaviour Assumptions	
Hedging ratio	Around 140% of annual power sector BAU emissions. Hedging practices by individual operators are considered commercially sensitive and not generally made public. ICIS publishes assumptions on historic hedging activity by the UK power sector in the EU ETS.[1] According to these assumptions the UK power sector collectively hedges around three years in advance, according to the following pattern: ~80%

[49] Enerdata Prospective Outlook on Long-term Energy Systems (POLES). POLES analyses and project supply, trade & demand (simulation model), it covers energy commodities, energy prices, climate change impacts. Integrates energy policies and analyses their impacts on energy markets.

	hedged for year x+1, ~40% hedged for year x+2, ~20% hedged for year x+3. Together (years x+1 to x+3) this amounts to a total hedge of ~140%.
Hedging position accumulation	2 years; this assumes that the power sector would attempt to build new hedges in a UK ETS over several years, as there are not enough allowances issued annually to allow them to do it in one year. Two years was selected as this is the period of time in which we project there to be a large surplus of allowances, before the cap could be tightened
Foresight period	Four years; this assumption was developed for the UK BCPM and peer reviewed[50].
Policy Assumptions	
Cap	The cap sets the limit on the number of allowances that are created each year and injected into the market within the model.
Banking and borrowing	Assumed that banking and borrowing of allowances is allowed and there is no 'time-stamping' of allowances. Banking is the process by which allowances can be saved in a given year and used in a future year, while borrowing is the process of using future years' allowance to meet current year compliance.
Auction Reserve Price	The UK ETS has a reserve price under which allowances will not be auctioned into the market. The ARP in the model, limits the allowances supplied when the BCPM would result in an equilibrium value lower than the current ARP=£22.
Reserve Allowances	The UK ETS has proposed to have a pot of reserve allowances set aside for use by the UK ETS various market stability mechanisms such as the CCM and for potential 2026-2030 CSCF reserve. We assume that 100% of these allowances enter the market from 2024-2030.

Business as usual (BAU) emissions

148. BAU emissions aim to capture expected emissions in the absence of the carbon pricing policy that aims to limit them i.e., the UK ETS. The BAU emissions used in the UK BCPM are developed by external energy intelligence consultants Enerdata, using their Prospective Outlook on Long-term Energy Systems (POLES) model. The modelling assumptions used to determine these emissions projections are developed in collaboration with a cross-government steering group.

149. Emissions in the BAU scenarios are considered as a baseline and change over time with technological or behavioural change, and other current and committed future UK policies which also affect decarbonisation. BAU emissions are influential in modelling both the counterfactual and policy options: as BAU emissions set the baseline against which abatement required to meet the cap level is considered, the higher the BAU emissions the more effort is required to reduce emissions in line with the cap.

150. In the BCPM, low and high BAU emissions projections are used. This low-high range reflects uncertainty around the projections of future government decarbonisation policies. The assumptions underpinning this low-high range are given in table 2 below, however note that any considerable change, such as a recession (or economic boom) leading to much lower (or higher) than expected emissions could fall outside of this range.

Annex 1 Table 3. Drivers of the low and high policy BAU projections used in the UK BCPM

[50] https://www.gov.uk/government/publications/updated-short-term-traded-carbon-values-used-for-uk-policy-appraisal-2014

BAU scenario	Power sector assumptions	Policies
Low Policy Baseline (Higher BAU emissions)	Power sector mix of known policies	Known policies that have policy funding
High Policy Baseline (Lower BAU emissions)	Power sector mix of Net Zero Strategy High demand Power sector demand is deduced from application of policies	NZS full policy list [51]

151. Common assumptions across all BAU scenarios include the following:
    a. It is assumed there is no carbon price (equivalent to a carbon price of zero) in BAUs from 2021 onwards.
    b. The UK-specific BAU emissions projections used were calibrated to BEIS's 2019 [52]Energy and Emissions Projections (EEP) for 2020, 2030 and 2040 for the power, aviation and industrial sectors within scope of the UK ETS. 2019's projections were the most recent at the time of the modelling update.[2] Future BAU emissions levels (for other years and up to 2050) are the result of the calibration to the EEP scenario for those three years.

152. The EEP emissions projections that were used in the calibration of BAU emissions for the model reflect the best available evidence on future traded sector emissions. They assume a zero traded carbon value. The projections reflect how the UK energy and emissions system could evolve under implemented, adopted, and agreed UK Government policies if no new policies or changes to existing policies were introduced.[3]

153. Table 2 sets out the high-level policy assumptions that were made when creating out two BAU emissions scenarios. To create these scenarios, emissions savings by sector and year, were identified to associated government decarbonisation policies, and were then removed from the EEP 2019, to lower the BAU emissions.

154. On 30th March 2023 the Carbon Budget Delivery Plan was published which sets out the package of policies and proposals, and associated timescales and delivery risks, in order to meet Carbon Budgets 4-6. Our modelling baselines were created before this product was produced and published meaning it could not be used to base our analysis. The latest baseline sits just below the high policy scenario line during the Carbon Budget 4 period (meaning emissions are lower). We could therefore expect lower demand for allowances in each scenario, all else equal, resulting in a lower carbon value. For more information on UK emission projection please see the Carbon Budget Delivery Plan publication.[53]

Marginal abatement cost curves (MACCs)

155. Marginal Abatement Cost Curves (MACCs) aim to capture the quantity of abatement available at a given carbon value across sectors within scope of the UK ETS. The low and high MACCs used in the UK BCPM are also provided by Enerdata and developed using the POLES model and correspond to the low and high BAU emissions projections described above.

156. MACCs influence the results of carbon value modelling in both the counterfactual and scenarios as they provide the cost of delivering the required amount of abatement effort under each policy. For a

[51] https://www.gov.uk/government/publications/net-zero-strategy

[52] This was the most recent EEP projection at the time of the BAU production. Adjustments to emissions were made as discussed in paragraphs 151-154 to update for additional policy.

[53] https://www.gov.uk/government/publications/carbon-budget-delivery-plan

given level of abatement effort, the low and high MACCs result in different abatement opportunities available at the same price point and therefore lower or higher (respectively) carbon values.

157. In the POLES model, the MACCs are produced by exposing all sectors in the economy to a single carbon value in a given time horizon and comparing the emissions level that results to a scenario with no carbon value (i.e., the BAU scenario). Abatement potential is the result of the POLES model dynamic, which is sector-specific and centred on technology data (costs, equipment lifetime), prices (fuel prices, and price-based energy and climate policies outside of the carbon price) and modelling parameters (e.g., price elasticities in econometric-type equations in certain sectors).

158. For each BAU scenario, following the creation of the aggregated sectoral MACCs, mitigation options underlying the emission reductions are provided. These options are activity-related (e.g., decrease of electricity demand induced by higher prices) or technology-related (e.g., different competition environment for certain heating fuels, increased competitiveness for non-emitting technologies, increased stimuli for efficiency measures).

159. Technology costs come from the International Energy Agency's World Energy Outlook and the Université de Grenoble's TECHPOL database. New capacities are calculated depending on the competition between electricity generation technologies, in particular on their relative costs. MACC generation considers average power plants per technology type and incorporates a decommissioning process throughout time, at a regular rate over the lifetime of these average plants. Learning rates and research and development per technology are based on International Energy Agency and TECHPOL estimates.

Market behaviour

160. To go beyond a purely fundamentals-based approach, assumptions around market behaviour have also been included in the model to simulate market interactions when estimating the demand for allowances. In modelling the counterfactual and policy scenario in the IA, such assumptions include market foresight, hedging behaviour, cost of carry and banking and borrowing of traded allowances. These assumptions (summarised in table 1 above) are based on the current best understanding of existing market behaviour in the UK ETS.

Auction Reserve Price and Market Stability allowances

161. The UK ETS includes certain design features which exist to provide stability to the market. While many of these relate to auction rules and in-year price shocks which are not suitable for inclusion in the UK BCPM, the Auction Reserve Price (ARP) is covered. The ARP sets a minimum price at which allowances can be sold at auctions, and any unsold allowances as a result are either rolled forward into the next four auctions or placed in a reserve. The UK BCPM cannot simulate individual auctions; instead, it calculates the number of allowances which are assumed to be unsold, by comparing the target ARP to the corresponding carbon value in the MACCs. Using this, it determines the annual effort needed to achieve that value (in $MtCO_2e$ of abatement). This annual effort value is then used to calculate the annual supply need to achieve the ARP. Finally, the number of allowances is calculated and is annually adjusted to be equivalent to the annual supply needed to achieve the ARP. These allowances are assumed to go unsold and placed into the UK reserve.

162. As set out in table 1, each of the credible scenarios has been designed to have a number of reserve allowances remaining for use as either 2026 onwards CSCF mitigation[54], or to be used by current or future market stability mechanisms. CSCF is a process in which the total amount of required free allocation is greater than allowances in the industry cap, and no additional allowances are available. In this case a reduction in all free allocation would be applied. Some allowances are being set aside to try and prevent a CSCF being needed to be applied. In our modelling we assumed that possible 2026-30 CSCF mitigation use is 5% of the free allocation during this period. We assume these

allowances enter uniformly from 2026 to 2030. For the remaining allowances, we assume that 100% of these allowances are injected into the model through current or future market stability mechanisms. These allowances enter from 2024 to 2030 and enter proportionately to the auction allowance volume over this period.

Fundamental and Market Carbon Values

163. Our initial fundamental carbon values are produced as described above. These are the value of carbon needed to incentivise the marginal amount of abatement in order to meet the cap, under the presence of market behaviour assumptions as described. These values also assume the rational behaviour assumption holds true.

164. However, our modelling is not able to account for all behaviours and factors that affect the observed UKA market price. Therefore, to better capture these factors, we created two market carbon values series, to better proxy what the market price may be, for the purposes of determining the impacts of transfers. These market carbon values are:
    a. Foresight Market carbon values
    b. Permanent Premium carbon values

165. To create the foresight market carbon values, we compared the difference between the observed 2022 UKA price, and our modelled 2022 fundamental carbon values, to create an average market premium. We then assumed that this market premium would be fully in place in 2022, but would decrease over the period of firms' foresight, as the market becomes driven by pure fundamentals. Therefore, the relative weighting of the premium, decreases from 100% in 2022, to 0% by 2026, in line with our four-year market foresight assumption.

166. To create the permanent premium market carbon value, we use the same method to calculate the market premium. We add this market premium, to the fundamental carbon values and hold this market premium constant over the phase, with no decline in the weighting or the size of the premium.

167. In our analysis of transfers to government and the cost to business, we use both of these market carbon value series to capture the inherent uncertainty of market prices, and their impact on scheme participants and end users.

Limitations/Caveats

168. The emissions baseline is based on the Energy and Emissions Projections (EEP)[55] 2019 emissions, which have been updated for announced and proposed policies. There have been more recent EEP publications but given time constraints were unable to procure new baselines for this impact assessment.

169. As noted above, this analysis was developed in parallel with the Carbon Budgets Delivery Plan, and as such is unable to be updated to account for additional policies and proposals in this publication.

170. The Carbon values used in this analysis are based on market fundamentals and observed market behaviour. However, we are not able to account for all trading behaviour or within year dynamics.

[55] https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019

Annex 2: Sensitivities

171. There are three main sensitivities in the monetised analysis.

172. Counterfactual emissions – this is the same approach as the modelling annex sets out. Where there is a lot of supporting policy the level of emissions in the counterfactual is low. Hence the volume of *further* emissions reductions attributable to the ETS is smaller, benefits and costs are smaller, and marginal abatement costs (key driver carbon values) are lower. This is also our approach to additionality.

173. Value of Emissions – under the Green Book guidance, there is an intrinsic uncertainty over the value of GHG reductions to society. This (relatively wide) range means the value of our key monetized benefit is subject to uncertainty.

174. Costs of abatement – this also carries over from the modelling analysis annex. The modelled marginal abatement cost curves (MACCs) have an uncertainty range. This reflects factors like fossil fuel prices, macro-economic conditions, technology costs and availability, learning rates and other factors. In the CBA we take a scenario-based approach based on the underlying modelling. The high cost scenario assumes costs are, across the board, approximately 3 times higher than our central estimate. We felt this wide range of uncertainty was useful to reflect the scale of the transformational change required in the traded sector, as well as adequately showing the robustness of the VfM case to uncertainty over costs.

175. We considered low/high scenarios and unilateral sensitivities. The assumptions are summarised in table 1 below.

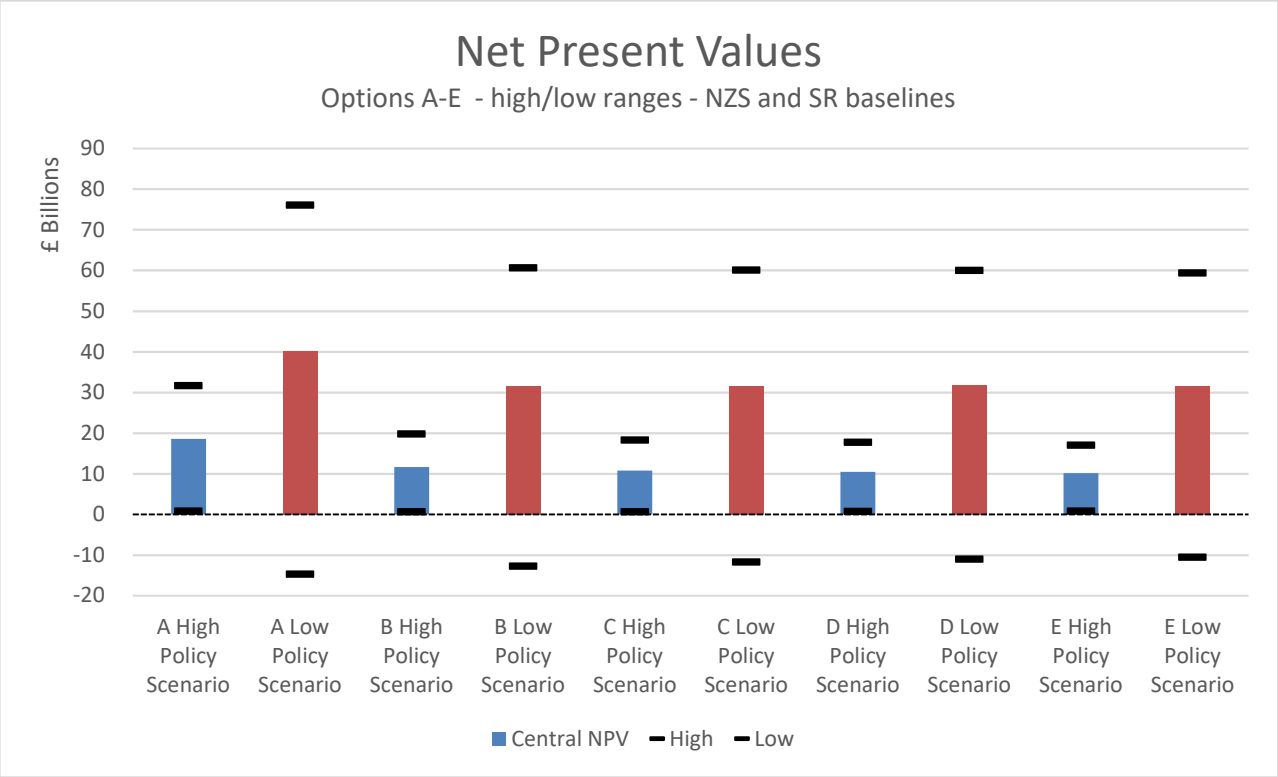
Annex 2 Table 1 – Sensitivities

Sensitivity	*Baseline*	*Value of Emissions*	*Costs*	*Cap options calculated for*
Central	**High Policy**	**Central**	**Central**	**All**
High	High Policy	High	Low	All
Low	High Policy	Low	High	All
Central	**Low Policy**	**Central**	**Central**	**All**
High	Low Policy	High	Low	All
Low	Low Policy	Low	High	All
Unilateral	High Policy	Central	High	Option E Only
Unilateral	High Policy	Central	Low	Option E Only
Unilateral	High Policy	High	Central	Option E Only
Unilateral	High Policy	Low	Central	Option E Only

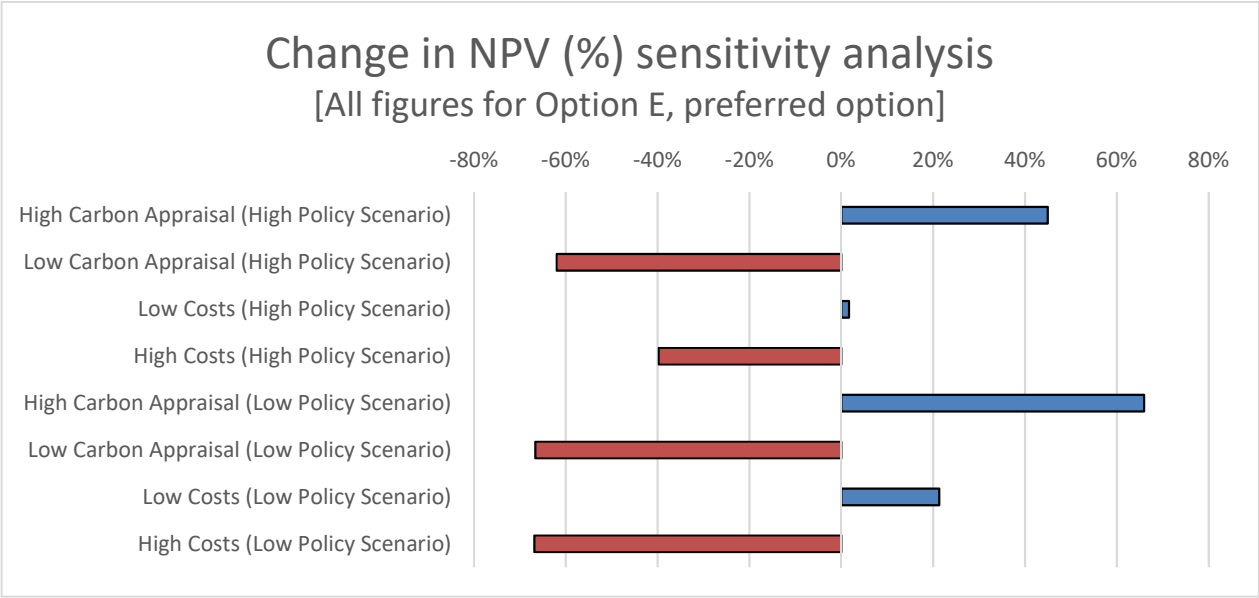
Unilateral	Low Policy		Central	High		Option E Only
Unilateral	Low Policy		Central	Low		Option E Only
Unilateral	Low Policy		High	Central		Option E Only
Unilateral	Low Policy		Low	Central		Option E Only

176. Unilateral sensitivities were also conducted. For high policy baseline, carbon appraisal affects the NPV more. The low policy baseline scenario is sensitive to both carbon appraisal and costs. This is a 'low policy' scenario with higher additionality which makes it more sensitive to inputs. Option E was used throughout as it is the preferred option. Though Option A would be numerically slightly distinct, we do not expect the overall conclusions would differ.

Annex 2 Figure 1 NPVs of shortlisted options including sensitivities



Annex 2 Figure 2 unilateral sensitivities of preferred option


Change in NPV (%) sensitivity analysis
[All figures for Option E, preferred option]
-80%
-60%
-40%
-20%
0%
20%
40%
60%
80%
High Carbon Appraisal (High Policy Scenario)
Low Carbon Appraisal (High Policy Scenario)
Low Costs (High Policy Scenario)
High Costs (High Policy Scenario)
High Carbon Appraisal (Low Policy Scenario)
Low Carbon Appraisal (Low Policy Scenario)
Low Costs (Low Policy Scenario)
High Costs (Low Policy Scenario)

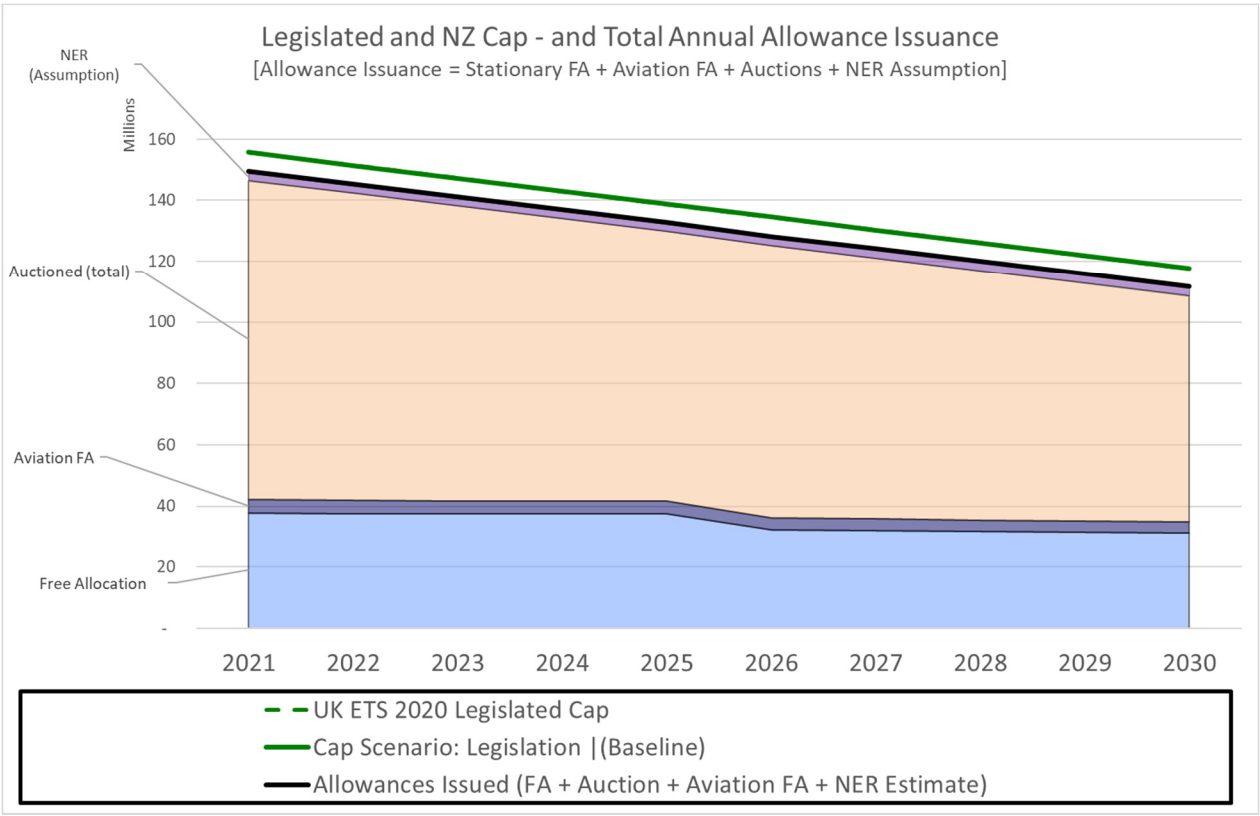
Annex 3: Cap Composition

177. All figures in this annex are included for **illustrative purposes only**, to clarify the likely differences between options. Final figures will be subject to confirmation by the UK ETS Authority and will be confirmed in due course.

Counterfactual

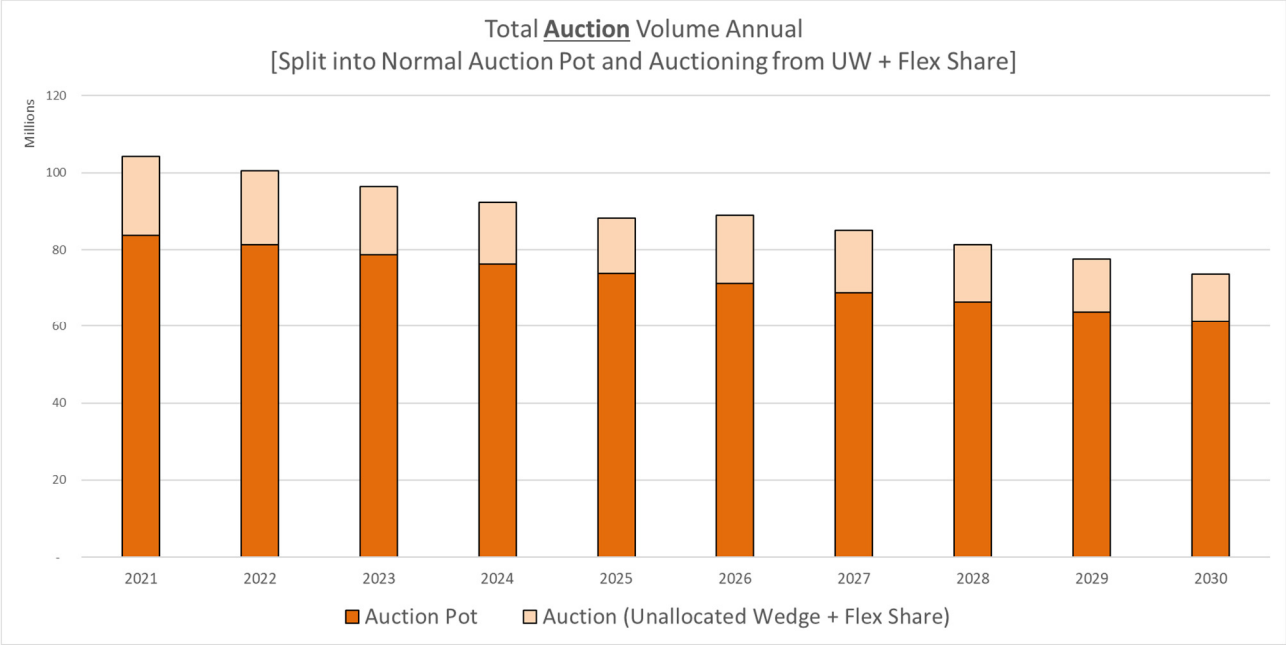
178. Figure 1 below shows the supply of allowances in the counterfactual.

Annex 3 Figure 1 – supply of allowances

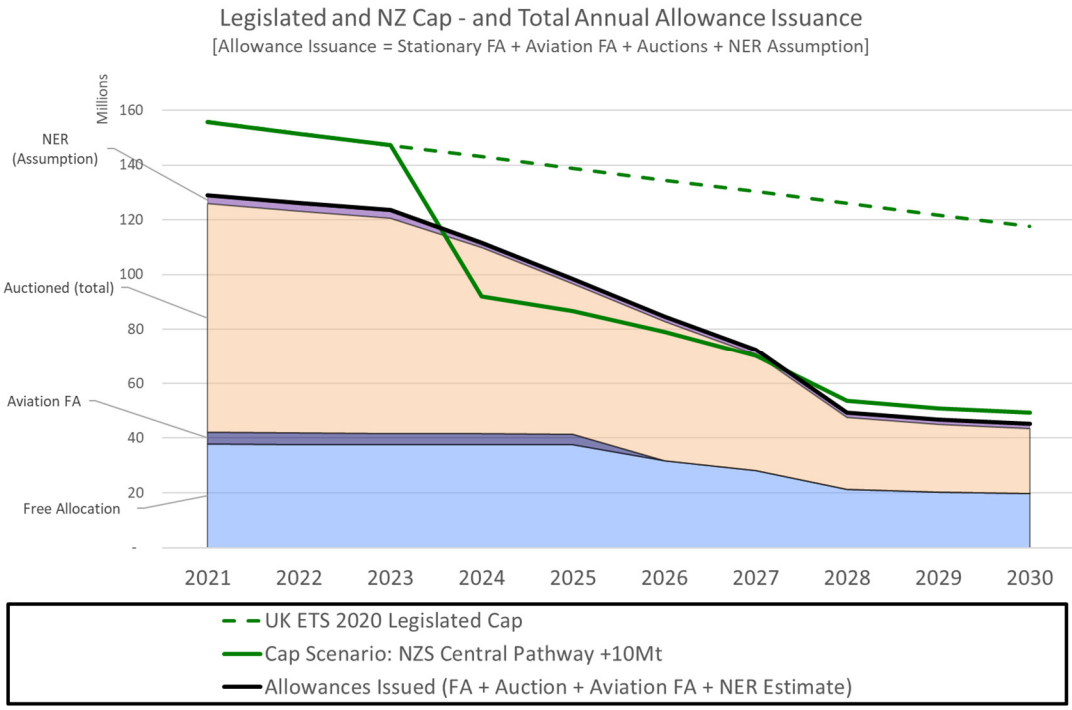


179. Figure 2 shows the expected auction supply (annual) in the counterfactual. As discussed in the assumptions we would not expect all of the legislated supply of allowances to be demanded in the counterfactual as emissions are expected to be substantively below the legislated cap. Figure 2 shows our assumption of auctioning the unallocated allowances within each year. This amounts to a relatively small increase in proposed auction volumes, and since auctions are not expected to clear, does not materially impact the conclusions of this IA.

Annex 3 Figure 2 Expected annual auction supply



Annex 3 Figure 3 Preferred Option allowance issuance

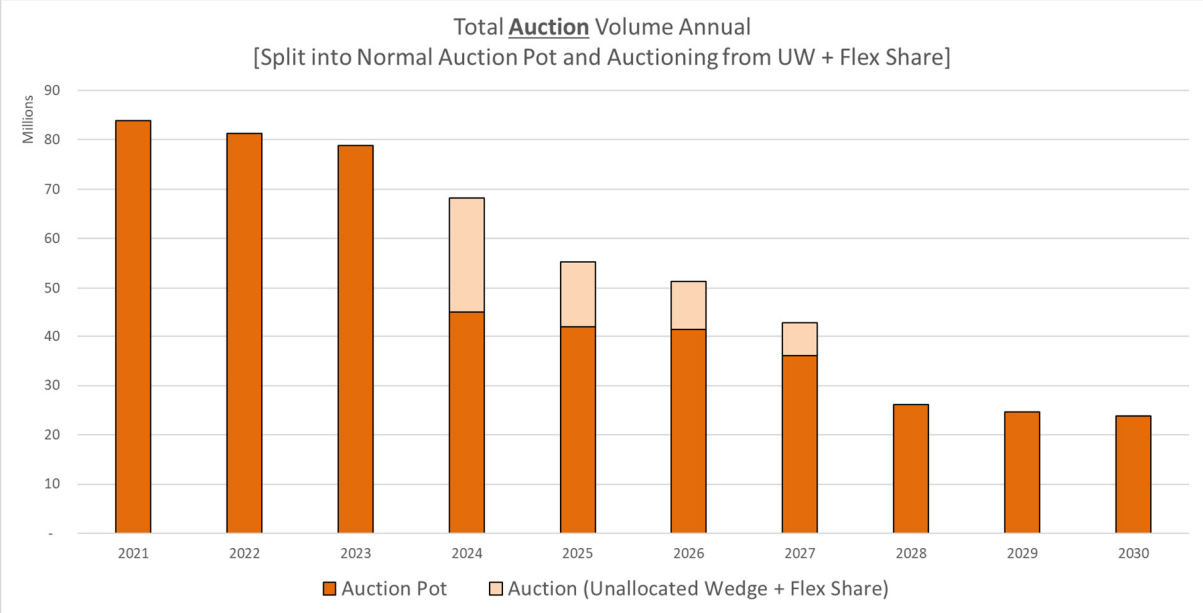


180. Figure 3 shows the supply for the preferred option.

181. We expect allowance supply to exceed the cap in the years 2024-2027, as allowances from the unallocated allowances are used to smooth the transition. By the end of the phase, we expect annual allowance issuance to be in line with the cap (small differences are driven by Hospital Small Emitters and Ultra Small Emitters HSE/USE adjustments, reserve pots and similar small mechanisms).

182. Figure 4 shows the auction volume in the preferred option.

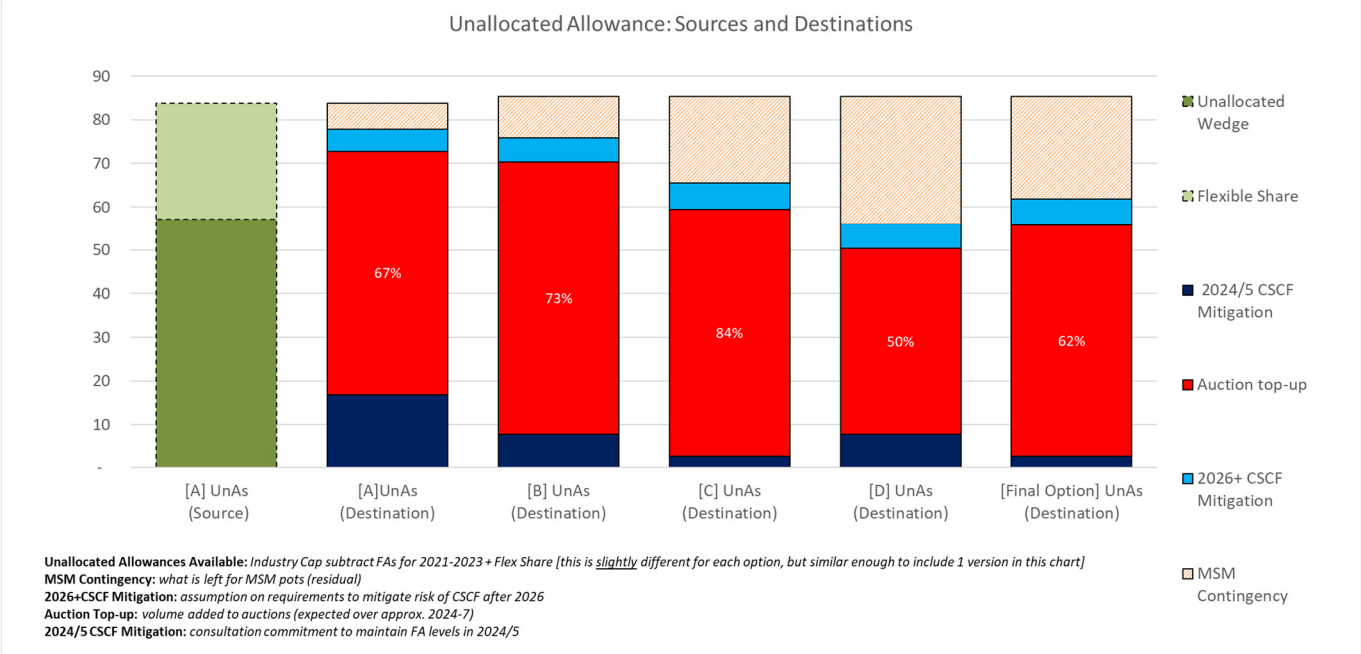
Annex 3 Figure 4 Preferred option annual auction volume



183. The total volume of unallocated allowances used to smooth the change in auction volumes is approximately 53 million allowances from 2024 to 2027. The timings over which they will be distributed are subject to review – the above is an illustrative profile of how they **could** be used.

184. Figure 5 and table 1 show the main differences between the shortlist options and the final option. Option E is a middle option when compared to the other shortlisted options.

Annex 3 Figure 5 Unallocated allowance distribution for shortlisted options



Annex 3 Table 1 Allowance distribution for shortlisted options

Option	*Average UKA supply over CB4 (Mt)*	*Total Auctioned over phase (Mt)*	*Contingency (Mt)*	*Supply Reduction 2023 vs 2024 (%)*	*FA Reduction 2025 vs 2026 (%)*

A	91.9	520	11	-12.8%	-34%
B	101.0	555	15	-4.3%	-22%
C	98.8	535	26	-8.5%	-16%
D	97.0	535	35	-11.4%	-22%
E	98.1	536	29	-9.8%	-16%

Annex 4: Aviation Free Allocation

Problem under consideration and rationale for intervention

What is Aviation Free Allocation?

185. Aviation free allocation (AFA) is a policy instrument that aims to mitigate carbon leakage and competitiveness risks associated with carbon leakage. Eligible aircraft operators receive a proportion of UK ETS allowances for free, which they can use towards their scheme obligations[56]. Currently, the methodology for calculating aviation free allocation mirrors that of the EU ETS as a temporary approach to ensure a smooth transition for aircraft operators from the EU ETS to the UK ETS.

186. The number of free allowances each aircraft operator may be entitled to is based on their activity levels in 2010 – measured in terms of tonne kilometre (TKM) unless it applied for a UK ETS free allocation entitlement as a beneficiary of the EU ETS special reserve. An aircraft operator's free allocation entitlement is calculated by multiplying the aviation benchmark by the verified 2010 aviation activity and by the reduction factor for the scheme year. The aviation benchmark is the same as for the EU ETS (approximately 0.64 per 1000 TKM), which was calculated by dividing the aviation cap by the sum of all the 2010 TKM reported on flights to and from the EEA. The reduction factor of 2.2% per annum for each year of the 2021-2025 allocation period is set out in UK ETS legislation and is in line with the current EU ETS aviation free allocation trajectory:

$$Aviation\ Free\ Allocation = benchmark \times 2010\ TKM\ data \times reduction\ factor$$

Free Allocation Review

The methodology for calculating aviation free allocation entitlement is independent to the allocation methodology for stationary installations, and as such, has been reviewed separately.

187. In the Authority Response to the Future of UK Carbon Pricing consultation[57], the UK ETS Authority committed to reviewing the UK's approach to free allocation in the UK ETS as the scheme evolves to ensure the policy is fit for purpose and supports the UK's climate objectives. Now that the UK ETS is fully established, the Authority reviewed aviation free-allocation policy to ensure that the scheme continues to develop in a way that supports our ambition for net zero by 2050 in the most cost-effective way.

188. The review[58] into aviation free allocation policy aimed to assess the suitability of the policy in mitigating against carbon leakage and competitiveness risks associated with carbon leakage and to determine any new objectives in the context of a UK ETS. The review launched in Spring 2021 with a call for evidence and the Developing the UK ETS consultation sought stakeholders' views on the future of AFAs.

189. The UK ETS Authority also sought evidence on how free allocation should be distributed amongst eligible aircraft operators in the UK ETS in an equitable and proportionate way, specifically in the context of the setting of a net zero consistent emissions cap. The review aimed to answer two fundamental questions:

a. Is there still an appropriate rationale for an aviation free allocation policy in the UK ETS?

b. How should the distribution and trajectory of aviation free allocation be calculated?

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[56] Under Phase III of the EU ETS (2013-2020), 82% of allowances in the aviation cap were allocated to airlines for free and 3% were held in special reserve to be allocated to new participants and fast growers. The UK ETS does not have a separate cap for aviation, however free allocation calculations for individual airlines operators mirrors the EU ETS calculations.

[57] https://www.gov.uk/government/consultations/the-future-of-uk-carbon-pricing

[58] https://www.gov.uk/government/consultations/uk-emissions-trading-scheme-free-allocation-review-call-for-evidence

Rationale and evidence to justify the level of analysis used in the IA (proportionality approach)

Summary of evidence

190. The UK Government's Department for Transport and the Department for Business, Energy and Industrial Strategy jointly commissioned an external economic research study to develop a robust evidence base on the extent to which potential aviation carbon pricing policies applied to UK departing flights could lead to carbon leakage and competitive disadvantage[59]. A summary of key findings most relevant to the decisions taken are below.

191. Twenty illustrative policy scenarios were assessed over the period 2021-2035, combining different UK ETS design characteristics, including variations on the UK ETS carbon price, Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and UK ETS interaction options, and free allocation trajectories and methodologies. Recognising that there are a wide range of CORSIA and UK ETS interaction options that might be taken forward, the study modelled three options from among those included in the Department for Transport's initial 2021 consultation[60]. This selection was made as a proportionate and representative means of illustrating the range of impacts that the wide variety of interaction options could have and is not a statement of government preferences or policy.

Risk of carbon leakage is minimal

192. The study found minimal risk of carbon leakage under the current scope of the UK ETS. Firstly, this is because CO2 emissions were projected overwhelmingly to decrease both inside and outside UK ETS scope when carbon pricing is applied to aviation. This is because the vast majority of passengers take round trips, and so a decrease in demand and emissions on flights in scope of the UK ETS is found to be matched by an equivalent decrease in demand and emissions outside its scope. The study found minimal impact on the number of passengers transferring through UK hub airports because the vast majority of UK international-to-international transfer flows are long-haul and are minimally impacted by the UK ETS. The study also qualitatively assessed a number of carbon leakage channels that were found to have an insignificant impact on carbon leakage, this includes: reassignment of high emissions aircraft towards/away from UK ETS routes; changes in fuel tankering; changes in destination choice; changes in spending on non-aviation activities.

193. Under all free allocation trajectories analysed in the study (ranging from the current trajectory to 2024 withdrawal), changes in free allocation had negligible impact on carbon leakage and did not affect airport competitiveness. For airline competitiveness, faster withdrawal of free allocation was associated with higher operating costs, although the study found annual changes were below maximum yearly change in operating cost per revenue tonne-kilometre seen during the 2007-08 or 2014-16 fuel price fluctuations. Where free allowances were phased-out, regional airlines were shown to be likely to experience proportionately higher changes in revenue tonne-kilometre costs per year than other airlines. Out of the characteristics examined, the UK ETS carbon price had the largest impact on outcomes.

Withdrawal of aviation free allocation does not influence marginal abatement decisions

194. The study explains that aviation free allocation has the effect of a lump-sum endowment to operators that does not vary with a change to capacity, effectively reducing fixed costs. The study found that a change in free allowances does not affect the direct margin of a given route and generally operators should continue to operate at the same capacity. Therefore, the level of free

[59] Economic research on the impacts of carbon pricing on the UK aviation sector (frontier-economics.com)

[60] https://www.gov.uk/government/consultations/implementing-the-carbon-offsetting-and-reduction-scheme-for-international-aviation/implementing-the-carbon-offsetting-and-reduction-scheme-for-international-aviation-corsia

allocation does not generally influence operators' marginal abatement decisions[61]. An exception to this finding occurs where a reduction in free allowances impacts upon profitability to the extent that an operator may choose to exit the market or scale back operations. Where routes continue to be commercially viable, other aircraft operators may be expected to increase supply, or 'backfill'[62]. However, there is a risk that in some instances, for example on some domestic routes where route profitability is marginal and routes are uncompetitive, the withdrawn capacity is not replaced leading to a sustained reduction in capacity or reduction in competition on a route. The full report of the economic study contains a detailed summary of the findings of the impacts of carbon pricing on the UK aviation sector[63].

Withdrawal of free allowances may in some cases lead to a sustained reduction in capacity

195. Further analysis was conducted by Department for Transport to understand the impact of withdrawal of aviation free allocation on aircraft operator finances and the risk of reduced overall profitability leading to a sustained reduction in capacity. For airlines serving primarily UK domestic and UK-European Economic Area routes, the value of aviation free allocation represents a material proportion of profitability, especially in a world following COVID restrictions where the majority of operators took on additional debt to cope with the loss of demand due to COVID.

196. Inherent uncertainty concerning aircraft operators' responses to withdrawal of aviation free allocation means that it has not been possible to quantitatively predict the risk of capacity reduction. However, the UK government's aviation commercial experts, based in DfT, have advised that there is sufficient evidence to suggest that withdrawal of aviation free allocation may introduce a potentially significant downside pressure on the finances of the UK domestic aviation sector, in particular to the extent that there is a risk of market exit or scaling back of operations that is not subsequently backfilled, and hence leads to a sustained reduction in capacity and the corresponding loss of connectivity, loss of jobs etc.

Reallocation of aviation free allocation amongst aircraft operators

197. The study also identified several potential benefits to updating the activity data from the 2010 TKM data currently used to distribute free allowances amongst aircraft operators in the UK ETS. Updating the activity year would bring the distribution of free allocation into closer alignment with activity levels in the sector. Regular updating of activity data would also allow free allowances to adjust to sector developments or shocks that impact capacity and help to avoid abrupt shifts in the level of free allocation relative to current sector activity.

198. Updating the activity year will inevitably lead to winners and losers relative to the current UK ETS design. Faster growing airlines and new entrants will benefit from an update, while slower growing airlines and incumbents may experience negative impacts on profitability and potentially capacity.

199. Regular updating would peg free allocation distribution to relative activity levels among airlines, so that positive and negative impacts on profitability to fast- and slow-growers would be repeated on an ongoing basis. This would reward capacity growth and may weaken the incentive to abate emissions via reductions in capacity by creating a link between free allowances and marginal costs. Any regular or anticipated one-off updating of the activity year should seek to avoid the possibility of distortive or 'gaming' behaviour among airlines; this could include choosing a baseline year before the announcement date or averaging together multiple years of activity to form a new baseline.

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[61] An operator's decision to invest in abatement opportunities is influenced by the direct cost and revenue associated with an additional unit of capacity. Higher carbon prices increase the price of burning fuel, which affects the cost of adding capacity, influencing marginal abatement decisions. The level of free allocation does not vary with capacity, and therefore does not influence marginal abatement decisions.

[62] The degree to which backfill will occur on a given route depends on a range of factors including the level of demand for services and level of existing competition on the route.

[63] Economic research on the impacts of carbon pricing on the UK aviation sector (frontier-economics.com)

200. The study observes that as the number of UK domestic flights has decreased relative to the number of UK international flights since 2010, updating the activity baseline year from its current baseline would redistribute free allocation toward airlines with relatively more international flights. Regional airlines' profitability is relatively sensitive to free allocation, compared with network and low-cost carrier profitability, as a larger share of regional airline capacity is within UK ETS scope. Updating the activity baseline year would also shift allocation toward low-cost carriers, who have on the whole gained UK market share over the last decade.

201. Negative impacts on regional airlines' capacity could have spillover effects for regional airports, domestic aviation, and domestic connectivity.

Description of options considered

Business as usual

202. We have assumed for the business-as-usual trajectory that the "current policy intent" would be to continue AFA policy beyond its legislated end date (of 2025) and the current trajectory would continue declining annually at 2.2% until the end of the appraisal period.

203. The appraisal period for AFA phase-out is 2024-2033; starting from the year in which the policy deviates from business as usual and covers the subsequent 10years, in line with Green Book guidance. Given that one of the short-listed options, was option 3A, to continue free allowances until 2031 we have an appraisal period that is different from that covered in section 1 of the impact assessment above,

Long-list options

204. As outlined in detail above (paragraphs 187-194) the study's key finding identified minimal carbon leakage risks and associated competitiveness risks under the current scope of the UK ETS for the aviation sector. The consultation[64] proposed to increase the rate at which AFAs are phased-out and proposed the following options:

1. Early phase-out: the rate at which free allocation entitlement reduces will increase so that full auctioning will apply from 2026 – option referenced as 1.
2. Intermediate phase-out: the rate at which free allocation entitlement reduces will increase so that full auctioning will apply no later than 2028 – option referenced at 2.
3. Later phase-out: The rate at which free allocation entitlement reduces will increase so that full auctioning will apply from the start of 2031 – option referenced as 3.

205. The majority of consultation respondents who indicated a preference on the distribution of free allocation during the phase-out supported a weighted approach with smaller annual reductions to free allocation entitlement in the immediate years and faster reductions in later years i.e., profiles that have greater total AFAs over a given period. As such, the UK ETS Authority developed the following 4 sub-options applied to the phase-out dates outlined above:

a) Linear: AFA entitlement decreases by a constant amount every year – option referenced as A.

b) Smooth backloaded – AFA entitlement decreases by an exponentially increasing amount – option referenced as B.

[64] https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets

c) Sharp backloaded: half of the original AFA entitlement is phased-out linearly, the remaining half is phased-out in the final year – option referenced as C.

d) Sharp backload 2: AFA entitlement follows do business as usual trajectory (aviation free allocation annual reduction rate of 2.2%) until all the remaining AFA is removed in the final year – option referenced as D.

206. This resulted in giving 12 phase-out trajectories in total for consideration, 1A through to 3D. E.g., Option 2A refers to a Linear aviation free allocation phase out trajectory, so that AFA phases out by 2028.

207. The majority of the 12 trajectory options would result in a faster decline of an aircraft operator's free allocation entitlement compared to the current year-on-year reduction set out in UK law; apart from sharp backloaded 2 (option referenced as D) that would follow a business-as-usual trajectory. Given the impacts of COVID-19 on the aviation sector and expected increase in costs associated with the phase-out of free allocation, the UK ETS Authority sought views on whether a linear year-on-year reduction would be preferable in the above scenarios, or whether alternative options should be considered. For example, a weighted approach could see smaller annual reductions to free allocation entitlement in the immediate years and greater reductions in later years.

Assessment of options

208. Consideration has been given to the 12 phase-out trajectories, these comprised of four trajectories (see above descriptions A to D) for each phase-out year 2026, 2028 and 2031 (referenced as 1, 2 and 3, again see above). A multi-criteria type approach was applied to each trajectory using the assessment criteria (see below) to inform a preferred option. The UK ETS Authority agreed on a shortlist of 6 options shown in figure 1 below.

Criteria against which trajectories were assessed:

209. Cost: faster withdrawal of free allocation will increase the proportion of UK ETS allowances purchased via auction or secondary markets, increasing UK ETS compliance costs for aircraft operators. Costs of phasing-out were found to be relatively higher under a linear 2026 phase-out (option 1A) and relatively smaller under a later 2031 phase-out (option 3A) compared to other options. For each phase-out year, backloading removal of allowances moderately reduces the cost impacts to aircraft operators as more allowances are received in the initial years of phase-out. These costs are a direct transfer from airline operators to government and therefore are excluded from the overall estimate of Net Present Social Value.

210. Revenue: Assuming phased-out free allocations are added to the UK ETS auction pot, earlier phase-out dates will mean a greater transfer from aircraft operators to HMG in the form of additional UK Allowance purchases by the sector. The most backload options (1D, 2D, 3D) reduces revenue to HMG compared to a linear trajectory. In effect the costs and revenue streams will balance out as the change is simply a transfer from either HMG to the sector or vice versa.

211. UK ETS design and Objectives: Given the minimal risk of carbon leakage for the sector under current UK ETS scope and the purpose of FA to mitigate this risk, earlier phase-out aligns AFA most closely with wider UK ETS objectives whereas later phase out could risk undermining the intended purpose of free allowances by continuing to allocate FAs to a sector with minimal risk of carbon leakage.

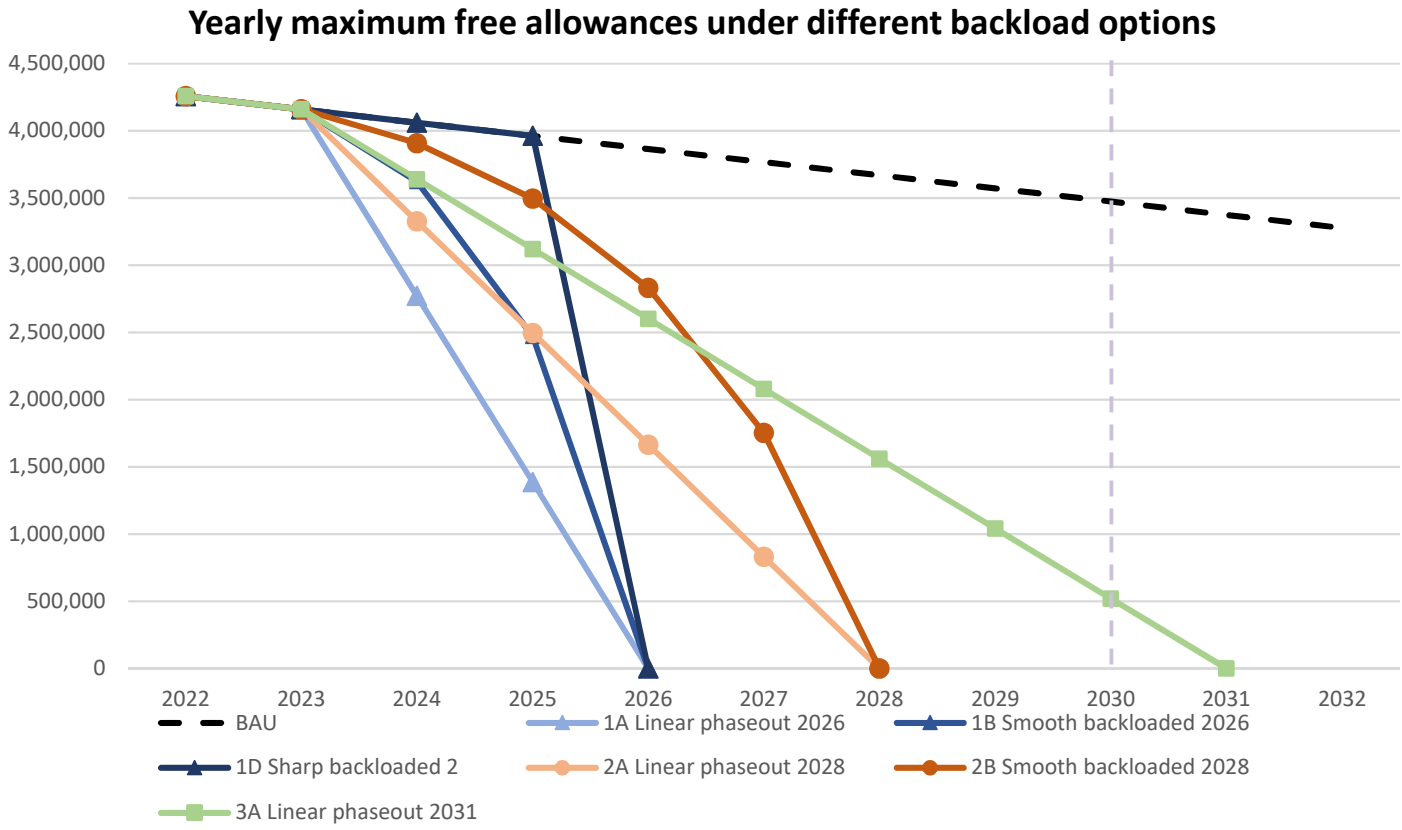
212. Impact on competition and market distortion: The existing AFA methodology introduces a competitive distortion in the market by allocating AFA to some airlines (based on 2010 activity data) compared to their rivals or new entrants who are not eligible. The earlier the phase-out, the earlier this competitive distortion is removed. In addition, the EU has committed to removing AFAs by 2026 and UK ETS alignment may remove limited instances of competitive disadvantage between aircraft operators more or less exposed to UK ETS and EU ETS AFA phase out, respectively.

213. Commercial viability and air connectivity: Earlier phase-out of AFA may introduce a significant downside pressure on underlying profitability for regional aircraft operators, posing a risk to domestic air connectivity (see paragraph 195-196). Later or backloaded phase-out options would allow the

sector more time to recover and reduce the risk that operators will scale back operations or exit the market, possibly leading to a loss of vital air connectivity where routes are not backfilled.

214. Operational delivery: All phase out options apart from the trajectory currently in legislation whereby AFA's are not provided for beyond 2025 (option 1D) will require some action by Government/Regulators to either extend aviation free allowance policy and/or to adjust the reduction factor. This is because aviation free allowances are legislated until 2025 only and without any amendments to legislation would follow the 1D trajectory.

Figure 1: Six shortlisted trajectories compared to the business-as-usual option (the vertical dashed line at 2030 indicates that figures past this point are hypothetical; the ETS is not currently legislated past 2030)



215. The following options were removed after assessment against the criteria:

a) Sharp back-loaded (options C) across all trajectories: options B (smooth backloaded) and C (sharp backloaded) scored similarly across all trajectories. While they provided for optionality, there was limited benefit in taking both options forward. As option B provides a smoother transition to full phase-out of AFAs and also maintains higher levels of AFAs to support industry compared to option C, all C sub-options were removed.

b) Sharp backloaded 2 (option 2D and 3D): under sub-options D, free allocation entitlements follow business as usual trajectory (2.2% annual reduction) with the remaining AFA removed in the final year. Maintaining AFAs at the business-as-usual level until 2028 or 2031 where minimal carbon leakage risks have been identified could be seen as not meeting the objective of AFA policy and were discounted; whereas option 1D (2026 phase-out) provides useful optionality being operationally simple as this is the current legislated trajectory and scored similarly across the assessment criteria compared to option 2A (2028 phase-out).

c) Smooth backloaded (option 3B): option 3A (linear) performed better in the assessment than the backloaded options for the 2031 phase-out. Backloading options were developed

primarily to mitigate the impact of AFA removal in the years following COVID and by phasing out AFAs later in 2031 there is less rationale for back-loaded options as we expect the industry to have recovered[65].

Preferred option:

216. Following assessment of all short-listed options phase-out trajectory 1D is the selected preferred option. Under this option the aviation free allocation annual reduction rate will follow business as usual trajectory, a 2.2% annual reduction, until the remaining AFA is removed in 2026. This will result in the sector being subject to full auctioning from 2026. Aviation free allocation will continue to be distributed to currently eligible operators based on 2010 TKM data for the duration of the phase-out period.

217. Option 1D has been selected due to its alignment with policy objectives and operational deliverability. Given the minimal risk of carbon leakage for the aviation sector under the current scope of the UK ETS, phasing-out AFA by 2026 will support the objectives of UK ETS. In addition, the sharp-backloaded trajectory will help to mitigate the impacts of the expected increase in costs associated with the withdrawal of free allocation as the sector recovers from COVID-19 by giving Aircraft Operators two years to prepare for withdrawal of AFA. As option 1D is the currently legislated for trajectory, it is the most operationally simple to deliver.

Distribution of aviation free allocation

218. The current distribution of aviation free allowances amongst participants in the UK ETS does not reflect current activity levels; as AFA entitlement is based on 2010 activity data. As such, the consultation[66] gave consideration as to how to address this issue through changes to the free allocation methodology to ensure distribution was equitable and proportionate across Aircraft Operators for the duration of the policy.

219. The study explored different design options for aviation free allocation policy, assessing their merits and disadvantages; a summary of findings is outlined above in paragraphs 194-201 and further detail can be found in the study[67].

220. Consideration was given to whether updating the methodology for all phase-out dates, 2026, 2028 and 2031 was appropriate and proportionate. Given current UK ETS data submitted by Aircraft Operators were deemed not appropriate,[68] a new TKM exercise would have to be undertaken by all Aircraft Operators who wanted to receive AFA. This would also introduce uncertainty by making potentially large changes to Aircraft Operators' free allocation, which would create winners and losers).The UK ETS Authority agreed that only with a later phase-out date of 2031 would the methodology be updated to give enough time for a new data collection exercise to be carried out and for the change to be implemented for a more substantial period of time before AFA is fully phased-out. For earlier phase-out dates the burden of data collection and the uncertainty introduced by making

[65] DfT analysis of CAA airports data undertaken for the DfT Jet Zero Strategy suggests that market demand will return to pre-covid levels by 2030. A month-to-month comparison of UK airport data suggests PAX demand in December 2022 was 83% of December 2019 levels.

[66] https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets

[67] Economic research on the impacts of carbon pricing on the UK aviation sector (frontier-economics.com)

[68] The study found that using emissions as an activity unit would punish early action, reward carbon intensive airlines, and reduce abatement incentives. This design option would therefore not meet the objectives of the UK ETS.

potentially large changes to AFA and therefore operating costs were deemed disproportionate given the length of the phase-out.

221. Currently some Aircraft Operators receive more free allowances than their total verified emissions, which is inconsistent with the objective of free allocation to mitigate carbon leakage risk and introduces a competitive distortion. The UK ETS Authority agreed that if an earlier phase out date of 2026 or 2028 was selected and an update to the distribution of AFAs was not implemented, a cap would be placed on the total amount of allowances Aircraft Operators are eligible to receive which would be equal to emissions reported i.e., free allowances could not be received in volumes greater than an airline's verified emissions[69].

222. As the selected option 1D delivers on competition objectives, by removing the competitive distortion between Aircraft Operators introduced by the current methodology (based on historical activity data) earlier than under the later phase-out options; the UK ETS Authority have agreed it would be disproportionate to change the FA methodology to remove competitive distortions in the interim.

Policy objective

223. The objectives of the intervention are as follows:

a. To align the aviation free allocation methodology with the approach to free allocation across the UK ETS, i.e., the level of free allocation is consistent with the goal of mitigating risk of carbon leakage.

b. To ensure consistency with wider UK ETS objectives of incentivising emission reductions and upholding the 'polluter pays' principle whilst mitigating carbon leakage and competitiveness risks.

c. To improve the scheme's approach to carbon leakage mitigations

d. To minimise competitive distortions within the aviation sector, and between the aviation sector and its rivals.

e. To better distribute allowances between scheme participants in a proportionate and equitable way

f. To reduce administrative burden where possible for aircraft operators, regulators and the UK ETS Authority.

224. As a result of the decision to not extend AFA policy beyond the trajectory set out in legislation, aircraft operators will receive their existing entitlement for the 2024 and 2025 scheme years as set out in the aviation allocation table whereby the AFA entitlement will reduce at a 2.2% annual reduction until a full phase-out in 2026, subject to the cap referred to above. From 2026, Aircraft Operators will have to purchase allowances for all of their reported emissions.

Summary and preferred option with description of implementation plan

225. The preferred policy option represents what is currently legislated, and no further amendments will be required. AFA will continue to reduce at an annual rate of 2.2% until current legislation ends in 2025, after which AFA will cease to exist and no further legislation will be required.

226. The cap on the total AFA aircraft operators are eligible to receive will be implemented via secondary legislation through a statutory instrument and will apply from 1 January 2024.

[69] An issue especially acutely during COVID period

Monetised and non-monetised costs and benefits of each option (including administrative burden)

227. Monetised costs

228. Loss of free allocation to aircraft operators is a direct transfer from aircraft operators to Government because after the phase-out of free allowances operators must purchase allowances to cover all emissions rather than having some allowances allocated for free. Assuming that free allowances are then returned to the auction pot[70] (or used as part of the market support mechanism) this, all things being equal, should result in a non-material impact on the UK allowance price; the reason being that the total supply of allowances from phasing-out aviation free allowances would remain the same as the allowances in circulation.

229. Table 1 outlines the volume of AFA's and the cost to industry for each of the six short-listed options and the counterfactual.

230. Earlier phase-out options that are faster in the withdrawal of AFAs would lead to greater loss of revenue to aircraft operators compared to the counterfactual and could pose significantly greater costs to the industry. However as outlined above (see paragraph 194) we would not generally expect operators to reduce capacity as a result of AFA removal. However, as flagged in paragraphs 195-196, where the removal of AFA significantly affects a carrier's profitability, there could be an implication for those carriers' capacity decisions.

Annex 4 Table 1: Yearly phase-out trajectory for short-listed options compared to business as usual (BAU) [ranges presented low to high, to the closest £10m] [71]

Option	Unit	2024	2025	2026	2027	2028	2029	2030	2031	2032	3033
1A	**Volume of allowances (millions)**	2.8	1.4	0	0	0	0	0	0	0	0
	Cost to aircraft operators compared to BAU(£millions)	70-190	150-380	220-570	210-550	210-540	200-520	200-510	190-490	190-480	180-470
1B	**Volume of allowances (millions)**	3.6	2.5	0	0	0	0	0	0	0	0
	Cost to aircraft operators compared to BAU(£millions)	30-60	90-220	220-570	210-550	210-540	200-520	200-510	190-490	190-480	180-470
1D	**Volume of allowances (millions)**	4.1	4	0	0	0	0	0	0	0	0
	Cost to aircraft operators compared to BAU(£millions)	0	0	220-570	210-550	210-540	200-520	200-510	190-490	190-480	180-470

[70] Applies to years prior to 2026 after which aviation free allocations are not legislated for and therefore would not be returned to the auction pot but the conclusion would remain for years after 2026 that there would be no material impact on the UK allowance price from the phase-out

2A	**Volume of allowances (millions)**	3.3	2.5	1.7	0.8	0	0	0	0	0	0
	Cost to aircraft operators compared to BAU(£millions)	40-110	80-220	130-320	170-430	210-540	200-520	200-510	190-490	190-480	180-470
2B	**Volume of allowances (millions)**	3.9	3.5	2.8	1.8	0	0	0	0	0	0
	Cost to aircraft operators compared to BAU(£millions)	10-20	30-70	60-150	110-300	210-540	200-520	200-510	190-490	190-480	180-470
3A	**Volume of allowances (millions)**	3.6	3.1	2.6	2.1	1.6	1	0.5	0	0	0
	Cost to aircraft operators compared to BAU(£millions)	20-60	50-120	70-190	100-250	120-310	140-370	170-430	190-490	190-480	180-470

231. Carbon price assumptions used here are consistent with those used throughout this impact assessment and further detail can be found in section 1, paragraph 43. Carbon price assumptions used to calculate the cost to aircraft operators have been averaged over the period 2024-2030.

232. Phase-out option 1D would mean that there would be a business-as-usual reduction in allowances in 2024 and 2025 to allow for a smoother transition by operators (relative to a linear option). This provides time for the industry to prepare for the removal of FA in 2026. Under the preferred option (1D), aircraft operators would not incur additional annual costs, relative to the Do-Nothing scenario, in 2024 and 2025. However, they would incur additional costs of £220m-570m in 2026, and a total of between £1,610m and £4,130m over the ten-year appraisal period; see table 1 for estimated phase-out volumes and costs to operators.

233. Monetised benefits

234. Phase-out of AFA means there is a direct transfer from aircraft operators to HMG as operators would be required to purchase UK allowances to cover all in scope emissions. As these costs represent a transfer from operators to Government, Table 1 on costs to operators also represents the expected Government revenue from the options. i.e., expected revenues for the preferred option (1D), above the Do-Nothing and between £1,610m and £4,130m over the ten-year appraisal period.

235. Unmonetised costs

236. Risk of sustained reduction in capacity: faster phase-out of AFAs would adversely affect the profitability of some operators and could potentially lead to market exit or scaling back of operations that is not replaced, resulting in loss of capacity. This risk is more pronounced for those airlines for whom the value of the free allowances they receive represents a relative large share of their overall profitability. With perfect information we could measure the routes lost, the demand for these journeys and estimate the welfare loss. However, we do not have a) data at such a granular level on route demand over time, b) foresight of the response of individual airlines to loss of AFA. Decision-making is likely to be complex and sensitive to many factors in addition to the profitability of individual routes.

237. Unmonetised benefits

238. Removal of competitive distortions: current AFA distribution is based on 2010 activity data and means some operators are receiving a lump sum of endowments disproportionate to their share of aviation activity. New entrants and fast growers are currently at a competitive disadvantage with their rivals who receive considerably greater share of AFA. Both the withdrawal of AFA and capping of AFA to no more than the level of Aircraft Operator's verified emissions will remove competitive distortions and contribute to a better functioning market.

Risks and assumptions

239. The study, key findings have formed the basis for the evidence presented and more detail can be found in the full report.

240. Table 2 below contains the assumption log from which conclusions in this impact assessment were formed.

Annex 4 Table 2: Assumptions log

Assumption No.	Assumption summary	Evidence	Impact rating (5 = high, 1 = low)	Confidence rating (5 = high, 1 = low)	Sensitivity analysis (where applicable)
1	Minimal risk of carbon leakage from aviation's participation in UK ETS	Economic research on the impacts of carbon pricing on the UK aviation sector (frontier-economics.com)	5	5	N/A
2	Aviation FA functions as a lump sum endowment and does not influence marginal abatement incentives	Economic research on the impacts of carbon pricing on the UK aviation sector (frontier-economics.com)	5	4	N/A
3	Withdrawal of free allowances may in some cases lead to a sustained reduction in capacity	Economic research on the impacts of carbon pricing on the UK aviation sector (frontier-economics.com) Supplemented by Department for Transport analysis of commercial data	1	2	N/A
4	Value of AFA to aviation sector calculated using BEIS projected carbon prices	See annex 1 for details on how carbon values were applied	4	3	High and low projections applied to reflect uncertainty in future carbon projections.

Impact on small and micro businesses

241. It is estimated that there were 125 micro businesses (1-9 employees) and 65 small businesses (10-49 employees) in the passenger air transport sector in the UK; and 180 micro businesses and 10 small businesses in the freight air transport and space transport sector in the UK at the start of 2022.[1] Of these small and micro businesses, less than 5 are currently recipients of free allocation.[2] The majority of SMBs are exempt from the UK ETS due to the nature of their operations. Therefore, there would not be a disproportionate impact on small and micro businesses (SMBs) from free allocation withdrawal. There are not thought to be any substantial indirect costs to other small or micro businesses. Overall, we do not expect there to be a large or disproportionate impact on small and micro businesses from free allocation withdrawal, given the small number of these businesses currently in receipt of AFA.

Wider impacts

242. Impact on consumers: withdrawing free allocation is expected to have minimal impacts on final consumers. The level of free allocation does not affect the marginal abatement incentive as they are viewed as a fixed cost. As such, the opportunity cost of using those allowances, rather than selling them back to the market, is already considered by Aircraft Operators when making their capacity decisions. As such, the existence of allowances should already be priced into ticket prices, and therefore our analysis does not indicate that withdrawing AFA should translate into higher ticket prices for final consumers[3]. However, if the withdrawal of AFA were to result in some airlines removing capacity, this would affect consumers due to less connectivity, which, in the case of certain routes, where backfill is less likely, could be sustained. While the evidence suggests that withdrawing AFA is unlikely to cause low-cost or package carriers to scale back operations in the event this did occur, there could be a reduction in competition at the margins that would indirectly increase airfares on certain routes.

243. Impact on regional airports: we expect that the withdrawal of free allocation may lead to small impacts on regional airports except where an Aircraft Operator leaves a market and there is a subsequent sustained reduction in capacity, there may be knock on impacts on small regional airports, particularly if they are reliant on one carrier or limited routes. The loss of a such a carrier would lead to a sustained loss of revenue for these airports and may lead to reduced employment and even airport closure. There could also be a further knock-on impact of regional airport closure on any businesses that draw custom from these airports.

A summary of the potential trade implications of measure

244. We do not expect there to be any impact on international trade and investment as a result of the phasing out of AFAs or capping the AFAs to no more than the level of Aircraft Operator's verified emissions.

Monitoring and Evaluation

245. Aviation will be included in the wider scheme M&E that is detailed in section 1 above, from paragraph 126.

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[1] The Department for Business, Innovation & Skills (2016) Business population estimates 2022 Business population estimates 2022 - GOV.UK (www.gov.uk)

[2] UK ETS Aviation Allocation Table - GOV.UK (www.gov.uk)

[3] This is assuming the market is in equilibrium and is perfectly competitive. More detail on the assumptions are available in the aforementioned report.

Annex 5: Technical Changes

246. These sections set out the analysis prepared to support decisions from Chapter 2 of the Authority Response. Only those changes with sufficiently large impacts are covered. In all cases decisions were made using the best available evidence, including consultation responses; though these annexes only cover additional analysis prepared to support the decision. Consultation responses are discussed in the AR text. In all sections, when referring to the data used, the term "UK ETS NIMS", refers to the data associated with the 2021 UK ETS FA Issuance process, as applied under the UK ETS legislation.

Annex [5.1]– Chapter 2, Proposal 5: Amending the electricity generator definition to only consider electricity exports in the baseline period.

Analytical Approach

247. The analysis discussed in this annex is not the final assessment of eligibility or amendments to installation allocations; these are expected to be carried out as part of the UK ETS NIMS process for the 2026-2030 allocation period.

248. This annex summarises the analysis and evidence used to inform the decisions covered in Chapter 2's Free allocation review - technical changes of the Authority Response.

249. Analysis was undertaken to: 1) support the decision on whether to intervene, and 2) develop additional detail to inform decisions on the design, methodology and data used in the policy intervention (e.g. the threshold). The threshold is a value comparing the installation's exported electricity and generated electricity. This is used to define "minimal" electricity exports.

250. Analysis used electricity export data submitted to Regulators as part of the UK ETS NIMS process for the 2021-2025 allocation period, as well electricity export data submitted as part of the 2022 Activity Level Changes (ALC) process. It used this data to estimate the number of installations that put a stop to their electricity exports since 2018. The analysis also estimated the number of installations that were currently classified as electricity generators and could be in scope of the policy change at different threshold levels of minimal electricity exports. The analysis also sought to understand the potential impact on their free allowances should the proposal be implemented in the current allocation period.

Summary of key impacts

251. The analysis indicated that only a very small number of installations had put a stop to their electricity exports. Through discussion with Regulators, it was understood that this was due to the decommissioning of CHP plants.

252. The analysis indicated that only a small number of sites currently classified as electricity generators could be deemed to be exporting "minimal" amounts of electricity. If these sites were no longer classified as electricity generators, the impact on free allowances distributed in the scheme would be minor.

253. The policy change will be in force for the next allocation period, and from 2026-2030 the stationary free allocation system will be revised as part of the Free Allocation Review. If the revised FA rules mean the industry cap "binds[4]", then this would effectively be redistributing free allowances between eligible sites, rather than between government/sites. We therefore do not expect there to be any significant impact on the carbon price or carbon leakage risk.

[4] This would mean that the industry cap sets the limit on the number of Free Allocation. This is in contrast to the current situation where the Industry cap is greater than the total yearly free allocation that is allocated.

254. The analysis informed the decision on the threshold value primarily by taking into account the number of sites that would be in scope at different threshold values. This evidence was used alongside evidence from the consultation responses and consideration of existing FA rules.

Limitations/Caveats

255. The analysis used in this section assessed data collected during the UK ETS NIMS and 2022 ALC process. This provided recent information on electricity exports. This did not include the complete information that will be used in the UK ETS NIMS process for the 2026-2030 allocation period, the period in which the policy change will be in force.

Annex [5.2] – Chapter 2, Proposal 6: Combined Heat and Power (CHP) plants and electricity generator definition

Analytical approach

256. The analysis discussed in this annex is not the final assessment of eligibility or amendments to installation allocations; these are expected to be carried out as part of the UK ETS NIMS process for the 2026-2030 allocation period.

257. This annex summarises the analysis and evidence used to inform the decisions covered in Chapter 2's Free allocation review - technical changes of the Authority Response. Analysis was undertaken to support the decision on whether to intervene.

258. The analysis used data submitted to Regulators as part of the UK ETS NIMS process, as well as site information provided as part of the CHPQA[5] scheme. This was used to identify installations that could be in scope of this policy change, and to understand the potential impact on their free allowances should the proposal be implemented in the current allocation period.

Summary of key impacts

259. The analysis indicated that only a relatively small number of installations would be in scope of this policy change. These are industrial operators with CHPQA-certified CHPs and are classified as electricity generators.

260. The policy change will be in force for the next allocation period, and from 2026-2030 the stationary free allocation system will be revised as part of the Free Allocation Review. If the revised FA rules mean the industry cap "binds", then this would effectively be redistributing free allowances between eligible sites, rather than between government/sites. We therefore do not expect there to be any significant impact on the carbon price or carbon leakage risk.

261. The analysis informed the decision on whether to effect a change to the electricity generator classification alongside evidence from the consultation responses and consideration of existing FA rules.

Limitations/Caveats

262. The analysis used in this section assessed data collected during the UK ETS NIMS process as well as data relating to the 2022 CHPQA certification process. The analysis does not consider installations that are not yet CHPQA-certified but may achieve certification prior to the next allocation period. It is therefore possible that additional installations could be in scope of the change beyond that which was captured by the analysis.

Annex [5.3] – Chapter 2 Proposal: Electricity Generators

Analytical approach

[5] Combined Heat and Power Quality Assurance Programme - https://www.gov.uk/guidance/combined-heat-power-quality-assurance-programme https://www.gov.uk/guidance/combined-heat-power-quality-assurance-programme

263. The analysis discussed in this annex is not the final assessment of eligibility or amendments to installation allocations; these are expected to be carried out as part of subsequent ALC processes.

264. This annex summarises the analysis and evidence used to inform the decisions covered in Chapter 2's Free allocation review - technical changes of the Authority Response. Analysis was undertaken to support the decision on whether to intervene.

265. The analysis used data submitted to Regulators as part of the UK ETS NIMS process. This was used to identify installations that could be in scope of this policy change, i.e., to understand the number of installations classified as electricity generators that had their FA application rejected on the basis they did not demonstrate high-efficiency cogeneration and to understand the number of free allowances they may have been eligible for in the current allocation period if they had demonstrated this.

Summary of key impacts

266. The analysis indicated that only a very small number of installations could be in scope of this policy change. Few installations classified as electricity generators had their FA applications rejected on the basis that they could not demonstrate that they produced measurable heat by means of high-efficiency cogeneration in the baseline period.

267. Given the relatively low estimated volume of additional allowances issued (compared to total supply), we do not expect there to be any significant impact on the carbon price, emissions, or carbon leakage risk. From 2026-2030 the stationary free allocation system will be revised as part of the Free Allocation Review. If the revised FA rules mean the industry cap "binds", then this would effectively be redistributing free allowances between eligible sites, rather than between government/sites.

268. The analysis informed the decision on whether to effect a change alongside evidence from the consultation responses and consideration of existing FA rules.

Limitations/Caveats

269. The analysis assumed that all installations that could be in scope of this policy change would be able to demonstrate that they produced measurable heat by means of high-efficiency cogeneration in future. As there is no certainty this is the case, the expected number of installations in scope could be even more limited than the analysis indicates. Furthermore, as the UK ETS NIMS process has not yet occurred for the next allocation period, the analysis was focused on the current allocation period.

Annex [5.4] – Chapter 2 Proposal: Amendments to Benchmarks and CLL

Analytical approach

270. This annex summarises the analysis and evidence used to inform the decisions covered in response to question 11 in Chapter 2 of the Authority Response. Analysis was undertaken to support the decision on whether to intervene.

271. The analysis used data submitted to Regulators as part of the UK ETS NIMS process as well as through the 2022 ALC process. This was used to identify the number of installations in scope of changes to specific benchmarks and applications of the carbon leakage list, and to understand the impact on free allowances distributed in the 2024 and 2025 scheme years.

Summary of key impacts

272. The analysis indicated that a small number of installations would be in scope of the change to the lime benchmark, and to the change to the carbon leakage classification of malt extract production.

273. Given the relatively low estimated volume of additional allowances issued (compared to total supply), we do not expect there to be any significant impact on the carbon price, emissions or carbon leakage risk. The primary impact will be a moderate social transfer from government to eligible firms in the form of the additional free allowances over 2024-2025.

Annex 6: Oil and Gas Venting

Analytical Approach

274. **The analysis discussed in this annex is not the final assessment of eligibility or amendments to thresholds.**

275. This annex summarises the analysis and evidence used to inform the decisions covered in Chapter 5 of the Authority Response. The sections relate to the Oil and Gas venting referred to in Chapter 5 of the Consultation.

276. Analysis was undertaken to:

a. Review the proposal to include CO2 venting emissions in the scope of UK ETS,

b. Consider whether it covered all the elements that were considered as venting,

c. Develop additional detail to inform decisions on the minimal threshold for inclusion and the date from which to begin the inclusion, and

d. Provide evidence on the potential impacts of the policy, given available information.

277. This analysis used GHG emissions in 2018-2020 from upstream oil and gas production (Mt CO2e, AR5 without feedback GWPs) classified into categories following discussions with NSTA (North Sea Transition Authority) and OPRED (Offshore Petroleum Regulator for Environment and Decommissioning).6

278. It used these data to estimate the emissions that would be covered by these categories. These are initial estimates based on data in past years.

Summary of key impacts

279. The consultation gave the total emissions of upstream oil and gas CO2 venting that were planned to be brought into scope as <0.01 MtCO2e. Further discussion with regulators and emitters suggested that this amount was not the full element of oil and gas venting that should be considered. Instead, the scope should be expanded to cover some elements of direct process emissions which are considered venting in some contexts: the categories are named “Upstream Gas Production: direct process emissions” and “Gas Terminal: Other Fugitives”.

[6] BEIS and OGA analysis based on BEIS 2020, Final UK Greenhouse Gas Emissions National Statistics, https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2020

Annex 6 Table 1: Emissions for 2018 - 2020

Emissions for 2018-2020:

CO2 Emissions from Upstream Oil and Gas Production (Mt CO_2)	**2018**	**2019**	**2020**
Combustion	12.19	12.59	12.11
Of which Natural Gas	*10.47*	*10.82*	*10.41*
Of which Other	*1.72*	*1.77*	*1.70*
Non-combustion (process emissions, oil/gas terminal storage, oil loading)	**0.34**	**0.40**	**0.40**
Flaring	3.71	3.68	2.81
Venting	**0.08**	**0.01**	**0.00**
Total Flaring & Venting	*3.79*	*3.69*	*2.81*

Source: Greenhouse gas emissions classified into categories following discussions with North Sea Transition Authority and Offshore Petroleum Regulator for Environment and Decommissioning
Note: The categories "Upstream Gas Production: direct process emissions" and "Gas Terminal: Other Fugitives" are the majority of the emissions in the "Non-combustion" category.[7]

280. Any net social emissions reduction resulting from this change to include these emissions will depend on any change made to the emissions cap. This is because the cap is set on the total quantity of emissions allocated in the system. Adding additional sectors, such as oil and gas venting, without a change to the cap would increase demand for allowances without increasing the total allowances issued (and hence, generally, emissions) from the system over the phase.

281. On average over the last three years, oil and gas venting in these categories was 0.41MtCO2. When compared to the UK ETS emissions for 2021 (108MtCO2e) this is 0.38 per cent of the total. Therefore, the additional demand is small relative to the existing emissions and hence we expect the impact on the market to be modest, regardless of whether the cap is adjusted.

282. The cost to business will depend on the number of allowances they have to purchase and the price of those when purchased. This activity is not expected to be eligible for free allocation. If the emitters in this sector have abatement for this activity that is cost-effective to deploy, their cost-effective approach would be for some or all of these emissions to be abated rather than paying the carbon price. The scale of the emissions, an average of 0.41MtCO2 per year, suggest that this is relatively small compared to other sectors. Some of these costs may be passed on downstream.

283. Other effects will depend on the nature of this additional venting, when it occurs and the extent to which it can be avoided. If there is a link between venting and flaring, then putting both into scope will remove any unintentional distortions of the economic incentives around whether to use vent or flare.

Risks and Limitations

284. The analysis presented here is not a final assessment of which sites and activities will be in scope; it is an estimate based on historic data. Hence, as the policy is operationalised, new and more up to date data may shift the results. This is consistent with the observation that these data vary from year

[7] The full set of categories that fall into this section are: Oil Terminal: Direct Process, Oil Terminal: Other Fugitives, Onshore oil production (conventional), Petroleum processes, Upstream Oil Production - fugitive emissions, Upstream Oil Production: direct process emissions, Oil transport fugitives: pipelines (onshore), Oil transport fugitives: road tankers, Upstream Oil Production – Offshore, Oil Loading Upstream, Oil Production – Onshore, Oil Loading Upstream, Oil Production - Oil terminal storage, Gas Terminal: Direct Process, Gas Terminal: Other Fugitives, Upstream Gas Production - fugitive emissions, Upstream Gas Production: direct process emissions, and Upstream Gas Production - Gas terminal storage.

to year. Additionally, the results are sensitive to the inclusion/exclusion of additional emitters due to uncertainty in our assessment against the threshold.

285. Overall, the analysis was sufficient to support the decision to include oil and gas venting in the future.

Annex 7: UK ETS Theory of Change

KEY: Theory of Change components

This Theory of Change (ToC) describes how (and why) BEIS expects the UK ETS to function. It is made up of seven components (described below). The purpose of the ToC is to provide a model against which the actual operation of the UK ETS can be tested.

Gold / amber boxes identify the desired **OUTCOMES** (the purpose of the UK ETS)

Turqoise boxes describe the key activities and responses associated with the operation of the UK ETS. These are triggered by the intervention (and its associated mechanisms) and are expected to lead to the attainment of the the desired outcomes - sometimes called the **LOGIC PATH** or causal chain.

The light blue boxes describe the key activities and responses associated with the introduction of the UK ETS (**LOGIC PATH**)

The light green box describes **INPUTS** i.e. the resources which BEIS have invested in the UK ETS

The dark blue box describes the **RATIONALE** for introducing the UK ETS. I.e. the reason that the policy was introduced.

White text boxes describe **EXTERNAL FACTORS**. These are factors external which are not accounted for within the design of the scheme and which might be expected to interact +/- with the operation of the policy.

EXTERNAL FACTORS

Non-UK ETS - participation in other schemes (e.g. EU ETS) can cause additional administration for firms affected by one or more schemes; presence / absence of other schemes can reinforce / undermine likely impact of UK ETS.

Wider UK Energy / climate and industrial policy.

Emergence of new or more cost effective abatement options - innovative systems / processes / technologies / service solutions which may reduce the cost of abatement (e.g. large scale CCUS) / potential evolution of disruptive technologies and services.

Energy prices.

Investment outlook (cost of capital).

Growing awareness of climate change means regulated firms may be under pressure to reduce carbon emissions from investors, customers and staff.

Carbon policies of international competitors (e.g. emergence of carbon border adjustment mechanisms. May include sector specific measures such as the proposed EU tax on aviation fuel).

Covid- 19 and national / international responses.

Sector specific issues (e.g. trade policy; CORSIA; increased trade via power interconnections).

Economic performance of the UK.