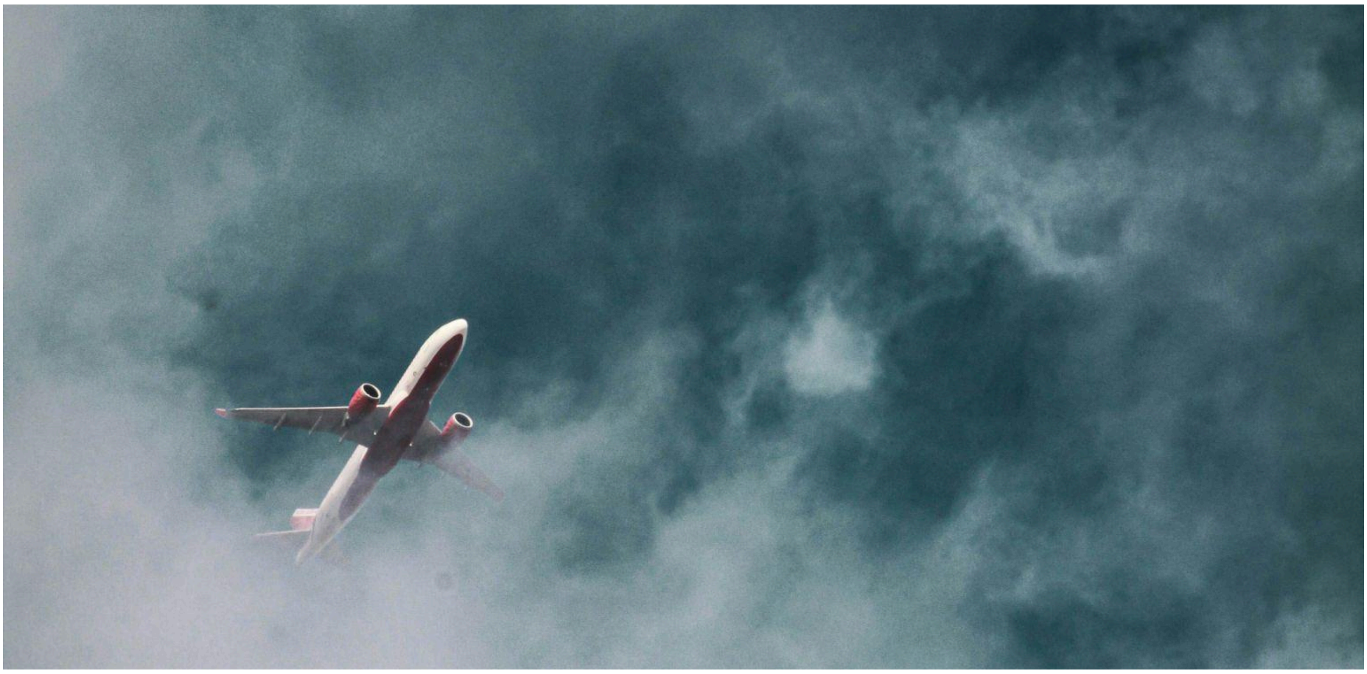

REPORT - MAY 2026

Flying blind: European aviation hits new emissions high

The case for extending European carbon pricing to all departing flights

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Table of contents

Executive Summary

European aviation emissions surpassed pre-pandemic levels in 2025

In 2025, flights departing from European airports generated 195 Mt of CO_2, surpassing their 2019 level for the first time since the pandemic. Emissions rose 4% compared to 2024. This milestone is not cause for celebration. It confirms that the sector has rebuilt without cleaning up. Aviation remains the EU's fastest-growing source of emissions, having risen by more than 30% since 2005 while other sectors have cut theirs.

Europe is recovering faster than any other major market. Growth is concentrated among low-cost carriers: Ryanair's global emissions are now 50% above their 2019 level, the largest increase of any airline worldwide. Legacy carriers such as Lufthansa and Air France remain below pre-pandemic levels. Low-cost expansion, not legacy recovery, is driving European emissions back beyond their pre-pandemic peak.

Two-thirds of emissions escape carbon pricing

The carbon market remains structurally flawed. In 2025, 68% of emissions from European departing flights went unpriced, a consequence of the carbon market's scope limitation to intra-European routes, leaving the most polluting long-haul routes entirely exempt. The effective price airlines paid per tonne of CO_2 resulted in a total of €23, far below the average EU ETS price of €73, paid for by other sectors.

None of the ten most polluting routes departing from Europe fall within the carbon market's scope. London-New York alone generated 1.4 Mt of CO_2, roughly equivalent to the annual tailpipe emissions of all cars in a city the size of Munich, yet it escaped any carbon pricing. The first route covered by the ETS appears only at 131st place in the global ranking: London-Milan, with 0.16 Mt of CO_2.

International offsetting through CORSIA is not a substitute for the carbon market

CORSIA, ICAO's global offsetting scheme for international aviation, is not a credible alternative to the EU's carbon market. The scheme's coverage is structurally limited and covers only a fraction of the EU aviation's CO_2 emissions. Many major aviation markets, including China and the United States, have not implemented it into national law. Its offsetting credits have serious environmental integrity concerns: the overwhelming majority of currently available credits derive from artificial adjustments that the UN review team found do not represent genuine emissions reductions. Unlike a cap-and-trade system, CORSIA sets no hard limit on emissions and provides no meaningful price signal for decarbonisation. The EU's assessment of CORSIA by 1 July 2026 should reflect this reality.

Extending carbon pricing can unlock billions for the green transition

Airlines avoided an estimated €8.5 billion in emissions costs in 2025 through scope exemptions and free allowances. Had the ETS applied to all departing flights, total revenues could have reached €12.7 billion, a threefold increase on what was actually collected in 2025. Extending the ETS to all departing flights would align the sector with the polluter pays principle and unlock significant revenue for public budgets. Total revenues could exceed €17 billion annually by 2030. Member States would be the primary beneficiaries, with some, including Poland, Czechia and Romania, gaining disproportionately due to the way general allowances are allocated.

We recommend that approximately 25% of these revenues be repurposed to accelerate the greening of the sector through three key measures:

- **Transform the Hydrogen Bank** into a market intermediary to de-risk the transition to e-fuels via long-term purchase contracts.
- **Redesign SAF allowances** to prioritise scalable e-SAF options and provide long-term revenue certainty for producers.
- **Establish a contrail allowance scheme** using a small share of free ETS allowances to fund the operational costs of contrail avoidance, which could deliver massive climate benefits at a minimal cost to the industry.

The European Commission's 2026 revision of the carbon market is the moment to act. By closing the current pricing loopholes, Europe can ensure that aviation finally pays for its full climate impact while funding the breakthrough technologies needed for a zero-emission future.

Recommendations

01	**Expand the EU ETS to cover all departing flights from 2027**, instead of continuing to rely on CORSIA.
02	Upgrade the **Hydrogen Bank into a European-wide double sided auction mechanism to boost the uptake of e-SAF**. Allocate e.g. 25% of aviation ETS revenues to the market intermediary.
03	**Reform the SAF allowances in order to better support e-SAF** by extending the mechanism in time and amount; earmarking allowances for e-SAF and advanced biofuels; phasing out support for HEFA-SAF; reducing the price coverage of the different types of fuels; and by moving away from an ex-post allocation to an ex-ante system.
04	Introduce an **incentive scheme for airlines called contrail allowances** using ETS revenues, to support airlines to perform contrail avoidance manoeuvres.

Section 1

Introduction

European aviation emissions surpassed their 2019 levels in 2025 for the first time since the pandemic, driven almost entirely by low-cost carrier growth. European aviation is recovering faster than any other part of the world, yet 68% of its emissions remain unpriced. With the EU's carbon market review due in 2026, the window to act is narrow.

European aviation has completely recovered from COVID

195.3
Mt of CO_2

Emissions growth 2024-2025: **+4%**.
Change in emissions compared to 2019: **+2%**.

8.6
Million flights

Traffic growth 2024-2025: **+3%.** Traffic has almost returned to 2019 levels (**98%**).

Methodological note: Throughout this report, we analyse emissions from all flights departing from European airports, covering the EU Member States, Norway, Iceland, Switzerland and the United Kingdom, referred to collectively as EU31. All figures refer to departing or outbound flights only, consistent with how emissions are reported and priced under the EU, Swiss and UK carbon markets.

1.1 European aviation emissions hits new emissions high in 2025

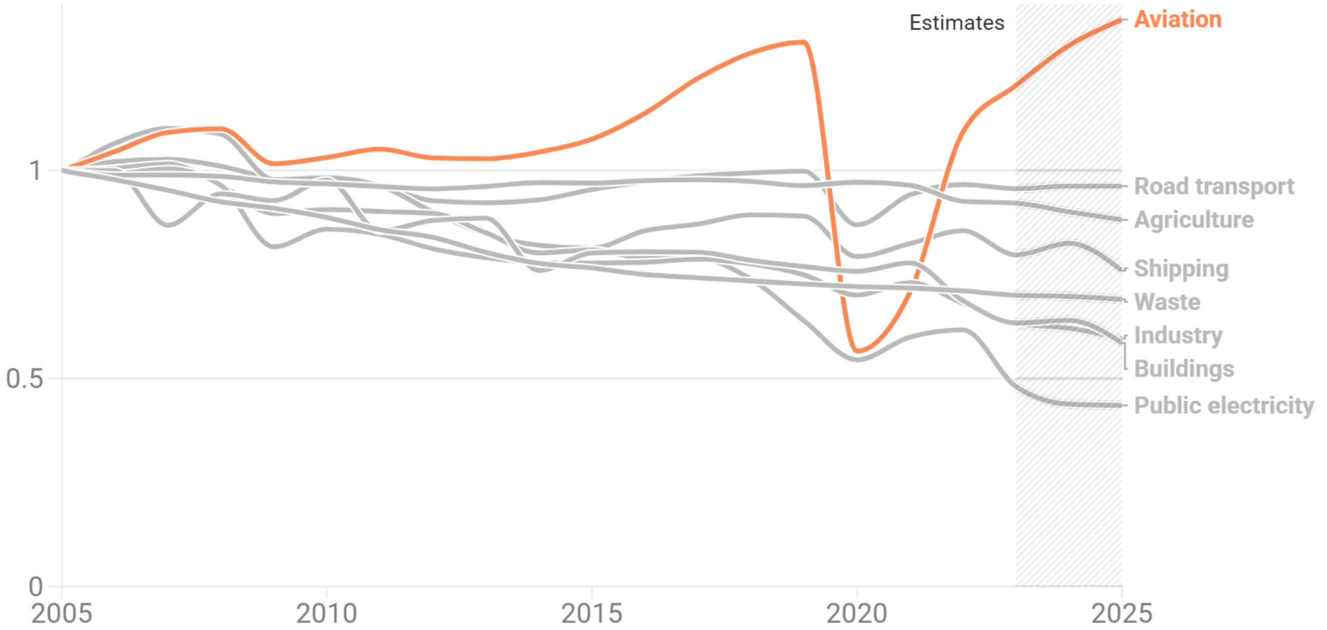
European aviation has crossed a symbolic threshold. According to Eurocontrol data, in 2025, flights departing from European airports generated 195 Mt of CO_2, returning to and surpassing their 2019 pre-pandemic level for the first time (192 Mt of CO_2 in 2019). Across 8.6 million departures, emissions rose 4% compared to 2024. This milestone is not cause for celebration. It confirms that the sector has rebuilt without cleaning up.

Aviation emissions have risen by more than 30% since 2005, moving in the opposite direction to virtually every other sector of the economy, making it the EU's fastest-growing source of emissions in the last 20 years.

Aviation is EU's fastest growing source of emissions

Aviation emissions have risen by more than 30% since 2005 - the start of the ETS - while emissions from other sectors have declined.

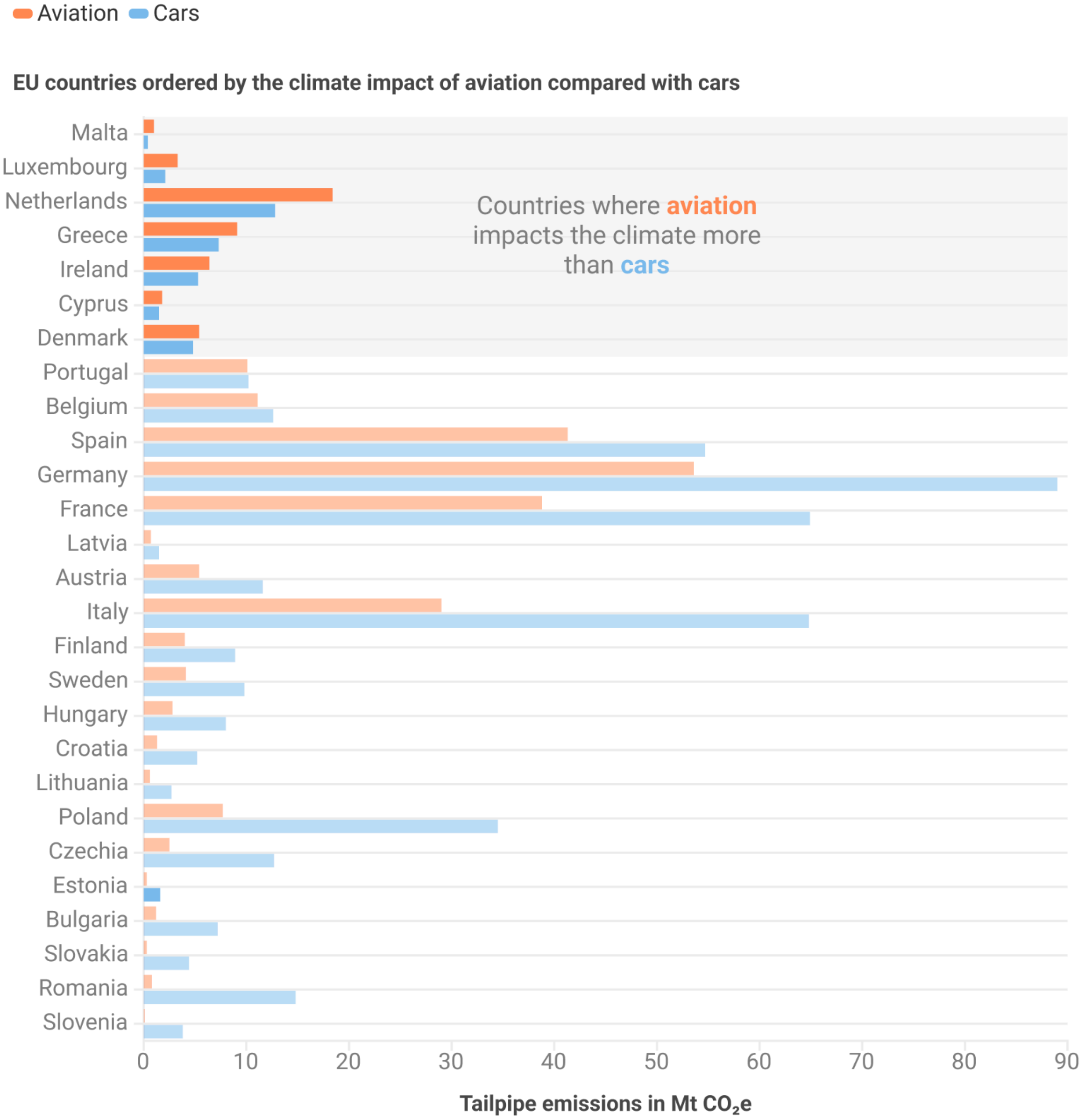
Change in greenhouse gas emissions by sector, $MtCO_2e$) (2005 = 100)



Source: T&E (2026) based on UNFCCC, EEA, Eurostat, IPCC, Ember

The scale of this divergence is striking: in seven European countries, aviation has overtaken cars as a source of CO_2 and non-CO_2 emissions, despite carrying a fraction of the passengers.

Aviation now impacts the climate more than cars in seven EU countries



Source: T&E (2026), based on UNFCCC data • Account for aviation's non-CO_2 climate impact using a 1.7 multiplier.

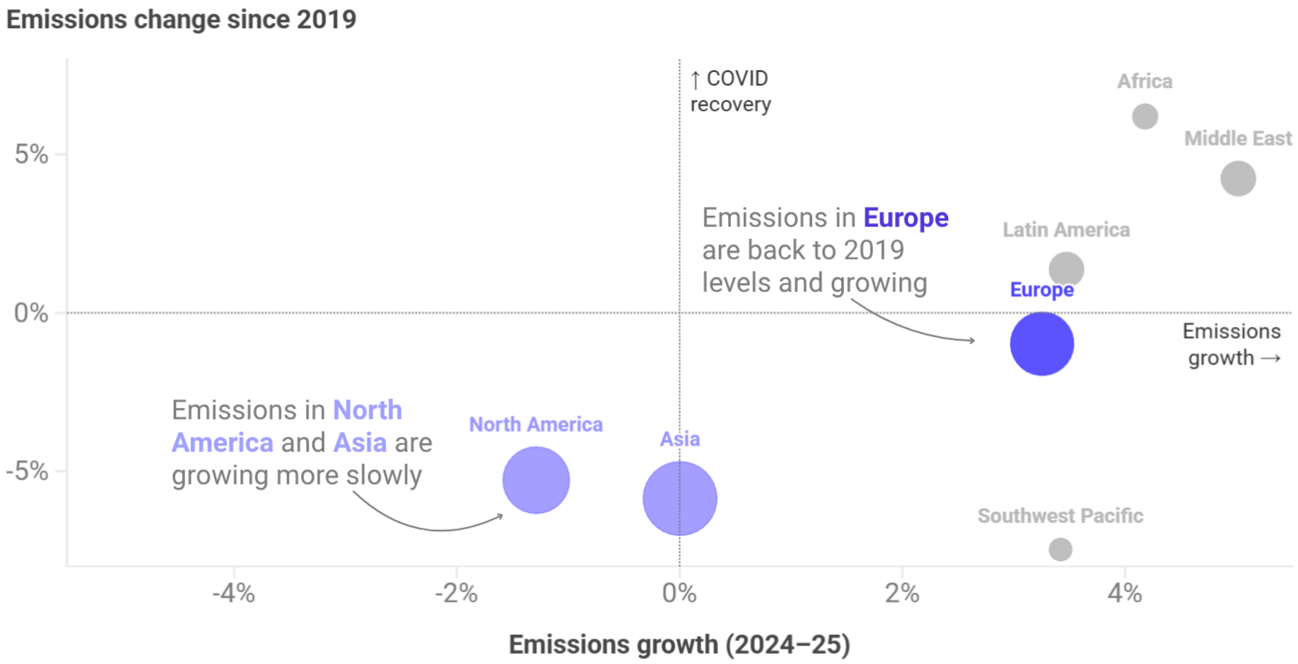
1.1.1 A global picture: Europe leads the regional recovery

Flights departing from Europe accounted for more than 23% of worldwide aviation emissions, making it the third-largest emitting region after Asia (31%) and North America (25%). Despite its smaller share compared to the first two markets, Europe is the closest of these three regions to its pre-pandemic level.

We estimate that the two larger emitting regions are recovering more slowly: Asia remains 6% below its 2019 levels and North America, whose emissions declined in 2025 compared to 2024, falls 5% short of its pre-pandemic baseline.

Europe's aviation emissions are back to 2019 levels and still growing, while larger markets stall

Bubble size represents CO_2 emissions in 2025



Source: T&E modeling based on OAG data and Eurocontrol method

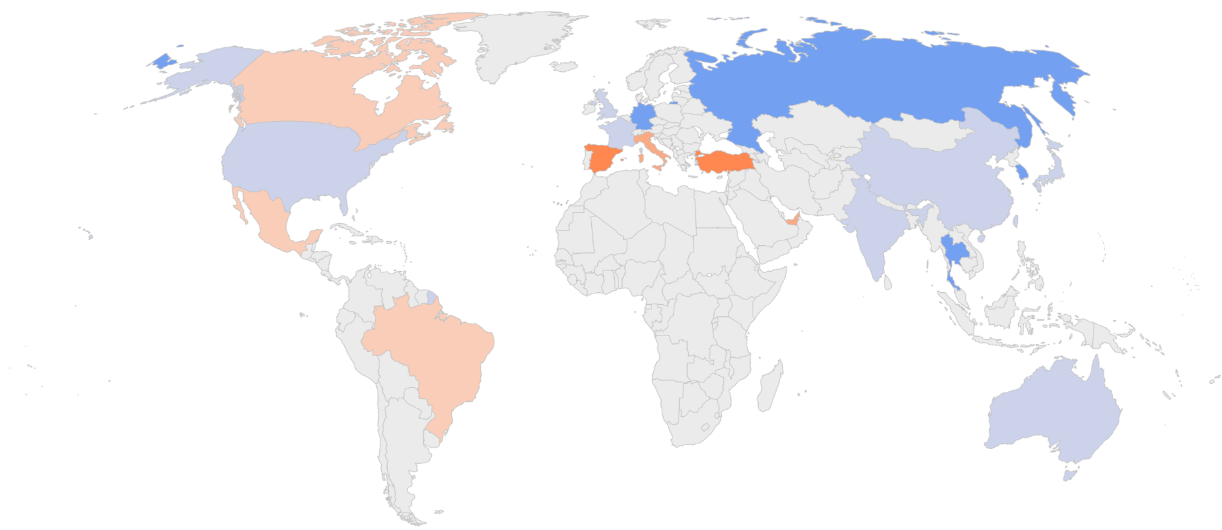
At the country level, the United States and China together account for nearly one third of global aviation emissions, yet both recorded a 2% decline in 2025 compared to 2024 and remain below their 2019 levels.

The situation in European countries is more heterogeneous. The United Kingdom, Germany, Spain, France and Italy together represent around 12% of global aviation emissions - for comparison, this is roughly the same level as China - but their trajectories diverge substantially. Spain and Italy have already surpassed their pre-pandemic emissions, at 14% and 10% above 2019 respectively, driven by strong tourism recovery and growing low-cost capacity. Germany is the notable outlier among major European markets, still 16% below its 2019 level.

In 2025, Europe grew faster than Asia and North America, the world's two largest aviation markets

CO_2 emissions from the top 20 aviation markets

Change in aviation emissions in 2025 compared to 2019 (%) -20% 0% +20%



	Country	CO_2 emissions 2025 ($MtCO_2$)
1	United States	225
2	China	115
3	United Kingdom	35
4	United Arab Emirates	32
5	Japan	30
6	India	27
7	Germany	24
8	Spain	24
9	Australia	22
10	France	22

Source: T&E modeling based on OAG data and Eurocontrol method

1.1.2 The policy response has not kept pace with the sector's growth

These figures contradict the pledges made by the aviation sector that it would build back greener after the pandemic. In T&E's Down to Earth report, we estimated that passenger traffic at European airports could more than double by 2050. Fleet modernisation and sustainable aviation fuels have a role to play to reduce aviation emissions, but compliance with the EU's mandate on these fuels will not be enough to address the sector's continued growth. If Europe continues down this path, aviation could be burning as much fossil kerosene in 2049 as it did in 2023, even while complying with the EU's sustainable fuel mandate.

A robust market measure is the missing piece. This makes the upcoming 2026 review of the ETS for aviation particularly significant. Since 2012, the ETS has been limited to intra-EEA flights. A central question for this revision is whether it should be extended to all flights departing the EEA.

T&E analysis, outlined in this report, points to one conclusion: **the urgent need to extend the scope of the ETS to all departing flights.**

Section 2

Analysis

European aviation emissions have returned to pre-pandemic levels, yet the ETS leaves two-thirds of this pollution unpriced. By excluding long-haul flights and maintaining free allowances, airlines avoided an estimated €8.5 billion in emissions costs in 2025. Extending the scheme to all departing flights would close this loophole, align the sector with the polluter pays principle and unlock crucial revenues for the green transition of the sector.

Key figures on European aviation emissions pricing in 2025

68%

Share of CO_2 emissions from European departing flights that remained unpriced in 2025.

€23 vs €73

Effective carbon price airlines paid per tonne of CO_2 versus average ETS auction price in 2025.

€8.5 billion

The estimated emissions cost left unpaid in 2025 due to free allowances and the exclusion of long-haul flights.

2.1 The aviation carbon market remains a flawed system

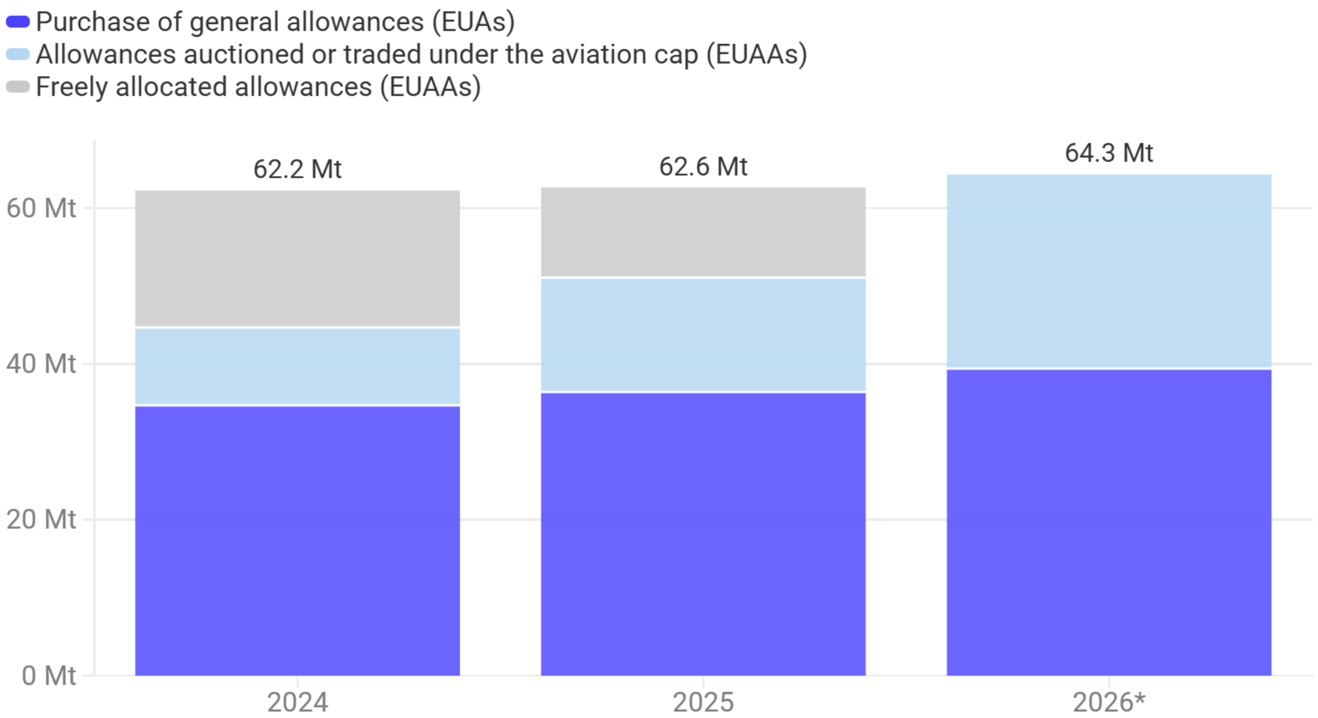
European aviation has never polluted this much: the sector emitted 195 Mt of CO_2 from departing flights in 2025, exceeding its 2019 levels for the first time since the pandemic (+2% compared to pre-COVID levels).

The ETS has covered intra-EEA flights since 2012, with UK-to-EU routes switching to the UK ETS in 2021 following Brexit. Under both systems, airlines surrender allowances equal to their prior-year CO_2 emissions, acquired through annual allocations, auctions or secondary purchases, under a cap that tightens progressively over time.

In principle, a rising carbon price creates an incentive to cut emissions when doing so costs less than purchasing permits. In practice, the aviation cap is set separately from the rest of the carbon market and is already well below the sector's actual verified emissions. This means airlines must purchase general allowances, the same permits used by power stations and heavy industry, to cover the gap.

This dynamic is set to intensify in the future as the aviation cap reduces linearly and aviation emissions continue to grow, the gap between the aviation cap and actual (verified) emissions will likely increase. The relative importance of general allowances in airlines' compliance strategies is therefore going to rise significantly over the coming years. Put simply, airlines will need to purchase an increasing volume of general allowances to remain compliant, making aviation an ever-larger buyer in the broader carbon market.

Aviation increasingly relies on the general carbon market to cover its emissions



Source: T&E modeling based on verified emissions, EUTL • Departing flights from EEA. *2026 figures are based on estimated growth.

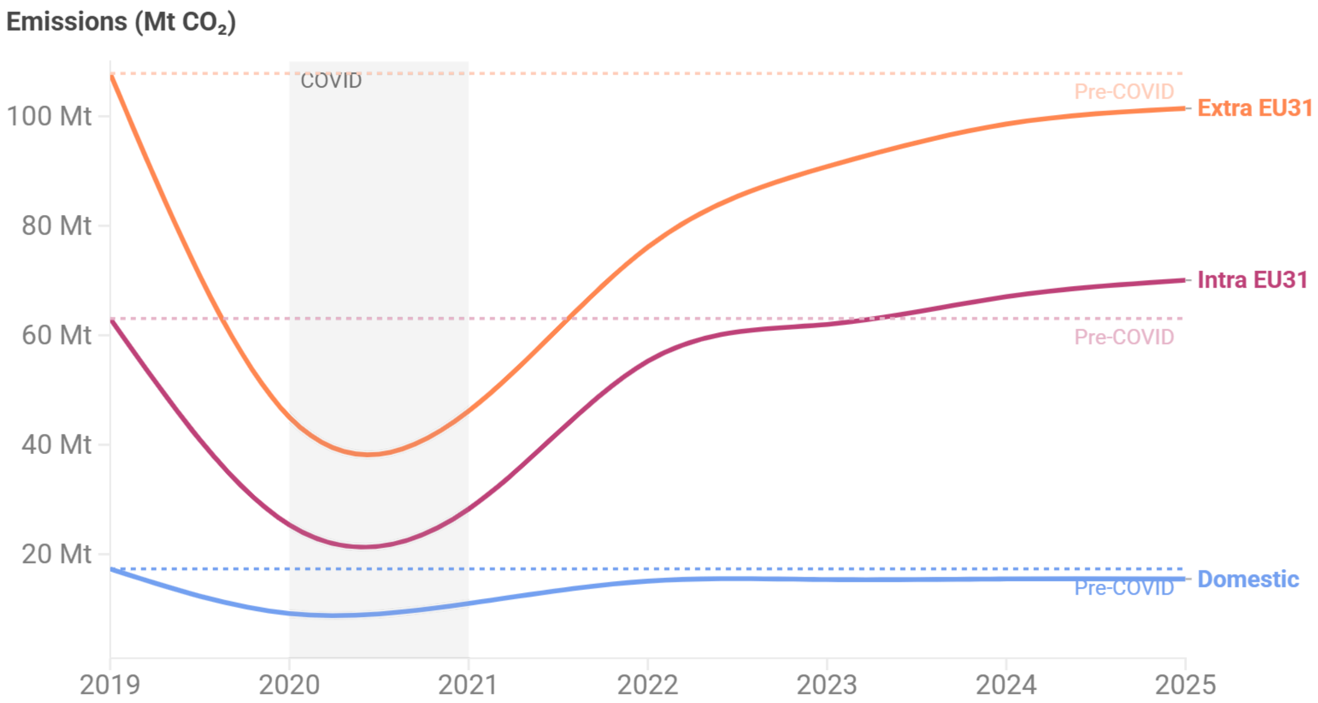
A significant milestone in 2025 was the near-completion of the free allowance phase-out. Free allowances were reduced by 25% in 2024, by 50% in 2025 and will be fully phased out from 2026. In the UK, the phase-out follows a similar timeline. This has had a more substantial effect on the effective carbon price than the tightening of the cap itself: by reducing the volume of permits airlines receive for free, the phase-out directly increases the share of emissions that must be purchased at market price.

As a result, the estimated effective price per tonne of CO_2, meaning the price paid once free allowances and unpriced emissions are accounted for, rose to €22.6 in 2025. This is an increase of 26% compared to last year's estimate of €17.9. For comparison, in the same period the average allowance prices under the general ETS increased by 13% and UK-ETS increased by 29%, due to the tightening cap.

The more fundamental shortcoming of the aviation ETS remains scope. The European carbon markets covered 74 Mt of CO_2 in 2025 (considering emissions from EU and Swiss administered airlines, plus UK ETS estimated emissions). Had they applied to all departing flights, a further 107 Mt would have been included. Taking unpriced international emissions and remaining free allowances together, **68% of CO_2 from European departing flights went unpriced in 2025**.

The breakdown is unequivocal. Intra-European emissions have grown 4.5% in 2025 and now are 11% above their 2019 level, the strongest recovery of any segment. Extra-European emissions, which the ETS does not price, grew 3% in 2025 but remain nearly 6% below their pre-pandemic levels. The segment growing fastest and furthest above 2019 is the one the system already prices, yet emissions have continued to rise. **Both a broader scope and a more ambitious carbon price are needed**.

Intra-European routes have already exceeded pre-Covid emissions levels, extra-European emissions have not



Source: T&E modeling based on OAG data and Eurocontrol method. Departing flights from Europe (EEA/CH/UK)

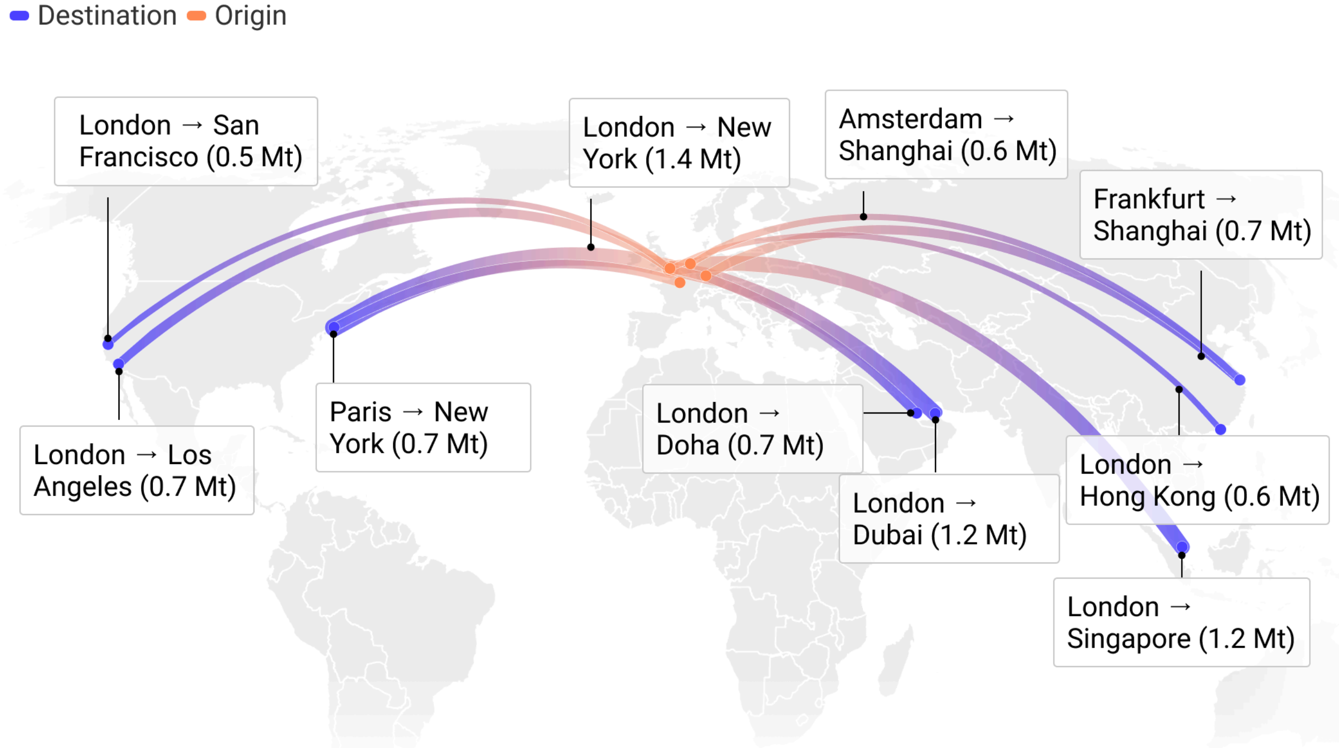
2.2 The most polluting routes: long-haul escapes pricing, short-haul misses the train

2.2.1. Long-haul routes continue to escape carbon pricing entirely

None of the most polluting routes departing from Europe in 2025 fall within the scope of the current ETS schemes. Every flight in the top ten ranking is intercontinental and therefore exempt from EU, Swiss and UK carbon pricing alike.

The ten most polluting routes departing Europe escape carbon pricing

CO_2 emissions per city pairs (only departing flights)



Source: T&E modeling based on OAG data and Eurocontrol method, EUTL, Swiss EHR • Departing flights from EU31

T&E

London-New York remains the single most polluting departure route, generating nearly 1.4 Mt of CO_2 in 2025 (all departing flights combined), roughly equivalent to the annual emissions from all combustion cars in a city the size of Munich. Most of the other top-ranked routes depart from London, reflecting the scale of long-haul traffic through UK airports (especially London Heathrow). The highest-ranked EEA-originating route is Frankfurt-Shanghai, in fifth place, with 0.7 Mt of CO_2. To find the first route covered by the current ETS, one must scroll to the 131st place: London-Milan, which falls under the UK ETS, with 0.16 Mt of CO_2 in 2025.

This highlights the key loophole in the European carbon pricing system: **the flights doing the most damage are precisely those the system does not reach**.

2.2.2. Closer to home: Europe's most polluting short-haul routes have a rail alternative

Due to the current ETS scope, intra-European routes are already priced. However, pricing alone is only part of the picture. Many of the most polluting short-haul routes within Europe connect city pairs where a credible rail alternative exists. These are routes where carbon pricing, combined with the right conditions for modal shift, could deliver the most immediate emissions benefit.

Route (ranking among top polluting intra-European routes)	**CO_2 emissions in 2025** (Mt CO_2), arrivals and departures	**Rail equivalent journey**
13- Milan-Paris	0.229	Rail equivalent journey can be done in less than 8h of travel
15- Nice-Paris	0.214	Rail equivalent journey can be done in less than 8h of travel
20- Geneva-London	0.194	Rail equivalent journey can be done in less than 8h of travel
21- London-Amsterdam	0.193	Rail equivalent journey can be done in less than 8h of travel
24- London-Edinburgh	0.185	Rail equivalent journey can be done in less than 8h of travel

Overview of intra-European routes with corresponding rail equivalent journeys

Looking specifically at routes where a rail journey can be completed within 8 hours, several of Europe's most polluting intra-European departures stand out. London-Amsterdam can be reached in around four hours by rail. London-Edinburgh takes roughly five hours. Milan-Paris is under seven hours, and both Nice-Paris and Geneva-London can be completed in approximately six hours. Together, these routes generated 0.5 Mt of CO_2 in departing flights alone or 1 Mt when both departing and arriving flights are counted.

To put this in perspective, this is less than the emissions of a single route in the previous, global ranking: the kind of figure generated by the yearly departing emissions of the London-Dubai or London-Singapore routes alone.

London-Milan remains the most polluting intra-European route overall, generating 0.16 Mt of CO_2 from departing flights in 2025 (roughly 9 times less than London-New York). That it is simultaneously one of the most polluting short-haul routes and one with a clear rail alternative (rail equivalent journey can be done in two legs), underlying how much the current policy framework leaves on the table.

That so many of Europe's most polluting short-haul routes already have a rail option makes the barriers to using it all the more frustrating. For many passengers, the will to travel by train exists, but the conditions do not. On cross-border routes in particular, train fares frequently exceed the cost of flying by a significant margin, direct connections aren't always possible and booking a through-ticket across multiple operators can be a near-impossible task. A recent T&E survey, conducted with YouGov, found that 61% of rail passengers had already avoided booking a rail journey because the booking process was too complicated. The result is that passengers are pushed towards the most climate-damaging option not by preference, but by a system that has failed to make the sustainable choice the easy one.

A more recent T&E study found that on half of the most flown routes within the EU, booking a rail equivalent journey from dominant rail operators is complicated or impossible. Carbon pricing creates a financial incentive to shift demand, but it works most effectively where a competitive alternative is not only available but also easy to book. For the routes identified here, the alternative is available. What is missing is a high enough carbon price and a reliable, affordable and easy-to-use rail network to make the choice straightforward for passengers.

2.3 Airlines under the carbon market: growing fast, paying little

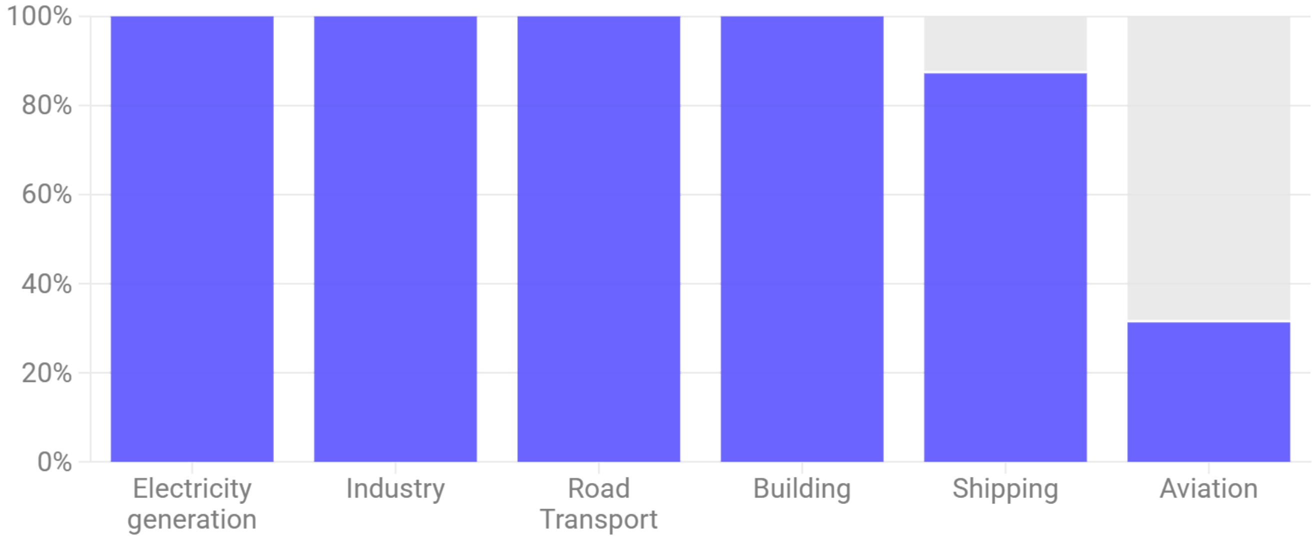
Aviation is the only major emitting sector in Europe that does not fully pay for its pollution. While industry, power generation and other heavy emitters face a progressively tightening carbon price across their full output, aviation benefits from a combination of scope exemptions and free allowances that leave the majority of its emissions unpriced. The gap has widened as the sector has grown.

68% of EU aviation emissions escape pricing

ETS2 puts a carbon price on driving and heating - yet long-distance flights remain largely unpriced.

Covered by ETS1 or 2 · Not covered

ETS coverage of CO2 emissions from fuel combustion (%)



Source: UNFCCC, OAG, T&E SEA model • Chart scope (100% base): Aviation: departing EU flights; Maritime: intra-EU + 50% extra-EU voyages.
'Covered' means regulated under the ETS - some allowances are allocated free of charge.

2.3.1. Low-cost carriers drive European emissions growth

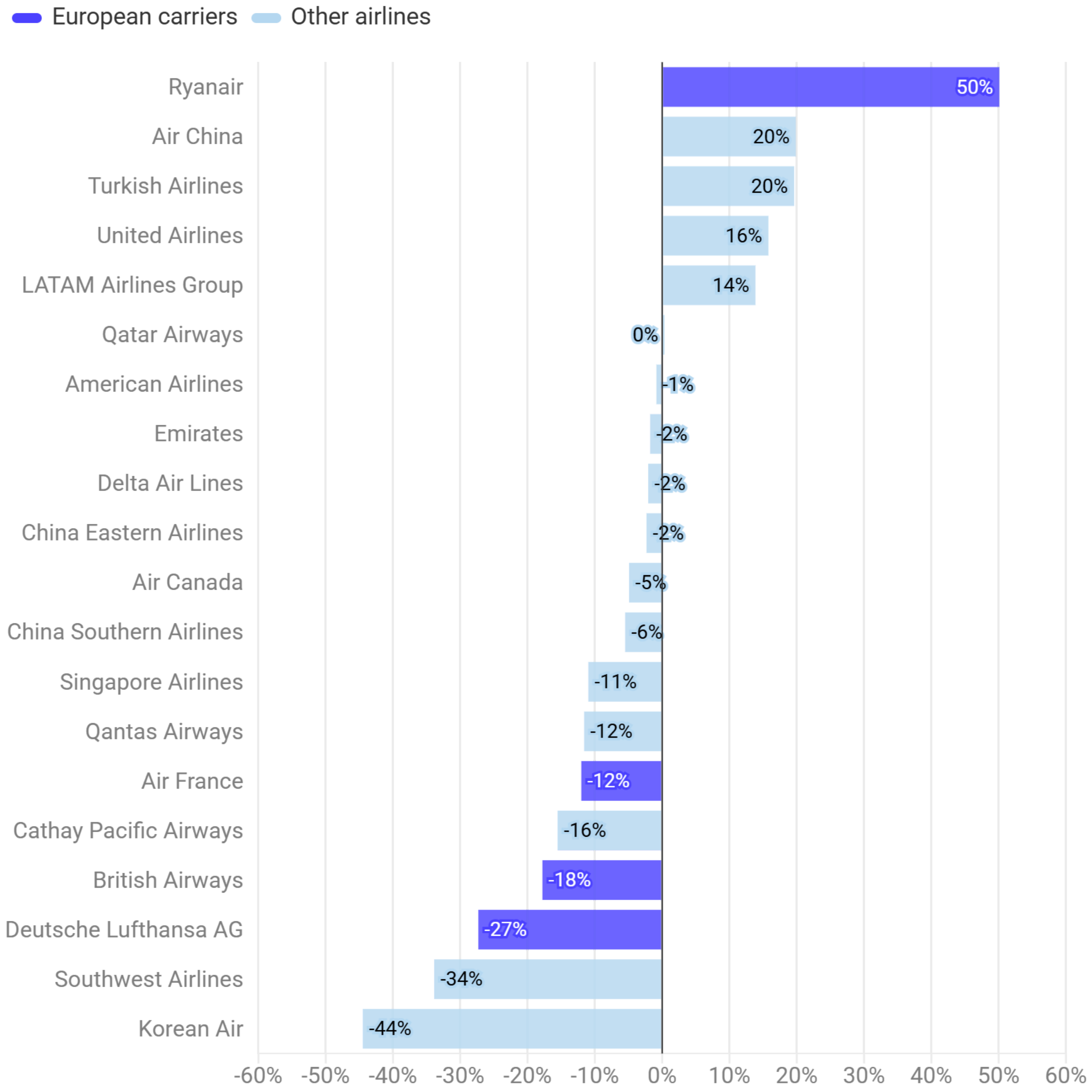
At the airline level, growth has been concentrated among low-cost carriers. Ryanair remains Europe's most polluting airline, emitting 16.6 Mt of CO_2 from departing flights in 2025, roughly equivalent to the total annual CO_2 emissions of a country the size of Croatia. This is a 3% increase compared to 2024 and approximately 1.4 times its 2019 level. The top ten most polluting airlines together accounted for 41% of all emissions from European departing flights, a share that has remained broadly stable in recent years.

The divergence is even more pronounced when looking beyond Europe. Among the world's 20 highest-emitting airlines globally, **Ryanair recorded the largest emissions increase of any airline worldwide since 2019, with emissions now 50% above its pre-pandemic level**. European legacy carriers tell the opposite story: Deutsche Lufthansa AG, British Airways and Air France are all still below their 2019 levels, broadly in line with legacy peers from other parts of the world.

Put simply, **low-cost expansion, not legacy recovery, is what is pushing European emissions back towards and beyond their pre-pandemic peak**.

No airline has grown its emissions more than Ryanair since the pandemic

CO_2 emissions from the world's top 20 emitting airlines, change since 2019



Source: T&E modeling based on OAG data and Eurocontrol method • Figures refer to individual operating brands rather than wider corporate groups (Lufthansa Group, IAG, Air France-KLM)

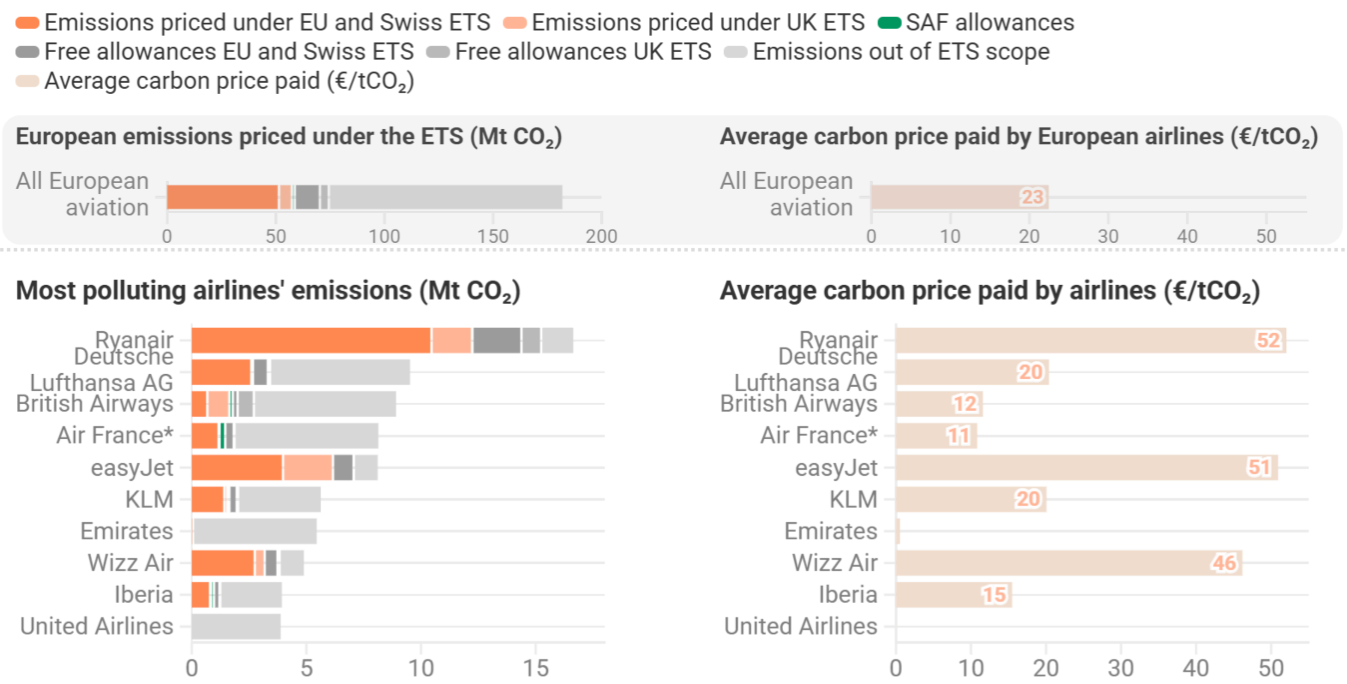
2.3.2. How little airlines are paying

Low-cost carriers, whose networks are concentrated within Europe, pay for a higher share of their emissions simply because more of their flights fall within the ETS scope. Legacy carriers, with large long-haul networks, pay for far less. Non-European carriers pay the least of all.

The chart below shows the effective price paid per tonne of CO_2 by the ten highest-emitting airlines in 2025, considering the average EU, Swiss and UK ETS prices of €73 and £48 (€55), free allocations and scope exemptions.

Airlines paid an average of €23 per tonne of CO_2, one third of the ETS allowance price

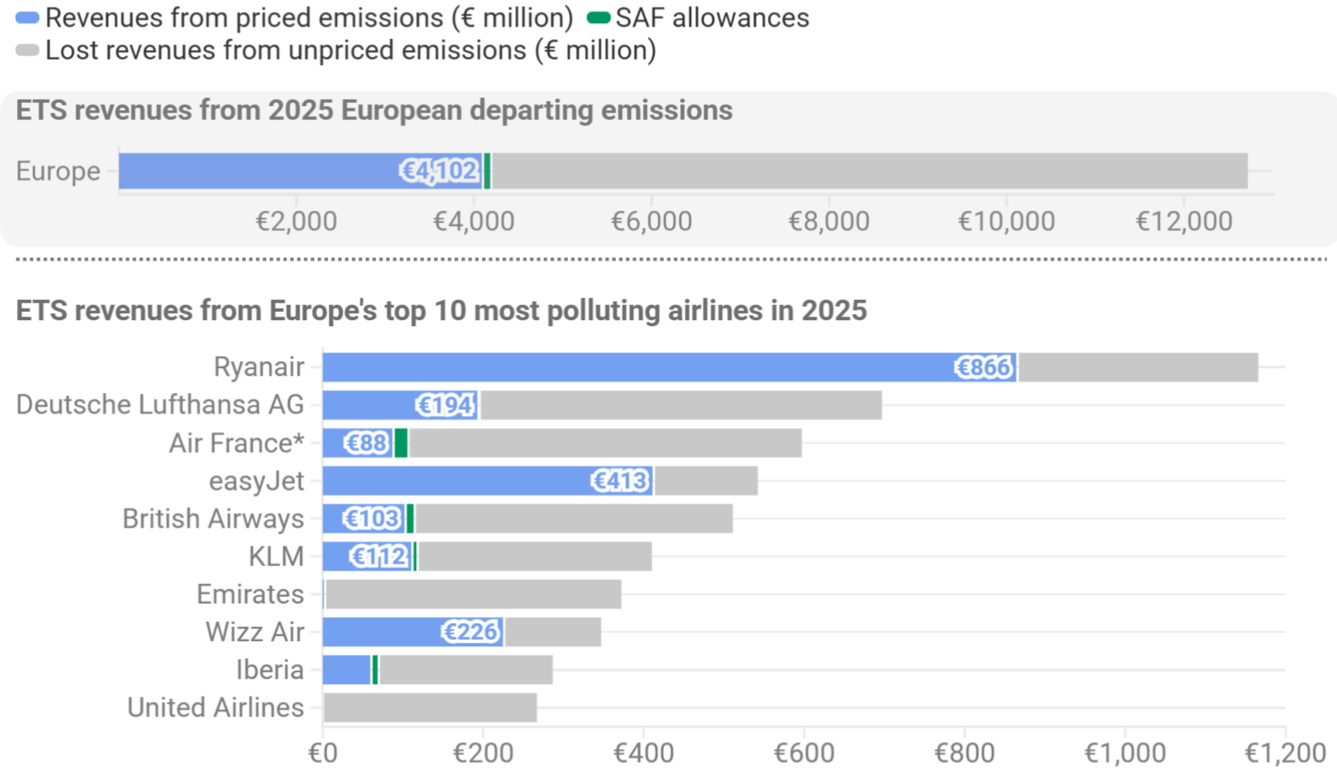
Paid emissions and free emissions



Source: T&E modeling based on ICAP ETS prices, OAG data and Eurocontrol method, EUTL, Swiss EHR • Departing flights from Europe (EU31) • * Estimate based on year-on-year growth

In total, airlines operating in Europe paid nearly €4.1 billion for EU, Swiss and UK ETS allowances in 2025. An estimated €8.5 billion in emissions costs went unpaid, a consequence of remaining free allowances and, more importantly, the exclusion of long-haul flights.

€8.5 billion in emissions costs were left unpaid in 2025



Source: T&E modeling based on ICAP ETS prices, OAG data and Eurocontrol method, EUTL, Swiss EHR • Departing flights from Europe (EU31) • *Estimate based on year-on-year growth

Low-cost carriers paid for a higher share of their emissions given their Europe-focused networks. Even so, the gap remains visible: Ryanair, easyJet and Wizz Air left 26%, 24% and 35% of their emissions costs unpaid in 2025 respectively. This is primarily because free allowances, while sharply reduced, had not yet been fully eliminated in 2025. Meaning that even on routes covered by the carbon market, a portion of emissions were not subject to a charge.

Legacy carriers such as Deutsche Lufthansa AG, British Airways and Air France left 72%, 78% and 82% of their emissions costs unpaid in 2025. This is largely explained by the high share of long-haul flights in their networks, falling outside of ETS coverage. Non-European carriers, including Emirates and United Airlines, emit at comparable levels to their European peers overall yet pay even less, if not zero, as virtually all their flights are international. This is a competitive distortion. Extending the carbon market to all departing flights would bring non-European airlines into scope and align the system with the polluter pays principle.

Based on these numbers, we can conclude that European ETSs currently add just €7 to the cost of an intra-EU31 flight ticket on average. Passengers on international routes pay nothing, as the scheme does not yet cover flights outside the EU. If the ETS were extended to all departing flights from EU31, the average additional cost for a passenger travelling outside the EU would be €45 per ticket. Across all departing passengers, the average cost would remain under €17 per ticket.

Scope	**ETS compliance costs** (€ billion)	**Total departing passengers** (million)	**ETS cost per ticket** (€/passenger)
Intra-EU31, current ETS scope	€4.1 billion	576	€7
Extra-EU31 (with extended ETS)	€0 (€8.5 billion)	188	€0 (€45)
Total (with extended ETS)	€4.1 (€12.7 billion)	764	€7 (€17)

Average ETS costs per passenger

These figures deserve context. A recent T&E analysis shows that for long-haul flights, the current geopolitical oil shock of the Iran crisis is adding around €90 per passenger to fuel costs, while the SAF mandate adds around €3. The carbon market adds nothing, as it does not apply to long-haul routes. Extending the ETS to long-haul flights would add roughly half of what passengers are paying today because of fossil fuel price volatility.

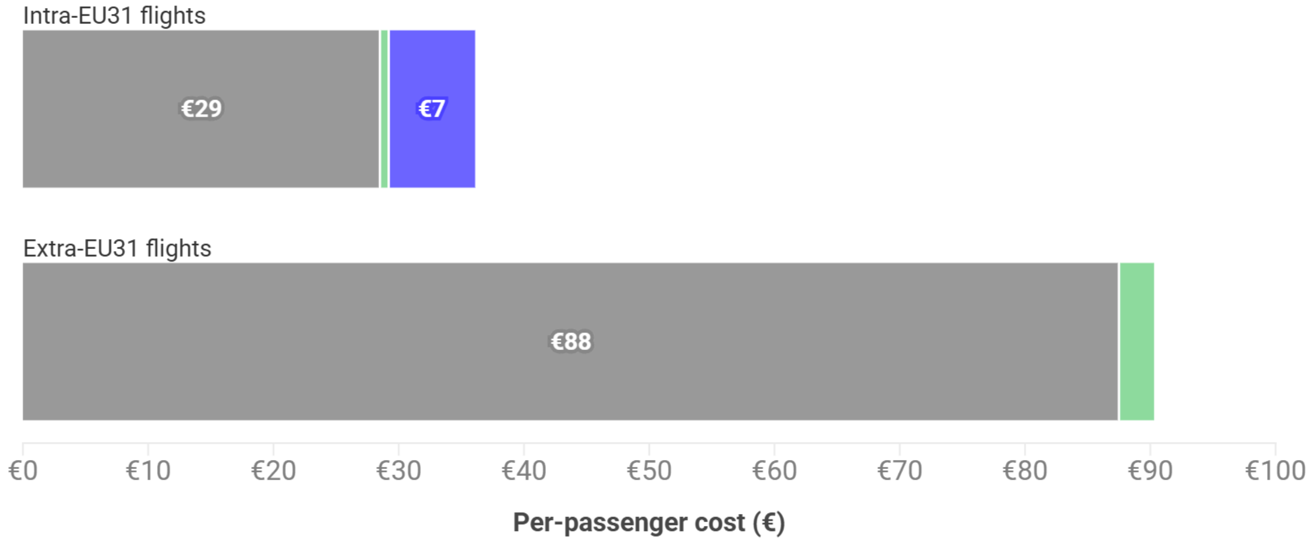
The same can be said about short-haul flights. Fossil fuel volatility adds around €30 to fuel costs, while all climate policies combined (current ETS and RefuelEU compliance) add less than €10.

Ticket prices are rising because of Europe's dependence on fossil fuels, not because of the measures intended to steer the sector away from them.

Middle East energy crisis adds far more to fuel costs than EU climate policies

Estimated additional per-passenger costs through climate policies and geopolitical fossil fuel cost increase

Geopolitical penalty (March 2026) ReFuelEU (March 2026) ETS (2025 baseline)



Source: T&E modeling based on OAG data and Eurocontrol method • Departing flights from Europe (EU31)

2.4 Extending the carbon market to all departing flights could unlock billions in additional revenue

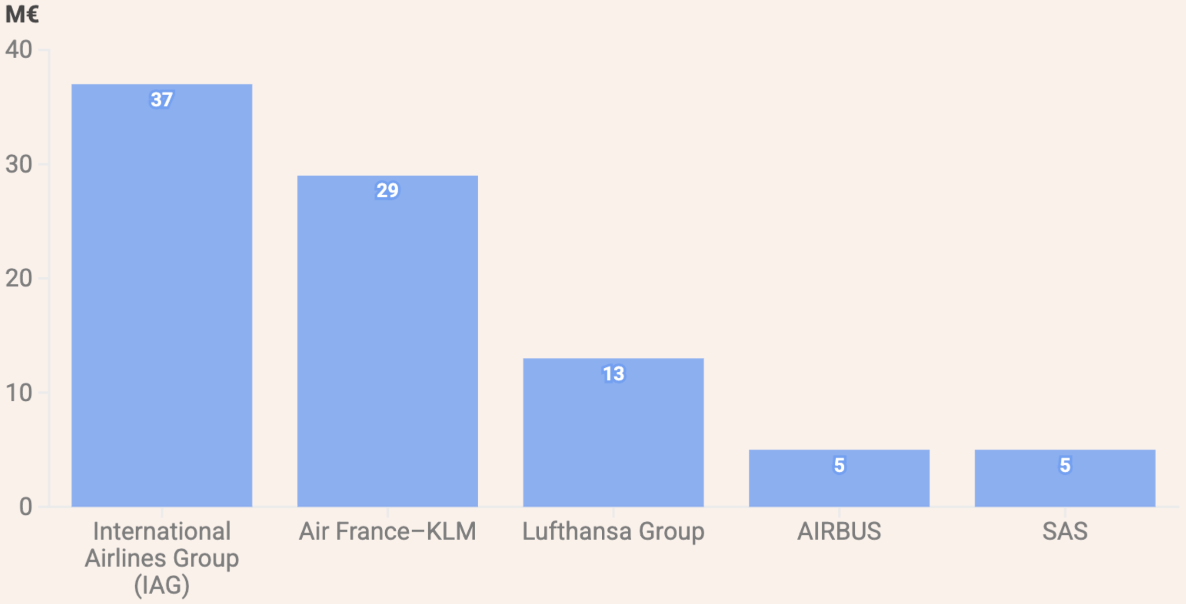
As mentioned before, airlines operating in Europe paid €4.1 billion in 2025 under the ETS aviation, covering just 32% of departing emissions. Had the schemes applied to all departing flights, revenues could have reached nearly €12.7 billion under the same carbon price conditions, unlocking an additional €8.5 billion for public budgets to direct towards the green transition. Two main schemes using ETS revenues for aviation decarbonisation stand out: the SAF allowances and the Innovation Fund, explored in the Infoxbox below. Chapter 3 of this report also explores how carbon pricing can spur the use of greener aircraft, namely electric and hydrogen planes.

Who is benefiting from SAF allowances?

Alongside auction revenues, the carbon market also distributes SAF allowances, free permits that compensate airlines for part of the cost difference between sustainable aviation fuels and fossil kerosene on intra-European flights.

European airlines receive 100M€-worth of ETS allowances for their 2024 SAF purchases

Top 5 beneficiaries of EU SAF allowances in 2024 (in M€)



Source: T&E (2025) based on European Commission (2025).

In 2024, the European Commission distributed 1.3 million such allowances across 53 airlines, worth around €100 million in total support. Three airline groups captured the overwhelming majority: IAG received around 500,000 allowances (roughly €37 million), Air France-KLM around 380,000 (€29 million) and the Lufthansa Group around 180,000 (€13 million).

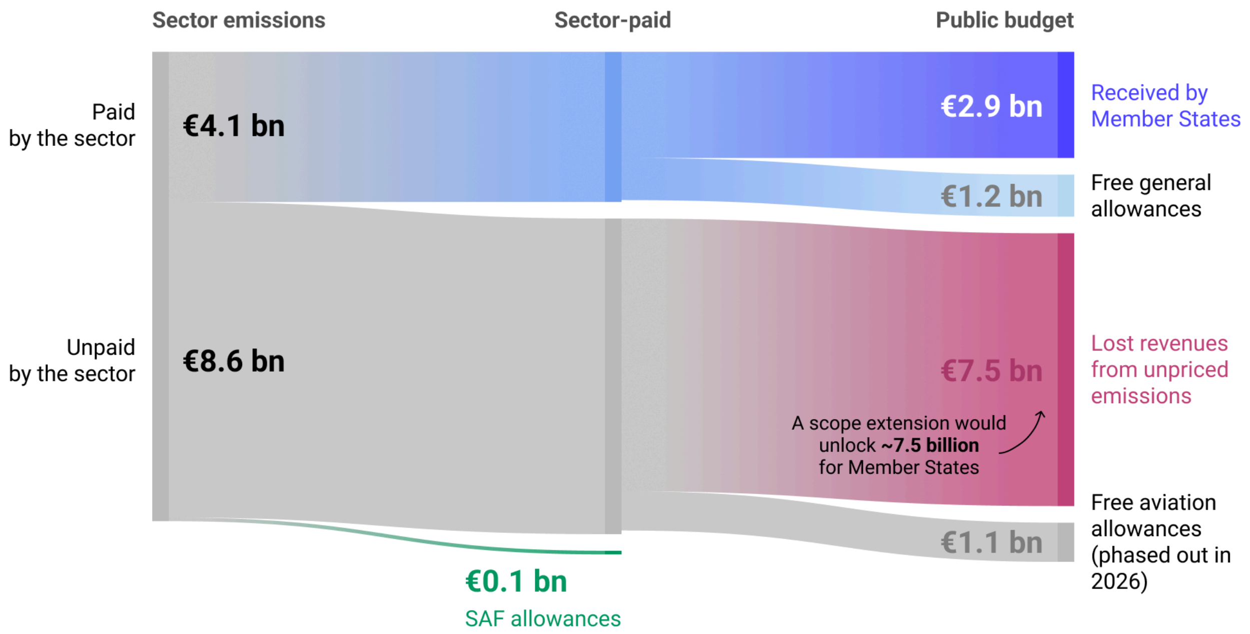
Our calculations suggest this covered approximately 40% of IAG's total SAF use in 2024, around 50% of Air France-KLM's and close to 100% of Lufthansa's. This shows how ETS revenues can be used to support the sector's green transition. Only 6% of the total pot of 20 million allowances has been used so far, but demand is rising quickly now that the SAF mandate is in force. An extension of the SAF allowances beyond 2030 is important to ensure the scheme does not only benefit HEFA-SAF but effectively encourages the use of more innovative and scalable pathways, in particular e-SAF. See our recommendations below.

A success story of the Innovation Fund: supporting electric aviation

The Innovation Fund - another product of the ETS - is already supporting projects such as Aura Aero's HERMES in France. HERMES was awarded €95 million and aims to bring to market a 19 seat hybrid-electric regional aircraft. Compared with the reference scenario of a conventional aircraft of the same size, it is expected to reduce energy and maintenance costs by around 50% and achieve a 51% relative GHG emissions avoidance. Over its first ten years of operation, it is also expected to avoid more than 10 million tonnes of CO_2 equivalent. With entry into operation planned for 31 December 2029, the project is a concrete example of how ETS-related revenues can support the decarbonisation of Europe's aviation sector.

The main beneficiaries of a scope extension would be Member States themselves. With the current rules, we estimate that Member States will receive roughly €3 billion from auction revenues (about 72% of the total €4.1 billion paid by the airlines), given that part of the allowances are non-auctioned or used for the Innovation Fund and other schemes.

Extending the ETS scope would unlock substantial new revenues for Member States



Source: T&E modeling based on OAG data and Eurocontrol method, EUTL, Swiss EHR • Departing flights from Europe (EU31)

If the scope had been extended in 2025, it would have brought €7.5 billion to national budgets (assuming that the additional allowances were purchased from the general ETS cap). Countries with large aviation sectors already capture the largest shares: Germany, Spain, Italy, Poland and France rank among the top recipients under the current scope.

Looking ahead, with a full scope extension to all EU31 departing flights, total revenues could reach more than €17 billion a year by 2030, driven by market growth and the completion of the free allowance phase-out from 2026.[1]

Some Member States would gain disproportionately. Poland, for instance, would become the second-largest beneficiary of carbon market revenues from aviation, alongside substantial gains for Czechia, Romania and Greece. This reflects the way general allowance auction shares are allocated: based on historical industrial emissions rather than aviation activity, countries like Poland and Czechia hold higher shares that translate into outsized gains when airlines increase their demand for allowances through a scope extension.

These revenues represent a significant and growing public climate fund. The European Commission's upcoming revision of the carbon market offers a direct opportunity to transform it into a leading policy instrument for aviation decarbonisation, above all by scaling up sustainable aviation fuel production and incentivising contrail avoidance. As outlined previously, T&E recommends that approximately 25% of ETS aviation revenues should be repurposed for the greening of the sector, through three measures:

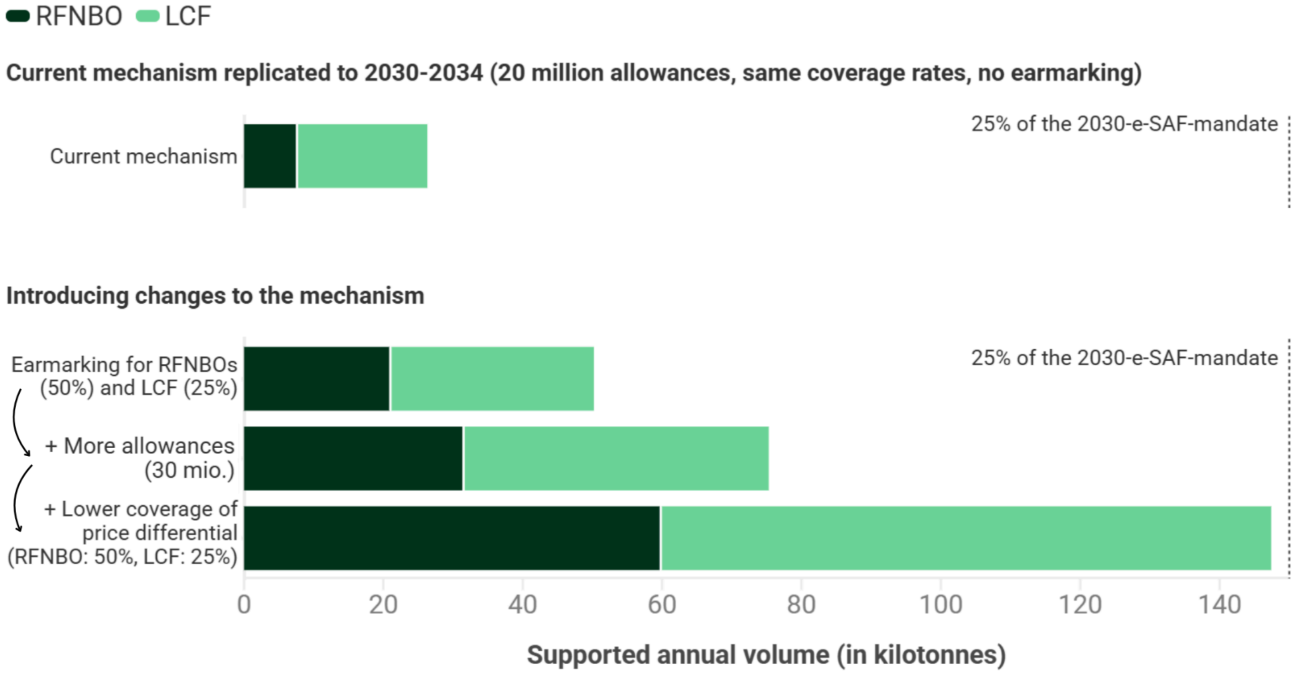
- **Reform of the Hydrogen Bank into a market intermediary for e-SAF**: T&E recommends earmarking a share of ETS aviation revenues to transform the Hydrogen Bank into a market intermediary for e-fuels. This entity would conduct double-sided auctions, signing long-term purchase contracts with producers to ensure bankability and reselling to airlines via shorter-term contracts to manage price risk. This structure, which can be implemented under the existing ETS framework by 2027, would bridge the price gap, provide transparent market signals and de-risk the transition to e-fuels.

- **Redesign of the SAF allowances to better unlock e-SAF investment**: To move beyond the current ex-post, "first-come-first-served" system - which largely subsidises HEFA-SAF and expires in 2030 - T&E calls for an extension of the mechanism to 2034 with an increased pool of 30 million allowances. This reform should prioritise scalability by earmarking 50% of support for e-SAF from 2030, phasing out HEFA subsidies and shifting to an ex-ante allocation model. By allowing airlines to secure support based on binding forward offtake agreements rather than annual claims, the system would provide the long-term revenue certainty necessary for e-SAF projects to reach final investment decisions and meet EU sub-mandates.

[1] In our recent publication, we estimated that total revenues for EEA Member States could rise to nearly €14 billion a year in 2030 with an extended carbon market scope. Here the scope also includes Switzerland and the UK.

How the SAF allowances can be reformed to better support e-SAF

Scenario analysis of different adjustments to the allowance mechanism



Source: T&E, EC 2025 • Only fuels counting towards the e-SAF sub-mandate are displayed. Details on assumptions for different scenarios in the annex.

- **Establish a contrail allowance scheme**: To address aviation's non-CO_2 climate impact, T&E proposes using 1.5% of current ETS aviation revenues (approx. €50 million annually) to fund a "world-first" incentive scheme for contrail avoidance. This mechanism would cover the marginal fuel and operational costs via CAPEX allowances for integrating forecast technology and OPEX allowances to cover additional fuel burn. By incentivizing the systematic redirection of flights to avoid warming contrails, the EU could achieve a climate benefit of 20-40 million tonnes of CO_2 equivalent annually without placing a significant financial burden on the industry.

2.5. CORSIA is not a credible alternative to the European carbon market

The contrast between the EU's cap-and-trade system and CORSIA, ICAO's global offsetting scheme for international aviation, is stark.

Our analysis finds that CORSIA would cost European aviation between €7 billion and €43 billion over the next ten years, a wide range reflecting deep uncertainty about credit supply and participation. None of that money would stay in Europe. It would instead flow to global offset providers, with no guarantee of genuine emissions reductions and little transparency over how payments reach the local communities the credits are supposed to benefit.

CORSIA credits still remain far cheaper than ETS allowances, which means they provide no meaningful price signal for decarbonisation. A cap-and-trade system sets a hard limit on emissions and makes polluters pay progressively more as the cap tightens. CORSIA does neither.

The case for keeping the EU ETS in its current, limited scope has long rested on the existence of CORSIA. Through three successive stop-the-clock derogations, the latest running until 2027, the EU has exempted all flights to and from the EEA from carbon pricing, on the assumption that CORSIA provides an equivalent safeguard. Our analysis shows it does not. The EU has committed to evaluating whether CORSIA delivers emissions reductions in line with its climate goals and the Paris Agreement by 1 July 2026. If CORSIA is deemed insufficiently robust, meaning ICAO has not strengthened the scheme in line with achieving these goals and fewer than 70% of international aviation emissions are covered, the European Commission could propose to apply the ETS to all departing flights from 2027. Our analysis shows that such a conclusion is inevitable.

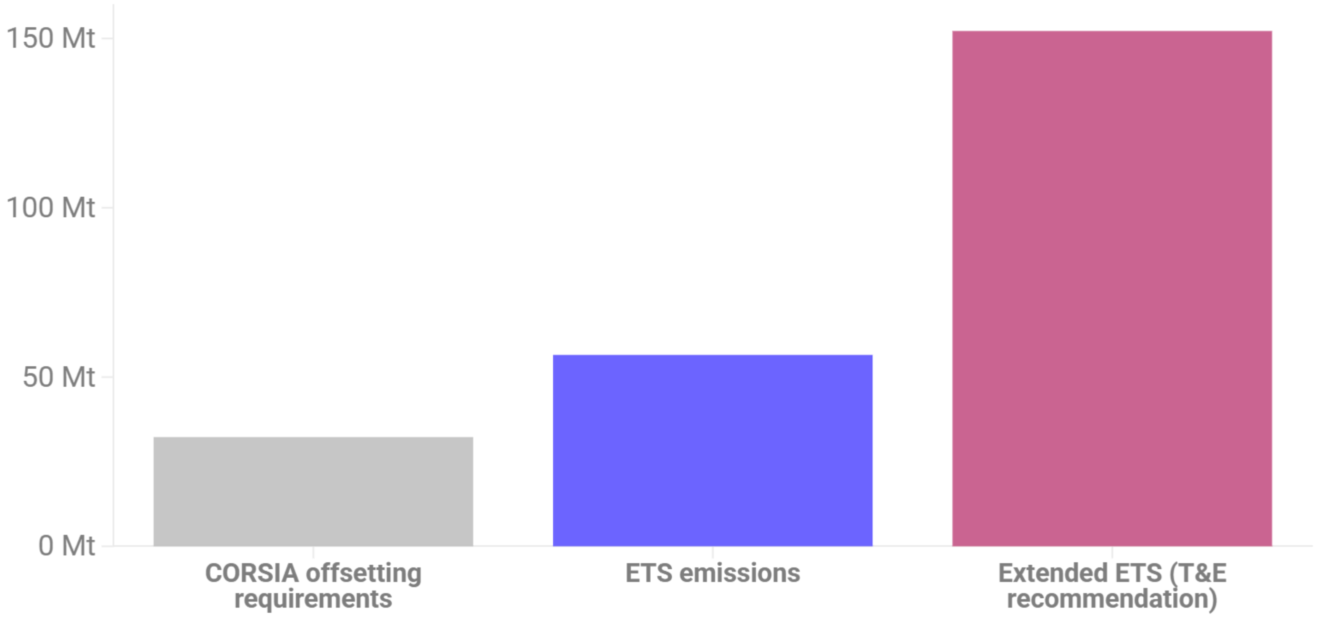
The scheme's coverage is structurally limited. CORSIA applies only to international flights between participating states, leaving domestic aviation entirely outside its scope. Participation, meanwhile, is more fragile than headline figures suggest. Key aviation markets including China, Brazil, Russia, India and the United States have not implemented CORSIA into national law. Based on 2022 analysis, participating states account for 66% of global aviation emissions, a share that could fall further if non-implementing countries withdraw.

Even within its scope, CORSIA addresses only a fraction of the problem. Airlines must offset emissions above a baseline set at 85% of 2019 levels. Our analysis finds that, on this basis, just 26% of EU aviation's CO_2 emissions will be covered by the scheme by 2035. There is no cap, no emissions reduction built into the design and no enforcement power at ICAO level in the event of non-compliance. Airlines can continue to grow their emissions indefinitely, provided they purchase sufficient offsets.

ETS currently covers nearly 75% more emissions than CORSIA

A comparison of ETS-verified emissions and the European offsetting requirements under CORSIA

Emissions 2025 ($MtCO_2$/yr)



Source: T&E modeling based on OAG data and Eurocontrol method, EUTL, Swiss EHR • Departing flights from Europe (EU30)

The quality of those offsets is itself a serious concern, even as more projects are technically entering the market. A recent analysis revealed that, while the pool of eligible credits reached 32 million units by early 2026, including new clean cooking projects from Africa, the Guyana ART TREES programme still accounts for 90% of recent issuances. Analysis of this programme found that 84% of its credits resulted from an artificial adjustment for countries with low deforestation rates, a practice the UN review team found does not represent genuine emissions reductions. Furthermore, host country approval remains a significant bottleneck to high-quality supply; for instance, a major clean energy project in Kenya recently collapsed after failing to secure the necessary government authorisation. This reinforces that the scheme relies on a fragile and often low-quality supply chain that cannot guarantee the climate integrity required by the EU.

Beyond environmental integrity, there are also unresolved questions about who benefits financially from credit sales. Research by Carbon Market Watch found a persistent lack of public data on how payments are distributed between intermediaries, project developers and the local communities nominally at the centre of these projects. An investigation into BP's use of credits from rural Mexico found that local communities received only a fraction of the market price, with intermediaries capturing the remainder. This is not an isolated case: the companies that own and manage offsetting programmes are overwhelmingly based in high-income countries, while the projects themselves are concentrated in lower-income ones. The result is a scheme that risks transferring billions of euros out of Europe in exchange for offsets that deliver little for the climate and even less for the communities they claim to support.

The conclusion is clear. **CORSIA is not a credible substitute for extending the European carbon markets to all departing flights**. It covers too few emissions, enforces too weakly and relies on credits whose environmental integrity cannot be assured. The EU's assessment of CORSIA's robustness should reflect this reality.

It is important to note that extending the ETS to all departing flights would not require dismantling CORSIA. The two systems can coexist. Under Article 28b of the ETS directive, airlines are not required to pay twice for the same emissions: where a flight is covered by both the ETS and CORSIA, ETS takes precedence and the CORSIA obligation is deducted accordingly. We estimate that CORSIA offsetting requirements for flights within the EU31 amounted to 10.6 Mt of CO_2 in 2025, at a cost of around €146 million at current credit prices. This figure would be fully offset against ETS compliance obligations. A scope extension from 2027 would expand this deduction mechanism to a larger share of international routes, but the underlying principle remains the same. Airlines would face one carbon price, not two. The case for extending the carbon market is not a case for replacing CORSIA, it is a case for ensuring that European aviation finally pays for the full cost of its emissions, on every route it flies.

In 2025, European airlines left €8.5 billion in emissions costs unpaid. Every year the carbon market fails to cover all departing flights is another year the aviation industry passes that cost to society.

Section 3

Ending aviation tax exemptions will unlock investments in revolutionary planes, including hydrogen and electric aircraft

Aviation is the only major industry that has never paid for the fuel it burns. No fuel tax, no VAT on international tickets and no meaningful carbon price on long-haul flights. Decades of these exemptions have done more than cost public budgets billions in foregone revenue. They have removed the single most powerful incentive for aircraft manufacturers to innovate: the prospect that cheaper, cleaner technology will outcompete a dirty one.

The consequences are visible in the industry's own product pipeline. The commercial aircraft market is dominated by a duopoly, Airbus and Boeing, which severely limits competition and disincentivises the creation of disruptive aircraft. Neither manufacturer has introduced a clean-sheet aircraft design since 2015. Instead, both have spent the intervening decade fitting new engines onto airframes designed in the 1960s and 1980s.

Our previous analysis found that no new aircraft models are expected from either manufacturer in the next ten years, leaving the European fleet locked into a stalled efficiency trajectory for at least another decade. With fossil jet fuel kept artificially cheap, there is simply no commercial case for the multi-billion-euro investment that a genuinely new aircraft requires. The market signal that should be driving that investment, namely the rising cost of polluting, has been deliberately suppressed.

The fragility of this model was exposed by the 2022 oil price shock, a stark warning that the industry largely ignored, making the current 2026 crisis an inevitable consequence of a system built on artificially cheap energy. An aviation ecosystem built around the assumption of cheap, untaxed fossil energy is not a resilient one. It is a system that has traded long-run decarbonisation capacity for short-run cost comfort and it will remain exposed to exactly these shocks for as long as manufacturers have no incentive to develop aircraft that use less of it.

Extending the EU carbon market to all departing flights changes this calculus. A meaningful and rising carbon price raises the operating cost of fossil-fuelled aircraft year after year, while simultaneously narrowing the price gap between today's polluting planes and more efficient planes, including zero-emission hydrogen and electric aircraft, that are technically feasible but commercially stranded.

We quantified this effect. Using a total cost of ownership model, we compared two scenarios: one in which the carbon market continues to apply only to intra-European flights and one in which it extends to full scope, covering all departing flights from 2027. The model tracks the full economics of aircraft development and operation across regional, single-aisle and widebody aircraft classes covering both revolutionary next-generation kerosene aircraft and zero-emission hydrogen and electric alternatives, from entry into service through to fleet retirement. It incorporates manufacturer development costs, airline fuel and carbon expenditure and projected SAF blending mandates under ReFuelEU.

Our central estimate is that an additional carbon price of €121 per tonne of CO_2 would be sufficient to make cleaner aircraft cost-competitive with conventional alternatives at a system level. Crucially, this figure sits within the range of carbon prices that current EU ETS projections already imply by the mid-2030s. The policy lever needed to tip the economics is not out of reach.

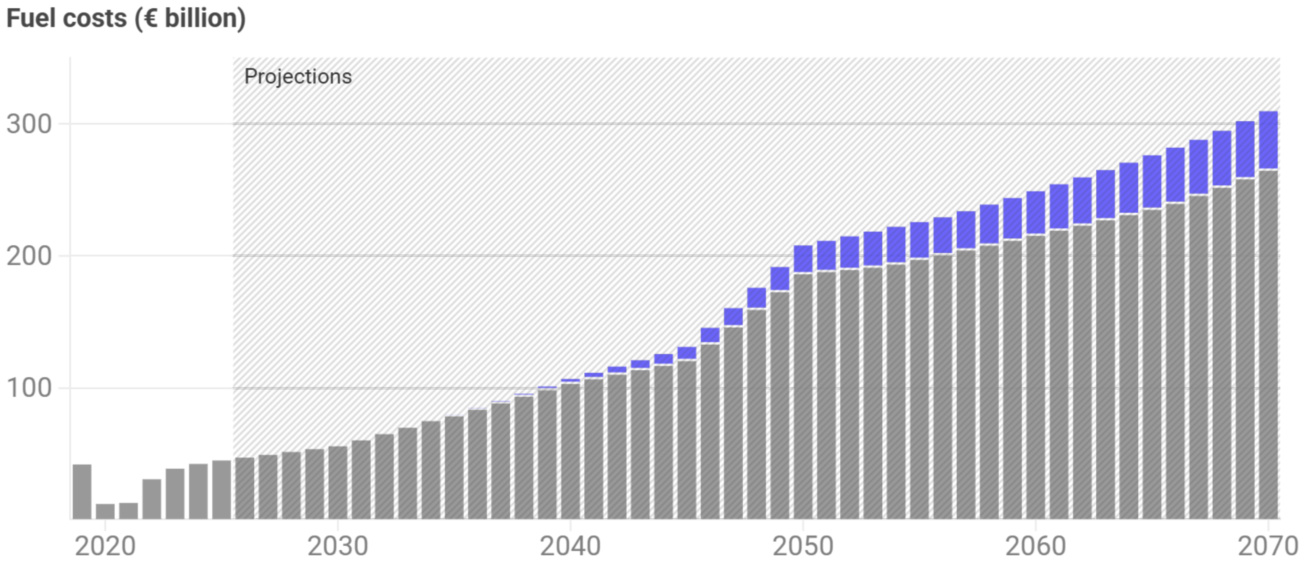
However, if the ETS scope is not extended after 2027, the additional carbon price needed to make efficient technologies cost competitive rises to €245 per tonne of CO_2. Restricting the scope of the ETS would hinder the economic case for new aircraft, incentivising the aviation industry to stick to a logic of low cost, incremental improvements which has slowed down technological progress in recent decades.

That support requirement is visible in the numbers. Bringing revolutionary aircraft to market would require an estimated €186 billion in development expenditure across all manufacturers, compared to €26 billion in a scenario where only conventional next-generation aircraft are built. This seven-fold difference in upfront capital is the core structural barrier. It is also precisely the gap that revenues from a fully scoped carbon market could help to address: through industrial support measures like the Innovation Fund, the Clean Aviation Joint Undertaking successor programme and measures to bring the cost of capital down for the development of revolutionary aircraft technologies.

A stronger carbon price accelerates the shift to cleaner aircraft and saves operators 800 billion in fuel costs over 50 years

Projected operator fuel expenditure under two fleet scenarios

- Fuel costs if next-generation revolutionary aircraft enter service from the 2030s
- Additional fuel costs under a conventional low-innovation fleet trajectory



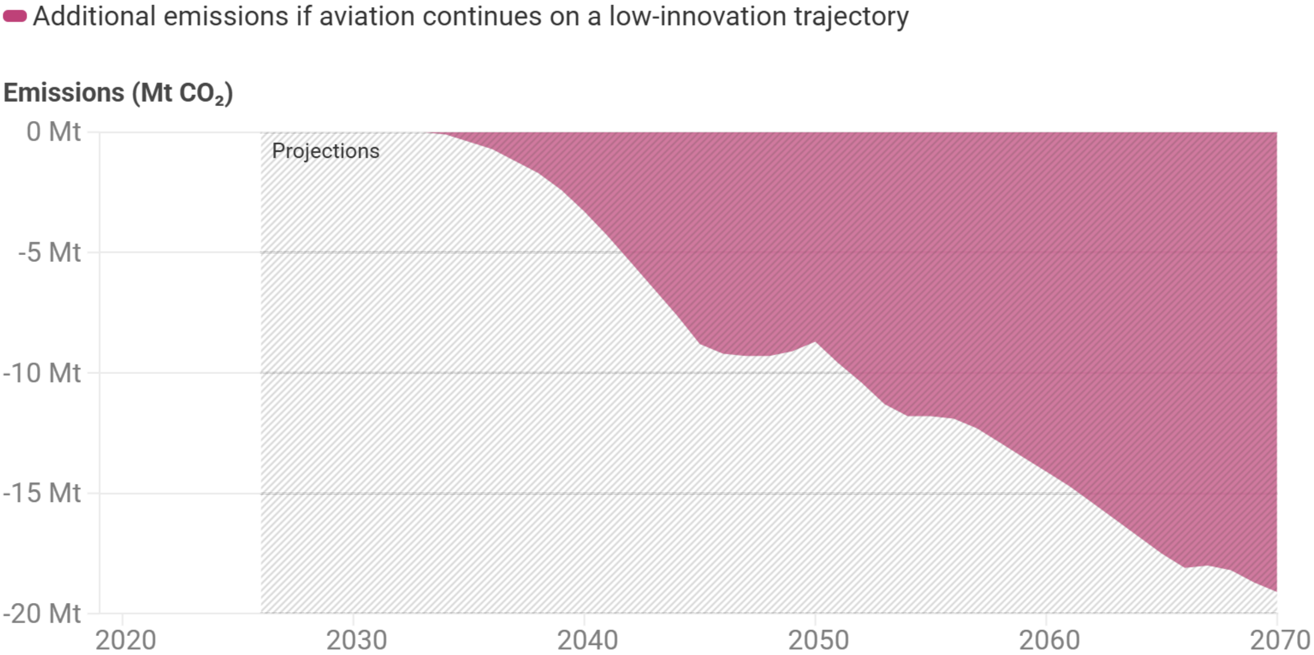
Source: T&E/PH Shift modelling based on BNEF ETS/CORSIA price projections, ReFuelEU, long-term fuel prices • See Annex for aircraft entry-into-service and technology assumptions

The benefits add up for operators. Over the model horizon, airlines flying next-generation aircraft face structurally lower exposure to fuel price volatility. In the scenario, operators spend nearly €800 billion less on fuel than if they continued to fly conventional aircraft. This saving materialises precisely when energy prices are high or volatile and therefore when the conventional fleet is most exposed.

This would obviously translate into an emissions benefit. In the scenario with more efficient aircraft, airlines emit approximately 380 Mt fewer cumulative CO_2 emissions over the period, roughly equivalent to the total annual CO_2 emissions of a country the size of Australia. In a world of adequate carbon prices or repeated oil price shocks, zero-emission aircraft are not just cleaner. They are cheaper to operate. The carbon market, in other words, does not simply penalise the business-as-usual. It makes the alternative worth building, while providing a predictable price signal to help the financial planning of operators, unlike oil price shocks.

Cleaner aircraft cut cumulative emissions by 600 million tonnes of CO_2 compared to a low-innovation future

Projected CO_2 emissions from European aviation under two fleet scenarios



Source: T&E/PH Shift modelling based on BNEF ETS/CORSIA price projections, ReFuelEU, long-term fuel prices • See Annex for aircraft entry-into-service and technology assumptions

Section 4

The importance of non-CO_2 emissions and the need to address aviation's full climate impact

The EU's Monitoring, Reporting and Verification (MRV) framework for non-CO_2 aviation effects is a critical step toward addressing aviation's full climate impact. But currently, its limited scope fails to capture the full extent of aviation's non-CO_2 effects. It must be maintained and expanded as a "no-regret" instrument that builds the evidence base, enables future regulation and supports near-term mitigation.

More than 20 Mt CO_2e of contrail climate impact falling off the radar through reduced non-CO_2 MRV scope

Top non-EEA destination countries by contrail climate impact from EEA departures (Mt CO_2e, EGWP100), 2025

Europe to:

1. United States 4.3 Mt CO_2e
2. China 1.4 Mt CO_2e
3. Turkey 1.0 Mt CO_2e
4. Canada 0.6 Mt CO_2e
5. Morocco 0.3 Mt CO_2e

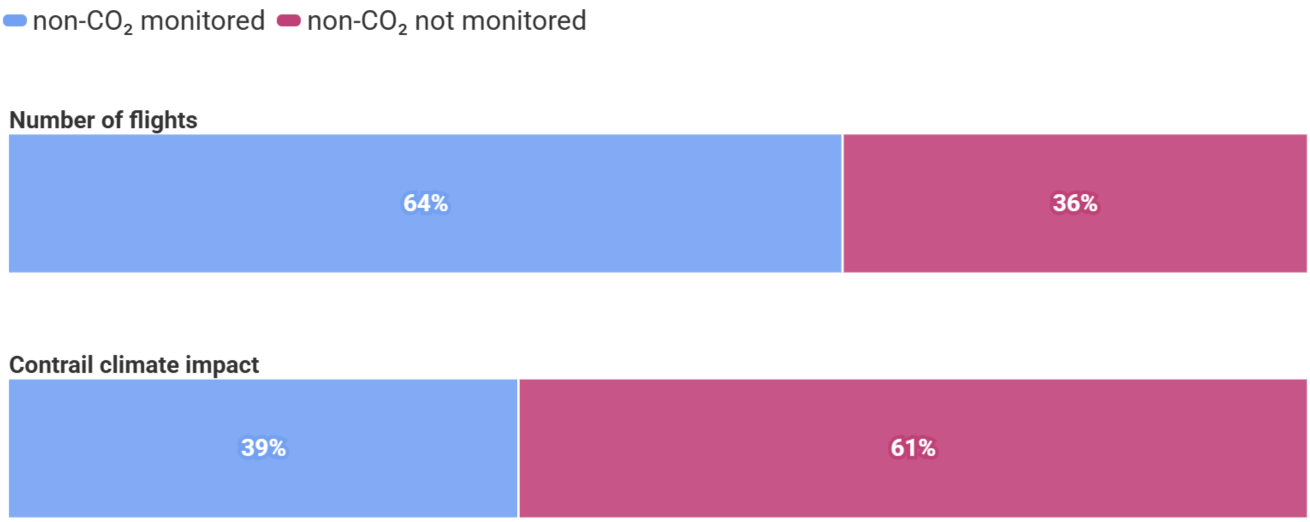
Source: T&E (2026), based on own analysis of Spire aviation data for 2025 using pycontrails v0.60.4 • CO_2eq using EGWP100 with climate efficacy of 0.21 based on Bickel et al. (2025)

There is a broad scientific consensus that **aviation's non-CO_2 effects are of a similar order of magnitude to its CO_2 impact**. It is therefore crucial to consider these emissions in European climate policy. An important step in the right direction was the launch of the Monitoring, Reporting and Verification (MRV) scheme of aviation's non-CO_2 emissions in January 2025. The system enables the collection of data on non-CO_2 effects. Although co-legislators agreed that the MRV would cover all flights from and into the EEA area, airline lobbying restricted its application for the first two years to intra-EEA flights only. As of 1 January 2027, the scope will be automatically extended to all flights arriving to or departing from the EEA. By the end of 2027, the Commission will assess the MRV data and, if appropriate, propose legislation to address these effects.

The non-CO_2 emissions reported by airlines for the year 2025 will only be available later this year due to a delay of reporting. Therefore, we give an estimate of the share of European aviation's contrail warming not captured by the reduced scope MRV based on our own analysis of 2025 data, as well as an overview of the most polluting flight destination countries. We find that **the reduced intra-EEA scope in the first two years leaves more than 50% of European contrail warming** outside the scheme. Maintaining the extension of the scheme to all EEA flights therefore matters not just for accuracy, but for credibility. If the major warming effects are on long-haul flights and those flights are left out, the evidence base for future policy will be incomplete.

More than half of contrail climate impact is excluded from the reduced-scope non-CO_2 MRV framework

Share of flights and contrail warming monitored in reduced-scope non-CO_2 MRV, covering intra-EEA flights and flights to Switzerland and the UK



Source: T&E (2026), based on own analysis of Spire Aviation ADS-B data for the year 2025 using pycontrails v0.60.4

Why we need to act on contrails today

While there is uncertainty around the magnitude of the warming effect of aviation's non-CO_2 emissions, the evidence we have today is already strong enough to justify action based on the precautionary principle: the potential harm from inaction is large, while the risk of acting prematurely is small. Addressing contrails, for instance, would only require rerouting a small number of flights. This means that even in the unlikely event that contrail models were systematically wrong, the consequence would be modest: at worst a small increase in CO_2 from occasional, unnecessary flight deviations. In contrast, ignoring the problem or waiting for perfect data could delay action by years. **The biggest climate risk associated with contrail avoidance is therefore inaction**.

This is precisely why a robust monitoring, reporting and verification (MRV) system must remain in place. Acting under uncertainty requires a framework that enables learning, improves data over time and supports targeted mitigation.

The Commission designed the system to automate reporting as much as possible, integrate it with existing ETS processes and offer simplified approaches for smaller operators. In fact, airlines do not even need to report primary data if they prefer to rely on default values. This means that by default, the MRV means minimal reporting burden for airlines.

Airlines are right to point out that some inputs are difficult, for instance fuel-property data in pipeline systems. The Commission acknowledges this and already allows pragmatic solutions, including the use of secondary data and airport-level proxies based on ReFuelEU where direct primary data are not available. Additionally, the aromatic content, sulphur and naphthalene fuel properties that airlines can provide, are not even used in the calculations performed under the current version of NEATS.

That means the real issue is not whether reporting is possible. It is how to improve accuracy over time. This is precisely what MRV is for. **A monitoring system should reveal where data quality is weak, where defaults are too conservative and where better data collection is needed.** If fuel-property reporting is imperfect, the answer is to fix reporting methods, not to weaken the law.

Contrail avoidance is one of the clearest reasons to keep the MRV strong. **Contrail management could be aviation's biggest climate opportunity before 2050** and the highest-impact opportunities are concentrated in a relatively small share of flights - especially night flights in autumn and winter when traffic is lower and impact on air traffic management minimal. The climate benefits from targeted contrail avoidance are at least 15 times greater than the CO_2 penalty from extra fuel burn in a conservative case and can be much higher based on real-life tests. For smart mitigation strategies, there is no risk of doing more harm than good. To incentivise mitigation today, we propose an incentive mechanism for contrail avoidance based on so-called contrail allowances.

Recommendations

01

Expand the EU ETS to cover all departing flights from 2027, instead of continuing to rely on CORSIA. The European carbon markets covered 74 Mt of CO_2 in 2025. Had it applied to all departing flights, a further 107 Mt of CO_2 would have been included - generating an additional €8.5 billion in revenues.

02

Use the upcoming revision of the carbon market as an opportunity to transform it into a leading policy instrument for aviation decarbonisation, above all by scaling up sustainable aviation fuel production and incentivising contrail avoidance:

- Upgrade the Hydrogen Bank into a European-wide double sided auction mechanism to boost the uptake of e-SAF. Allocate e.g. 25% of aviation ETS revenues to the market intermediary.
- Reform the SAF allowances in order to better support e-SAF by extending the mechanism in time and amount; earmarking allowances for e-SAF and advanced biofuels; phasing out support for HEFA-SAF; reducing the price coverage of the different types of fuels; and by moving away from an ex-post allocation to an ex-ante system.
- Introduce an incentive scheme for airlines called *contrail allowances* using ETS revenues, to support airlines to perform contrail avoidance manoeuvres.

03

Consider additional decarbonisation measures - such as short-haul flight bans under Article 20 of the Air Services Regulation - to address top-polluting intra-European aviation routes.

04

Maintain and strengthen Innovation Fund support to European innovative companies developing disruptive aviation technologies, including electric, hybrid and hydrogen aircraft.

05

Automatically expand the scope of the non-CO_2 MRV to cover departing and incoming flights, to better the understanding of aviation's full climate impact.

Annex

Methodological note

Every April, the European Commission releases compiled EU and Swiss emissions trading system (ETS) emissions data. T&E analysed this data to understand the trends in the aviation sector. Since 2023, we have extended the scope of our analysis to cover emissions from all flights departing from EU27, Norway, Iceland, Switzerland and the UK - referred to here as EU31 - to give a more complete picture of the ETS pricing mechanisms.

We calculate aircraft fuel consumption from scheduled flights data provided by OAG, using Eurocontrol's fuel consumption methodology. Our analysis focuses on 2025 and 2024 emissions, with 2019 as the pre-COVID historical peak year for reference.

This methodological note details how we estimated the emissions from the different scopes to build the top polluting airline ranking and the most polluting routes, as well as how we estimated the effective average carbon pricing paid per airline and the CORSIA offset requirements.

5.1 Geographical scopes and corresponding emission sources

Our analysis covers emissions from flights departing from EU31 countries. Depending on the destination, emissions from those flights are covered by one of three Emission Trading Systems in Europe: the EU ETS, the Swiss ETS and the UK ETS, or they are not covered by any of them.

Following the 2020 agreement between Switzerland and the EU to link their systems, airlines report emissions and allocations from flights within Switzerland and departing from Switzerland to the EEA (EU Member States, Norway and Iceland) in a separate section in the ETS log called 'CH emissions' and 'CH allocations'. Additionally, airlines administered by Switzerland, mainly SWISS International Air Lines and easyJet Switzerland, publish their verified emissions on the Swiss ETS portal.

In 2021 the scope of the EU ETS was reduced. Aircraft operators now report emissions from UK domestic flights and flights from the UK to the EEA under the UK ETS. Since UK ETS verified emissions were not available at the time of publication, we estimated them from OAG data.

From January 2024, flights between EU Member States and European outermost regions fall under the ETS scope. Similarly, flights departing from Switzerland to the EU's outermost regions now fall under the Swiss ETS. Domestic flights between a Member State and its own outermost regions remain exempt from the ETS until 2030.

Geographical scope of emissions	ETS coverage in 2019	ETS coverage in 2025	Source for 2019 emissions	Source for 2025 emissions
Emissions from flights within the EEA	EU ETS	EU ETS	EU transaction log	EU transaction log
Emissions from flights from the EEA to the UK	EU ETS	EU ETS	EU transaction log	EU transaction log
Emissions from flights from the UK to the EEA and Switzerland	EU ETS	UK ETS**	EU transaction log	OAG, Eurocontrol*
Emissions from Switzerland to the EEA and UK	Not covered	Swiss ETS	OAG, Eurocontrol*	EU transaction log
Emissions from the EEA to Switzerland	Not covered	EU ETS	OAG, Eurocontrol*	EU transaction log
Other emissions, from flights departing from EU31 that are not included in the above categories	Not covered	Not covered	OAG, Eurocontrol*	OAG, Eurocontrol*

*Geographical scopes, ETS coverage and emission sources. * Estimated emissions. **Official UK ETS emissions are to be released later this year.*

5.2 EU transaction log

5.2.1 Emissions filling

We fill emissions if an ETS account has not yet reported them, remains listed as an open account, and is not excluded from reporting. Typically, some accounts do not report their emissions on time. At the date of data extraction, 136 operators had not yet reported their 2025 verified emissions.

For these operators we imputed their 2025 emissions by multiplying their 2024 verified emissions by the average year-on-year growth in EU and Swiss verified emissions between 2024 and 2025. Two major airlines, Air France and Qatar Airways, fell into this category. For Air France, we multiplied the average growth rate of Lufthansa and British Airways (the other two major European legacy carriers) by Air France's reported verified emissions for 2024. For Qatar Airways, we applied the average growth rate of Emirates and Etihad, multiplied by the airline's reported verified emissions in 2024.

T&E analysis also includes verified emissions data from airlines administered by Switzerland, available on the Swiss ETS registry (under surrendering obligation).

We contacted all airlines from the top ten ranking ahead of publication to provide their emissions under the EU and Swiss ETS scopes and outside the ETS scope, allowing them to correct any discrepancies

5.2.2 Airline grouping

Some airlines hold separate accounts across different EU Member States. Where these accounts belong to a single operating brand, we grouped them together under a common alias. For example, easyJet holds four accounts. However, they do not operate four separate airlines or websites. This differs from subsidiaries. For example, Lufthansa owns Brussels Airlines and ITA Airways, but they operate as different brands than their parent company. We grouped these airlines under their commonly used alias.

Airline ALIAS	Identifier in ETS log	Note
TUI	30011.TUI AIRLINES BELGIUM Handelskonto TUIfly GmbH TUI Airlines Nederland BV TUIfly Nordic AB Thomson Airways Limited	
Ryanair	Ryanair Sun S.A. Ryanair UK Limited Ryanair DAC	
ASL	27011.ASL Airlines Belgium ASL AIRLINES FRANCE SA ASL Airlines (Ireland) Limited	
	Farnair Switzerland ASL Airlines (Hungary) Kft.	Account closed Account closed

Airline ALIAS	Identifier in ETS log	Note
FedEx	11102.FedEx Express Corporate Aviation FEDERAL EXPRESS CORPORATION	
EasyJet	easyJet Switzerland SA	Account closed in the EU ETS log. Verified emissions from easyJet Switzerland are displayed in the Swiss ETS portal
	EACL ETS Account EASYJET UK LIMITED easyJet Europe Airline GMBH	
Norwegian	Norwegian Air Shuttle AOC Norwegian Air Sweden AOC AB Norwegian Air UK	
	Norwegian Air International Limited AOHA	Excluded
DHL	European Air Transport Leipzig GmbH DHL Air Limited	
Iberia	IBERIA LAE SA OPERADORA SU Iberia Express, S.A.	
Eurowings	Handelskonto der Germanwings GmbH Eurowings GmbH	
Transavia	TRANSAVIA FRANCE Transavia Airlines	
Wizz air	WIZZ AIR UK LIMITED WIZZ AIR HUNGARY LTD	
British Airways	British Airways PLC BA CITYFLYER LIMITED	
Deutsche Lufthansa AG	Deutsche Lufthansa AG Lufthansa Cargo AG	

Airline ALIAS	Identifier in ETS log	Note
Qatar Airways	Qatar Airways QATAR EXECUTIVE	
SunExpress	SunExpress ETS holding account	
	ETS Konto SunExpress Deutschland	Account closed
Air China	Air China Cargo Co., Ltd Air China Limited	
Singapore Airlines	27975.SINGAPORE AIRLINES CARGO PTE LTD	
	Singapore Airlines Limited	Account closed

Accounts combined in the ETS

5.3 Estimates of emissions from the remaining geographical scopes

5.3.1 OAG flight coverage and estimates

We estimated the emissions not covered by the EU and Swiss ETS by calculating the aircraft fuel consumption of scheduled flights data from OAG, to which we apply the emission factor of kerosene. Fuel consumption from aircraft is calculated following Eurocontrol's fuel consumption methodology.

Whereas cargo integrators (e.g. DHL) report their emissions in the ETS log, they are excluded from OAG coverage due to the economic sensitivity of the data. As a consequence, although ETS emissions from cargo integrators are included in the analysis, emissions from cargo integrators outside the ETS scope are excluded. This inconsistency is deemed minimal since emissions from full cargo operators were only 5% of all emissions in 2018.

Other types of flights such as chartered flights, flights from military aviation or governmental and humanitarian flights, for instance, are not covered by OAG. This results in a lower number of flights when compared with other data sources, such as Eurocontrol. However, the impact on emissions is estimated to be minimal.

As the number of flights is not reported in the ETS log, all data on flights and market share are derived from OAG and therefore only include scheduled passenger flights (including flights with belly cargo).

We calculate that the emissions from flights departing from EU27 using OAG data are 4.6% below the emissions from UNFCCC in 2019 and that emissions from the 2019 ETS scope are 1.3% below the verified emissions from the EU transaction log. The same comparison for 2025 shows that OAG emissions are 8% higher than ETS emissions calculated from the EU and Swiss ETS portals.

We further compared emissions calculated using OAG for 2019 and 2025 to emissions published by Eurocontrol for these two years. We calculated that our data are respectively 2% and 4% below Eurocontrol emissions.

The table below shows the airline-level comparison between the emissions calculated from OAG and the emissions reported under the EU and Swiss ETS for the years 2019 and 2025. Although the OAG estimates of ETS emissions are not used in our analysis (we use OAG estimates only for emissions not covered by the EU and Swiss ETS, including UK ETS emissions), this comparison aims to verify the accuracy of OAG estimates at the airline level.

Scope of emissions	**2019 EU ETS scope (incl. flights to and from the UK)**			**2025 EU ETS scope (incl. flights from and to Switzerland, but excl. flights from the UK)**		
Airline / scope	OAG estimated emissions 2019 (Mt)	Reported ETS emissions in 2019* (Mt)	Difference OAG - ETS (Mt)	OAG estimated emissions 2025 (Mt)	Reported ETS emissions in 2025* (Mt)	Differenc OAG - ETS (Mt)
EU/CH verified emissions	67.5	68.5	-0.9	69.4	64.2	5.2
Ryanair	11.1	10.5	0.59	14.9	12.6	2.3
Deutsche Lufthansa AG	4.6	4.4	0.21	3.6	3.3	0.4
British Airways	2.9	2.9	-0.03	1.3	1.0	0.3
Air France**	2.6	2.5	0.06	2.3	1.8	0.5

Scope of emissions	2019 EU ETS scope (incl. flights to and from the UK)			2025 EU ETS scope (incl. flights from and to Switzerland, but excl. flights from the UK)		
easyJet***	6.5	6.6	-0.03	5.1	4.9	0.2
Emirates	0.1	0.0	0.01	0.06	0.05	0.01
KLM	2.1	1.9	0.18	2.2	1.8	0.4
Wizz Air	2.9	2.6	0.24	4.0	3.3	0.7
Iberia	1.7	1.3	0.43	1.8	1.2	0.6
United Airlines	0.0	0.0	0.0	0.0	0.0	0.0

*Comparison of OAG data with ETS data from the EU transaction for the top 10 airlines. Note that the scope of the ETS in 2025 is different from the one in 2019 and that emissions are not directly comparable from one year to the other. *Verified emissions from EU and Swiss ETS registries; **Estimate based on YoY growth; ***easyJet Switzerland emissions are available on the Swiss ETS.*

5.3.2 Most frequented and most polluting routes in Europe

Using frequencies of flights departing from EU31 from OAG, we estimated the most polluting routes in 2025. We used the city name data field from OAG to regroup airports belonging to the same hub. The regrouping of airports per European city used in our analysis is presented in the table below. We ranked routes based on one-way emissions (i.e. departing emissions).

City	Airport	IATA code
Brussels	Brussels Airport Brussels South Charleroi Airport	BRU CRL
Hamburg	Hamburg Airport Hamburg Finkenwerder Airport Lübeck Airport	HAM XFW LBC
Berlin	Berlin Tegel International Airport Berlin Schönefeld International Airport Berlin Brandenburg Airport	TXL SXF BER

City	Airport	IATA code
Belfast	Belfast International Airport George Best Belfast	BFS BHD
London	London Gatwick Airport London Heathrow Airport London City Airport London Stansted Airport Southend Airport London Luton Airport	LGW LHR LCY STN SEN LTN
Glasgow	Glasgow International Airport Glasgow Prestwick Airport	GLA PIK
Stockholm	Stockholm Västerås Airport Stockholm Arlanda Airport Stockholm Bromma Airport Stockholm Skavsta Airport	VST ARN BMA NYO
Tenerife	Tenerife South Airport Tenerife Norte Airport	TFS TFN
Paris	Charles de Gaulle International Airport Paris Orly Airport Paris Beauvais Tillé Airport Paris-Vatry Airport	CDG ORY BVA XCR
Milan	Milano Linate Airport Malpensa International Airport Il Caravaggio International Airport	LIN MXP BGY
Rome	Leonardo da Vinci Fiumicino Airport Ciampino G.B. Pastine International Airport	FCO CIA
Frankfurt	Frankfurt am Main Airport Frankfurt Hahn Airport	FRA HHN

City	Airport	IATA code
New York	John F. Kennedy International Airport Newark Liberty International Airport New York Stewart International Airport	JFK EWR SWF

Main cities and their respective airports

5.4 Effective price of carbon emissions

We calculate the effective price per tonne of CO_2 emitted for each airline. To do this, we divide the amounts paid for emissions under ETS systems (EU, Swiss and UK) by the total emissions from flights departing from EU31.

Under the EU ETS scheme, free allowances had been allocated to around 500 aircraft operators. While 2024 saw the initial phase-out of free allowances, with 25% fewer free allowances distributed to airlines, in 2025, this has been reduced to 50%. The phase-out will be completed by 2026. Free allowances data is available on EU, Swiss and UK ETS data portals.

Priced emissions are emissions covered by the ETS, minus the free allowances. Using ICAP data, we applied the 2025 average carbon price of €73.5 per tonne of CO_2 for the EU and the Swiss ETS, and £48 (€55) per tonne of CO_2 for the UK ETS price.

5.5 Calculating Member State revenues from the carbon market

We calculated the fiscal revenues that EU Member States receive from aviation under the ETS for 2025. This methodology accounts for the transition from aviation allowances to general allowances and the complete phase-out of free allocations.

Revenues from aviation allowances stem from the aviation-specific cap, estimated at 26.2 million allowances for 2025. To find the auctioned volume, we subtracted three non-auctioned categories: free allocations (11.1 million allowances for 2025), sustainable aviation fuel reserve allowances (1.3 million allowances) and Innovation Fund allowances (1.9 million allowances).

Precisely, the 2023 revision introduced a sustainable aviation fuel support scheme within the carbon market. It set aside 20 million allowances until 2030 for aircraft operators to incentivise the uptake of sustainable aviation fuels. The European Commission reported that the first year of application, 2024, the support amounted to about 1.3 million allowances, equivalent to approximately €100 million, distributed between 53 operators. In the absence of updated estimates for 2025, we used the 2024 SAF allowances as a proxy. These figures should therefore be regarded as conservative estimates.

In addition, the 2023 revision also allocated further 5 million allowances from the aviation sector to the EU Innovation Fund. These reserved allowances are subtracted from the aviation cap and are not auctioned directly. In the absence of updated estimates for 2025, we used the [2024 allocation] of 1.9 million allowances as a proxy.

Because EEA aviation emissions (62.6 Mt of CO_2) consistently exceed the sector's specific cap, airlines are net importers of allowances from the general industrial and maritime pool. It means that airlines must buy general allowances from the secondary market. We therefore must attribute a portion of general auction proceeds to the aviation sector to reflect this economic demand. We calculated this shortfall for 2025, estimated at 36.9 million allowances and applied the 57% auction share applicable to the general ETS. The reason for this is that the aviation sector pays for general allowances, which it buys from the secondary market. However, this money does not actually go to public budgets because 43% of these allowances were originally given out for free to installations other than airlines.

From this total, we subtracted aviation's contribution to the general Innovation Fund. Under current rules, 80 million carbon market allowances that would otherwise be auctioned by Member States are earmarked for the Innovation Fund over 2024-2030. We assume these are evenly distributed across the period, roughly 11.5 million allowances per year. To estimate aviation's contribution to the Innovation Fund, we first calculate aviation's share of additional allowances relative to all auctioned allowances under the carbon market cap. We then apply this share to the 11.5 million annual allowances allocated to the Innovation Fund to estimate aviation's contribution for 2025. The corresponding revenues are then subtracted from total aviation carbon market revenues distributed among Member States.

We finally allocated 4.5% of total aviation-related carbon market revenues to the Modernisation Fund (MF). We multiplied the net auctioned allowances (remaining total) by the ETS price to get the total revenues received by Member States.

Category	2025
Aviation EU ETS verified emissions	**62.6**
Aviation cap (million allowances)	26.2
Auctioned aviation allowances (million EUAAs)	11.8
Over the cap emissions (million)	36.4
Auctioned general allowances (million EUAs)	18.8
Average EU/CH ETS price (€/t CO_2)	73.5

Category	2025
Total EEA aviation revenues (billion €)	**2.5**

Revenues from EU ETS allowances

5.6 ICAO's international carbon offsetting and reduction scheme

We estimated the airlines' offsetting requirements under ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The first phase of the CORSIA offsetting scheme began in January 2024 and will run until 2026. Participation is voluntary for this phase. In 2025, 129 states voluntarily participated in CORSIA.

Until 2026, the scheme will only apply to international flights between participating states that have volunteered to take part in the pilot or first phases. From 2027, all international flights between non-exempt ICAO Member States will be included. Our estimates reflect the expected timeline of countries joining the scheme. We assume all non-exempt and volunteering states will take part, including China, Russia, India and Brazil, which have not yet volunteered. By 2027, this would mean 134 participating countries. In contrast, we assume that currently exempt, non-voluntary states remain exempt throughout the period.

Within participating states, not all airlines fall under offsetting requirements. We applied CORSIA's eligibility rules to CO_2 emissions at airline level, as stated in the CORSIA handbook. A given operator's emissions are only included within the scope if they meet one of the following two criteria. Firstly, their annual emissions from international flights within CORSIA's scope exceeded 10,000 tonnes three years earlier. Alternatively, their total CO_2 emissions from international flights represented more than 0.1% of global international aviation emissions in 2019 the year before.

For the offsetting requirement calculation we followed ICAO's methodology. The system gradually shifts from being entirely sector-based to a mix of sectoral and individual components (85% and 15% respectively) by 2033. We calculated the two components of the formula as follows:

- The **sectoral component** multiplies state-pair emissions from CORSIA-eligible airlines departing EU31 airports by a sectoral growth factor (SGF). The SGF reflects how much global aviation emissions exceed the baseline, set at 85% of 2019 emissions between participating states.

- The **individual component** calculates the difference between each CORSIA-eligible airline's state-pair annual emissions for departing EU31 airports and its 2019 baseline. This baseline is again 85% of the airline's emissions in 2019 on the same state-pairs.

Using world global coverage OAG data, we estimated that total emissions under CORSIA scope in 2025 amount to 353 million tonnes of CO_2 and that 2019 total emissions from the same CORSIA geographical scope (using 2025 participation) amounted to 358 million tonnes of CO_2. Using these estimates, we calculated a SGF_{2025} of 16%.

We applied this factor to European emissions from carriers subject to carbon offsetting requirements under CORSIA to get the offsetting requirements for this year. As CORSIA covers whole routes, we used departing and arriving emissions.

5.7 Total cost of ownership model

5.7.1 Overview

The results presented in Chapter 3 are based on a total cost of ownership model. The model compares two fleet scenarios: a scenario in which next-generation hydrogen and electric regional aircraft enter service alongside revolutionary kerosene aircraft (both regional, single aisle and widebody) against the counterfactual in which only conventional, less efficient next-generation kerosene aircraft are developed (business as usual). The model estimates the additional carbon price required to make the net present value of operator costs in the scenario equal to that in the counterfactual. If the additional carbon price is negative, the scenario is already cheaper than the counterfactual at a system level without further policy intervention.

The analysis runs from 2019 to 2070, with the additional ETS charge applied from 2027, when the ETS is assumed to extend to all departing flights.

5.7.2 Fleet model and aircraft assumptions

Aircraft fleet evolution is modelled using a Boeing Cascade-based framework, extended to handle multiple aircraft types, propulsion technologies and geographic regions simultaneously. Fleet replacement follows a moderate replacement rate scenario, with a 25-year phase-out duration and an 8-year ramp-in period for new aircraft types.

Next-generation kerosene regional aircraft are assumed to enter service in 2032, delivering a 27% efficiency improvement over the current generation. The counterfactual assumes a derivative kerosene aircraft entering service in 2038 with a 15% efficiency improvement. For single aisle and widebody next-generation revolutionary kerosene aircraft, entry into service is estimated at 2034 and 2039 respectively, with efficiency gains of 25% in both cases. The counterfactual assumes entry into service of evolutionary single aisle and widebody designs in 2035 and 2040, with efficiency gains of 15%.

Next-generation hydrogen regional aircraft are assumed to enter service in 2040, delivering a 25% efficiency improvement and electric regional aircraft in 2035, delivering a 50% efficiency improvement. All next-generation regional aircraft are modelled with a production rate of 100 aircraft per year per manufacturer at entry into service, across two manufacturers in each category. This is in line with current backlogs in the industry. For single aisle and widebody aircraft next-generation kerosene aircraft, the production rate is estimated at 1000 and 250 aircraft per year per manufacturer at entry into service, in line with the sector's current backlog trends.

5.7.3 Economic assumptions

The OEM discount rate is set at 15%, reflecting the high-risk, capital-intensive nature of aircraft development programmes. The operator discount rate is 7%, consistent with a standard weighted average cost of capital for airlines in a stable regulatory environment. Fossil jet fuel is priced at €800/tonne JetA-equivalent. Bio-SAF is priced at €2,000/tonne and PtL-SAF at €4,000/tonne, with GHG reductions of 85% and 100% respectively relative to fossil kerosene on a well-to-wake basis. Hydrogen is priced at €3,500/tonne JetA-equivalent and electricity at €700/tonne JetA-equivalent, both assumed zero-emission. SAF blending obligations follow the ReFuelEU mandate schedule. ETS and CORSIA carbon price projections are based on BNEF forecasts.

5.7.4 Sensitivity analysis

The range of plausible outcomes is wide and reflects genuine uncertainty about different factors. We have selected two of the most impactful ones: the cost of developing more efficient planes from scratch (or in technical terms, the non-engineering costs) and how effectively hydrogen and electric propulsion can serve real-world routes given their expected performance.

Under more optimistic assumptions on both (20% lower development costs and 15% higher performance) no additional carbon pricing is required in order to incentivise the uptake of these technologies, because the scenario becomes cheaper than the business as usual counterfactual at a system level without any further policy intervention. The fuel cost savings from zero-emission operations outweigh the upfront investment over the model horizon.

Under more pessimistic assumptions, the required additional price rises to nearly €1,500 per tonne, a level that underlines that carbon pricing, while important, may not be sufficient on its own and must be complemented by support for research and development.

The two varying assumptions and their ranges are set out in the table below.

Scenario	**NRE per OEM, hydrogen regional aircraft** (€ billion)	**NRE per OEM, electric regional aircraft** (€ billion)	**Utility factor, hydrogen regional aircraft** (%)	**Utility factor, electric regional aircraft** (%)
Lower bound	€16	€24	90%	65%

Scenario	NRE per OEM, hydrogen regional aircraft (€ billion)	NRE per OEM, electric regional aircraft (€ billion)	Utility factor, hydrogen regional aircraft (%)	Utility factor, electric regional aircraft (%)
Upper bound	€24	€36	60%	35%
Base case	**€20**	**€30**	**75%**	**50%**

Total cost of ownership model's sensitivity scenario assumptions

All other assumptions are held constant across scenarios. The utility factor reflects the effective revenue tonne-kilometres served by each aircraft type relative to a conventional kerosene aircraft of equivalent size, accounting for range limitations and payload penalties associated with hydrogen storage and battery weight.

5.8 Estimating the share of contrail climate impact not covered by the reduced-scope non-CO_2 MRV

We used global Spire Aviation ADS-B data for the year 2025 to estimate the contrail climate impact included in the non-CO_2 MRV using pycontrails.

1. **Flight segmentation:** Spire ADS-B data (60 s time resolution, terrestrial and satellite data, data fields including flight information) was segmented into flights using a rule-based approach, yielding 34.5 million flights compatible with the Poll-Schumann performance model for global aviation in 2025.
2. **Fuel burn calculation:** Flights were resampled to 1-minute resolution in case of time gaps and fuel burn was computed using the Poll-Schumann performance model. Meteorological inputs were taken from ERA5 reanalysis (0.25° horizontal resolution; 20 pressure levels from 1000 to 150 hPa). Default engine assumptions in pycontrails were applied across all aircraft types. Total tailpipe CO_2 emissions for the 34.5 million flights amount to 975 Mt.
3. **Contrail estimation:** Contrail impacts were estimated using the CoCiP model in pycontrails v0.60.4 (Poll-Schumann precomputed fuel flow, 10-minute integration time step). Meteorological inputs were based on ERA5 reanalysis (0.25° resolution; 28 pressure levels between 600 and 180 hPa, interpolated from model-level data, with exponential boost latitude correction humidity scaling). Default engine assumptions were applied for all aircraft types. Total contrail energy forcing in 2025 is estimated at 6.4×10^{20} J. We do not account for contrail-contrail overlap in this analysis and therefore likely slightly overestimate total contrail climate impact. At the same time, this pycontrails version does not include vPM activation effects and therefore likely underestimates the global contrail climate impact because of lean-burn engines.

4. **Conversion to EGWP100**: Contrail energy forcing was converted to EGWP100 contrail CO_2e using a factor of 1.48E-10 kg CO_2e/J, taking into account a climate efficacy of 0.21 based on Bickel et al. (2025).
5. **Scope aggregation**: Flights were aggregated by different geographical scopes based on airline, departure and arrival information included in the Spire dataset to estimate the contrail climate impact included in the different monitoring scopes. The results are consistent with T&E's 2024 analysis of 2019 data provided by Imperial College London.

A more detailed methodology and full set of results will be published once airline-reported non-CO_2 emissions data become available.

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