BRIEFING - OCTOBER 2025

Carbon leakage in the aviation sector

Is it a problem and if so what can be done to address it?

Summary

T&E commissioned CE Delft to assess the risk of carbon leakage in the aviation sector (including the impacts of an extended EU Emissions Trading System scope) and Lexavia Aviation Consultants to analyse the legal feasibility of three measures to limit the risk of aviation carbon leakage.

The analysis shows:

- **The risk of carbon leakage is minimal**. At most, only 3% of the emissions savings as a result of the Fit for 55 measures will be lost (out of a total of 38.4 $MtCO_2$ emissions savings expected in the aviation sector by 2035 from RefuelEU and the EU ETS), meaning EU measures remain overwhelmingly effective.
- **Risk is concentrated on a few long-haul routes.** Flights to South East Asia via nearby hubs such as Istanbul may see the possibility for diversion.
- **Previous studies have overstated the overall problem**. By using inflated definitions of leakage, some industry reports counted emissions still covered by EU policies, wrongly labelling them as 'leaked'.
- **Expanding the EU ETS to cover all departing flights only leads to minimal increases in ticket prices of between 2% and 6%** in 2030. When placed in the context of the ticket price, non-EU hubs like Istanbul only see a small cost advantage of between 1% and 4%. It is therefore likely that these cost increases will only lead to route change decisions for a fraction of passengers.
- T&E has analysed the following policy measures:
    - **Targeted SAF allowances** which would lower costs on specific high-risk routes to reduce incentives to reroute via non-EU hubs. This is found to be a legally robust and proportionate policy option and can be implemented in the existing ETS framework.
    - **Targeted airport-pair carbon pricing** would apply higher charges on flights via non-EU hubs to correct cost advantages. If based on transparent evidence, narrowly targeted and integrated into the ETS it is legally feasible.
    - **A SAF-BAM** would impose SAF certificates on non-EU carriers, would impose heavy administrative burdens and carries high diplomatic risks of being perceived as extraterritorial or discriminatory.

Therefore T&E recommends:

- A robust methodology to **define routes at risk of carbon leakage** is designed by the European Commission
- Any policy measure is **targeted specifically at high-risk routes** and integrated into existing EU legislation, such as targeted SAF allowances or targeted carbon pricing. This decreases risk of international retaliation and increases operational feasibility.

1. Does the EU aviation sector face a real risk of carbon leakage?

1.1 What is carbon leakage?

Carbon leakage occurs when policy measures to decrease emissions in one region lead to an increase in emissions somewhere else. In Europe, when applied to the aviation sector, this refers to the potential increase in emissions as a result of passengers choosing to make transfers at non-European Economic Area (EEA) airports or choosing destinations outside of the EEA due to increased ticket prices within the EEA. Passengers 'escape' EU climate measures, thereby leading to higher emissions than intended by the policy and the growth of airlines in regions not regulated by similar climate policies.

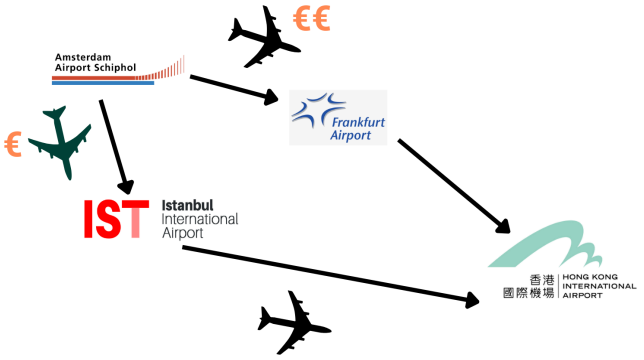
In aviation, there are three ways in which this could occur:

1. **Direct long haul flight → Long haul flight with non-EEA transfer**

A transfer at a hub just outside the EEA becomes relatively more attractive, since only the first, shorter flight is subject to EU climate measures, rather than the whole direct flight. A typical case study of this would be a direct flight from Amsterdam to Hong Kong that turns into a flight with a transfer in Istanbul or Doha.

2. **Long haul flight with EEA transfer → Long haul flight with non-EEA transfer**

In this case, the passenger, when faced with the option of transferring at an EEA hub or a non-EEA hub, picks a non-EEA hub to avoid EU climate measures. For example, on the Nice to Bangkok route passengers could choose to transfer either at Munich, Copenhagen or Amsterdam (EEA) or at Istanbul or Dubai (non-EEA).



Passengers starting at a non-EEA airport could also choose to avoid EEA airports as their transfer hub. For example, on the Toronto to Mumbai route, passengers could choose to transfer at either Paris or Amsterdam (EEA) or Dubai or Abu Dhabi (non-EEA).

3. **EEA destination choice → Non-EEA destination choice**

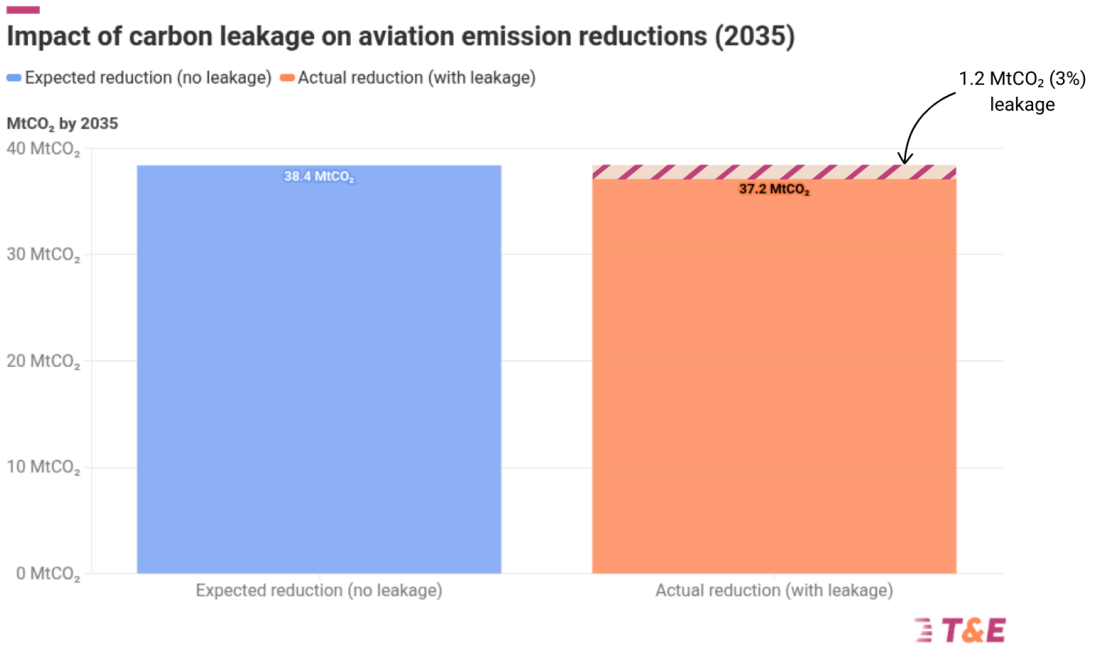
Finally, passengers could choose to change their destination choice from one within the EEA (and therefore within the intra-EEA scope of the EU Emissions Trading System) to one outside the EEA (and the scope of the ETS). For example, passengers could change their holiday

destination from Greece or Spain to Morocco or Turkey to avoid paying ETS costs which only apply to intra-EEA flights.

1.2 To what extent is there a risk of carbon leakage?

There is little to no empirical evidence to suggest that carbon leakage occurred as a result of EU climate policies from 2012 to 2024. The European Commission's *Impact Assessment* on the Fit for 55 measures found "no evidence of carbon leakage at present for aviation". This is largely due to the extent of the climate policy exemptions that the aviation sector has received, including the equivalent of €8 billion in free allowances from 2013 to 2023.

With the introduction of the ReFuelEU mandates in 2025 and the phase out of free allowances for the aviation sector under the EU ETS, the potential for carbon leakage to occur as a result of these more ambitious policies must be re-evaluated.



Analysis suggests that the risk of carbon leakage undermining EU climate policies is minimal. In fact, a 2023 T&E study found that the risks of carbon leakage as a result of the Fit for 55 (FF55) measures (i.e. ReFuelEU and EU ETS) are limited to 3% of the total emissions savings brought by the measures in 2035. Although ideally no emissions savings would be lost to carbon leakage, the amount is so minimal that it is evident that **the FF55 measures have an overwhelmingly net positive effect on emissions reductions**.

Although the overall risk of carbon leakage is limited, there are certain routes where there is a higher risk. This includes flights towards South East Asia where there is a possibility of avoiding EU climate measures by adding an extra stopover in Istanbul.

However, a recent study commissioned by T&E to CE Delft showed that even on these routes previous assessments of carbon leakage have overestimated the actual value. This is due to the way in which carbon leakage was defined.

There are three possible ways to define carbon leakage:

1. Total emissions of the indirect route
2. Emissions outside the scope of EU climate measures
3. Additional emissions from the indirect route vs. the direct route

The IEA[1] and IPCC[2] definitions clearly state that estimations of carbon leakage should only take into account the increase in emissions *outside* of the region where there are climate measures. For aviation, this would be in line with Option 2. Crucially, previous aviation stakeholder assessments of carbon leakage have used a different definition of carbon leakage. Namely, they define carbon leakage as the *total* emissions of the indirect route i.e. Option 1. This definition is not relevant to determine the actual carbon leakage caused, since it includes emissions that are still within the scope of the EU's climate measures. This means that what these studies are measuring is actually shifts in emissions, not leaked emissions, meaning their estimations of carbon leakage are over-inflated.

A good example of this is the carbon leakage estimations given for the Hamburg-Bangkok route. The 2022 SEO & NLR report finds that in 2030 (with a scope extension of the EU ETS) carbon leakage for this route would be up to 48.1%. However, this includes emissions within the scope of EU climate measures. Therefore, CE Delft recalculated what the true carbon leakage should be according to the IEA and IPCC definitions by using the ratio of the distance of the second leg compared to the total route length. They found a significantly lower level of carbon leakage: 37% rather than 48%. While certain routes may have a higher risk of carbon leakage, their impact should also not be over-inflated. Furthermore, this higher risk of carbon leakage is only present on a very limited selection of routes and hubs, meaning that the overall amount of carbon leakage remains low.

In A4E's most recent publication on the topic, they do not just address carbon leakage but also 'business leakage'. This describes European airlines losing passengers to non-EEA airlines due to the potential competitive disadvantage caused by EU climate measures. This focuses more on the competitive and economic impacts of EU climate measures on airlines rather than the environmental ones.

A4E claims that on the route from Nice to Tokyo, around two-thirds of the reduced passenger numbers are gained by carriers with a non-EU hub on that route. The methodology used to reach this result relies on assumptions of the price elasticity of demand, which determines by how much percent demand changes when the price increases or decreases by one percent. An

[1] "Carbon leakage is defined as the increase in emissions outside a region as a direct result of the policy to cap emissions in this region."
[2] "Carbon leakage is defined as the increase in CO_2 emissions outside the countries taking domestic mitigation action divided by the reduction in the emissions of these countries."

upcoming T&E study will highlight, however, that there are many problems with applying price elasticity models to aviation. Demand in aviation is difficult to quantify and rarely measured directly. Passenger numbers are also shaped by wider factors, such as hotel and holiday costs, shocks like pandemics, and dynamic airline pricing, that simple price-demand elasticities cannot capture.

A further point that must be taken into account is whether the growth at non-EEA hubs is occurring as a result of EU climate measures and business leakage. A 2023 analysis of traffic forecasts shows that this rapid increase in traffic would happen regardless of whether the EU introduces climate measures. Istanbul would see a 73.4% increase in passenger traffic in 2035 with no EU policy change. The additional increase in traffic as a result of EU climate measures (and 'business leakage') is a mere 3.1%. The picture looks the same in Doha: traffic would increase by 54.7% in 2035 if no new EU measures were introduced, and only increase by a negligible <0.1% more with the FF55 measures. At Dubai Airport traffic actually decreases in 2035 in the FF55 scenario by -1.9%. This analysis makes clear: **the FF55 measures do not cause a substantial shift of European demand to non-EEA hubs**.

Airport	2018 passengers	2035 passengers (no policy change)	2035 passengers + FF55
Istanbul	47.3M	+73.4%	+3.1%
Dubai	26.5M	+60.8%	-1.9%
Doha	13M	+54.7%	<0.1%
Casablanca	77.3M	+40%	+1.7%

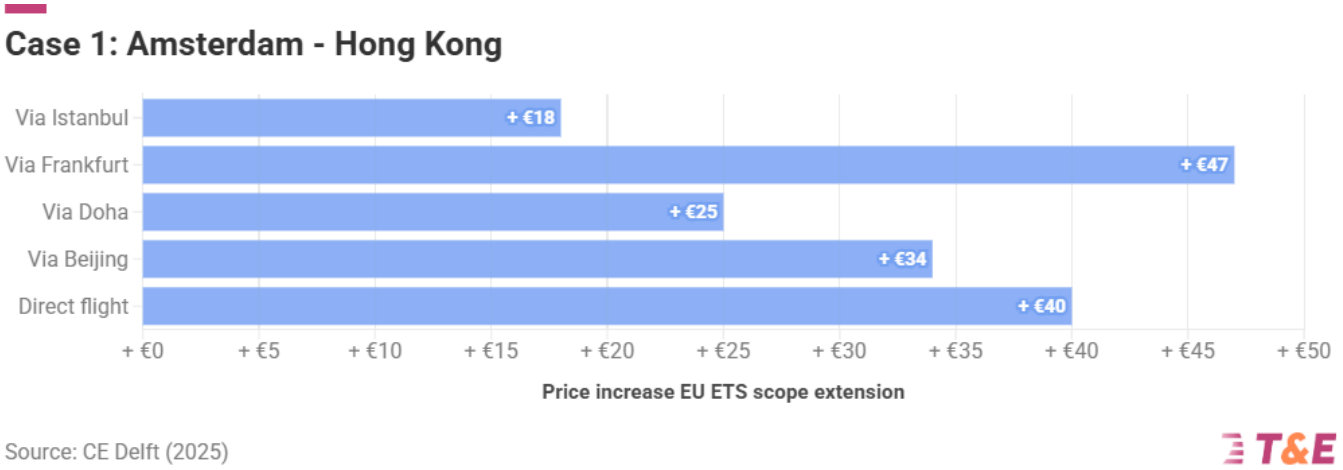
Finally, it is important to recognise that **despite relative increases in ticket prices, demand for flying will continue to grow**. Even with the introduction of the FF55 measures, there will be 24% more passengers travelling through EEA airports in 2035 compared to 2018.

1.3 To what extent would this risk increase with a scope extension of the Emissions Trading System?

A scope extension of the EU Emissions Trading System (ETS) to include all departing flights is a key policy measure to generate much needed revenues and to ensure that long-haul flights are not exempt from paying a carbon price. Naturally, such a scope extension comes with concerns about further ticket price increases and carbon leakage.

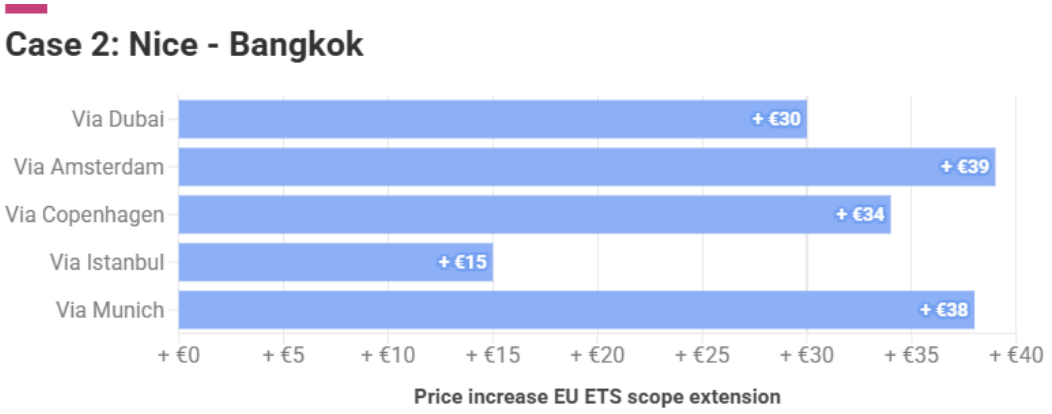
Therefore, CE Delft modelled what price increases would look like at different airports as a result of the ETS scope extension (assuming a 100% cost-pass through rate) in three different

case scenarios: passengers choosing a non-EEA hub transfer instead of (1.) a direct flight or (2.) an EEA hub transfer and (3.) passengers choosing a non-EEA destination over an EEA-destination.



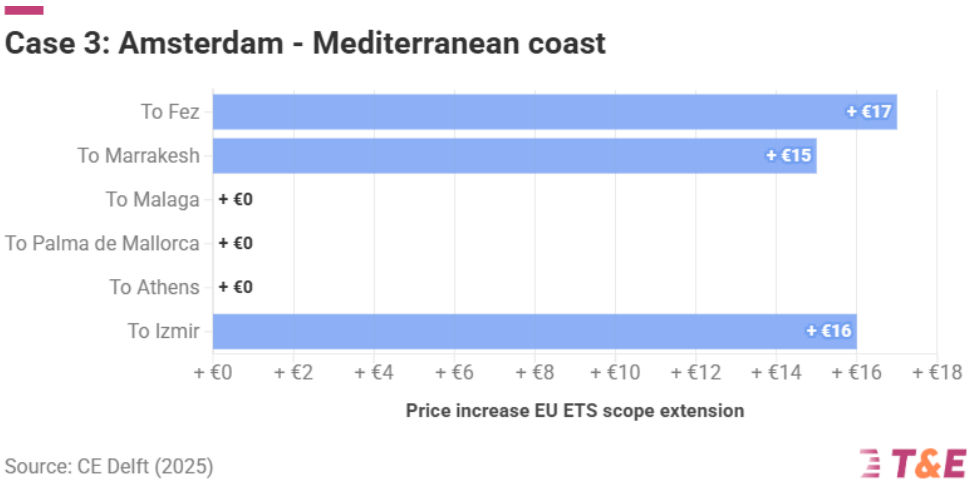
Source: CE Delft (2025)

For cases 1 and 2 – where passengers could choose a non-EEA hub transfer – it is evident that the price increases as a result of an ETS scope extension affect EEA airports more. This is especially the case when flying via EEA airports is compared to flying via Istanbul: on the Amsterdam-Hong Kong route flying via Istanbul becomes €29 less expensive due to the ETS scope extension. On the Nice-Bangkok route, the ETS scope extension causes a €15 ticket price increase on routes via Istanbul and a €38 increase via Munich.



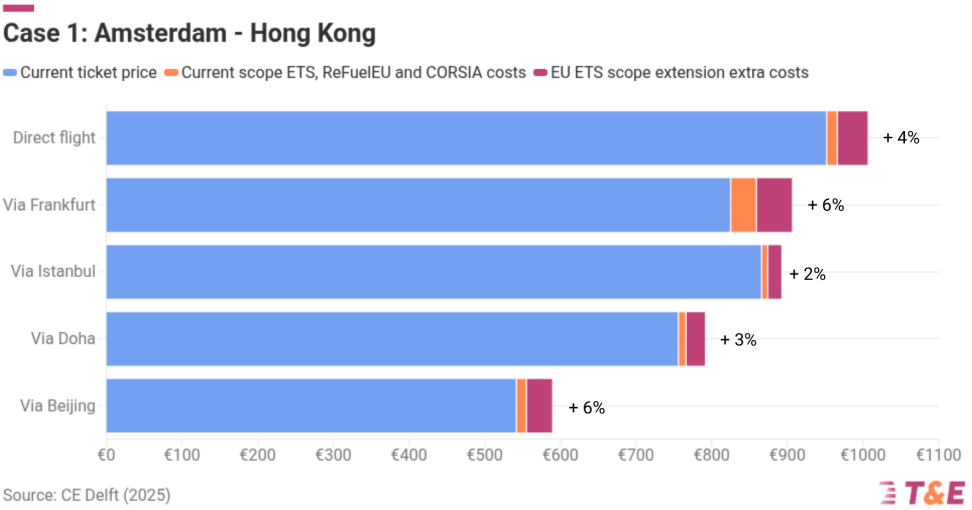
Source: CE Delft (2025)

For case 3, the opposite happens. Namely, there is only a cost increase for non-EEA destinations. This means that the carbon/business leakage scenario in which passengers choose to switch destinations is actually resolved by an ETS scope extension. The ETS is the only EU climate policy instrument that currently has an intra-EU scope. Applying all aviation climate policy instruments to all departing flights removes the incentive to switch from an intra-EU to an extra-EU destination due to potential price increases that only apply within the EU.



This leaves only the potential risk of passengers switching to a non-EEA hub to avoid EU climate measures. However, the price increases as a result of the ETS scope extension must be put into perspective. To do this, CE applied the extra ETS costs to illustrative ticket prices.[3]

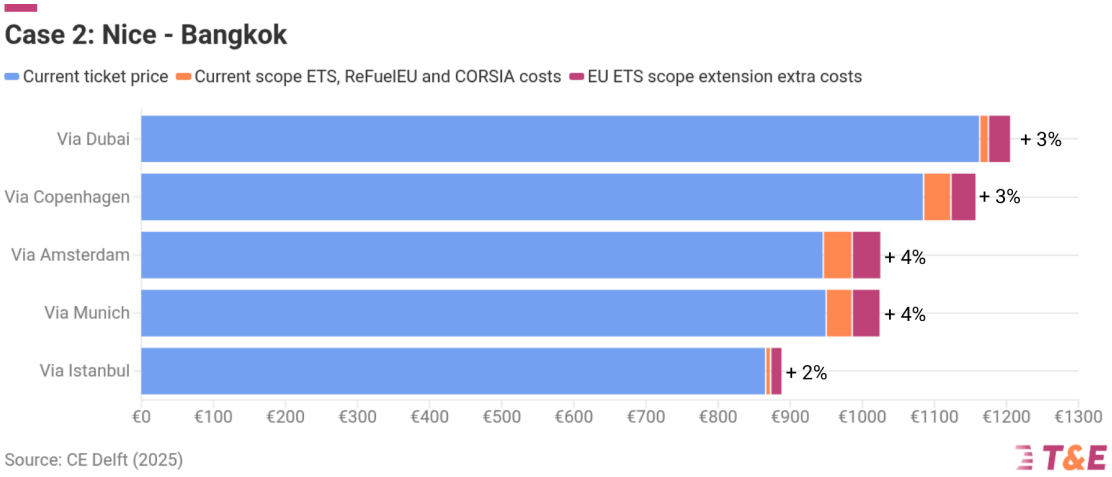
The graph highlights that expanding the EU ETS to cover all departing flights only leads to **minimal increases in ticket prices of between 2% and 6%** in 2030. When placed in the context of the ticket price, non-EU hubs like Istanbul only see a small cost advantage of between 1% and 4%. It is therefore likely that these cost increases will only lead to route change decisions

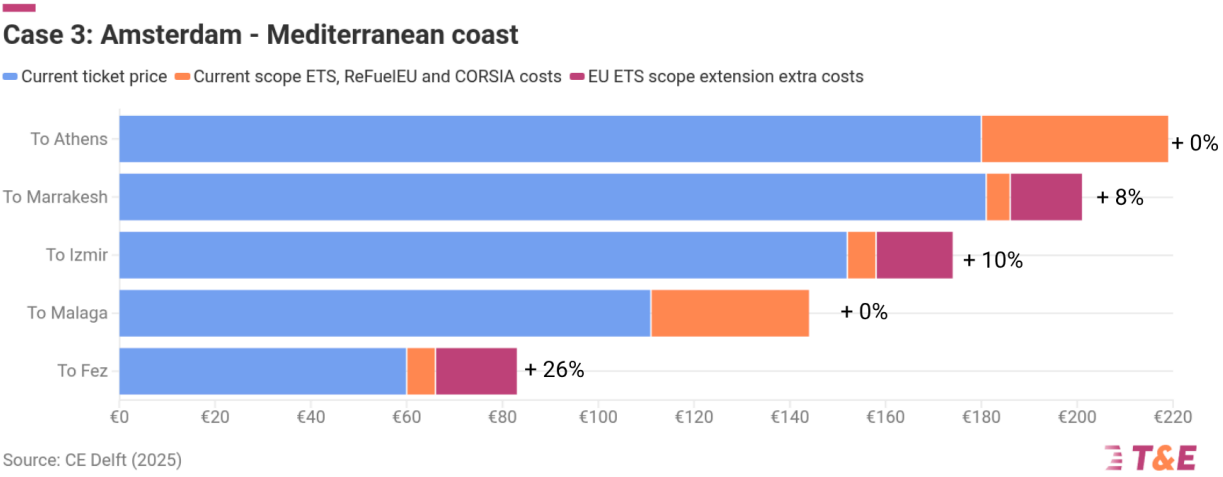


for a fraction of passengers. Furthermore, when researching ticket prices CE Delft selected the cheapest available tickets. This means that the results shown of the relative ticket price

[3] The ticket prices are from December 2024-March 2025 found via Skyscanner. It is important to note that these ticket prices are uncertain and fluctuate continuously. They depend on several factors such as the time in advance a ticket is booked, the day of the week, demand for specific routes, and other market conditions. The ticket prices in the graph should therefore only be viewed as indicative, intended to illustrate the magnitude of impact for passengers, rather than providing precise values.

increases are likely an overestimation, as higher ticket prices would result in relatively smaller effects.





2. What measures could feasibly be implemented at EU level?

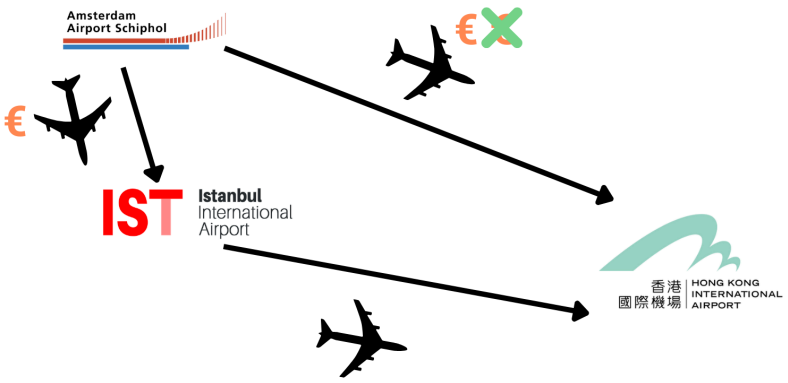
T&E commissioned Lexavia Aviation Consultants to conduct a legal feasibility analysis of three different measures to tackle the risk of carbon leakage as a result of EU climate measures. These include: targeting the SAF Allowances under the EU ETS to routes at risk of carbon leakage; introducing targeted increased carbon pricing under the EU ETS on routes at risk of carbon leakage; and a SAF-BAM (originally proposed by A4E).

Any EU measure introduced must be legally defensible, proportionate, administratively feasible and respectful of existing aviation treaties.

The analysis finds that both the targeted SAF allowances and targeted carbon pricing between airport pairs are legally feasible if the criteria to determine the routes at risk of carbon leakage

is transparent, objective and proportionate. The SAF-BAM was found to be less feasible due to the high administrative burden of establishing a new registry and due to the risk of being perceived as extraterritorial or discriminatory under international aviation law.

2.1 Targeted SAF allowances



The targeted Sustainable Aviation Fuel (SAF) allowance option builds directly on the revised EU ETS framework, which already contains a dedicated reserve of 20 million allowances (2024-2030) to partially offset the price differential between SAF and fossil kerosene. Using this existing tool to address carbon leakage, this mechanism would adapt the existing allowances so that they can be allocated on routes shown to be at high risk of carbon leakage (i.e. those facing strong competition from non-EEA hubs). This effectively lowers the price of flying on these routes, reducing the incentive for passengers to fly via nearby non-EEA hubs to evade EU climate measures.

Legally, this approach can be included as an amendment to the ETS Directive or its delegated acts. The current SAF allowance reserve is route-neutral. Enabling route-differentiated allocation would necessitate amending Delegated Regulation (EU) 2025/723 and revising the ETS Directive to create an explicit legal basis for conditional, route specific support. Some changes would need to be made to the Monitoring, Reporting and Verification framework and the Union Registry, but - if well designed - these administrative adaptations are not insurmountable.

The measure crucially must not depart from the principles of uniform and non-discriminatory treatment that are embedded in the ETS. According to settled case law of the Court of Justice of the EU, differential treatment is not unlawful if it is objectively justified, meaning:[4]

- It is based on objective, reasonable and transparent criteria
- It pursues a legitimate public interest
- It is proportionate to the risk identified
- And it is consistently applied, avoiding arbitrary or selective favouritism

Therefore, if the introduction of targeted SAF Allowances includes robust, objective and evidence-based methodology to identify carbon leakage prone routes where the risk is demonstrably high and transparent eligibility criteria then the measure would be compliant with

[4] See Case C-127/07, Arcelor Atlantique et Lorraine and Others, paragraphs 23 and 47

equal treatment and non-discrimination principles. Any perception of a selective advantage for certain carriers must be avoided.

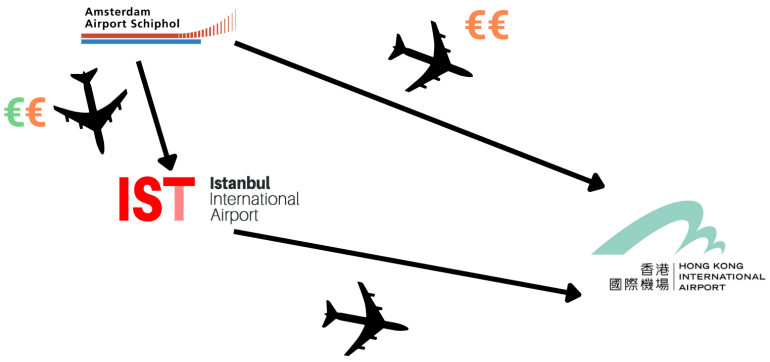
Similarly, in order to avoid concerns around State Aid and the measures resulting in selective advantages or distorting competition, the targeted SAF Allowances would have to be targeted, proportionate (i.e. limited to the minimum necessary to achieve the objective), contribute to environmental objectives, be time-bound and transparent.[5]

Targeted SAF allowances can be structured to comply with international aviation law. Article 15 of the Chicago Convention prohibits discriminatory charges. However, since this mechanism would be route-based rather than nationality-based, is open on equal terms to all operators serving the eligible routes, and is transparently justified as a proportionate cost-correction to EU environmental obligations it would be defensible under the Convention and consistent with ICAO's climate objectives. Similarly, for Air Service Agreements risk of retaliation is minimised where eligibility is objective, published and operator-neutral and it is clearly framed as addressing regulatory asymmetry rather than conferring an advantage on EU carriers.

In short, the limited diplomatic risk and internal coherence with the ETS architecture of this measure make it a legally viable option.

2.2 Targeted carbon pricing (between airport pairs)

This measure would involve applying a differentiated carbon price on routes where there is a risk of evading EU climate measures. Contrary to the proposal of using SAF allowances, which will provide a "discount" on the direct routes at risk, this option would increase the price of the stop-over route via a non-EEA hub.



Three different ways to implement this were explored: airport-pair pricing, final destination pricing and border-distance pricing. Final-destination pricing (i.e. determining the routes to be priced based on the passenger's final destination) was found to be largely unfeasible due to GDPR and data-protection constraints with tracking passenger final destinations and its broad scope, which makes its proportionality harder to defend. A measure designed based on distance from EEA borders also faces potential problems with proportionality if the criteria is drawn too broadly and therefore captures routes or airports with limited risks.

[5] See, Commission Communication, Guidelines on State aid for climate, environmental protection and energy 2022. For a detailed analysis of the CEEAG see, A. Metaxas, "The new State Aid Guidelines on Climate, Environmental Protection and Energy: what changes do they bring?" In Research Handbook on EU Competition Law and the Energy Transition. Edward Elgar Publishing Limited (2024).

Therefore, the best way for this targeted carbon pricing measure to be designed is for it to be between airport pairs. This means a differentiated carbon price would be applied to flights between specifically designated airport pairs, typically linking an EU/EEA hub to a non-EU airport where the risk of carbon leakage is demonstrably high.

The mechanism could be integrated into the existing EU ETS framework. An amendment would need to define the concept of a 'designated high-risk airport pair', establish the criteria and authority for designation and provide for differentiated compliance obligations. Integration within the ETS is the favoured implementation option. The alternative would be to introduce a separate fiscal instrument, requiring unanimity in the Council - a threshold rarely met in taxation matters.

As with the SAF Allowances mechanism, differential treatment may be deemed permissible if it pursues a legitimate public interest objective (such as the prevention of carbon leakage) and where it is justified by objective, transparent and proportionate criteria. Airport-pair pricing can therefore be legally defensible if supported by robust evidence and narrowly targeted at routes where the risk of carbon leakage is demonstrably high.

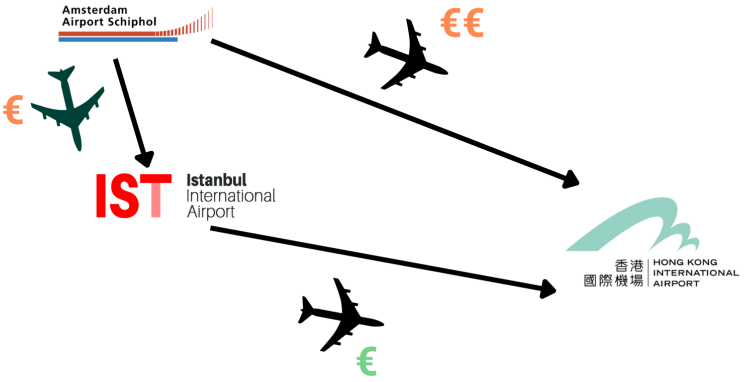
A key advantage of airport-pair pricing lies in the availability of route-level emissions data within the ETS Monitoring, Reporting and Verification frame. Airlines already report aggregated annual emissions per aerodrome pair, meaning that the data infrastructure for differentiated obligations already exists in principle. Nonetheless, adaptations would be required in the Union Registry and MRV processes to allow for transparent monitoring and enforcement.

The measure would become even more robust if paired with a cost-correction mechanism, allowing carriers subject to equivalent climate obligations to deduct the verified costs from the airport-pair charge.

Similarly to the SAF Allowances mechanism, the airport-pair pricing mechanism can be protected from international retaliation if the measure applies equally to all operators on a designated route, is transparently justified and proportionately corrects a regulatory asymmetry. Air Service Agreements pose a source of potential contention, particularly where non-EU carriers dominate the designated routes. Transparent designation criteria and the inclusion of cost-correction mechanisms to recognise equivalent obligations can mitigate the risk, allowing the measure to be framed as an internal adjustment rather than discrimination.

In summary, airport-pair pricing offers a legally feasible and proportionate means to address carbon leakage in EU aviation. Its narrow scope, reliance on existing emissions data, and potential for transparent, evidence-based targeting strengthen its compatibility with EU law and international obligations.

2.3 SAF-BAM



The SAF-BAM has been proposed by A4E and Deloitte as an analogue to the EU's Carbon Border Adjustment Mechanism. It aims to address the regulatory asymmetry created by the EU's ReFuelEU Sustainable Aviation Fuel (SAF) blending mandate, which applies to EU/EEA carriers but not to non-EU operators routing passengers via third-country hubs. The SAF-BAM would require airlines operating such journeys via third country hubs to purchase certificates corresponding to the SAF obligation that would have applied had the entire journey remained within the scope of ReFuelEU.

Unlike the SAF Allowances and route-based pricing measures, the SAF-BAM can not be integrated into the ETS framework, since it does not regulate emissions directly but rather compensates for avoided SAF blending obligations. It would therefore need to be established as a separate instrument, most likely by means of a dedicated regulation linked to ReFuelEU.

To comply with the principles of equal treatment and non-discrimination, the mechanism would need to apply to all carriers operating journeys originating in the EU, irrespective of nationality. While in practice the burden would fall more heavily on non-EU hub carriers, the measure could be justified as proportionate if it is transparently framed as correcting a regulatory asymmetry rather than conferring an advantage on EU airlines.

However, proportionality also concerns the extent to which the environmental and competitiveness benefits of the measure outweigh its administrative and financial burdens. Implementing a SAF-BAM would require a new compliance and registry system, as existing ETS infrastructure is not designed to track avoided fuel obligations on extra-EU segments. Obligations would be benchmarked against SAF price indices and blending requirements, and could be calculated either on the basis of actual passenger and cargo data or through default values such as average load factors per route.

Actual data would enhance accuracy but impose higher verification costs, while default values reduce administrative burdens but risk undermining proportionality. As with the CBAM, a transitional phase relying on simplified reporting could ease implementation before the full system is introduced. Even with such safeguards, **the complexity of creating a dedicated registry and certificate scheme raises questions about cost-effectiveness and proportionality, particularly in light of the limited empirical evidence of carbon leakage to date.**

The most significant sensitivities arise under the Chicago Convention, in particular Article 15, which prohibits discriminatory charges and requires that any fees imposed on international aviation be cost-related to services rendered. A SAF-BAM would not be directly linked to the use

of airport or navigation services, but rather to compliance with an EU regulatory mandate on segments operated outside EU jurisdictions. This raises the risk of the measure being characterised as an extraterritorial application of EU law.

Air Service Agreements are an equally important source of exposure. Many contain provisions on fair competition and equal opportunity. Since a SAF-BAM would predominantly affect non-EU hub carriers, affected states may argue that the measure undermines these treaty commitments and may seek consultations or impose retaliatory measures. Although the mechanism can be framed as a neutral cost-equalisation measure, the diplomatic risks are far more substantial than with the SAF Allowances or targeted carbon pricing mechanisms.

The SAF-BAM is legally feasible in principle, provided it is introduced as a stand-alone regulation linked to ReFuelEU and designed to comply with the principles of neutrality, proportionality and transparency. However, its feasibility is constrained by the high administrative burden of establishing a new registry and by the risk of being perceived as extraterritorial or discriminatory under international aviation law. The question arises if the administrative burden and extraterritorial risks are proportional to the real risk of carbon leakage.

3. Conclusions and policy recommendations

1	**Carbon leakage must not be used as an excuse to weaken EU climate measures**. Overall leakage is limited and therefore does not justify less ambition on EU measures.
2	**Use an accurate definition of carbon leakage.** Even on routes where carbon leakage may be more likely, previous analyses have overestimated the actual carbon leakage value by using the wrong definition of carbon leakage. The European Commission needs to define a methodology to identify which routes are at risk of carbon leakage. This methodology must be objective, transparent and proportional in order to minimise risk of retaliation.
3	**Implement targeted policy measures on high-risk routes.** Once specific routes have been defined, *existing* policy frameworks should be used to adjust pricing on these routes. This could be done by targeting the use of SAF allowances, for example, or by targeting carbon pricing on specific routes.

Further information

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