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Report prepared for Airlines for Europe (A4E)

Creating a level playing field for decarbonisation in aviation

The role of Border Adjustment Mechanisms and alternative policies to prevent carbon leakage and maintain EU airlines competitiveness

May 2025

Foreword by Airlines for Europe (A4E)

Dear reader,

European air carriers operate in a highly competitive market where the overall costs associated with Fit for 55 policies make traveling to or through EU destinations more expensive.

A4E has commissioned this study to establish the impact of these policies on European airlines and European destinations. With this report, A4E asked Deloitte to review the state of play and the impact on the competitiveness of the European aviation industry including carbon and business leakage, particularly coming from ReFuelEU Aviation; to provide a legal and practical assessment of the possible application of CBAM to air transport; and finally to assess existing mechanisms and new concepts that can potentially address carbon and business leakage while considering their potential benefits and limits.

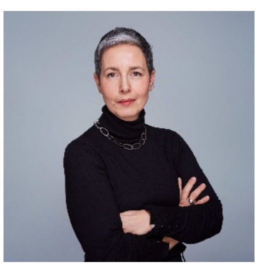
The aim of this study is not to outline the policy preferences of A4E, but to map the different options to mitigate carbon leakage from European aviation and list their advantages and drawbacks.

Any future actions taken by policymakers to address carbon and business leakage must respect the following principles:

- Bring no additional cost to all European operators and avoid a negative impact on the competitiveness of Europe as a destination.
- Keep administrative and regulatory burden for all aircraft operators to a minimum.
- Seek to address both hub switching and destination switching carbon leakage.

A4E will be liaising with European and national authorities to shape and implement mitigation measures that minimise the risk of carbon leakage and maintain the competitiveness of Europe's airlines and of Europe as a global destination for business and leisure.

Thank you,



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Executive Summary

The drive towards more ambitious climate policies in Europe, including the introduction of ReFuelEU, which mandates minimum shares of Sustainable Aviation Fuels (SAFs) at EU airports from 2025 onwards, has added cost pressures on carriers with an EU hub and those subject to similar requirements, e.g., in the UK. Unilateral implementation of climate policies by the EU creates a risk of both carbon leakage and business leakage. This is particularly pronounced when compared to competitors with nearby hubs. A limited number of competing aviation hubs, such as the ones in Türkiye, the United Arab Emirates, Saudi Arabia and Qatar, constitute the bulk of carbon leakage risk in EU aviation. The use of their alternative routes often implies longer flights and the use of more conventional fossil kerosene, reducing the climate benefit of ReFuelEU.

This report analyses how existing policies designed to combat carbon leakage in other sectors, such as a CBAM, could be applied to aviation. This report considers amending the design of the existing CBAM to address specific requirements for the aviation sector. This is discussed through the form of a SAF Border Adjustment Mechanism (*SAF-BAM)*[1] *which* could help to reduce or eliminate future carbon and business leakage[2] effects of ReFuelEU. SAF-BAM aims to reduce the competitiveness distortions and carbon leakage created by ReFuelEU, by applying a border adjustment to equalise costs of ReFuelEU paid by EU operators and non-EEA operators. Routes expected to be at high risk of carbon leakage were selected for modelling, and the results find that SAF-BAM can significantly reduce carbon and business leakage on these routes. The policy is not without implementation challenges, therefore an initial legal and practical assessment is also provided.

This report focuses on passenger aviation. Future research and further analysis would be needed to define a separate mechanism for cargo aviation, where operational models and customer relationships differ quite drastically from passenger aviation.

Where limitations are identified in a SAF-BAM this report analyses other policy options to combat carbon leakage and provides an outlook for the policy process ahead. The aim is to improve the current policy mix on aviation departing from EU airports to allow effective decarbonisation and strong competitiveness to go hand-in-hand.

Carbon and business leakage risks for EU aviation

Different sources of carbon and business leakage are relevant for aviation in the context of EU climate policies[3]:

1. Hub-switching: Flying via non-EU hubs like Istanbul (IST), Dubai (DXB) instead of EU-hubs like Paris (CGE) or Frankfurt (FRA) to reduce the share of the journey covered by ReFuelEU.
2. Additional layover: Opting for a layover outside the EU instead of taking a direct flight as ReFuelEU only applies to the first leg of the journey.
3. Destination switching: EU residents choosing a non-EU holiday destination instead of an EU one to avoid costs from the EU ETS, or non-EU residents avoiding the EU as destination.

Using Deloitte's Aviation Competitiveness Model (DACM), this report models nine journeys that are particularly relevant for EU passenger and cargo airlines to quantify the carbon and business leakage from additional layovers and hub-switching.

[1] Working title.

[2] This analysis and modelling exercise focuses on hub switching and additional layovers as sources of carbon and business leakage. It does not examine leakage for intra-EU flights resulting from destination switching, and more work is required to determine the impact and remediation for this form of leakage.

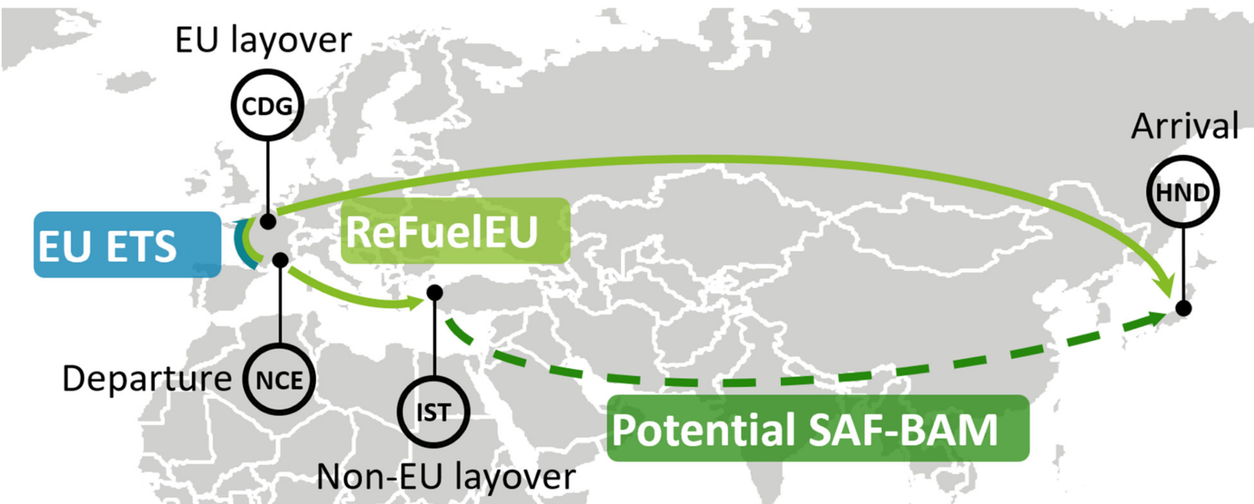
[3] This report focusses on ReFuelEU as source of carbon leakage. Modelling also includes the EU-ETS and CORSIA to show the combined impact of EU climate policies on aviation.

For example, passengers flying from Nice to Tokyo can choose between a layover in Paris or Istanbul (Figure 1). With the current policy setting, the flight from Nice to Paris is covered by the EU ETS, and both parts of the journey are subject to ReFuelEU. The journey via Istanbul is only covered by ReFuelEU until Istanbul and no equivalent climate policies apply for the transfer leg of the journey.

Already with a SAF mandate of 6% by 2030, carriers with an EU hub face a cost disadvantage compared to their non-EU competitors, leading to potential carbon and business leakage, as passengers will shift to carriers with lower climate policy costs. This is most explicitly the case in flights to Asia, which has several alternative hub airport options, where ReFuelEU increases the costs for carriers with an EU hub substantially while routes via Istanbul or Dubai face only minor cost increases.

These changes in costs affect the demand for carriers with an EU hub or for intra EU travel and can cause emissions to leak (Figure 2, left-hand side). For the journey from Nice to Tokyo, the modelled cost differential increases from 9 percent in 2024 in favour of the Istanbul route to 15 percent in 2030. The higher cost increase for the carrier with an EU hub results in business leakage of around 65 percent. Around two-thirds of reduced passenger numbers are gained by carriers with a non-EU hub on that route. With regard to carbon leakage, around 26 percent of achieved emissions reductions in the EU merely switch to carriers with non-EU hubs, who become more competitive as a result of EU climate policies and gain market share. The emissions are still released into the atmosphere, just by carriers with non-EU hubs instead, causing carbon leakage and making EU climate policies less effective.

Figure 1: Policy applicability of EU Climate policies in aviation



Source: Deloitte. Note: Arrows represent illustrative route

Legal and practical assessment of Border Adjustment Mechanisms in Aviation

The report analyses the legal and practical feasibility to implement a border adjustment mechanism. In the context of the upcoming review of the Carbon Border Adjustment Mechanism (CBAM), an EU tariff on carbon-intensive imported goods to face the same CO_2 costs as those produced within the EU, the existing CBAM could be extended to aviation services to mitigate carbon leakage caused by EU climate policies.

However, this report concludes that this is not legally and practically feasible. CBAM is designed for the import of industrial and energy goods into the EU and specifically tied to the EU ETS, preventing its adaptation to international aviation services affected by ReFuelEU.

A different system is required to cover international air transportation services departing from the EU A different form of border adjustment mechanism referred to in this report as a SAF=BAM could be implemented as legislation directly linked to ReFuelEU requirements. Table 1 summarises a potential design that balances effectiveness with high legal and practical feasibility.

Table 1: Description of a potential SAF-BAM design

Category	Description of the characteristics of the SAF-BAM mechanism
Purpose	Prevent carbon and business leakage due to ReFuelEU on passenger flights.
Regulatory Framework	Introduced via EU regulation, enforced by national authorities. Revenues generated from the sale of SAF-BAM certificates could be dedicated to further support the aviation sector, including for green transition projects.
Scope	Flights with passengers' original point of departure in the EU and transfer in a non-EU hub onto subsequent legs not covered under the current ReFuelEU framework.
Mechanism	Passenger data could be integrated with broader flight data systems to generate reports on SAF consumption per flight segment and per passenger. Alternatively, airlines could rely on default values based on average passenger occupancy for specific routes, such as EU hub to a specific non-EU hub, to calculate SAF consumption on each flight segment per passenger/per shipment.
Taxable event	Triggered when a passenger has bypassed SAF mandates by transiting through a non-EU hub instead of complying in full (i.e., for the end-to-end journey) with ReFuelEU obligations.
SAF-BAM certificates price	Platts Northwest Europe (NWE) SAF price assessments could be used as a basis, as they reflect prices relevant to key EU markets. This basis could be adjusted to reflect compliance, logistics and other additional costs.

Source: Deloitte

While there are challenges such as passenger data privacy concerns, the legal basis for SAF-BAM appears feasible, provided it is structured to align with the principles of international trade, including compliance with the ICAO, WTO's GATS and TBT agreements.

While the risk of carbon leakage is also pertinent to cargo aviation, further analysis of the applicability of a "SAF-BAM"-inspired mechanism or similar mitigation method to cargo is needed to establish a mechanism that duly considers the sector-specific concerns of all types of cargo aviation (belly-cargo and full-freighter operations).

A SAF-BAM would complement existing international frameworks such as CORSIA by incentivising the use of SAF for international flights to and from the EU. Based on the principles developed in this report, the area of greatest difficulties linked to the implementation of SAF-BAM mechanism will be achieving political support. To concretely design the mechanism, more work must determine how an appropriate border adjustment policy could work in detail to ensure it is fairly implemented and politically palatable without retaliation by third countries.

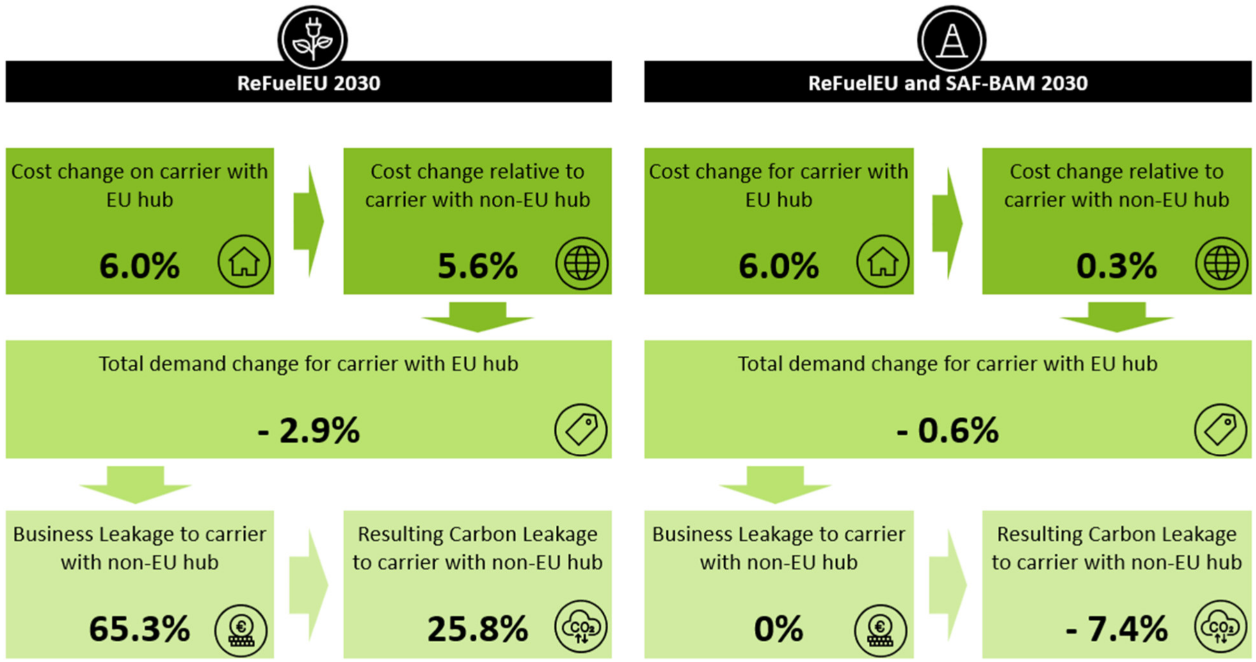
Analysing the potential impact of a SAF Border Adjustment Mechanism for carbon leakage

To create a more even playing field, SAF-BAM could extend ReFuelEU to charge the equivalent costs of using the SAF mandated by ReFuelEU to airlines with flights not subject to the mandate per passenger departing from the EU until their final destination. However, SAF-BAM cannot be applied to all journeys at risk of carbon leakage. It has the potential to mitigate competitive disadvantages for EU carriers that stem from ReFuelEU in the form of additional layovers and hub-switching for flights that originate in the EU. It does not cover cases of hub-switching, where the EU is neither origin nor destination, but only a hub, nor will it have a meaningful impact on cases of destination switching.

In addition to the analysis of the legal and practical feasibility to implement a SAF-BAM, the report conducts a quantitative analysis. The model results suggest that SAF-BAM is effective in levelling the cost differences from ReFuelEU where application of the mechanism is possible. SAF-BAM can even lead to negative carbon leakage in some cases and improve the competitiveness of carriers with EU hub. This is because routes via non-EU hubs often require more fuel for detours. SAF-BAM would increase the cost of such detours.[4]

Deloitte modelling suggests that a well-designed and enforced SAF-BAM could effectively mitigate carbon leakage (right-hand side of Figure 2). With the introduction of an SAF-BAM, the demand reduction of carriers using EU hubs for the route from Nice to Tokyo would be reduced from 2.9% to only 0.6%. In addition to the modest decline in demand for EU carriers, no passengers are expected to shift to non-EU competitors.

Figure 2: Impact to passenger journey from Nice to Tokyo



Source: Deloitte modelling

Alternative mechanisms to prevent carbon and business leakage

Where implementation limits have been identified for SAF-BAM, a sample of six alternative policies to address carbon leakage in aviation are assessed. The policies include establishing SAF Climate Clubs, strengthening CORSIA, introducing a SAF-Levy or SAF Buyer subsidies, extending SAF Allowances and implementing Tax Rebates. These measures can be categorised into three generic approaches:

1) pursuing international agreements to deliver equitable climate policy costs for all carriers;

2) balancing cost of compliance between carriers serving the EU market by either increasing the cost for carriers with a non-EU hub;

3) reducing costs for carriers with an EU hub.

A qualitative assessment of their economic and environmental effects as well as their legal, administrative, and political feasibility is provided.

If implemented individually, each policy has at least one structural weakness identified. Hence, a combination of different policy options appears optimal

[4] Note modelling does not include analysis of other SAF mandates under development or in force globally, or how SAF could also be more directly targeted by CORSIA - crucial elements that could change the impact and feasibility of the options.

Outlook for EU aviation

European aviation operates within a global industry, and in an optimal world, climate policy instruments of similar ambition would be implemented in all jurisdictions. However, in the current policy context, the EU's acceleration towards more ambitious climate policies presents a significant challenge in maintaining the competitiveness of its aircraft operators, until global climate policy instruments are strengthened (such as ICAO's CORSIA) and universally implemented.

A change in the EU's policy mix is therefore required to avoid carbon leakage and better reconcile its climate policy objectives with competitiveness concerns. EU policymakers should consider a combination of policies, that collectively work towards reducing aviation emissions, while minimising the risk of carbon leakage and maintaining the competitiveness of Europe's aviation industry. SAF-BAM could be part of a comprehensive strategy to address the complex issue of carbon leakage in the aviation sector.

A balance of reducing SAF costs for EU carriers, adapting costs for non-EU based carriers by SAF-BAM, and driving forwards international cooperation with countries hosting key non-EU hubs and strengthening CORSIA is required to achieve these policy objectives. Further work is needed to understand the interactions of the different policies discussed in this paper, accounting for competitiveness and climate implications.

Table of Content

1 Carbon leakage risk for EU aviation

Carriers with EU hubs already operate under significant competitive pressure today, particularly due to competition with carriers from the Middle East and Türkiye[5]. In addition, the EU sets additional climate policies that increase costs in the short term while decarbonisation options in the aviation sector remain expensive. This challenge has also recently been emphasised by the so-called "Draghi Report" on *The future of European competitiveness*, which underlines that the current EU climate legislation for aviation creates high costs and competitive disadvantages for carriers with EU hubs[6].

This section discusses first the climate policy landscape for the aviation sector in the EU and relevant competitors and derives relevant types of carbon leakage. Then these policy implications are modelled by Deloitte's Aviation Competitiveness Model (DACM) to derive impacts on cost, demand and carbon and business leakage. The results inform the subsequent analysis to look at options to prevent carbon leakage.

1.1 Policy Landscape

1.1.1 EU Policy

The EU has set its climate goal to reduce emissions by 55% by 2030 from the baseline of 1990 and to reach climate neutrality by 2050[7]. To achieve this, the European Green Deal and the corresponding Fit For 55 package foresee to reduce transport sector emissions by 90% by 2050[8]. Aviation emissions of flights starting from the Europe, standing at 164.9Mt CO_2 in 2023[9], will need to be reduced accordingly. This chapter lays out the state of EU legislation and describes two scenarios of how they could evolve until 2030.

ReFuelEU

ReFuelEU is a blending obligation for aviation fuel to include a share of sustainable aviation fuels (SAF) at EU airports, hence applying equally to most aircraft operators conducting commercial flights from those EU airports with annual traffic above 800,000 passengers or 100,000 tonnes of freight. The measure was introduced by Regulation (EU) 2023/2405, with a blending requirement of 2% SAF in kerosene from 2025, gradually increasing to 70% in 2050 (see Table 2).

The ReFuelEU legislation allows for using synthetic aviation fuels, aviation biofuels and recycled carbon aviation fuels as SAF and contains a specific sub-mandate for synthetic fuels, also referred to as renewable fuels of non-biological origin (RFNBOs). The policy reduces the net-CO_2 emissions from flights departing the EEA but also increases costs for airlines departing from EU airports, as SAF is priced at a multiple of fossil kerosene. While price estimates vary, a recent IEA study (2024) estimates the costs of biomass-based SAF at 2713€/t[10] in 2030 in the EU, while synthetic SAF is estimated to cost 3932€/t[11] by an NLR/SEO study, both being multiples of fossil kerosene prices that are currently around 685€/t[12]. The large-scale rollout of various production technologies is expected to drive down production costs over time, thanks to the technological learning curve. Prices are projected to remain significantly higher than those of conventional kerosene. However, SAF price projections are subject to uncertainty

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[5] Centre for Strategy and Scenario Planning (2022). Future Scenarios for the European Airline Industry

[6] Draghi (2024). The future of European Competitiveness.

[7] Official Journal of the European Union, Regulation (EU) 2021/1119

[8] European Commission (2021) Putting European transport on track for the future

[9] Including EU27, Norway, Iceland, Switzerland and the UK, see: Transport & Environment (2024) Above the clouds: European aviation emissions in 2023

[10] IEA (2024) Global Hydrogen Review 2024

[11] NLR/SEO (2025) Destination 2050 - Roadmap

[12] IATA (2025) Jet Fuel Price Monitor, (accessed 18.12.2024)

as SAF production and market scale up is yet to be achieved. Shortages in production inputs and available quantity may occur for both biofuels and synthetic SAF[13], leading to a risk of sustained high prices.

To avoid the carbon leakage associated with the practice of "fuel tankering", where plane operators carry excess fuel from non-EU airports to minimise refueling at EU airports and circumvent higher prices of SAF-blended fuel, ReFuelEU contains an obligation to refuel 90% of required fuel at EU airports. This essentially avoids carbon leakage from tankering.

Table 2: ReFuelEU: Minimal requirements for aviation fuel supplied at EU airports

Year	2025	2030	2032	2035	2040	2045	2050
SAF (total)	2 %	6 %	6 %	20 %	34 %	42 %	70 %
Synthetic SAF	0 %	1,2 %	2 %	5 %	10 %	15 %	35 %

Source: Official Journal of the European Union, Regulation (EU) 2023/2405

EU ETS

The carbon pricing mechanism EU ETS covers the emissions from aviation for intra-EEA[14] flights and flights from EEA to the UK and Switzerland. To comply, aircraft operators must surrender allowances for each tonne of CO_2 they emit. While airlines received approximately 85% of allowances for free until 2023, free allocations are currently being reduced by 25% in 2024 and by 50% 2025 before moving to full auctioning of the allowances by 2026[15]. The phase-in of full auctioning marks a significant cost increase for airlines operating intra-EEA flights. EU ETS allowance prices were at an average of 66.38€ per t/CO_2 in 2024 and are estimated to grow to 137.5€ per t/CO_2 by 2030[16]. This would amount to prices of 209.80€ and 434.50€ respectively per tonne of kerosene[17], increasing the price of using kerosene on intra-EU flights by 25% from 2024 to 2030.

EU Carbon Border Adjustment Mechanisms

The Carbon Border Adjustment Mechanism (CBAM) currently applies to imports of energy-intensive goods such as cement, iron and steel, aluminium, fertilisers, electricity, and hydrogen. The core concept of CBAM is to ensure that importers of these goods face the same carbon price as domestic producers, thereby fostering a level playing field. At the same time, a carbon border mechanism should account for climate policies in other jurisdictions.

Chapter 2 elaborates on the details of the current CBAM and develops how a CBAM-like instrument in aviation could be designed.

1.1.2 Overseas national policies (non-EU)

Most other jurisdictions lag behind in regulatory carbon pricing and SAF mandates in comparison to the EEA. To compare the potentially distortive cost impacts of EU policy, it is crucial to include the implications of third country policies where applicable. In the following section, respective policies of third countries are presented with a focus

[13] EASA (2025) European Aviation Environmental Report 2025

[14] The European Economic Area (EEA) contains Iceland, Liechtenstein and Norway in addition to the EU member states.

[15] EU Commission (2024) Reducing emissions from aviation

[16] Median of price projections of 14 different organizations by April 2024: CAKE/KOBise, Capital Economics, Carlton Carbon, Commerzbank, Enerdata, Energy Aspects, Engie EnergyScan, Macquarie, Morgan Stanley, Pact Capital, LSEG/Refinitiv, Vertis, Veyt, Volue Insight.

[17] German Emissions Trading Authority (2024) Emission Factor for jet Kerosene

on Türkiye, the Middle East, the UK and the US, whose large aviation hubs have the potential to play key roles in EU carbon leakage in aviation.

Regulatory carbon pricing

Most non-EU countries do not use carbon pricing instruments for aviation, including jurisdictions with airport hubs near the EEA, which compete for air traffic with EU hubs. For example, Türkiye plans to start a national carbon trading scheme (TR-ETS) in 2025, but it will exclude the aviation sector, focusing solely on energy and industry. Similarly, the UAE currently lacks carbon pricing, and while discussions are ongoing, no concrete measures have been introduced. Saudi Arabia, Qatar and the US also do not apply a carbon price to aviation.

An exception is the UK, which has a system similar to the EU ETS that includes aviation. The UK ETS is expected to develop almost in parallel with the EU ETS, applying to flights with destination in the EEA and Switzerland. Currently, the UK ETS price is lower than the EU ETS, averaging 47.08€ in 2024[18] (EU ETS: 66.49€).

SAF Mandates

No jurisdiction with major aviation hub in direct competition with EU aviation hubs other than the UK and Norway currently has a legislated SAF mandate for 2030[19]. To avoid carbon leakage, a situation with equivalent SAF mandates across jurisdictions would be ideal. In Türkiye a legislative proposal is pending, that would start a SAF mandate of 1% in 2025/2026 and would lead to a 5% blending rate in 2030[20]. As the policy is not yet passed, it is not included into this study's calculation. The UAE, Saudi Arabia, Qatar as well as the US do not have an SAF mandate in place. The UK's SAF mandate legislation will come into effect in 2025. From then onwards, the mandate will require 2% of all jet fuel tanked in the UK be made up of sustainable fuel. This will increase to 10% in 2030 and to 22% in 2040[21]. Norway's government has enacted an SAF mandate in 2020, and Switzerland's government has declared its intention to guide its legislation by the ReFuelEU mandate[22].

1.1.3 International measures

CORSIA

In addition to carbon pricing mechanisms like emissions trading schemes or carbon taxes, airlines may also be affected by carbon credit markets, such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Starting in 2027, CORSIA will be mandatory for international flights between 193 countries. It has already been implemented into EU law for international flights leaving the EU.

Under CORSIA, airlines are required to purchase and retire eligible carbon offset credits for a share of their emissions if sectoral emissions exceed the baseline of 85% of 2019 emissions. The cost of these carbon credits varies depending on the type of project. Prices in 2024 are quantified at 17-48€ per t/CO_2, but estimates suggest prices will be in the range of 27-82€ per t/CO_2 in 2030[23] for ICAO-accepted carbon credits[24].

To date, the Sectoral Growth Factor, which determines the share of emissions that airlines must offset under CORSIA, has been set to zero for the reporting years 2021, 2022, and 2023. However, projections indicate it could

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[18] Intercontinental Exchange (2024)

[19] IEA Bioenergy (2024) Progress in Commercialization of Biojet /Sustainable Aviation Fuels (SAF): Technologies and policies

[20] ICAO (2023) The European SAF policy landscape

[21] UK Department of Transport (2024) Written statement to Parliament: Sustainable aviation fuel initiatives

[22] The Federal Council of Switzerland (2024) Bundesrat eröffnet Vernehmlassung zur CO_2-Verordnung

[23] MSCI (2024) CORSIA: Costs and Implications for the Airline industry, November 2024

[24] Prices are likely to decrease if the EU introduces its Emissions Trading System (EU-ETS) for flights entering and leaving the European Economic Area (EEA). This would exempt these routes from CORSIA, reducing the demand for ICAO-eligible credits by an estimated 25-50%.

be positive for 2024. If this occurs, airlines would, for the first time, be required to purchase and retire carbon credits to meet their obligations.[25] By 2030, only 12.8% of emissions are estimated to be paid for under CORSIA at a substantially lower price than use of SAF. Still, SAF use under the ReFuelEU mandate can be deducted from CORSIA obligations for SAF that meets both EU RED and CORSIA sustainability criteria[26]. Compatibility between the two criteria for SAF remains an issue, as dual conformance is only possible if both certificates are obtained separately.

1.2 Types of Carbon Leakage

Carbon leakage in the aviation sector occurs when carbon pricing or regulatory climate policies like ReFuelEU are introduced asymmetrically between jurisdictions, increasing operating costs unevenly. Flight routes shift to take advantage of the cost differential, causing emissions to leak elsewhere and potentially increase rather than being mitigated. The occurrence of carbon leakage can partially or fully undermine the intended effects of climate policy. With emissions, economic factors like revenues or employment usually leak as well, also known as business leakage[27]. Leakage in aviation can occur in both passenger and cargo transportation, but not all cost increases result in leakage. Factors that increase the occurrence of carbon leakage include high cost differentials, price-sensitive consumers[28], and readily available alternatives[29]. Different types of carbon leakage are relevant for aviation in the context of the EU's current climate legislation.

1. Hub-switching: Many airlines rely on transportation hubs like Frankfurt (FRA) or Paris (CDG). With the ReFuelEU mandate applying only to flights starting in the EU, non-EU hubs like Istanbul (IST), Dubai (DXB) or Doha (DOH) gain a competitive advantage, as they do not face similar climate policies. This type of carbon leakage applies to outbound journeys departing in the EU, layover journeys departing from outside the EU towards the EU and transit layover journeys via the EU.
2. Additional layover: Opting for a layover outside the EU instead of taking a direct flight. An outbound direct flight from the EU is covered by the ReFuelEU mandate, which increases fuel costs for the entire journey. However, as ReFuelEU only applies to the first leg of a layover flight via a non-EU hub, the transfer flight would not be required to use SAF, leading to lower fuel costs for the second part of the journey. An example would be to replace a direct flight from Paris (CDG) to Hong Kong (HKG) with a layover in Istanbul (IST).
3. Destination switching: Destination switching occurs when customers switch from their original destinations to neighbouring destinations (short-haul switch) or even to long-haul destinations (long-haul switch) due to climate policy requirements, particularly the EU ETS. Destination switching primarily occurs in the passenger leisure segment. With higher costs associated with flying within the EU regulatory framework, leisure passengers may for example opt for vacation in a Turkish holiday destination instead of flying to Greece or decide for different kind of vacation, e.g. in South-East Asia that becomes more affordable relative to EEA destinations. Studies have identified destination-switching, which largely derives from the EU ETS scope on intra-EEA flights, as a significant source of carbon leakage[30], as passengers are encouraged to fly out of Europe to avoid increase in price. Destination switching can also occur for passengers starting

[25] The ICAO publishes the Annual Sector Growth Factor that informs the calculation of the amount of CO_2 emissions required to be offset in a given year in Q4 of the following year.

[26] IATA (2024) ReFuelEU Aviation Handbook, September 2024

[27] For the remainder of the report, the term carbon leakage is used to also include business leakage, unless addressed separately.

[28] Wei and Kallbekken (2024) Carbon leakage from aviation under the European Union Fit for 55 policies

[29] Buissing (2022) EU Air Transport and the EU's Environmental Agenda Struggle: A Leap of Faith or Can a CBAM Level the Playing Field?

[30] Steer, Carbon leakage risks from scope of aviation policy measures in 'Fit for 55', 2022

their journeys outside the EU, who may opt for a different destination than the EU due to increased ticket prices for their return flights.[31]

The resulting leakage can manifest itself in various forms. It could lead to higher total CO_2 emissions, fewer passengers and cargo on remaining flights, cancellation of flights, insolvency of carriers and even downsizing of airports.

1.3 Modelling

This section presents the results of modelling the impacts of the policy landscape on key journeys operated by EU airlines, using Deloitte's Aviation Competitiveness Model (DACM). Section 1.3.1 and 1.3.2 present the routes and scenarios modelled, Section 1.3.3 discusses the impact of the policies on flight costs and Section 1.3.4 analyses how the cost changes affect demand for EU airlines and result in carbon and business leakage. Throughout the modelling, SAF-BAM is assumed to be able to capture all fuel use as effectively as ReFuelEU and no avoidance or enforcement challenges arise. These are discussed in Section 2.

A summary of the modelling approach and key assumptions is provided in the Annex.

1.3.1 Modelled Routes

This report examines nine journeys that are particularly relevant for European airlines with respect to carbon leakage, both passenger and cargo journeys. Table 3 displays these journeys, the corresponding airport codes are listed in the Annex. For each journey, the route an airline with an EU hub would fly is compared to alternative routes to the same destinations that airlines with non-EU hubs would cover. The selection covers journeys from the EU to Asia, North America and North Africa, as well as flights from North America to Asia that could have a layover in the EU. One intra-EEA journey is included in the modelling to demonstrate the cost implications from the EU ETS.

Table 3: Modelled routes

Service	Journey	Route	Likely carrier hub location	Share of distance covered EU ETS (%)	Share covered ReFuelEU (%)	Additional distance to shortest route (%)[32]
Passenger	Stockholm (ARN) – Athens (ATH)	Direct	EU	100	100	-
	Barcelona (BCN) – Tokyo (HND)	Direct	EU	0	100	-
		Via Istanbul (IST)	Non-EU	0	20	7
		Via Abu Dhabi (AUH)	Non-EU	0	39	26
	Nice (NCE) – Tokyo (HND)	Via Paris (CDG)	EU	7	100	-
		Via Istanbul (IST)	Non-EU	0	17	4
		Via Dubai (DXB)	Non-EU	0	38	22
	Lyon (LYS) – Bangkok (BKK)	Via Amsterdam (AMS)	EU	7	100	5
		Via Istanbul (IST)	Non-EU	0	21	-
		Via Dubai (DXB)	Non-EU	0	50	5
		Direct	EU	0	100	-

[31] This report does not focus on EU ETS destination-switching and focuses instead on the distortions arising from the all-departing-flights scope of ReFuelEU.

[32] Great Circle Distance; does not account for the current detours due to the unavailability of Russian airspace.

Service	Journey	Route	Likely carrier hub location	Share of distance covered EU ETS (%)	Share covered ReFuelEU (%)	Additional distance to shortest route (%)[32]
	Frankfurt (FRA)- Los Angeles (LAX)	Via Istanbul (IST)	Non-EU	0	14	38
	Paris (CDG) – Dakar (DSS)	Direct	EU	0	100	-
		Via Madrid (MAD)	EU	25	100	-
		Via Istanbul (IST)	Non-EU	0	30	79
	Montreal (YUL) – Delhi (DEL)	Via Frankfurt	EU	0	51	-
		Via Istanbul (IST)	Non-EU	0	0	2
		Via Dubai (DXB)	Non-EU	0	0	7
Cargo	Frankfurt (FRA) – Hong Kong (HKG)	Direct	EU	0	100	-
		Via Istanbul (IST)	Non-EU	0	19	8
		Via Dubai (DXB)	Non-EU	0	45	18
	Chicago (ORD)- Hanoi (HAN)	Via Luxemburg (LUX)	EU	0	56	16
		Via Istanbul (IST)	Non-EU	0	0	19
		Via Anchorage (ANC)	Non-EU	0	0	-

Source: Deloitte based on A4E input and own modelling

1.3.2 Scenarios

The modelling covers two scenarios of policy combinations in EU aviation policy that can be envisioned for the year 2030, and compares their key parameters with a baseline scenario, i.e. the status quo of 2024 (see Table 4). Policy scenario 1 *ReFuelEU* assesses the effects of a continuation of currently legislated policies in the year 2030 and illustrates the risks of carbon leakage that emerge with an uneven playing field. Following this, in policy scenario 2 *ReFuelEU & SAF-BAM* the effect of a CBAM-like mechanism for aviation is added to the model to address carbon leakage caused by ReFuelEU.

Table 4: Modelled scenarios

Dimensions	Baseline 2024	ReFuelEU 2030	ReFuelEU & SAF-BAM 2030
EU ETS coverage intra-EEA flights	Covered	Covered	Covered
EU ETS coverage extra-EEA flights	Only outbound to UK & CH	Not covered	Not covered
EU ETS price	66 €/tCO_2 (avg. 2024 until Dec 16)	138 €/tCO_2 [33]	138 €/tCO_2
EU ETS free allowances	64%	0%	0%
ReFuelEU SAF Mandate	0%	6%	6%
SAF Price (biomass) SAF Price (synthetic) ReFuelEU mix[34] (assuming minimum synthetic share)	None	2713 €/t 3932 €/t 2957 €/t	2713 €/t 3932 €/t 2957 €/t
CORSIA application	Outbound and incoming flights (except UK & CH) with participating countries	Outbound and incoming flights (excluding EU ETS leg)	Outbound and incoming flights (excluding EU ETS leg)
Share of emissions priced under CORSIA on affected flights (offsetting requirement)	0%[35]	12.8%[36]	12.8%
CORSIA price	NA	54 €/tCO_2[37]	54€/tCO_2
SAF-BAM Coverage	None	None	Outbound passenger/cargo journey (excluding ReFuelEU part)
SAF-BAM Price	None	None	Price difference SAF-kerosene (see section 2)

Source: Deloitte

While many of the values in the above tables are uncertain, prices for synthetic SAF are particularly uncertain. The market today is small, and prices are more than twice as high as the used forecast for 2030.[38] The projected cost decrease depends on a variety of factors, including technology cost decrease and sufficient supply. A higher SAF price would increase the cost and leakage impact described in the upcoming sections.

[33] Median of price projections of 14 different organizations by April 2024: CAKE/KOBise, Capital Economics, Carlton Carbon, Commerzbank, Enerdata, Energy Aspects, Engie EnergyScan, Macquarie, Morgan Stanley, Pact Capital, LSEG/Refinitiv, Vertis, Veyt, Volue Insight.

[34] The EU ETS allowance support for SAF is not modelled due to its limited impact on long-haul flights.

[35] Decision if threshold for 2024 offsetting is reached has not been published yet. In 2023, the threshold was not reached.

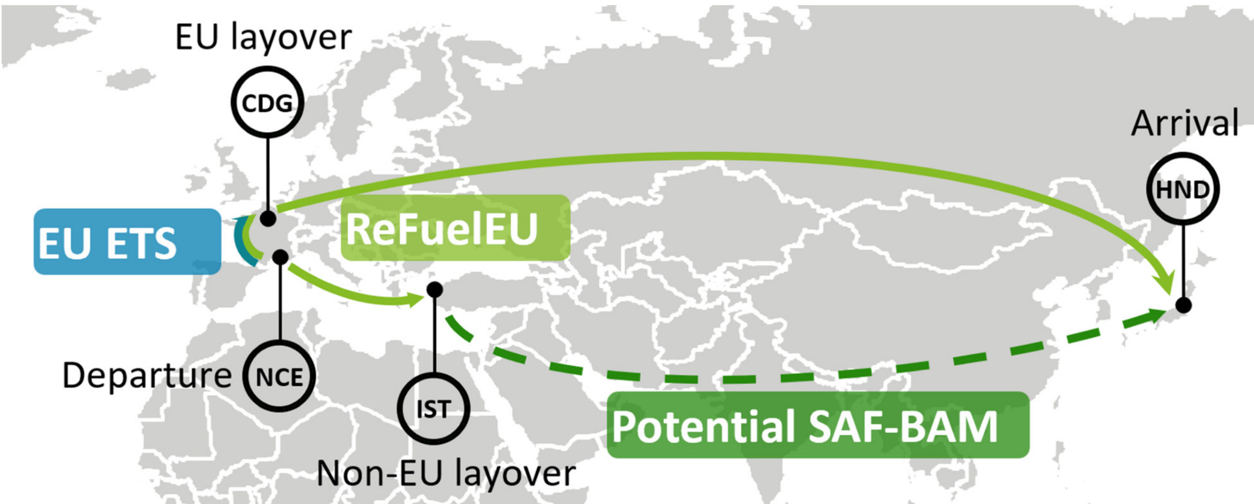
[36] Deloitte calculation based on Abatable & ICAO data. Specified price only refers to SAF component, not the fossil fuel component.

[37] Average of price range from MSCI (2024) CORSIA: Costs and Implications for the Airline industry.

[38] EASA (2024). State of the EU SAF market in 2023

The policies apply differently to flights based on the departure and arrival airports. Figure 2 illustrates this for the journey from Nice to Tokyo. If both departure and arrival airports are in the EEA – such as for the flight from Nice to Paris – the flight is covered by the EU ETS in all scenarios. If the departure airport is in the EU – such as from Nice to Paris, from Paris to Tokyo and from Paris to Istanbul – the ReFuelEU SAF mandate applies in 2030. If a flight departs from outside the EU but is part of a journey that departed from an EU airport – such as from Istanbul to Tokyo – SAF-BAM would be applicable in the corresponding scenario.

Figure 2: Policy coverage



Source: Deloitte. Note: Arrows only represent illustrative route

1.3.3 Impact on Costs

The modelling shows that EU policies on aviation create uneven cost increases for journeys based on the location of departure and destination airport. These costs are often higher for EU airlines, whose departure and transit airports are more exposed to EU climate policies. This often exacerbates existing cost advantages for competitors, particularly from the Middle East and Türkiye.

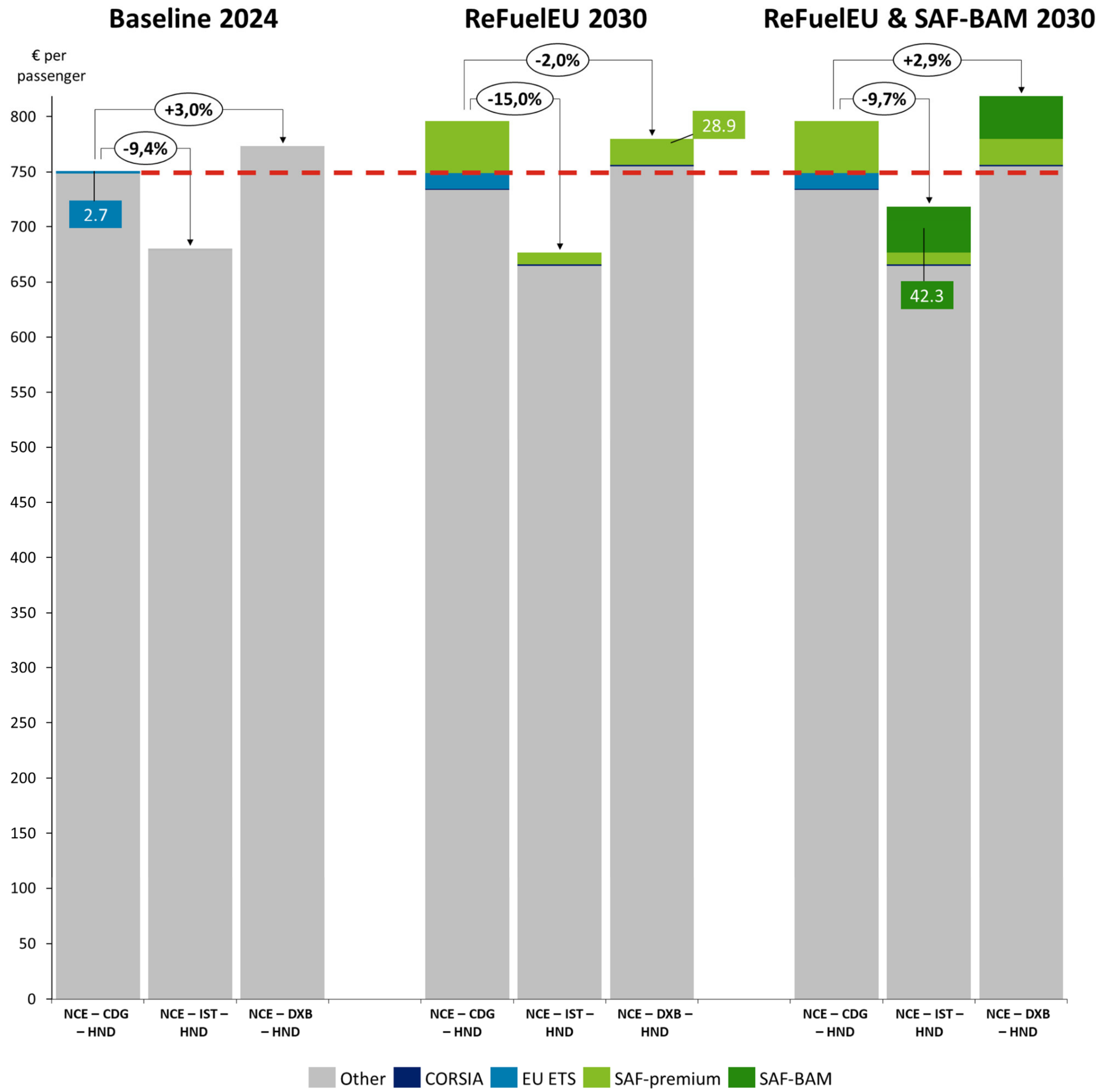
Passenger

The columns in Figure 3 represent the resulting cost per passenger for the journey from Nice to Tokyo. Total costs per passenger consist of policy costs and other costs. While climate policy costs for CORSIA, EU-ETS, SAF-Premium[39] and SAF-BAM are shown individually, other costs such as aircraft costs, crew or kerosene costs are summarised under other costs. These also include costs associated with layovers. Having an additional layover at a hub outside the EU adds costs compared to direct flights in this category, particularly in additional airport fees. For other costs the model distinguishes between regional kerosene prices and airport fees as well as between the cost structures of carriers. Moreover, the model includes annual efficiency gains in aircraft fuel burn, reducing fuel burn per unit in 2030 compared to 2024.[40].

[39] The SAF-Premium is defined as the difference between the costs of SAF and the costs of the same volume of kerosene. This allows a better comparison to the costs of SAF-BAM, which is levied based on the cost difference between SAF and kerosene

[40]Efficiency gains based on Fleming, de Lépinay and Schaufele (2022) Environmental Trends in Aviation to 2050.

Figure 3: Cost impact of different climate policies on passenger flights from Nice to Tokyo



Source: Deloitte modelling

Among the nine journeys analysed, the journey from Nice to Tokyo is particularly affected by the uneven impacts of EU climate policies (Figure 3). On this journey, a layover in Istanbul is a viable alternative that does not increase total travel time substantially since the route operated by EU airlines also requires a layover.

In the *Baseline 2024* scenario, the route via Istanbul is already cheaper than the route via Paris. Both routes have the same number of layovers, and the distance is similar (see Table 3). Furthermore, given that non-EU airlines on average have a lower cost structure compared to EU airlines[41], this results in a lower cost for the flight via Istanbul operated by a non-EU airline for this specific journey. The alternative via Dubai, on the other hand, results in a substantial increase in travel time and therefore higher kerosene usage and higher overall costs than the flight via

[41] Deloitte analysis based on company reports from EU and non-EU airlines.

Paris. In addition, the intra-EU leg is covered by the EU-ETS, while the first leg of the alternatives goes directly outside the EU.

In the *ReFuelEU 2030* scenario, the introduction of the 6% SAF mandate for flights leaving the EU in 2030 creates higher cost impacts for the routes that have a larger part of the distance covered by flights departing from an EU airport. Consequently, the existing cost differential between the route via Paris and the route via Istanbul increases from 9.4% to 15.0%. Compared to the route via Dubai, ReFuelEU increases the cost for the route via Paris over those for the route via Dubai, thereby stimulating additional fuel burn and CO_2 emissions. These cost changes will be much higher beyond 2030 as the ReFuelEU increases its mandated share over time, more than the unit cost of SAF (€/tonne) is anticipated to reduce – further increasing the disadvantage for carriers with an EU hub. Furthermore, if SAF prices do not decrease as anticipated, the price differential would be even higher.

The *ReFuelEU & SAF-BAM 2030* scenario levels the cost impacts introduced by ReFuelEU and might even decrease some of the pre-existing cost differentials of the Baseline 2024 scenario. This effect comes into play if the additional flight distance is sufficiently higher on the alternative routes. In this case, the cost increase through ReFuelEU and SAF-BAM is slightly greater than the SAF cost increase for the route via an EU hub. The cost differential between the route via Paris and the route via Istanbul still increases by a marginal 0.3 percentage points, thereby levelling out the negative cost impact of ReFuelEU effectively and reinstating the initial cost differential compared to the *Baseline 2024* scenario. In comparison to the route via Dubai, the route via Paris has a slight increase in cost competitiveness of 0.1 percentage points in the SAF-BAM scenario compared to the Baseline 2024 scenario. Overall, routes via hubs that require a significant detour would become less attractive.

In summary, the introduction of ReFuelEU leads to a relative decrease in cost competitiveness for carriers with an EU hub compared to the routes via Istanbul and Dubai of 5.6 and 5.0 percentage points, respectively. On the contrary, a parallel introduction of a corresponding SAF-BAM would level the unequally distributed competitive distortions introduced by ReFuelEU for EU carrier for this journey. Compared to the Baseline 2024 scenario, there would only be a 0.3 percentage points increase in costs differential to the Istanbul alternative and a 0.1 percentage points decrease in cost differential compared to the Dubai alternative compared to the Baseline 2024 scenario. Yet, the Istanbul alternative would remain the cheapest option in this scenario.

Across all modelled flights[42], we see an average increase in costs for carriers with an EU hub of 4.3% in the ReFuelEU scenario. This corresponds to an average increase in the cost differential between the carriers with an EU hub and their cheapest competitor with a non-EU hub of 3.8 percentage points. Introducing a parallel SAF-BAM proves to be effective in levelling out the negative impact of the unequal cost increases in the modelling by reducing the increase in the cost differential between the carriers with an EU hub and their cheapest competitor with a non-EU hub to only 0.1 percentage points on average.

Cargo

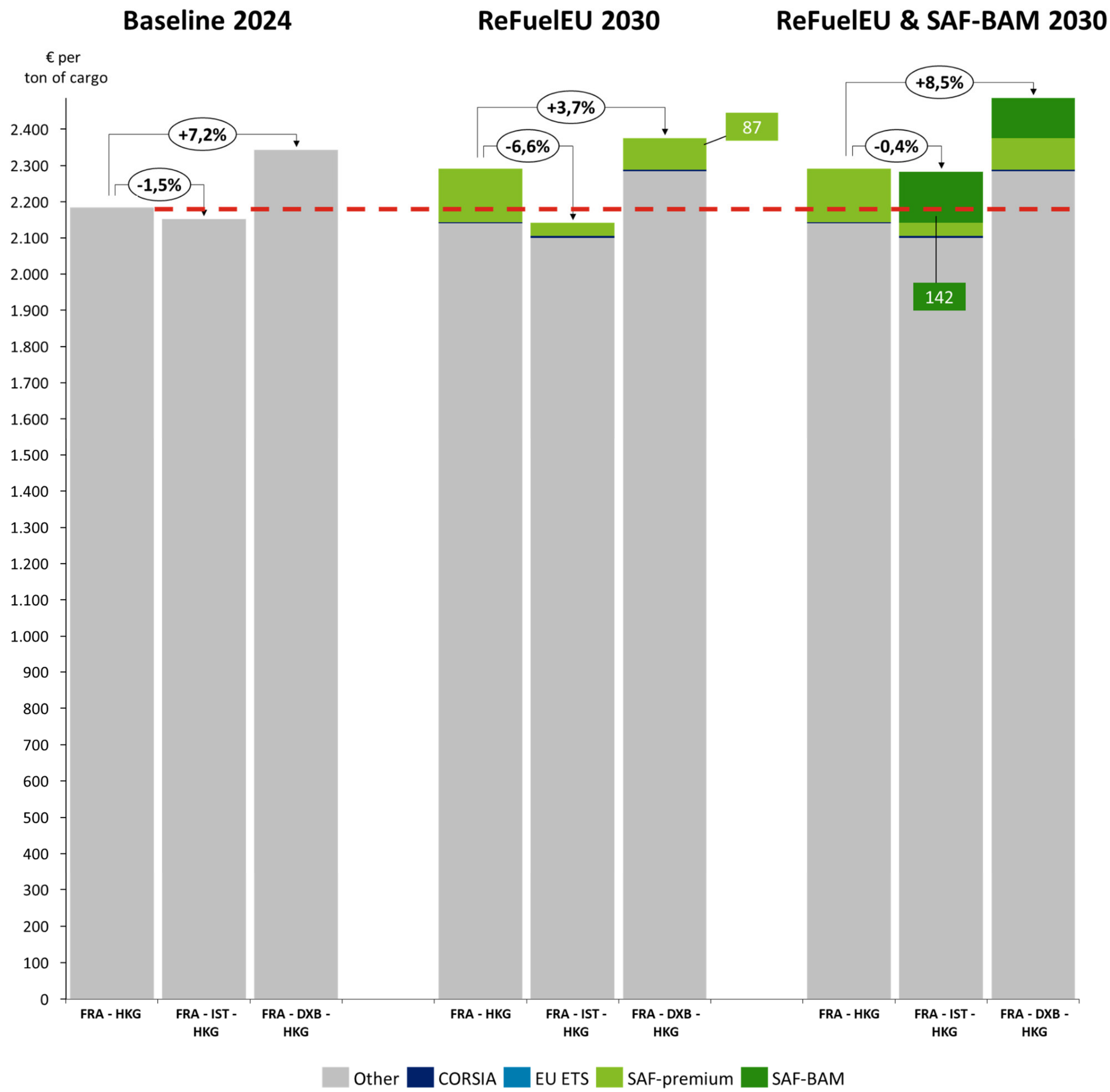
The air cargo business differs from passenger services in many ways. For example, whereas for passenger flights it is not common to route an aircraft in a triangle or even multi-angle, all-cargo operations can offer both direct flights and flights operating via a number of other (EU and non-EU) airports, depending on commercial interests and technical reasons. An all-cargo plane from an EU airport to East Asia may therefore fly either directly, or stop at various other airports along the route to on- and off-load cargo from any of these points for another point along the route within the constraints of customer demand and given traffic rights. In addition, modal switching may occur whereby cargo changes modes of transport (e.g. road feeder services (RFS) that may operate over EU-borders). Furthermore, cargo shipments are often transported in the bellies of passenger aircraft, especially on long-haul flights. This means that cargo operations and businesses are uniquely more complex to model than passenger aviation. The analysis given below focuses on a simplified version by comparing a direct flight from the

[42] Excluding the flight from ARS to ATH as it is only full Intra-European flight and therefore in the ReFuelEU 2030 scenario subject to sharp increase in ETS price.

EU to East Asia, to a flight via a non-EU hub. Further modelling would be required to capture the complexity of air freight operations.

For cargo, one of the most impacted journeys is also an intercontinental connection to Asia, from Frankfurt to Hong Kong. A direct flight is compared to routes via Istanbul and Dubai, respectively. The model follows the same logic by estimating the costs of flights, Figure 4 shows the costs per tonne of cargo instead of per passenger.

Figure 4: Cost impact of different climate policies on cargo flight from Frankfurt to Hong Kong



Source: Deloitte modelling

Overall results regarding price differentials are comparable to the discussed passenger journeys. In the *Baseline 2024* scenario there is an existing price disadvantage for carriers with an EU hub compared to the alternative route via Istanbul, because lower other costs such as lower labour or fuel offset the additional distance flown on this route. This price disadvantage increases significantly in the *ReFuelEU 2030* scenario. However, the introduction of SAF-BAM leads almost to a level playing field on this journey between the EU direct route and the route via Istanbul, as cost increases through ReFuelEU and SAF-BAM exceed the additional policy costs on the direct route. The route via Dubai remains more costly throughout all three scenarios. This underlines the conclusion that especially alternatives containing short initial outbound flights leaving the EU and limited additional total flight time pose a carbon leakage risk.

One major difference to the discussed passenger journey previously is that carriers with an EU hub may offer a direct flight from an EU departure airport such as Frankfurt to Hong Kong while both EU carriers and non-EU carriers regularly also fly via non-EU hubs. Flying via non-EU hubs also adds additional airport charges to the costs of these hub routes, though these are usually lower compared to passenger flights. As for passenger flights, carriers with a hub outside of the EU (and the US) are assumed to have lower other costs per unit. In the Baseline 2024 scenario, there is a slight total cost advantage of 1.5% for the route via Istanbul given the current policy landscape. With the introduction of ReFuelEU, this cost differential changes to 6.6%, making the route via Istanbul much more attractive than a direct flight from the EU. However, introducing SAF-BAM would bring that cost differential to almost zero. The difference in cost differential from scenario one to three results in the overall longer travel time for the route via Istanbul. Consequently, imposing the same SAF costs per unit of fuel as for ReFuelEU would result in overall higher SAF costs.

Overall, while the introduction of ReFuelEU leads to a relative decrease in cost competitiveness for EU cargo carriers compared to the routes via Istanbul and Dubai from 5.1 and 3.2 percentage points, respectively, a parallel introduction of SAF-BAM would improve the relative competitiveness of the EU carriers by 1.1 percentage points compared to both alternatives. This would level out the cost disadvantage of the direct flight from Frankfurt to Hong Kong in the Baseline scenario, making it competitive on this journey.

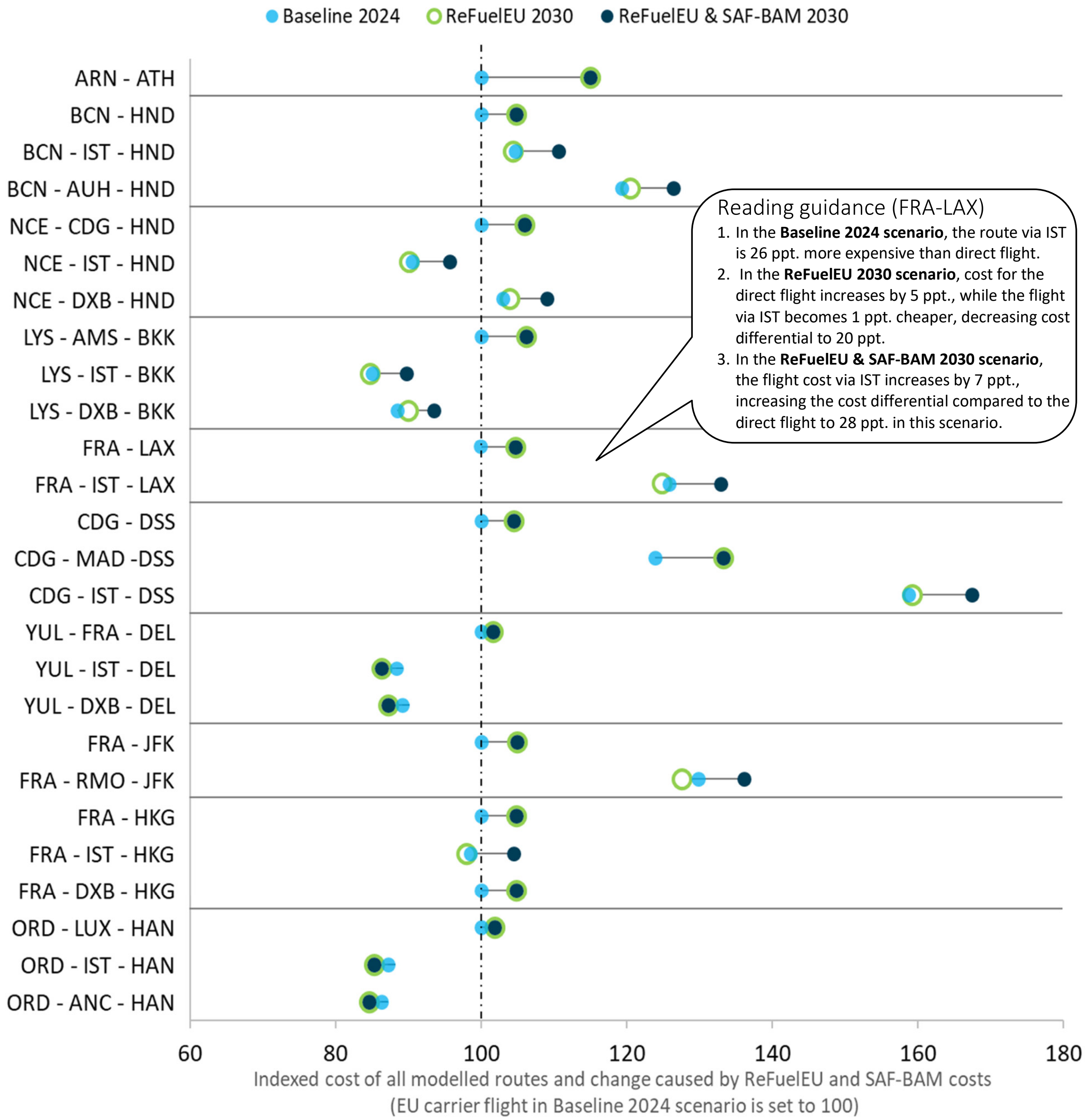
Cost comparison for all modelled journeys

Figure 5 displays the cost impacts on all modelled journeys and routes across the three scenarios. This provides an overview of initial cost differentials and how they develop with the introduction of the ReFuelEU policy and a potential SAF-BAM.

For all three scenarios, the indexed costs for each alternative on the nine modelled journeys are shown. For every journey, the costs of the first route, representing a carrier with an EU hub, are indexed to 100 percent. Accordingly, the figure shows the relative cost differential compared to the alternative routes to the EU-carrier flight in each of the three scenarios by route. Therefore, it not only shows the initial cost differentials, but also the development of the relative cost differentials across the *ReFuelEU 2030* and the *ReFuel & SAF-BAM 2030* scenario. This allows to compare the relative impact of the ReFuelEU and SAF-BAM policies for each route. Moreover, it allows to investigate how different regions might be affected to varying degrees.

In general, cost increases from the Baseline 2024 to the *ReFuelEU 2030* and the *ReFuel & SAF-BAM 2030* are observable. However, due to the assumption of increasing efficiency in fuel use there are flights that are cheaper in the ReFuelEU 2030 scenario if they are not subject to ReFuelEU.

Figure 5: Indexed costs of all modelled routes and change caused by ReFuelEU and SAF-BAM costs (EU carrier flight in Baseline 2024 scenario is set to 100)



Source: Deloitte modelling

Across all routes, the cost differentials caused by ReFuelEU are highest if a competitor is able to only fly a small share from an EU airport and the longest part of the journey from a non-EU airport. In contrast, impacts are lower if the hub is closer to the middle of the journey.

Overall, there is a clear distinction between the regions of destinations. Most affected by ReFuelEU and a respective SAF-BAM are flights from the EU to Asia. In the considered journeys, these are the passenger flights Barcelona – Tokyo, Nice – Tokyo and Lyon – Bangkok and the cargo flight Frankfurt– Hong Kong. Especially the Istanbul hub is a competitive alternative as the additional distance flown is very limited and the leg covered by ReFuelEU is much shorter than for the Dubai alternative. To a lesser degree, flights are affected from North America to Asia. Here the layover in the EU becomes even less attractive compared to a layover at a non-EU or Non-UK hub. These can be observed for the passenger flight Montreal - Delhi and for the cargo flight Chicago – Hanoi. The largest increase in costs experiences the flight from Stockholm to Athens as it is covered entirely by ReFuelEU and the EU ETS. While not explicitly modelled here, other studies find significant carbon leakage risk due to destination switching associated with cost increases for intra-EU flights.[43]

Flights where the potential avoidance hub requires a significant detour are not becoming competitive even despite asymmetrical cost increases in the second scenario. This, for example, is true for routes between the EU and Western Africa, such as Paris – Dakar, or North America, such as Frankfurt – Los Angeles or Frankfurt – New York. This remains the case irrespective of whether the flight under investigation is for passengers or cargo.

Regarding initial cost differential and cost development along scenarios, the results from Figure 3 and Figure 4 are confirmed: SAF-BAM appears effective in levelling the asymmetric cost implications of ReFuelEU. Moreover, for longer detours of alternatives, the SAF-BAM costs exceed the ReFuelEU costs for the shorter alternative. Therefore, it not only provides a more level field regarding ReFuelEU, but on certain routes, it might also decrease initial cost differentials and increase competitiveness of carriers with an EU hub. Overall, the flight distance remains decisive even with the introduction of ReFuelEU and a corresponding SAF-BAM. Hence, carriers are more competitive on routes where they operate a direct flight compared to flights via a hub.

1.3.4 Demand, carbon leakage and business leakage

The cost changes described above translate into changes in demand, emissions, and revenues. The model estimates demand effects, carbon and business leakage based on the absolute and relative cost increases between different route alternatives for the same journey, cost pass-through rates and price elasticities. Higher emissions lead to higher changes in costs, which are passed through and translate to demand and revenue losses.

Carbon leakage is defined as the ratio between e*missions changes in non-regulated regions* and *the decrease in emissions in regulated regions*.[44] In this specific case, it is applied as *changes in emissions for carriers with a non-EU hub* to *decreases in emissions for carriers with an EU hub* as a result of the policy changes (ReFuelEU, SAF-BAM) relative to a counterfactual without the policy changes.

$$Carbon\ leakage\ (\%) = \frac{Change\ in\ emissions\ for\ carriers\ with\ a\ non-EU\ hub}{Decrease\ in\ emissions\ for\ carriers\ with\ an\ EU\ hub}$$

In other words, it is an indicator of how much domestic emission reductions are not actually reduced but only shifted or leaked to other jurisdictions or operators.[45] Business leakage refers to the corresponding change in passengers and freight, i.e. *Changes in Passengers/Freight for carriers with a non-EU hub* to *Decreases in Passengers/Freight for carriers with an EU hub.*[46]

$$Business\ leakage\ (\%) = \frac{Net\ change\ in\ Passengers/Freight\ of\ carriers\ with\ a\ non-EU\ hub}{Decrease\ in\ Passengers/Freight\ for\ carriers\ with\ an\ EU\ hub.}$$

The journeys between the EU and Asia are also most affected by carbon leakage. Figure 6 provides an overview of the estimated carbon leakage in the ReFuelEU scenario without SAF-BAM for the selected journeys in this report for the modelled journeys and routes.[47] The size of the arrow shows the relevance for total travel in terms of

[43] Steer, Carbon leakage risks from scope of aviation policy measures in 'Fit for 55', 2022

[44] World Bank (2015) Carbon Leakage: Theory, Evidence, and Policy.

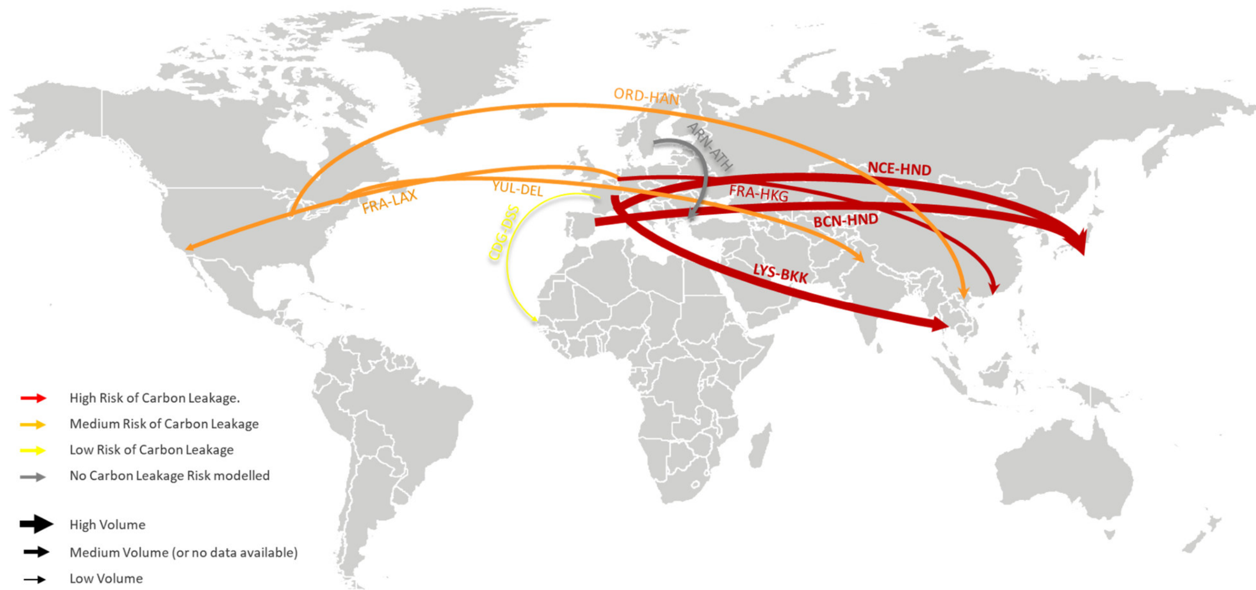
[45] In the case of airlines, emissions are less location-bound; domestically implies EU airlines, other jurisdictions refer to non-EU airlines.

[46] As the denominator can turn out negative (increase in passengers), the business leakage indicator cannot be interpreted analogue to the carbon leakage indicator. Therefore, the business leakage indicator is capped at zero if the denominator turns negative.

[47] Not all types of carbon leakage that are discussed in Section 1.2, such as destination switching, are represented in the graph.

passengers.[48,49] The colour of the arrow indicates the extent of carbon leakage on respective journey from the perspective of the EU, where red colour represents high carbon leakage and yellow colour low carbon leakage.[50]

Figure 6: Carbon leakage on the selected journeys and their relevance for air travel



Source: Deloitte based on IATA DDS data

For the flights between North America and the EU there is medium carbon leakage. As there are limited non-EU hubs directly available in between both regions, the hub flights have to make large detours and do not provide such viable alternatives. However, due to the significant price increases due to ReFuelEU there is still carbon leakage happening and this could become more significant after 2030 as the mandate increases in ambition.

For intra-EU flights there is carbon leakage originating from destination switching. While this is not modelled in this report and therefore not categorised in Figure 6, this kind of carbon leakage as described in Section 1.2 above can result from policies that affect short-haul journeys disproportionately. A switch to long-haul flights would particularly increase emissions due to the longer distances. Lastly, on flights between the EU and Western Africa, there is not much carbon leakage as the detours via Istanbul or Dubai impose significant additional costs, making them not competitive with routes of EU carriers.

Passenger

Disentangling the effects that lead to carbon leakage, Figure 7 shows the demand impact and resulting carbon and business leakage effects from the cost increases caused by ReFuelEU and SAF-BAM for the Nice to Tokyo journey (see Figure 3). The cost increase is presented from the perspective of a carrier with an EU hub, therefore, relative price increase compared to competitors always refers to the cheapest competitor route on that journey. However, demand and leakage effects are net effects for all alternatives on that journey.

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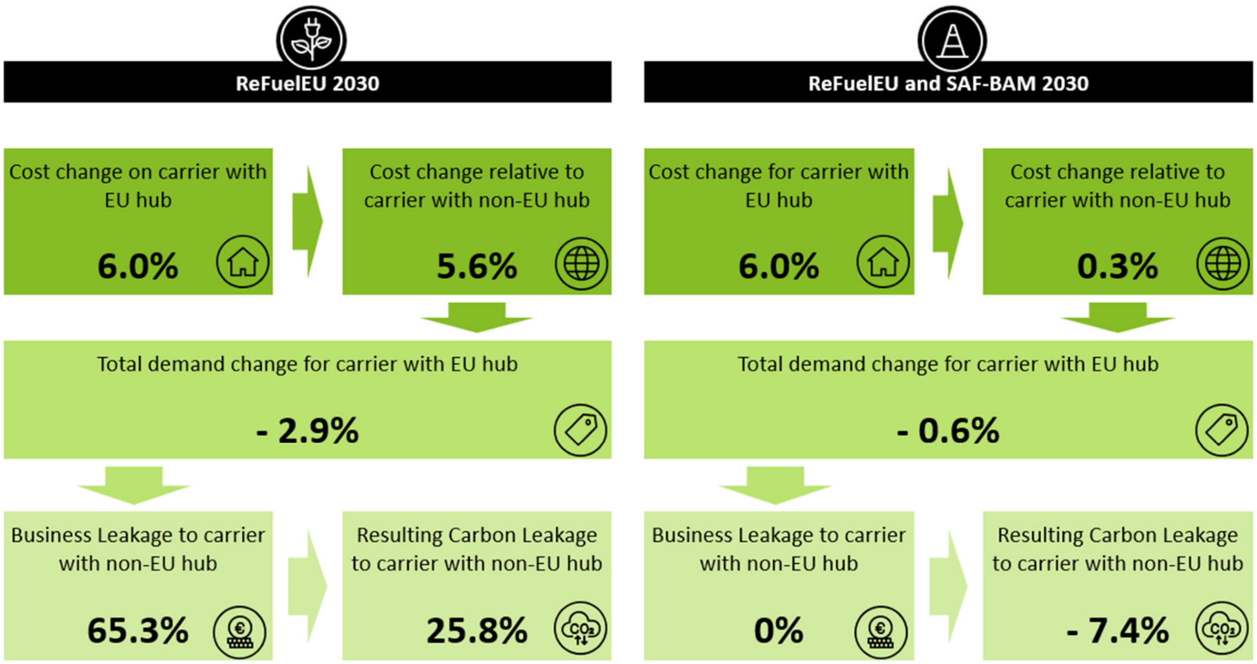
[48] Based on IATA DDS data. Volume of air travel is based on relative importance for passenger while cargo is not included. Final destinations in the Middle East were included in the Asia region. If no data was available medium importance was assumed.

[49] Arrows do not represent the actual flight route.

[50] Carbon leakage is considered low if leaked emissions are below 10%, medium if between 10% and 20% and high if leaked emissions exceed 20%. These thresholds are chosen based on the distribution of results.

For this journey, the cost increase in the *ReFuelEU 2030* scenario leads to a total demand change for the carrier with an EU hub of around 3%. **This results in a business leakage of around 65%, meaning that from the lost passengers, around two-thirds were gained by carriers with a non-EU hub on that journey through passenger substitution effects. With regard to carbon leakage, this implies that from the emission decreases achieved in the EU[51], around 26% of emissions were shifted to other carriers through passenger switching to alternative flights**. As a result, these emissions are still released into the atmosphere, just by a different carrier. This increase for other carriers includes not only the emissions of passengers switching, but also includes the higher emission intensity of those longer alternative flights.

Figure 7: Impact on passenger journey from Nice to Tokyo



Source: Deloitte modelling

The introduction of the SAF-BAM can eliminate all previously modelled carbon and business leakage (excluding those related to destination switching). The model results show that SAF-BAM seems to be effective in providing a level playing field and preventing carbon leakage (right-hand side of Figure 7). As costs for competitors increase more than for the EU carrier that operates the shortest route, there is a decrease in relative costs for the EU carrier. Therefore, there is no business leakage in the modelled ReFuelEU and SAF-BAM scenario. Furthermore, there is a positive substitution effect for the EU carrier, meaning more people choose their route than the often longer competitor routes, and a decrease in emissions in the other jurisdictions is the consequence. This shows that SAF-BAM not only decreases EU emissions but also leads to a decrease in emissions outside the EU. **Thereby SAF-BAM does meet climate policy objectives and competition policy objectives as it increases competitiveness of EU carriers on the respective journey**.

However, this assumes that the carriers with a non-EU hub do not tank SAF to comply with SAF-BAM on the transfer flight but choose to pay the obligations under SAF-BAM.[52] This appears plausible as SAF prices are more than four times higher than kerosene prices and therefore non-EU airlines are not expected to use substantial amounts of

[51] Total emissions decrease in the EU include all emissions savings from the use of SAF to comply with ReFuelEU and net demand effects through substitution and demand destruction.

[52] Carriers with a non-EU hub tank SAF to comply with SAF-BAM, they might benefit from cheaper regional SAF prices. Under this scenario, modelling results might differ and positive carbon leakage in the ReFuelEU and SAF-BAM 2030 scenario are conceivable as relative cost differentials would widen.

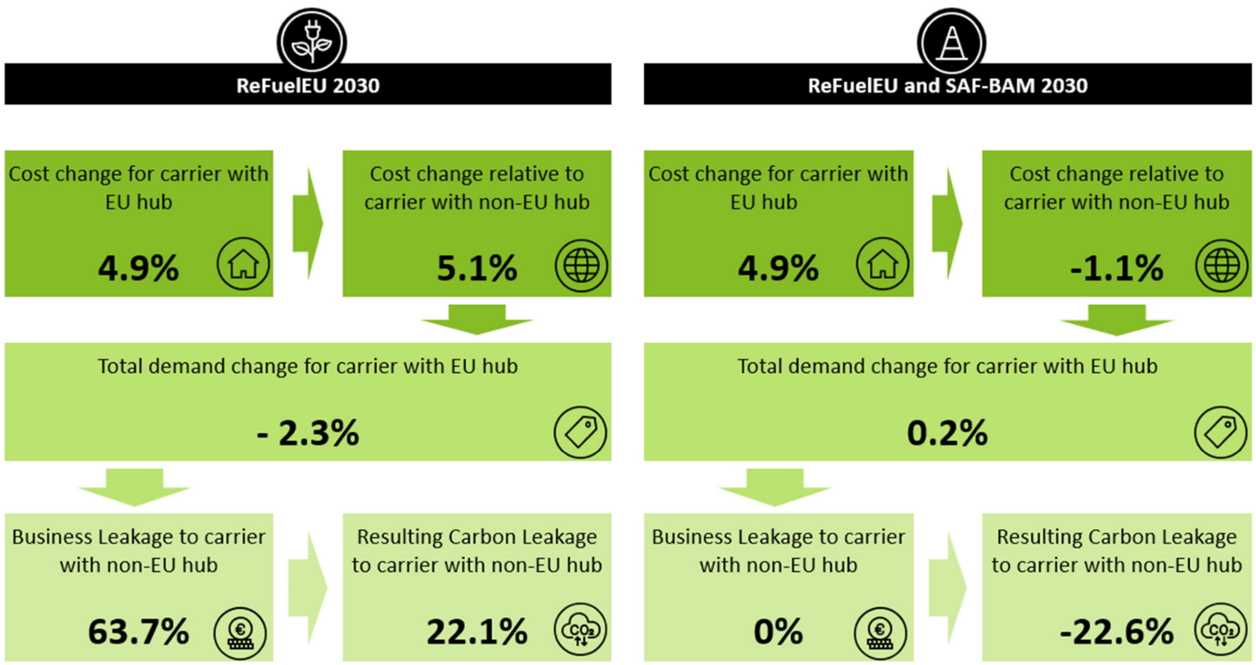
SAF if not required to by a mandate and SAF-BAM only applies to the fraction of passengers that departed from the EU.

Cargo

For the cargo flight there is a very similar pattern to be seen as shown in Figure 8. Following the introduction of ReFuelEU by the EU, there is significant decrease in demand for direct flights as a consequence of the increasing price differential for the EU cargo carrier on the journey from Frankfurt to Hong Kong. This results in similar business and carbon leakage values compared to the passenger flight of around two-thirds and one-fifth respectively.

For a comparison between direct flights from the EU and flights via non-EU hubs, the prevention of carbon leakage through SAF-BAM is even slightly more effective than for the passenger route. This is due to the fact that the cost increases for the competitors through SAF-BAM are slightly higher for this particular route. Again in the modelling, SAF-BAM is effective in preventing carbon and business leakage induced by ReFuelEU in the ReFuelEU and SAF-BAM scenario as the EU carriers experience a minor net increase in demand for its direct flight and therefore leads to a decrease of emissions outside the EU.

Figure 8: Impact on cargo journey from Frankfurt to Hongkong



Source: Deloitte modelling

2 Legal and practical assessment of border adjustment mechanisms in aviation

2.1 Transferability of the industrial CBAM

The CBAM is a key tool within the European Union's Fit for 55 package, designed to prevent carbon leakage related to manufacturing of goods, and as such supports the EU's ambitious climate targets. Carbon leakage in industrial and energy sectors occurs when production shifts to countries and regions with less strict climate policies, undermining global emission reduction efforts. CBAM addresses this issue by requiring importers of certain emissions-intensive goods—such as, for now, cement, iron and steel (and certain articles thereof), aluminium (and certain articles thereof), fertilisers, hydrogen, and electricity—to purchase CBAM certificates reflecting the carbon price that would have been paid if these goods had been produced in the EU and therefore fallen under the scope of the EU ETS.

The current CBAM focuses on goods with production processes involving significant embedded emissions. However, it is important to note that the regulation includes a review clause that foresees the possibility of expanding its scope in the future to other sectors or potentially to downstream products of the already covered sectors (e.g., cars). One addition under consideration is the inclusion of transportation services associated with the goods covered under CBAM following Article 30§2 of the EU Regulation 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a CBAM. This review process will assess whether emissions generated during the transportation of CBAM goods—such as aviation transport—should also be subject to carbon pricing. Such an expansion could strengthen CBAM's ability to address emissions across the full lifecycle of imported goods, enhancing its environmental effectiveness.

As part of this analysis, a legal assessment has been conducted to determine the extent to which the existing CBAM could be modified to include the aviation sector within its scope (this section). This involves examining the current legal provisions of the CBAM Regulation, assessing the possibility to use it to mitigate the competitiveness impact of the ReFuelEU initiative and exploring the feasibility of incorporating the aviation sector under CBAM. The analysis focuses on identifying any legal barriers and evaluating whether the existing framework allows for a rather straightforward expansion of this kind; or to the contrary significant amendments or even a separate legal instrument would be required.

Indeed, while the legal assessment in this section indicates that modifying CBAM is not an option for the aviation sector, the next phase of our analysis in section 2.2 explores the possibilities of adapting the mechanism in a separate framework and legislation. Specifically, an assessment has been performed to check to what extent CBAM principles can be transposed into a separate mechanism designed to address the carbon leakage impacts of ReFuelEU. This mechanism would aim to mitigate compliance challenges related to the mandatory use of SAF while adapting to the requirements of the aviation sector (taking into account the specificities linked to passenger and cargo flights). By aligning with some of CBAM's principles (such as monitoring and reporting), this alternative mechanism could provide an effective solution to provide a level playing field between EU and non-EU aviation hubs as well as to support the decarbonisation of aviation.

We have referred to this mechanism as a SAF-BAM throughout the report, reflecting its targeted focus on addressing additional costs linked to the use of SAF while aligning with CBAM's core principles.

Legal assessment

The current CBAM applies to goods imported into the EU, accounting for carbon emissions linked to their production. The aim is to ensure that competitiveness of European industries is not undermined by cheaper goods produced in countries with less stringent environmental regulations. CBAM is directly linked to the EU ETS as it mirrors the carbon pricing mechanism by requiring importers to purchase CBAM certificates equivalent to the carbon costs that would have been paid under the EU ETS if the goods were produced within the EU, ensuring a level playing field and preventing carbon leakage. However, ReFuelEU's objective is to decarbonise the aviation sector by increasing both the supply and demand for SAF, resulting in its increased utilization within the European Union. By enforcing a progressive increase in the proportion of SAF blended with conventional jet fuels at EU airports, ReFuelEU seeks to reduce the reliance of the aviation industry on fossil fuels. From a legal perspective, this regulation applies to aircraft operators, to Union airports and their respective Union airport managing bodies, and to aviation fuel suppliers. Aircraft operators have obligations related to refuelling (the so-called anti-tankering measure) as well as reporting. However, from an economic perspective, it is the responsibility of aviation fuel suppliers to ensure that all aviation fuel made available to aircraft operators at each Union airport contains the minimum shares of SAF. It is expected that the economic costs linked to the production and purchase of this fuel will be passed on to the aircraft operators fuelling at EU airports. ReFuelEU will have significant financial impacts on airlines operating in the EU, primarily due to the higher costs linked to SAF and the rising compliance obligations for SAF blending over the years. Furthermore, there is a risk of carbon leakage, as airlines might use non-EU hubs with less strict SAF requirements to refuel and avoid SAF mandates, undermining the worldwide effectiveness of such sustainability mechanism.

While these two mechanisms share the broad goal of reducing emissions, they diverge in several important areas when their potential applicability to aviation is considered.

As part of this analysis, a comparison has been conducted between ReFuelEU and CBAM to identify the key differences and similarities between the two legislations. This involves examining their respective aspects, characteristics, and geographical scopes, among other factors, to understand if and how CBAM can be adapted to the aviation sector to become a carbon leakage avoidance instrument in view of the impact of EU measures part of the EU Green Deal such as of ReFuelEU. In summary, the following conclusions are drawn from comparing both regulations:

1. The geographical scope of ReFuelEU and CBAM differs significantly in terms of their application. ReFuelEU specifically targets aviation fuels used within the EU, requiring the use of SAF for flights departing from all Union airports. However, CBAM has a broader international scope, applying to goods imported into the EU from non-EU countries. CBAM requires importers of CBAM goods within the EU to purchase certificates based on the carbon content of their products, aiming to prevent carbon leakage and ensure a level playing field for EU producers. Therefore, CBAM would need to target aviation fuels used outside of the EU and more specifically level playing field the carbon costs of its production and/or consumption to mitigate the impact of ReFuelEU. Looking at the applicability of the CBAM to the aviation sector, Article 30§2 of the EU Regulation 2023/956, only covers the inclusion of transportation services associated with the goods covered under CBAM meaning the emissions during the import within the EU of these goods produced outside of the EU. While this remains a possibility, these additional costs will be on top of the rest and not lead to any level playing field (other than for the EU producers of the CBAM goods) for the aviation sector.
2. The movements in scope of ReFuelEU and CBAM also differ significantly. CBAM targets goods entering the EU and being released into free circulation (being the customs procedure to bring them on the EU Single Market). In contrast, ReFuelEU focuses on flights departing from EU airports, mandating the use of SAF for all aviation fuel uplift taking place in the EU, irrespective of the flight's destination. While CBAM addresses emissions from imported goods entering free circulation, whether or not after undergoing processing within the EU (under the Inward Processing customs procedure), ReFuelEU is specifically about aviation

activities departing from EU airports to any EU and non-EU airports, making their geographical and operational scopes completely different. To include aviation sector, CBAM would also need to target subsequent leg flights of airlines, with passengers' or shipments' original point of departure in the EU, which are not covered under the current ReFuelEU framework. Regarding the overall aviation sector and its inclusion under the scope of the current CBAM, the targeted movements will also be linked to inbound movements within the EU of the specific goods in scope of CBAM. While this inclusion seems legally feasible, it is highly unlikely that it would set a level playing field for the EU airlines for the costs linked to the EU Green Deal.

3. The responsible parties liable under ReFuelEU and CBAM are different in terms of their roles and obligations within each mechanism. Under CBAM, the importers of the goods into the EU (or their CBAM representatives) are the primary responsible parties. On the other side, under ReFuelEU, the airlines operating within the EU are one of the responsible parties Generally, airlines suppliers are accountable for meeting the SAF blending requirements and are subject to penalties for non-compliance, whereas airlines are forced to uplift at least 90% of the required aviation fuel at that airport. While CBAM holds importers liable for the carbon content of goods entering the EU, ReFuelEU de facto places the burden on airlines to cope with the legislation's requirements (as they are obliged to purchase the fuel and report on it). The latter means that CBAM should target airlines carrying passengers or cargo that travel on flights not in scope of ReFuelEU framework to mitigate the impact of the latter. Looking at the inclusion of the aviation sector under the CBAM, it is highly likely that the costs of the transportation services associated with the goods covered under CBAM will still be borne by the EU importer.

4. The calculation methodologies under ReFuelEU and CBAM also differ significantly in focus. CBAM requires the calculation of direct and indirect emissions embedded in imported goods, which includes emissions from the production processes in non-EU countries as well as the consumption of electricity within this process. Importers must assess and report the carbon content of goods entering the EU, considering the full production lifecycle, including upstream emissions. However, ReFuelEU does not directly require airlines to report emissions resulting from the consumption of the fuels. Instead, the regulation sets a mandatory percentage for SAF to be used in aviation fuel uplift at EU airports. Airlines must ensure compliance with the reporting requirements, but the reporting focuses more on the amount of SAF used rather than the direct emissions from fuel consumption. Therefore, to include aviation sector into CBAM, the mechanism would have to calculate the SAF eluded by subsequent leg flights of airlines, with passengers' or shipments' original point of departure in the EU. To include aviation sector under the CBAM, calculation methodologies will have to be related to emissions of GHG during the flights (including as well additional changes to the Implementing Regulation on calculation methods of CBAM such as existing today under the EU ETS Directive).

5. Under ReFuelEU, there is no explicit "taxable event" as the regulation does not impose a tax (or levy). The compliance mechanism focuses on ensuring that fuel suppliers deliver, and airlines use a progressively increasing share of SAF at EU airports. If airlines or fuel suppliers fail to meet these obligations, they face penalties for non-compliance, which act as an enforcement tool rather than a levy. The penalty is generally calculated based on the shortage of SAF volumes compared to the required amounts set by the legislation. However, this legislation uses the "fuel supplier" definition as stated in Article 2 (38) of the EU Directive 2018/2001 on the promotion of the use of energy from renewable sources which indicates that is "an entity supplying fuel to the market that is responsible for passing fuel through an excise duty point".

   Under CBAM, the taxable event occurs when imported goods are released into free circulation in the EU. Therefore, while CBAM creates a clear taxable event linked to the release of goods into free circulation, ReFuelEU focuses on compliance with SAF blending obligations, with penalties for non-compliance rather than a direct taxation mechanism. Therefore, CBAM could be adapted to include a taxable event different than the release into free circulation of the goods. With regard to the taxable event in case of inclusion of the aviation sector in the CBAM, requirements should be linked to the moment these CBAM goods in scope are released into free circulation.

6. From a **reporting** perspective, ReFuelEU and CBAM have some similarities. Airlines and fuel suppliers must annually report SAF quantities to ensure compliance with the mandated blending targets/anti-tankering clause respectively. CBAM reporting is currently quarterly, reflecting the carbon footprint of imported goods over shorter intervals but is planned to also be annual as of CBAM's full implementation as of 2026. To include aviation sector, CBAM will have to ensure harmonization and potential synergies between the reporting period and the submission date of the reports or the single report encompassing different requirements for aircraft operators.

7. Another similarity between the two mechanisms relates to the reliance on accredited **third-party verification**. In both cases, the use of independent, accredited third parties is crucial for maintaining the integrity and reliability of the systems preventing errors, discrepancies or misreporting. For this criterion, CBAM would have to include the specificities linked to the verification pertaining to the aviation sector which can be different than the ones existing for the production of goods.

8. While CBAM explicitly allows for the use of defined **default values** for embedded emissions when actual data is unavailable, ReFuelEU relies on actual data. Therefore, ReFuelEU does not introduce specific default values but instead relies on sustainability certification systems that determine emissions reductions based on fuel origin, feedstock, and production processes. Therefore, while CBAM integrates default values as a fallback mechanism, ReFuelEU emphasises actual fuel data verified without directly implementing default values. Looking at the inclusion of the aviation sector under the CBAM, it is possible to use default value to calculate for the GHG emissions consumed during the transportation of CBAM goods within the EU.

9. The **exemptions and adjustments** under ReFuelEU and CBAM reflect their differences in scope and objectives, with CBAM offering more adjustments and exemptions compared to ReFuelEU. Under the latter, the regulation applies broadly to all flights departing from EU airports, regardless of the destination, and no significant exemptions are provided for airlines or fuel suppliers except under exceptional and temporary basis. On the other side, CBAM does incorporate a broader range of adjustments and exemptions with the objective to take into account specific circumstances. Goods imported from countries with carbon pricing mechanisms similar to the EU ETS may be partially or fully exempted to avoid double carbon pricing. Importers can claim reductions from their CBAM obligations if they can demonstrate that carbon costs have already been paid in the country of origin where the goods have been produced. To avoid double taxation, CBAM would also have to include exemptions for subsequent leg flights of airlines, with passengers' or shipments' original point of departure in the EU, which are not covered under the current ReFuelEU framework but used SAF voluntarily or due to a mandatory legal requirement. The CBAM's exemptions linked to carbon price paid in other countries or some threshold values could be applied to the aviation sector even though some modifications will be required in terms of threshold (current exemption are based on value).

Based on the analysis of the key features under ReFuelEU and CBAM, it is evident that these mechanisms are fundamentally different in terms of their scope, calculation methodologies, reporting obligations, and the types of exemptions and adjustments they offer. ReFuelEU focuses specifically on the aviation sector, primarily regulating the use of SAF and imposing blending mandates, while CBAM targets a broader range of goods and aims to address carbon emissions embedded in imports.

The substantial differences in geographical scope, taxable events and reporting requirements make it challenging to adapt the current CBAM legislation to effectively incorporate the aviation sector or mitigate the possible competitive disadvantage caused by additional costs associated with ReFuelEU, notably the increased fuel price due to addition of SAF, as compared to uplifts taking place outside of the EU. Moreover, the complexities of implementing adjustments within CBAM to make it fit as a SAF carbon leakage avoidance mechanism would likely lead to a mechanism too complex to allow for an efficient use by economic operators and competent authorities.

Next thereto, the possibility remains to include transportation services associated with the goods covered under CBAM.However, this will target inbound flights not currently impacted by the EU Green Deal measures and will unlikely lead to a level playing field between EU carriers with an EU hub vs carriers with a non-EU hub. After all, the CBAM is specifically set-up to ensure a level playing field between EU and non-EU producers pertaining to the production of goods and is hardly transposable to other actors.

Therefore, it will be difficult to try to adapt the current CBAM to include aviation and the creation of a separate mechanism. Instead, leveraging CBAM concepts and principles where it makes sense yet specifically designed to address the unique challenges of the aviation sector and its decarbonisation goals would be more likely to tackle the challenges of this sector. This new mechanism, SAF-BAM, would be tailored to manage the complexities of integrating SAF mandates into a piece of legislation directly linked to ReFuelEU while ensuring that airlines are not unduly burdened by the additional costs of SAF adoption. This approach would offer a more targeted, efficient, and flexible solution to the challenges faced by the aviation sector; with the additional advantage of offering a suitable platform for further extension to mitigate additional carbon leakage risks in view of a possible future expansion of other mechanisms into the aviation industry.

Table 5: Explanation of terms

Category	Explanation
CBAM Overview	CBAM prevents carbon leakage by requiring importers to buy certificates for carbon-intensive goods.
Review Clause	Potential future expansion to cover more sectors, including aviation transport emissions.
Legal Assessment	Analysis of whether CBAM can be expanded to include aviation or requires a new mechanism.
SAF-BAM Concept	A proposed mechanism (SAF-BAM) to address the aviation sector's SAF costs, aligned with CBAM principles.

Source: Deloitte

Table 6: Results of a legal assessment

Category	Summary
Comparison with ReFuelEU	ReFuelEU targets SAF use in aviation, while CBAM focuses on imported goods; key differences in scope and methodology.
Geographical Scope	ReFuelEU targets EU aviation, CBAM applies to goods entering the EU from non-EU countries.
Responsible Parties	CBAM holds importers accountable; ReFuelEU holds aviation fuel suppliers and airlines accountable for SAF compliance.
Calculation Methodologies	CBAM calculates embedded emissions of goods, ReFuelEU tracks SAF volumes used without direct emissions reporting.
Taxable Event	CBAM has a taxable event at goods entry, while ReFuelEU uses penalties for non-compliance instead of a tax.

Reporting	Both mechanisms require reporting, with CBAM quarterly in the transition period and annually as of 2026, while ReFuelEU requires annual reports on SAF usage.
Verification	Both use accredited third parties for verification of compliance.
Exemptions & Adjustments	CBAM allows adjustments for similar carbon pricing; ReFuelEU has limited exemptions, mainly for new routes.

Source: Deloitte

2.2 Feasibility of a border adjustment in aviation

This section outlines a first design option for a SAF-BAM, highlighting the key aspects required for its practical implementation. It focuses on the most important elements, such as amongst others the responsibilities of various parties, tracking of SAF usage, the required reporting procedures, etc. The aim is to establish a framework that allows to combat the risk of carbon leakage and mitigate the financial impact on operators impacted by ReFuelEU through setting a level playing field, whilst at the same time still encouraging the use of SAF and fostering the decarbonisation of the aviation industry.

In this view, to achieve a broad effect, it is important that the SAF-BAM mechanism addresses the challenges linked to both passenger flights and cargo flights. The below design option would also apply to cargo flights, including where there is a risk of circumvention by moving goods by land (e.g., truck) instead of air transport to EU neighbouring countries to avoid SAF obligations. Indeed, while passenger flights are directly covered by ReFuelEU and avoidance by resorting to alternative means of transport are relatively scarce, cargo flights may face different logistical considerations, and some goods could be diverted to land transportation, potentially bypassing SAF mandates for aviation. Therefore, it is important to treat these cases separately, ensuring that both passenger flights and cargo flights contribute fairly to the decarbonisation goals without encouraging the circumvention of regulations. The SAF-BAM mechanism would need to address this by ensuring that goods moved by truck are also accounted for under the scope of the regulations, preventing any carbon leakage and maintaining a level playing field between air and land transport. This point will be addressed further in this section.

The concept of a SAF-BAM builds on the principles of the CBAM mechanism while adapting to the unique characteristics of the aviation sector. Under SAF-BAM, airlines carrying passengers and cargo on subsequent-leg flights of journeys that originate in the EU and connect through non-EU hubs would be required to purchase certificates reflecting the SAF obligations avoided by not complying with ReFuelEU mandates. The mechanism would account for the SAF shortfall and associated costs, calculated using either actual passenger and cargo data or default values. In cases where SAF is used voluntarily on subsequent-leg flights, or where legal SAF mandates apply, exemptions or adjustments would be provided upon submission of proof of SAF usage as long as these SAF comply with the definition laid down in Article 3 of ReFuelEU).

Table 7 provides a summary of a potential design option for the SAF-BAM. The remainder of this chapter elaborates on and discusses the considerations in more detail. Considering the current phase of the debate, this should be regarded as a first assessment; further work would be needed to implement such a policy.

Table 7: Description of a potential SAF-BAM mechanism

Category	Description of the characteristics of the SAF-BAM mechanism
Purpose	Prevent carbon and business leakage from ReFuelEU on passenger flights.

Category	Description of the characteristics of the SAF-BAM mechanism
Regulatory Framework	Introduced via EU regulation, enforced by national authorities. Revenues generated from the sale of SAF-BAM certificates could be dedicated to further support the aviation sector, including for green transition projects.
Scope	Flights with passengers' original point of departure in the EU and transfer in a non-EU hub onto subsequent legs not covered under the current ReFuelEU framework.
Mechanism	Passenger data could be integrated with broader flight data systems to generate reports on SAF consumption per flight segment and per passenger. Alternatively, airlines could rely on default values based on average passenger occupancy for specific routes, such as EU hub to a specific non-EU hub, to calculate SAF consumption on each flight segment per passenger.
Responsible parties	Responsible party for compliance would generally be the airlines operating the flights departing from the EU to non-EU destinations. However, in specific cases, the responsible party could be an intermediary party.
Taxable event	Triggered when a passenger has avoided SAF mandates by transiting through a non-EU hub instead of complying in full (i.e., for the end-to-end journey) with ReFuelEU obligations.
Calculation methodologies	Difference in the SAF requirements between the passengers' actual route and if the complete route was covered by ReFuelEU. This would involve calculating the quantity of SAF that would have been required under ReFuelEU for that specific route from point of departure to final destination. The costs linked to the purchase of SAF-BAM certificates would reflect the market price of SAF, adjusted to account for the average SAF consumption of the flight, including passenger-specific consumption data.
SAF-BAM certificates price	Platts Northwest Europe (NWE) SAF price assessments could be used as a basis, as they reflect prices relevant to key EU markets. This basis could be adjusted to reflect compliance, logistics and other additional costs.
Adjustments and exemptions	Exemptions and adjustments related to SAF used would cover both legally mandated (by third countries such as those similar to ReFuelEU if existing) and voluntary SAF usage (where airlines might choose to exceed their SAF obligations to demonstrate environmental commitment or align with sustainability goals) beyond their ReFuelEU requirements.
Reporting	Operators would be required to submit a verified emissions report by March 31 of the following year such as for ReFuelEU. The specific information to be included in the report would cover various aspects of the flight operations, SAF consumption, and the SAF-BAM certificates purchased.

Source: Deloitte

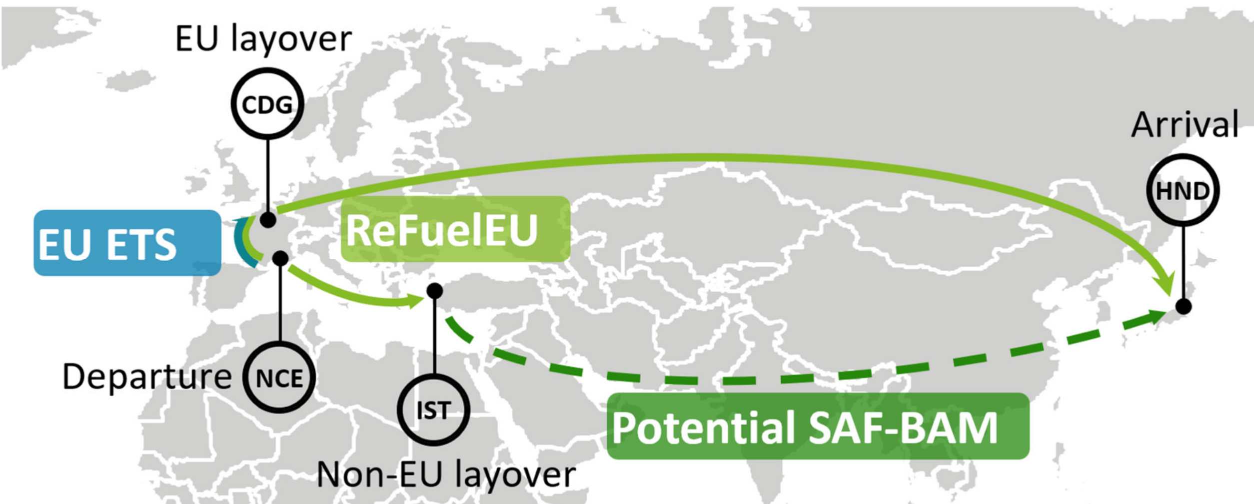
Legislative act

Like CBAM and ReFuelEU, SAF-BAM needs to be introduced through a regulation by the European Commission, ensuring that the mechanism is directly applicable across all EU Member States and states adopting EU legislation. National authorities (ideally the same that are competent for ReFuelEU) would be tasked with overseeing its implementation and ensuring compliance including enforcement and sanctions linked to the mechanism. These authorities would manage the revenues generated from the sale of SAF-BAM certificates, and should directly allocate these funds to further support the decarbonisation of the aviation sector including specific measures linked to SAF development and uptake. This framework would allow each Member State to manage its compliance processes while maintaining a harmonised approach across the EU.

Scope

In terms of scope, the proposed SAF-BAM would specifically target the subsequent leg flights of airlines, with passengers' or shipments' original point of departure in the EU, which are not covered under the current ReFuelEU framework. In the example in Figure 9. The flight from Istanbul to Tokyo would be covered. For these flights, airlines would be required to either track flight passenger data or use default values to calculate the amount of SAF not accounted for under ReFuelEU. Airlines carrying passengers or cargo that transfer to these flights would then be required to purchase SAF-BAM certificates to compensate the SAF consumption avoided by the layover in a non-EU hub, to the extent related to their operations within the EU.

Figure 9: Policy coverage



Source: Deloitte. Note: Arrows only represent illustrative route

Therefore, the number of SAF-BAM certificates to be purchased would represent the difference between the SAF that would have been consumed if all journey legs had been covered under ReFuelEU minus the SAF consumed during the first leg flights within the EU and from the EU airports to the first layover in a non-EU hub, and any subsequent flights which are covered by a comparable SAF scheme. Moreover, these certificates would have to represent the shares of passengers and cargo goods travelling from EU origins that elude the ReFuelEU requirements. This mechanism would ensure that airlines comply with SAF mandates even for flights that fall outside the current ReFuelEU scope yet do have a connection with the EU, providing a clear and effective way to address SAF-related obligations for international aviation. Introducing such a mechanism would help level the playing field between airlines departing from EU hubs and those mainly operating from non-EU hubs, especially for long-distance flights, effectively mitigating the risk of carbon leakage by ensuring consistent SAF obligations across all aviation operators.

In addition to the aforementioned, an extension of the SAF-BAM scope to 'residual' fuel brought into the EU in the reservoirs of aircraft, yet utilised for execution of outbound flights, could be considered as well.

Mechanism

Tracking passenger and cargo data for the SAF-BAM mechanism would require a technically robust system to accurately collect, process, and report the necessary information for each transfer flight within its scope. Furthermore, a key technical challenge in tracking passenger and cargo data is addressing privacy concerns, particularly with compliance to GDPR. Airlines would need to anonymise and aggregate the data for the routing segments outside of the EU, focusing on total passenger numbers and cargo volumes for each segment rather than individual passenger or cargo information. In the aviation sector, anonymisation of aggregated data of passengers and cargo is something already implemented by airlines.

Airlines already collect and share passenger data with governments for security and immigration purposes. This includes information on flight itineraries, ticket details, etc. Similarly, cargo data is tracked for compliance with security and customs regulations, with details such as cargo weight, type, and origin/destination and is visible in documents such as air waybill when departing the EU (even by RFS) and is shared with government authorities through customs systems. This passenger and cargo data could then be integrated with broader flight data systems to generate reports on actual and hypothetical SAF consumption per flight segment. To ensure the accuracy of this data, independent third-party verification would likely be necessary, similar to the processes used in CBAM and ReFuelEU, confirming the reliability of the reported passenger and cargo numbers and aligning them with actual fuel uplift and consumption. Such a mechanism has already been considered, however, has not been implemented due to concerns linked to political sensitivity and the potential disputes that such tracking would imply with other countries.

Given the operational and legal challenges of direct passenger and cargo data tracking, airlines could alternatively rely on default values based on average passenger occupancy and cargo load factors for specific routes, such as non-EU hub to a final destinations, to calculate actual and hypothetical SAF consumption of a passenger or cargo shipment with specific weight and volume on each flight segment. For passenger flights transporting belly cargo, the respective flights' actual and hypothetical SAF consumption would be distributed to passenger and cargo in an appropriate way. This approach would reduce the complexity of data collection while still ensuring fair compliance, be it in a less accurate manner. These technical solutions would enable airlines to track SAF usage on transfer flights, ensuring that the SAF-BAM mechanism can be implemented effectively while addressing privacy concerns and maintaining a fair degree of accuracy.

Responsible parties

Under the proposed SAF-BAM mechanism, the responsible party for compliance would generally be the airlines operating the flights departing from the EU and flying passenger or cargo to a transfer point outside of the EU, as they have full transparency of these passengers' and cargo shipments' ticket and AWB destinations. These airlines operate under traffic rights granted by the EU, so that the EU can impose the SAF-BAM requirements under these traffic rights. Technically, airlines can levy the cost of the SAF-BAM-certificates from the affected passengers and cargo shipments as a ticket tax, fees or charges and freight surcharges. However, in cases where goods are moved by truck instead of air transport to circumvent the SAF obligations the responsible party should be the freight forwarder. In such cases, the intermediary would be required to purchase SAF-BAM certificates to cover the emissions from the transported goods, ensuring that the mechanism remains effective, and no circumvention occurs by shifting cargo from air to ground transport.

"Taxable event"

Similar to ReFuelEU, the SAF-BAM mechanism would impose a requirement on airlines operating the subsequent legs of a flight to purchase the equivalent in SAF uplift evaded. This would be triggered when a passenger or shipment has avoided SAF mandates by transiting through a non-EU hub instead of complying in full (i.e. for the end-to-end journey) with ReFuelEU obligations. In this case, the airline would need to buy SAF-BAM certificates to account for the SAF consumption that would have been required if the passenger or shipment's transfer flight had also been operated under ReFuelEU conditions. This ensures that the SAF-BAM mechanism addresses the SAF consumption gap caused by the diversion of traffic through non-EU hubs and prevents a significant potential for circumvention of the EU SAF obligations.

In the case of road circumvention, where goods are moved by truck instead of being transported by air to avoid SAF obligations, the SAF-BAM mechanism would adjust the taxable event in the following manner. If goods are redirected from air transport to RFS (for example, when an airline avoids SAF obligations by transiting by RFS to a non-EU hub to continue the journey by air from thereon), the responsible party for the SAF-BAM certificates would still be the airline operating the RFS on the first leg. In other cases, where the first leg of the journey is conducted through road transport under the responsibility of a freight forwarder, then the freight forwarder—who arranged the transport—would become the responsible party for the SAF-BAM certificates (applied by equivalence) for a flight covering a part of the journey outside of the EU.

Calculation methodologies

The calculation of SAF-BAM certificates would be based on the amount of SAF avoided due to a passenger or shipment transiting through a non-EU hub instead of an EU hub, as well as the linked avoided costs associated with the SAF consumption gap. The SAF-BAM certificates would account for the difference in SAF requirements between the passenger's or shipment's actual flights and the ReFuelEU obligation that all flight segments would have had if they were operated within / from the EU. This would involve calculating the quantity, type, quality and price of SAF that would have been required under ReFuelEU for that specific journey, and the certificates would have to be purchased to cover this gap. The costs linked to the purchase of SAF-BAM certificates would reflect the market price of SAF, adjusted to account for the industry average SAF consumption per passenger / for a respective shipment for the flight segment (e.g. by distance). By purchasing these certificates, airlines and freight forwarders would be compensating for the avoided SAF obligations associated with the further legs of the journey departing from airports outside of the EU.

SAF-BAM certificates price

The price of SAF-BAM certificates would need to be implemented in a manner that ensures compliance with international frameworks relevant for aviation, such as ICAO, and aligns with existing mechanisms covering similar movements (such as ReFuelEU) to ensure a level playing field. To achieve this, the price of these certificates could be determined by taking as reference an international index, such as Platts, which publishes benchmark prices for aviation fuels, including SAF. Their Northwest Europe (NWE) SAF price assessments could be used as a basis, as they reflect prices relevant to key EU markets. This basis could be adjusted to reflect compliance, logistics and other additional costs. That would ensure that the SAF-BAM mechanism is harmonised with global market conditions and is legally compliant with international standards. Alternatively, the European Commission could release its own SAF price data or indices (or default values), further aligning the mechanism with EU policy and market dynamics and taking into considerations potential discrepancies between EU countries regarding the average prices.

Adjustments and exemptions

Exemptions and adjustments related to SAF used in the flight(s) to which the passenger / shipment is transferring after departing from the EU under the SAF-BAM mechanism would cover both legally mandated (by other countries such as those similar to ReFuelEU if existing) and voluntary effective SAF usage (whereby airlines might choose to exceed their SAF obligations to demonstrate environmental commitment or align with sustainability goals) for such flights. In both cases, airlines may be eligible for exemptions and proof of SAF use would be required to validate the adjustments or exemptions. Airlines would need to submit supporting documentation, such as fuel purchase records, certificates from SAF suppliers, and data on SAF blend percentages used in the flight. These proofs would ensure that adjustments and exemptions are properly accounted for, providing transparency, and maintaining the integrity of the SAF-BAM mechanism.

Another correction factor to pursue a level playing field not only from a SAF-usage but also from a cost-perspective would be to introduce a mitigating factor to consider the cost of the kerosene that was effectively consumed instead of SAF for the respective transfer flight (in such fashion that only the delta between both prices is taken into consideration for the calculation of the required number of SAF-BAM certificates).

Furthermore, for cases where freight forwarder / intermediary party are the responsible parties, no exemptions or rebates would be granted for freight using conventional diesel or other carbon-intensive trucks, as SAF-BAM specifically focuses on SAF, not on road transport emissions even if the latter are in scope of EU ETS 2. However, exemptions could be applied for freight forwarder / intermediary party if they are using sustainable means of transport (e.g. electric or hydrogen trucks) as this would be in line with the broader objective of decarbonising the transport sector.

Reporting

In terms of reporting requirements, operators would be required to submit a verified emissions report by March 31 of the following year similar to ReFuelEU. We suggest investigating the possibility of combining the SAF-BAM reporting with existing reporting (e.g., with ReFuelEU). The specific information to be included in the report would cover various aspects of the flight operations, SAF consumption, and the SAF-BAM certificates purchased. Key elements to be reported would potentially include:

1. Flight Data: For airlines, this would include the flight segments that passengers/shipments departing from the EU are transferring to, detailing the origin and destination airports, as well as the number of passengers in total and the number of transfer passengers from the EU (if tracking data is used) or the default values applied for specific flight routes. Additionally, it would also include details of cargo transported, such as the origin and destination, total weight and type of cargo, to provide a more comprehensive overview of the flight's operational impact.
2. SAF Consumption: The report would detail the amount, types, quality and prices of SAF effectively uplifted for the transfer flight and compare it against the SAF requirements under ReFuelEU, projected to that transfer flight. If the flight avoided SAF mandates by transiting through a non-EU hub, the report would reflect this discrepancy between both amounts. Cargo-related SAF consumption could be proportionally calculated based on the weight of cargo carried.
3. SAF-BAM Certificates Purchased: Airlines and freight forwarders would need to report the number of SAF-BAM certificates they have purchased to offset the SAF consumption gap. This would include the mechanism used (e.g., tracking passenger data or applying default values) and the total amount of SAF-BAM certificates purchased.
4. Adjustments: SAF proof of use or offsetting measures to reduce obligations, possibly complemented with proof of kerosene purchase price (if SAF-BAM is only to compensate for the delta).
5. Verification and Auditing: Reports should also include details of the verification done by third-party verifiers.

Cases not covered by SAF-BAM

The SAF-BAM in the form described above would cover most cases of carbon leakage but not all. Similarly to the Industrial CBAM, SAF-BAM would aim to mitigate the most pronounced cases of carbon leakage. SAF-BAM would not be able to cover:

- Leakage from journeys in which the EU is neither origin nor destination, but only a hub, e.g., flying from North America via Europe to Asia. To avoid such leakage, some incentives can be investigated to ensure the EU remains an attractive player in the aviation sector (see next section).
- Passengers buying separate tickets with different airlines. This would have consequences for passengers circumventing SAF-BAM by using this method (financial costs, visa requirements in some countries when changing terminals, loss of certain passenger advantages and rights like compensation for delays/cancellations, missed connections, baggage transfer, duty of care and additional waiting times). For cargo, shipments could be transported to intermediate destinations first, and then re-routed to the final destination. This would involve customs issues, additional operational activities (potentially requiring financial guarantees, etc.) and also loss of advantage or rights against an airline. Therefore, it is expected that passengers and cargo shippers using this method would represent a marginal portion of the total.
- Passengers who interrupt their journey for a few days and then continue, unless purchased on the same ticket, which would allow SAF-BAM to track their data.

In summary, while CBAM cannot be directly adapted to the aviation sector except in the scope of transportation of CBAM goods due to the unique nature of the aviation industry and the complexities of tracking emissions, its central idea, and objectives (namely, addressing carbon leakage and ensuring fair competition) can certainly be transposed into a similar mechanism tailored to aviation. A CBAM-like structure can be implemented for the aviation industry in the form of the SAF-BAM, which would focus on creating a level playing field between airlines operating flights departing from the EU and those using non-EU hubs to circumvent emissions obligations. **While the mechanisms differ in their scope and application, the core principles of emission reduction and fair competition are fully applicable to aviation and can be effectively supported by mechanisms like SAF-BAM.** This would not only ensure a fairer transition to sustainable aviation but, like CBAM, also foster a global, EU-led approach to carbon pricing in the sector, thereby contributing to the EU's climate goals while mitigating the risk of carbon leakage. Additionally, the use of exemptions, incentives, and anti-circumvention measures would be key to ensuring the success of SAF-BAM, providing flexibility while preventing potential abuses of the system.

2.2.1 Legal aspects

Compatibility with CORSIA and ICAO

The SAF-BAM mechanism and CORSIA are complementary rather than redundant. CORSIA is focused on offsetting CO_2 emissions from aviation. However, CORSIA does not specifically target the use of SAF as a means of meeting these offsetting obligations. It rather recognises SAF as a mean to reduce emissions, reducing CORSIA obligations. On the other hand, a SAF-BAM targets the use a certain percentage of SAF, thereby addressing fuel decarbonisation directly. This is where a SAF-BAM adds value. By setting requirements for SAF usage for flights to and from the EU, it ensures that airlines, regardless of their origin, are incentivised to adopt sustainable fuels.

CORSIA has already been designed to be complementary to existing systems like the EU ETS. The EU ETS applies to EU-based operators and certain flights to and from the EU, whereas CORSIA covers international aviation emissions on a global scale. This dual structure allows for regional schemes like the EU ETS to coexist alongside CORSIA's broader, global coverage. Given this existing framework, there is no reason why additional mechanisms, like SAF-BAM, cannot complement both systems by directly incentivising the adoption of sustainable aviation fuels.

The use of SAF-BAM and ReFuelEU, would lead to a direct reduction in emissions, as airlines adopt more sustainable fuel options. This reduction in emissions would, in turn, have an impact on CORSIA reporting, as the actual emissions from these flights would be lower, thereby reducing the offsetting obligations required under CORSIA.

Therefore, the combination of SAF-BAM with CORSIA and ReFuelEU would therefore create a coherent policy framework that incentivises SAF adoption across the entire aviation supply chain. Nevertheless, clear guidelines and coordination between the two mechanisms are necessary to prevent double counting of emissions, harmonisation of reporting and verification processes to avoid regulatory overlap and ensuring that these costs are proportionate and do not unduly burden airlines is crucial.

In addition, the SAF-BAM mechanism as discussed in this report has been designed with compliance to ICAO's Article 11 of the Convention on International Civil Aviation ("Chicago Convention") in mind, ensuring that it aligns with the principle of non-discrimination. According to that article, states are prohibited from applying discriminatory measures that would impact international aviation. SAF-BAM ensures that any obligations placed on airlines are applied without discrimination between EU and non-EU carriers. This means that airlines operating into or out of the EU will face the same requirements, irrespective of their nationality. By applying these requirements uniformly and without distinction, SAF-BAM is designed to comply with the non-discrimination principle under ICAO and avoid any unfair trade barriers between states.

Additionally, the SAF-BAM mechanism respects the sovereignty of states as outlined in Article 1 of the Chicago Convention, which recognises that every state has complete and exclusive sovereignty over the airspace above its territory. By requiring airlines to purchase certificates for SAF obligations avoided when carrying passengers or cargo that connect through non-EU hubs, the mechanism does not infringe upon the sovereignty of non-EU states. It applies to flights originating in the EU and connecting through non-EU hubs, with the requirement for airlines to purchase certificates being a measure imposed by the EU on its carriers, thereby respecting the sovereignty of other states.

Furthermore, the SAF-BAM mechanism complies with Article 6 of the Chicago Convention, which states that no scheduled international air service may be operated over or into the territory of a contracting state except with the special permission or other authorisation of that state. The mechanism does not interfere with the permission or authorisation required for scheduled international air services to operate over or into the territory of contracting states. It merely imposes a requirement on airlines to purchase certificates for SAF obligations avoided when carrying passengers or cargo that are transferring to subsequent-leg flights through non-EU hubs. This requirement is an internal EU regulation and does not affect the authorisation process of other states.

A SAF-BAM mechanism also aligns with Article 12 of the Chicago Convention, which requires each contracting state to adopt measures to ensure that every aircraft flying over or manoeuvring within its territory and every aircraft carrying its nationality complies with the rules and regulations relating to the flight and manoeuvre of aircraft there in force. The SAF-BAM would require airlines to purchase certificates for SAF obligations avoided, thereby promoting compliance with the ReFuelEU mandates. Additionally, exemptions or adjustments are provided upon submission of proof of SAF usage, ensuring that airlines using SAF voluntarily or under legal mandates are recognised. This promotes adherence to the rules and regulations relating to the flight and manoeuvre of aircraft within the EU territory.

Therefore, SAF-BAM would provide a level playing field and ensure that environmental objectives, such as the promotion of SAF adoption, are met without contradicting the broader legal frameworks that govern international aviation.

WTO Compliance and Trade in Services (GATS)

While SAF-BAM aims to influence fuel usage and emissions, it does not directly relate to traffic rights or air transport services governed by General Agreement on Trade in Services (GATS) of the Word Trade Organisation (WTO). GATS excludes air transport services related to traffic rights, and thus SAF-BAM would not fall under the primary scope of GATS. However, GATS does apply to subsectors like aircraft repair and maintenance, Computer Reservation System (CRS) Services, Selling and Marketing of Air Transport Services, and the mechanism must be designed to avoid discrimination in these areas against non-EU carriers. While the core of air transport services remains outside the scope of GATS, a SAF-BAM should be structured in a way that does not impose any undue burden or discriminatory practices on foreign airlines in these areas.

In addition to non-discrimination, the WTO's Technical Barriers to Trade (TBT) Agreement applies. This means that any technical standards introduced by SAF-BAM (such as those defining the minimum percentage of SAF required) must be necessary, proportionate, and transparent. The TBT Agreement requires that such standards do not unnecessarily restrict trade, and SAF-BAM must avoid disproportionate burdens on non-EU airlines. This can be achieved by ensuring clarity and fair application of SAF requirements, particularly when implementing the mechanism to international aviation services.

Similar to its compliance with ICAO principles, a SAF-BAM mechanism as discussed in this report is also designed to align with WTO principles, particularly the national treatment requirement. Non-discrimination is achieved by applying the same requirements to all airlines operating flights that originate in the EU and connect through non-EU hubs, regardless of their nationality. This ensures a level playing field and avoids any undue burden or discriminatory practices against foreign airlines in the covered GATS areas. Proportionality is maintained by ensuring that the costs imposed for SAF obligations avoided are directly related to the environmental objectives of the ReFuelEU mandates, avoiding excessive or unnecessary burdens on airlines. Transparency is ensured by basing the requirement for certificates on clear and transparent criteria, allowing airlines to understand and comply with the regulations effectively. By adhering to these principles, the SAF-BAM mechanism would promote fair treatment of all carriers while supporting the EU's environmental objectives.

In conclusion, the SAF-BAM mechanism is legally feasible, provided it is structured to align with the principles of international trade, including compliance with the ICAO, WTO's GATS and TBT agreements. A SAF-BAM would complement existing international frameworks such as CORSIA by incentivising the use of SAF for international aviation flights to and from the EU, without contradicting or overlapping with the objectives of CORSIA.

Based on the principles developed in this report, we expect the difficulties linked to the implementation of such mechanism to be related mainly to political obstacles rather than legal ones. While further adaptations might be necessary to address specific legal, operational, and political challenges, SAF-BAM offers a solid foundation to initiate discussions with EU institutions and Member States as well as potentially with other (partner) countries. As mentioned, SAF-BAM might represent a significant step toward addressing the challenges posed by the circumvention of ReFuelEU obligations, ensuring a level playing field and contributing to sustainability goals such as the decarbonisation of the aviation sector at a global level. Table 7 provides a summary of the SAF-BAM design option discussed above.

A range of other policy instruments exists that can either complement SAF-BAM, thereby addressing some of its weaknesses, or be used as policy alternatives instead of SAF-BAM. The next section presents and discusses these policy instruments.

3 Alternative mechanisms to prevent carbon leakage

3.1 Complementary and alternative policy instruments

SAF-BAM is one policy option that is available to policymakers for preventing carbon leakage. In this section, six alternative policy instruments are presented that could be used to address one or more types of carbon leakage. The instruments are selected from the ongoing policy debate and suggestions from A4E members, including applying carbon leakage solutions from other sectors to aviation. Some instruments build on existing policies and frameworks, while others would require new pieces of legislation. Overall, the identified policies that could address carbon leakage from European aviation are grouped into three categories, characterised by how they would address competitive distortions arising from ReFuelEU Aviation and other environmental policies of the EU:

- Pursuing international agreements on equivalent policies: Policies that establish common regulatory standards between the EU and other countries on the stringency of climate policies in aviation.
- Adapting climate policy related costs for carriers with a non-EU hub: Policies that increase costs for non-EU carriers to directly or indirectly mimic the impacts that EU climate policies have on EU carriers. This includes the aforementioned SAF-BAM policy as already discussed in this paper.
- Reducing costs for carriers with an EU hub: Policies that decrease costs for carriers to compensate for the increase in costs from climate policies are another option to avoid carbon leakage in the aviation sector.

3.1.1 International agreements

SAF Climate Clubs are multilateral agreements between countries to pursue similar ambitions in SAF mandates, e.g. through Air Transportation Agreements between the countries. The concept of climate clubs was popularised by Nordhaus[53] in 2015, who proposed it to overcome free-riding dynamics in international climate policy. A SAF Climate Club can also be used to agree on common criteria and standards for SAF between the members as well as monitoring requirements. With different SAF mandates under development around the globe, compatibility between the schemes may become an issue if no common standards are defined. An equal implementation of SAF mandates across the Climate Club would limit cost differentials of jet fuel caused by SAF mandates on flights within and between the member countries.

The creation of an ambitious Climate Club depends on the willingness of countries to agree on joint targets and implementation. From the EU perspective, currently only a few countries that host competing aviation hubs, such as Türkiye, the United Arab Emirates, Saudi Arabia, and Qatar would need to participate in a Climate Club to address the bulk of carbon leakage in EU aviation. The larger the coverage of the club, the more carbon leakage can be addressed, including carbon leakage faced by the non-EU members. A global SAF Climate Club would address all forms of carbon leakage that are caused by SAF mandates.

CORSIA: Strengthening CORSIA can be achieved by increasing the share of emissions that must be offset under the scheme, by further lowering the threshold of 85% of international emissions from international flights in 2019. In addition, increasing the certificate price through raising standards for admissible certificates could decrease the price differential to carriers under strong government regulation such as in the EU.

By requiring to purchase and surrender more carbon offsets, the strengthening of CORSIA increases the cost of emissions, reducing the relative price difference to SAF used under the ReFuelEU Aviation. The use of SAF could also be more directly targeted by CORSIA but is not further explored in this report.

[53] Nordhaus (2015) Climate Clubs: Overcoming Free-riding in International Climate Policy

Using an almost universal scheme like CORSIA has the advantage of addressing carbon leakage in aviation for most countries. The emergence of both ambitious SAF Climate Clubs and a strengthened CORSIA are hindered by free riding dynamics in international negotiations.

3.1.2 Adapt costs for carriers with a non-EU hub

As SAF-BAM is described in detail above, this section focuses on the concept of a SAF-Levy.

Similar to SAF-BAM, a SAF-Levy would be designed to level the climate costs for the transfer leg of flight journeys starting from the EU. The principle of a SAF-Levy consists of a fee on flight journeys of passengers. A SAF-levy could be administered in a number of ways, either applying on the transfer-legs of the flight akin to the design of a SAF-BAM or applying to all departing flights from the EU.

If applied to all departures instead of non-EU routes only like SAF-BAM, a SAF levy risks creating an additional burden on intra-EU flights and passengers, who are already exposed to EU ETS costs. This can increase destination switching carbon leakage and impact the competitiveness of intra-EU air transport. Similar to SAF-BAM, the levy would have to adjust for actual SAF usage on these routes.

Under a transfer-route approach, the levy would be charged as a fee on tickets sold with a connection, and account for the costs of SAF that have been avoided on the transfer leg which falls outside the scope of ReFuelEU Aviation.

In a scenario where a levy is applied on journeys departing from the EU to their final destination, the levy amount varies based on the distance to the final destination airport, regardless of layovers. The calculation method to define the exact amount of the levy and use of revenues remains to be determined. The effectiveness in reducing carbon leakage depends on the amount of the levy, which could cover the partial or full differential between SAF price and kerosene price.

The policy mitigates the cost advantage from using non-EU airport as hub or additional layover to avoid ReFuelEU Aviation. The payments could be collected by EU member states based on EU regulation. The revenue could be used to purchase and subsidise SAF for airlines. This means that funds levied from the aviation sector would be directly re-invested in decarbonisation of aviation to support the transformation.

Similar to SAF-BAM, the SAF-Levy is in principle at risk of compliance avoidance as passenger tickets might be purchased separately to circumvent the levy for parts of the journey. However, this avoidance risk is expected to be limited, as passengers who buy their tickets separately face issues concerning access to replacement flights in cases of missed connections as well as difficulties with visa requirements and checked luggage during layovers.

Further work is needed to ensure that if it is applied to all departures instead of non-EU routes only like SAF-BAM, a SAF-Levy does not result in an additional burden on intra-EU flights and passengers, does not increase destination switching or carbon leakage, or impacts the competitiveness of intra-EU air transport.

3.1.3 Reduce costs for carriers with EU hub

SAF Buyer Subsidies support airlines' ability to shoulder the higher costs of the mandated SAF fuel share depending on the quantity and type of SAF used. To optimally address carbon leakage, the subsidies for SAF users could be applied to all routes from EU airports, to mirror the coverage of ReFuelEU. Both EU and non-EU airlines would be eligible to receive the subsidy, following the principle of non-discrimination. The policy would need to be backed by significant additional funding to support both intra-EEA and outbound flights. With the increasing requirements of ReFuelEU over time, the cost of the subsidy would increase, despite expected technological advancement in SAF production.

The effectiveness of the SAF Buyer Subsidy to tackle carbon leakage depends on the share of the price differential between SAF and kerosene that it covers. The subsidy can be targeted to routes particularly at risk of carbon leakage, which may receive a higher share of the price differential than less threatened routes. The incidence of any fiscal market intervention as a subsidy depends on market factors such as the elasticity of supply and demand and level of competition in the SAF market[54]. Depending on the development of the SAF market, a share of the SAF Buyer Subsidies might be absorbed by increased SAF producers' profits, reducing the benefits for airlines.

From the period of 1 January 2024 to 31 December 2030, 20 million SAF Allowances are reserved under the EU Emissions Trading System (ETS) to be distributed to aircraft operators who use SAF and other non-fossil derived aviation fuels[55]. Airlines can submit proof of SAF utilisation to national ETS authorities to receive the support, which is provided in form of free ETS allowances. The allowances are aimed to cover part, or all, of the SAF price premium. The percentage of the price differential towards fossil kerosene covered is dependent upon the category of SAF, ranging from 50 to 95%. Assuming an average carbon allowance price of €100, this amounts to a funding of €2 billion. The allowances are only available to flights covered by the EU ETS.

For EU airlines, the financial burden of the EU ETS compliance remains a significant challenge, generating carbon leakage both by destination switching and hub switching. By increasing the quantity of the existing SAF Allowances mechanism, the EU could drive greater investment in SAF production, expand supply and potentially lower costs of SAF.

Lowering costs on intra-EEA routes only could reduce carbon leakage from hub-switching and destination switching caused by the EU ETS, but has a limited impact on extra-EU competitiveness, as the ReFuelEU-related costs on outgoing flights from the EU remain unchanged, leaving the issue of additional layovers at non-EU hubs on outgoing journeys unresolved.

Tax Rebates could support the aviation sector with lump-sum tax reductions for airlines that are by nature independent of specific SAF quantities used. In order to not trigger changes in marginal costs of the airlines, their volume is determined on airline level in relation to business volume in a past point of time, commonly referred to as 'grandfathering'. In a coordinated effort, EU member states would reduce corporate or other taxes for airlines at the national level. Tax Rebates would cushion financial losses due to carbon leakage by airlines and could allow them to offer competitive prices on international routes despite their ReFuelEU obligations.

As with the SAF buyer subsidies, tax rebates risk distorting the cost of compliance of EU short-haul versus long-haul routes. This in turn risks increasing destination switching carbon leakage and impacting the competitiveness of intra-EU air transport.

A difficulty of using tax rebates like corporate tax reductions or tax credits is the limited EU competence in tax policy. To achieve an equivalent tax reduction for airlines between EU countries, a multitude of national tax policies would need to be adapted in coordination, posing a significant political obstacle. Finally, there may also be a risk linked to member states using the tool to promote flagship carriers over competitors based in different countries.

Table 8 below compares the functioning of the six policies.

[54] Gruber (2018). Public Finance and Public Policy, Chapter 19; The Equity Implications of Taxation: Tax Incidence

[55] Official Journal of the European Union, Directive 2003/87/EC

Table 8: Comparing policy instruments

Category	International agreements		Adapt cost for carriers without EU hub		Reduce cost for carriers with EU hub		
Policy	SAF Climate Clubs	Strengthening CORSIA	SAF-BAM	SAF-Levy	SAF Buyer Subsidies	Strengthening SAF Allowances	Tax Rebates
Policy type	International standard	International emission offsetting scheme	Purchase requirement of carbon certificate	Levy	Subsidy	Subsidy/free allocation	Tax reduction
Policy level	Multinational	Global (ICAO)	EU policy	EU policy	EU policy	EU policy	Coordinated EU member state policies
Coverage	Routes departing and landing in member countries.	International routes between most countries.	Routes between non-EU airports on outgoing journeys from the EU.	Levy may apply on all outgoing journeys from EU or on flights between non-EU airports on out-going journeys from EU.	Mirroring ReFuelEU, routes departing EU airports.	Flights subject to EU ETS coverage (intra-EEA).	Carriers paying taxes in the EU.
Administrative burden	National authorities enforce SAF mandates and SAF standards.	Carriers buy offsetting certificates. National competent authorities oversee deletion of certificates.	Carriers use SAF and/ or submit information. EU member states sell certificates.	Carriers submit information. EU member-states collect the levy.	Carriers submit information. EU member states issue subsidy based on EU regulation.	Carriers document SAF uplift, apply for ETS financed support according to COM	EU member states collect less taxes.
Financial burden	Carriers are responsible for buying SAF according to standard. Partial pass-through via price increase to customers.	Carriers pay for certificates. Partial pass-through via price increase to customers.	Carriers buy SAF or pay the certificate. Partial pass-through via price increase to customers.	Carriers pay the levy. Partial pass-through via price increase to customers on outgoing journeys.	The EU budget subsidies carriers. Partial pass-through of price decrease to customers.	The EU budget and member state budgets subsidise carriers in the form of free allowances.	EU member states reduce taxation on carriers. Partial pass-through via price decrease to customers.
Carbon leakage prevention	Addressing all types of carbon leakage that derive from SAF-mandates, depending on membership.	Reducing all types of carbon leakage but only gaps a share of the price differential between SAF and offset price.	Addressing carbon leakage on outbound journeys from EU. Not addressing hub-switching for journeys starting outside EU.	Addressing carbon leakage on outbound journeys from EU. Not addressing hub-switching for journeys starting outside EU.	Addressing carbon leakage from destination and hub switching.	Mostly impacts intra-EEA flights with low carbon leakage risk. Limited impact on additional layover, hub- and destination switching for long-haul flights.	Not preventing carbon leakage but cushioning its effects on carriers with EU hub. The measure might increase destination switching as long-haul flights could benefit more from Tax Rebates.
Compatibility to SAF-BAM	Substitute	Complementary	N/A	Substitute	Complementary	Complementary	Complementary

3.2 Rapid assessment of policy instruments

This section assesses the six policy instruments regarding their environmental effectiveness to address carbon leakage and reduce aviation emissions, economic impacts as well as political, administrative, and legal feasibility. The assessment was carried out by Deloitte experts based on the rating framework with input from interviews with A4E members. This high-level comparison does not replace a full impact assessment.

Table 9: Criteria for policy instruments

Category	Criteria	Assessment statement
Environment	Carbon leakage	The policy effectively prevents carbon leakage caused by ReFuelEU.
	Emissions	The policy is effective in reducing international aviation emissions.
Economic	Public finance	Limited public expenses are required for the policy.
	Burden on airlines	The financial burden to carriers with an EU hub is limited.
	Airline distortions	The policy limits distortions between different airline business models.
Feasibility	Political feasibility - EU	The policy fits with declared strategies of EU policymakers and is compatible with existing legislation.
	Political feasibility – international	The policy is likely to be accepted by non-EU countries / unlikely to face major retaliation.
	Administrative feasibility	It is simple to collect the relevant information for enforcement.
	Legal feasibility	The EU has the competence to legislate/negotiate the policy.

Source: Deloitte

If implemented individually, each policy faces at least one key challenge or has a weakness in addressing all forms of carbon leakage from aviation, or both. The following section analyses the policies along the above criteria.

Environmental

From an EU perspective, a global SAF Climate Club is optimally suited to avoid **carbon leakage** caused by ReFuelEU. It would address carbon leakage from additional layovers, hub-switching as well as destination switching. SAF-BAM and the SAF-Levy would address most of these types of carbon leakage, but do not address hub-switching in flights that start outside of the EU and opt for non-EU hubs instead of EU hubs. A SAF-levy even risks increasing destination switching on flights from non-EU airports towards the EU.

Extending SAF Buyer Subsidies reduces hub-switching and additional layovers, as it enables flights from EU airports to remain in competition with international routes that are not subject to ReFuelEU. However, SAF Buyer Subsidies on their own risk encouraging destination switching between short-haul and long-haul flights from EU, unless they are applied equally to both. Tax rebates that are applied in a lump-sum fashion do not directly limit carbon leakage, as the marginal costs of carriers with an EU hub are unlikely to change. They rather cushion financial losses from carbon and business leakage of carriers that pay the larger part of their taxation in the EU. Strengthening CORSIA has the potential to address all types of carbon leakage. However, it only partially reduces carbon leakage, as the price for offsetting certificates is projected to remain well below the cost of using SAF and does not affect the SAF mandate under ReFuelEU.

When considering the **effectiveness in reducing international aviation emissions**, SAF-BAM, SAF Levy, SAF Buyer Subsidies, and SAF-Climate Clubs show the highest potential and are expected to lead to the greatest uptake of SAF, supporting decarbonisation of aviation emissions on a lifecycle basis. CORSIA does not directly reduce aviation emissions, except for minor demand reductions due to price increases, but rather causes negative emissions or emission avoidance in other sectors by financing offsetting projects. Tax Rebates do not directly cause emission reductions.

Economic

From a public finances perspective, the policies that raise public funds by increasing the cost for the competition are generally attractive: SAF-BAM and SAF-Levy. On the other end of the spectrum, SAF Buyer Subsidies, SAF Allowances and Tax Rebates could be costly for the public domain if not complemented with a revenue-generating policy such as the SAF-BAM. While the costs of SAF Buyer Subsidies depend on the size of the subsidy, the amount of public funds required would be fairly large, given that the price of SAF is 3-10 times the price of kerosene today[56], and is estimated to remain far above fossil kerosene in the medium term despite substantial cost reductions. Here, a joint implementation of policies of both types could both limit public sector costs and reduce carbon leakage in the aviation sector. CORSIA and SAF Climate Clubs are revenue-neutral from a public finance perspective, with minor administrative costs attached.

From the perspective of carriers with an EU hub, SAF Buyer Subsidies, SAF Allowances, and Tax Rebates are financially attractive. Most other policies are not placing a direct financial burden on carriers with an EU hub, but would benefit them indirectly, through reducing carbon leakage to different degrees. Increasing the level of ambition of CORSIA would increase costs for carriers with an EU hub to a limited extent, as the SAF use mandated by ReFuelEU can be in principle deducted from CORSIA requirements.

Strengthening CORSIA would reduce economic distortions between EU carriers' main business models (network carriers, budget carriers, cargo airlines), as it increases the cost of emissions in international flights, reducing incentives for both short-haul and long-haul destination switching that currently especially affects budget carriers who operate mostly intra-EEA routes. This interpretation relies on the current EU legislation, where CORSIA is not applied to intra-EEA flights that are covered by the EU ETS.

Tax Rebates would benefit long-haul routes over short-haul routes. This risks increasing distortions within the EU between cost of compliance for short-haul and long-haul routes.

SAF-BAM and SAF-Levy especially cater to the needs of EU long-haul carriers in reducing carbon leakage but have little to no direct impact on short-haul carriers that are mainly serving intra-EEA connections. The benefits of such a policy would be mostly felt by carriers with an EU hub that operate long-haul routes. SAF Climate Clubs are unlikely to cause new distortions between carriers with an EU hub business models but also do not reduce existing ones.

SAF-BAM and SAF-Levy address carbon leakage arising on transfer legs and would provide bigger mitigation to long-haul operations. The benefits of such a policy would be felt on long-haul routes.

For Tax Rebates, the impact on economic distortions between airline business models relies on the type of taxes that are reduced, and in which country the different airlines pay the larger part of their taxes. Hence, a possibly induced economic distortion would rely on tax structure and not on the type of business model. In general, airlines that pay the larger part of their taxes in the EU would achieve an advantage over airlines paying less taxes in the EU. However, there is a risk of variable implementation among member states, as it would be difficult to act in a coordinated way across 27 different member states, and this could undermine the level playing field within the EU.

Feasibility

From the perspective of political feasibility for EU policymakers, SAF-BAM, the SAF Buyer Subsidy as well as a SAF Climate Club, all of which build on existing EU policies, might appear compatible with the policy framework in place. However, they require significant further policy development to ensure they limits costs or administrative burden for operators with EU hubs. CORSIA's set-up as offsetting scheme is not aligned with the EU's current choice for mandatory carbon pricing and CORSIA's mechanism to only offset emissions from sectoral growth is not fully

[56] EASA (2025) European Aviation Environmental Report 2025

compatible with the EU ambition in emission reduction in the transport sector. Still, the EU does rely on CORSIA to reduce emissions in international aviation and has previously successfully pushed for strengthening the scheme[57].

The **political feasibility from an international perspective** draws an opposing picture, as the EU pricing non-EU competitors might be perceived as encroaching on their domestic policy space by other countries. The SAF Buyer Subsidy that only adjusts for additional costs of ReFuelEU is less likely to trigger retaliatory measures from non-EU countries. While threats to use retaliatory measures against the EU in the context of climate policy in the aviation sector have occurred already in the past[58], the risk to encounter retaliatory measures may have increased in the current geopolitical climate. Tax rebates in aviation bear the risk of a race to the bottom between jurisdictions. Finding international agreement with the relevant jurisdictions to limit carbon leakage (TR, UAE) to join an ambitious SAF Climate Club appears unlikely due to free-riding dynamics, and strengthening CORSIA equally relies on the cooperation of others. Updating an existing scheme such as CORSIA during its periodic review requires less political capital from the EU and has been achieved in the past[59], in comparison to creating a new platform such as a Climate Club.

Concerning the **ease of administrative implementation**, introducing additional SAF Buyer Subsidies that are based on extending existing legislation and the strengthening of CORSIA would be easiest to implement, as they require little additional enforcement efforts. Tax Rebates are, in principle, easy to implement on a national administrative level, while the coordination of national tax rebates between EU member states can become challenging and would have important consequences on the EU single market if member states differ in their implementation. There remains a risk of compliance avoidance for both SAF-BAM and the SAF-Levy, as customers could opt to book connecting flights separately, which could only be traced by authorities with a considerable monitoring effort.

From a **legislative feasibility** perspective, the EU has the competence to adapt existing policy like the SAF Buyer Subsidy. Introducing SAF-BAM on flights that take place outside the EU also falls into EU competence and can be compatible with EU law, similar to the FuelEU policy for the maritime transport sector that establishes environmental requirements for shipping routes between non-EU ports on journeys to and from the EU[60]. Whether SAF-BAM and SAF-Levy fall under the Ordinary Legislative Procedure which allows for qualified majority voting to be passed as EU law or require unanimity in the EU-legislative process depends on how they are integrated with existing environmental measures like RefuelEU.[61] Introducing a SAF-Levy is expected to be feasible under EU law. Despite only having an observer status at ICAO meetings, the EU Commission plays a role in coordinating EU members' engagement at the ICAO negotiations, where international negotiations concerning CORSIA are held[62] and coordinates CORSIA implementation in the member states. The EU's competence in tax policy is limited, hindering the implementation of EU-wide Tax Rebates to the aviation sector as harmonising taxation at the EU level requires unanimity in the Council[63].

With the results of this high-level expert assessment, some key challenges can be identified for each group of policies. While SAF-BAM, and similarly a SAF-Levy (when applied to routes between non-EU airports), have been found as implementable policy options to reduce carbon leakage in aviation from a legal and administrative

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[57] ICAO (2022) COVID-19 impacts and 2022 CORSIA periodic review

[58] Buissing (2022) EU Air Transport and the EU's Environmental Agenda Struggle: A Leap of Faith or Can a CBAM Level the Playing Field?

[59] ICAO Assembly (2022) Assembly Resolution A41-22

[60] Official Journal of the European Union, Regulation (EU) 2023/1805

[61] For example, CBAM has been passed under the ordinary legislative procedure, see European Parliament (2020) Trade Related Aspects of a Carbon Border Adjustment Mechanism. A Legal Assessment

[62] EU Commission (2024) The European Union at ICAO

[63] Ricardco (2021) Study on the taxation of the air transport sector

perspective, they require significant political capital to establish, and face the risk of retaliation from non-EU countries. Reliance on SAF-Buyer Subsidies and Tax Rebates would come at a high financial cost to the public domain, that may be hard to justify given the large volume required. The political feasibility of Tax Rebates is limited due to the high hurdles for harmonising taxation policy between EU member states. While international agreements like a SAF-Climate Club or CORSIA have the potential to reduce most types of carbon leakage, achieving such ambitious agreements on an international level appears difficult, particularly in the current policy environment. Given the limited evidence available on the different policy options that were assessed, additional research on legal, administrative options of implementation, as well as modelling of their exact economic implementations can further increase the understanding of their advantages and weaknesses.

Policy combinations – Complements and substitutes

Given the individual advantages and disadvantages of policies discussed in this report, a combination of options is likely to be required to address all forms of carbon leakage identified. From the policies explored in this report, some policies are substitutes for each other and should not be implemented in parallel, e.g. SAF-BAM and the SAF-Levy. Others are complementary to each other. Table 8 also provides insight of the compatibility and substitutability between different policy alternatives. Two individual policies that together reduce most types of carbon leakage and that can be implemented at the EU level without negotiations with third countries, are the SAF-BAM and the introduction of SAF Buyer Subsidies to flights leaving the EEA. If combined, the two policies can compensate for some of each other's shortcomings. Combining a policy that increases the costs of emissions as SAF-BAM does, with a subsidy that supports decarbonisation has been implemented in other economic sectors like European energy intensive industry. For them, the costs of emissions have been increased through policy that generates revenue for the public sector, with decarbonisation subsidies like Carbon Contracts for Differences (CCFDs) and Important Project of Common European Interest (IPCEIs) being offered in parallel to support the industrial players. At the same time, the interaction effects must be accounted for in policy design. In the given case, SAF-BAM would only be required to increase prices to flights covered to the price differential induced by ReFuelEU. As the price differential would be decreased by extended SAF Buyer subsidies, the two policies would need to be closely coordinated with each other.

Additional effort is required to consider the potential advantages and disadvantages of any combination of policies discussed in this paper, including the option described above. This includes potential negative outcomes resulting from a multiplicity of policies that increase the administrative burden for airlines.

4 Outlook for EU Aviation

Our analysis has shown that ambitious climate policies can have substantial carbon leakage impacts if not carefully designed, potentially reducing their overall climate impact while threatening EU revenues and employment. This is particularly pronounced for routes that can access a hub near the EU with limited detours, as are routes towards Asia. Given the multiple pressures already facing the aviation industry, it is crucial to implement policies that effectively address carbon leakage risks.

Applying the current CBAM is not suitable for aviation. But SAF-BAM, a border adjustment mechanism designed to level the costs associated with ReFuelEU, could play a vital role in reducing carbon leakage. If implemented well, it could even create an advantage on combined ReFuelEU and SAF-BAM costs for airlines that fly a shorter route, creating climate benefits. However, technical challenges remain, and similar to the industrial CBAM, the effectiveness of the instrument largely depends on its specific details.

It is also important to note that certain types of carbon leakage, such as transit cargo and passengers avoiding the EU as a layover, cannot be prevented by SAF-BAM alone. These transit passengers, such as from North America to Asia, are an important revenue source for carriers with an EU hub.

While alternative solutions could be suitable, each policy has weaknesses, and international solutions face the challenge of EU dependence on global cooperation. A combination of SAF-BAM and additional SAF support could be a viable option that the EU can implement independently. However, it is crucial to recognise that carbon leakage resulting from destination switching induced by the EU ETS will not be addressed by these policies, affecting both short-haul and long-haul switching.

In conclusion, EU policymakers should carefully consider that appropriate carbon leakage prevention mechanisms are in place when aviation climate policies increase in ambition. By implementing a well-designed combination of policies, the EU can work towards reducing aviation emissions while minimising the risk of carbon leakage and maintaining the competitiveness of its aviation industry. Further work is needed to understand the interactions of different policies, and there is a risk of legislating policies without fully accounting for competitiveness and climate implications.

Airlines can work together to advocate for the strengthening of global carbon pricing and SAF mandates to reduce the need for government policies to ensure a level playing field and ambitious decarbonisation.

Abbreviations and acronyms

A4E	Airlines for Europe
CBAM	Carbon Border Adjustment Mechanism
CCFD	Carbon Contracts for Differences
CO_2	Carbon dioxide
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DACM	Deloitte Aviation Competitiveness Model
EEA	European Economic Area
EU	European Union
EU ETS	EU Emission Trading System
EU RED	EU Renewable Energy Directive
ICAO	International Civil Aviation Organization
IPCEIs	Important Project of Common European Interest
NWE	Northwest Europe
RFNBO	Renewable fuels of non-biological origin
RFS	Road Feeder Service
SAF	Sustainable aviation fuel
SAF-BAM	Sustainable aviation fuel border adjustment mechanism
TR-ETS	Turkish Emission Trading System
UAE	United Arab Emirates
UK ETS	United Kingdom Emission Trading System

Table 10: Airport codes

Airport code	City
AMS	Amsterdam
ANC	Anchorage
ARN	Stockholm
ATH	Athens
AUH	Abu Dhabi
BCN	Barcelona
BKK	Bangkok
CDG	Paris
DEL	Delhi
DSS	Dakar
DXB	Dubai
FRA	Frankfurt
HAN	Hanoi
HKG	Hong Kong
HND	Tokyo Haneda
IST	Istanbul
LAX	Los Angeles
LUX	Luxembourg
LYS	Lyon
MAD	Madrid
NCE	Nice
ORD	Chicago
YUL	Montreal

Source: IATA

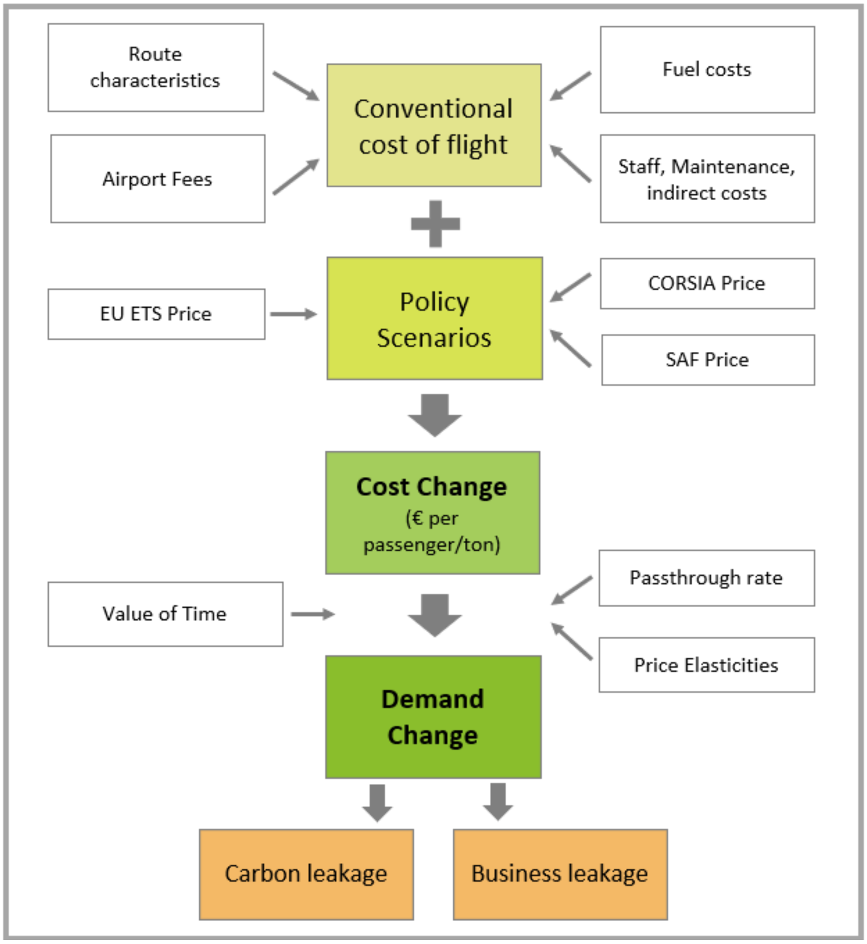
Modelling

To estimate the cost implications and resulting leakage effects, Deloitte's Aviation Competitiveness Model (DACM), a bottom-up flight cost and demand model, is applied. Figure 10 presents the basic architecture of the model.

Non-policy-related flight costs are modelled as a function of costs per time travelled, whereby the costs per unit are dependent on the aircraft used. The model divides between aircrafts for short and long-haul flights. Kerosene and policy-related costs are estimated as a function of the fuel burned for the respective route and aircraft combination. Combining the policy and non-policy-related costs provides the costs for the routes of each journey and for each of the defined scenarios.[64] In the next step the model calculates the final relative price increases by using a cost-pass-through approach of the obtained cost increases. Then by comparing the relative price increases, the model estimates the demand effects for each of the respective journeys considering price and cross-price elasticities as well as a value of time measure to price-in perceived costs for passengers of additional layovers. Passenger and cargo customers choose between the defined routes based on costs and flight time. As result, net demand effects are obtained, consisting of demand destruction and substitution effects between. Based on these net effects changes in revenue and emissions for the respective routes on a journey, which are caused by ReFuelEU, are calculated to identify the business and carbon leakage effects of the EU climate policy.

[64] National policies are not included in the modelling.

Figure 10: DACM flow chart



Source: Deloitte

Table 11: DACM main assumptions

Variable	Value	Source
SAF prices	Biomass 2716 €/t Synthetic 3932 €/t	IEA (2024) Global Hydrogen Review Destination 2050 (2025). A route to net zero European aviation
Kerosene prices	Europe & CIS 688 €/t North America 697 €/t Middle East & Africa 671 €/t	IATA Jet Fuel Price Monitor (accessed 18.12.2024)
EU ETS price	2024 - 66€/tCO_2 2030 - 138 €/tCO_2	Ember (2024) Median of price projections of 14 different organizations (see footnote 8)
Average airport fees	EU airports 4230 € Non-EU airports 4112 €	CDG Airport Paris, Frankfurt Fraport, General Directorate Of State Airports Authority, Dubai International
Value of time	27.47 €/h	T&E (2022) Assessment of carbon leakage potential for European aviation

Cost-pass-through rate	100%	Oesingmann (2022) The economic impact of EU climate policies on Intra-European aviation
Fuel efficiency increase	0.96% p.a.	Fleming, de Lépinay and Schaufele (2022) Environmental Trends in Aviation to 2050
Exchange rate ($/€)	1.06	European Central Bank (accessed 29.11.2024)

Source: Deloitte

Table 12: DACM results for the modelled journeys

Journey	RefuelEU 2030					ReFuelEU & SAF-BAM 2030				
	Cost change for carriers with EU hub (%)	Cost change relative to carrier with non-EU hub (ppt.)	Total demand change for carriers with EU hub (%)	Business Leakage to carriers with non-EU hub (%)	Resulting Carbon Leakage to carriers with non-EU hub (%)	Cost change for carriers with EU hub (%)	Cost change relative to carrier with non-EU hub (ppt.)	Total demand change for carriers with EU hub (%)	Business Leakage to carriers with non-EU hub (%)	Resulting Carbon Leakage to carriers with non-EU hub (%)
Barcelona (BCN) – Tokyo (HND)	4.8	5.1	-2.4	58.7	22.2	4.8	-0.9	-0.2	0.0	-18.3
Nice (NCE) – Tokyo (HND)	6.0	5.6	-2.9	65.3	25.8	6.0	0.3	-0.6	0.0	-7.4
Lyon (LYS) – Bangkok (BKK)	6.2	5.2	-2.8	74.3	25.0	6.2	0.5	-0.8	11.6	1.5
Frankfurt (FRA) - Los Angeles (LAX)	4.8	6.6	-3.6	22.5	12.5	4.8	-1.1	-2.3	0.0	-9.5
Paris (CDG) – Dakar (DSS)	4.5	-3.7	-1.7	0.0	4.8	4.5	-3.7	-0.6	0.0	-24.1
Montreal (YUL) – Delhi (DEL)	1.6	3.3	-2.0	74.0	18.9	1.6	3.3	-2.0	74.0	18.9
Frankfurt (FRA) – Hong Kong (HKG)	4.9	5.1	-2.3	63.7	22.1	4.9	-1.1	0.2	0.0	-22.6
Chicago (ORD)- Hanoi (HAN)	1.8	3.2	-1.8	67.2	15.5	1.8	3.2	-1.8	67.2	15.5

Source: Deloitte

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