Who benefits from free allocation in aviation?

Impact on airlines, decarbonisation and the internalisation of external costs

CE Delft

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Summary

Between 2013 and 2025, the aviation sector received free allowances under the EU Emissions Trading System (EU ETS). These freely allocated European Union Aviation Allowances (EUAAs) were originally intended to address concerns about competitiveness and carbon leakage. This study assesses how free allocation affected airlines' profitability and EU decarbonisation. The study also quantifies the impact of free allocation on the internalisation rate of aviation's external climate costs. Figure 1 at the end of this summary visualises the main findings of this study.

The analysis covers the period 2013-2025 and combines an aggregate analysis of aviation under the EU ETS with more detailed analysis of six European airline groups: Ryanair, Lufthansa, Air France-KLM, EasyJet, Wizz Air and IAG.

The value of free allocation for airlines was about € 10.9 billion, which very likely has resulted in higher profits for airlines. This value represented about half of the verified aviation emissions covered by the EU ETS over the same period. The share of emissions covered by free allocation declined over time, with a temporary increase during the COVID-19 period. From 2024 onwards, the phase-out of free allocation was accelerated with 2025 being the last year with free allocation. According to economic theory, free allocation does not substantially reduce ticket prices or preserve demand compared with auctioning. Instead, it increases the profitability of airlines relative to a situation in which allowances are auctioned. Even though free allocation is directly related to airline profitability, historic trends show that the recent phase-out has not led to lower profitability or ability to invest for airlines compared to pre-COVID-19 years.

Without free allocation, there would have been more revenues that could have been used for the decarbonisation of the European economy. The € 10.9 billion in avoided airline costs can also be interpreted as foregone EU ETS auction revenue. Had these allowances been auctioned, the revenues could have been used by Member States or EU funds for climate and energy transition purposes. Historic sustainable expenditures by airlines have been low relative to their profitability and the value of the free allocation. We found that the analysed airlines spent about one billion euros on sustainability between 2013-2025 (see Text box 1 for our definition of sustainable expenditures). Furthermore, there is no strong reason to suspect that airlines would have spent less on sustainability if there had been no free allocation. EU ETS auctioning revenues, on the other hand, are mostly used for the decarbonisation of the European economy. Auction revenues allocated to Member States and EU Funds are invested in sustainability with a reasonable degree of certainty. We therefore conclude that most likely, without free allocation, significantly more funds would have been dedicated to the decarbonisation of the European economy.

In 2025, the external climate costs of the six airline groups analysed amounted to almost € 30 billion. This consisted of € 14.7 billion from tank-to-wing CO_2 emissions, € 4.6 billion from well-to-tank emissions and € 10.3 billion from non-CO_2 climate effects measured in GWP_{100}. From 2013 to 2022, only a fraction of these costs was paid for. Since 2022, the share of intra-EEA external CO_2 costs that has been paid for through EU ETS costs have increased to around 40%, but it remains much lower when non-CO_2 effects are included. Without free allocation, the internalisation rate for these tank-to-wing CO_2 emissions would have reached around 50-70% in these years. When also considering intercontinental aviation, the internalisation has been very low because these emissions are not covered by the EU ETS and pricing by CORSIA was marginal.

Text box 1 – Findings related to the EU Taxonomy and our own definition of sustainable expenditures

Transitional activities in the EU taxonomy and our definition of sustainable expenditures

The EU Taxonomy classifies investments as sustainable when they contribute to one of six environmental objectives, including climate change mitigation, without harming the others. It also includes ‘transitional’ activities in sectors where low-carbon alternatives are not yet available. However, we concluded that the way transitional activities are defined makes the Taxonomy unsuitable for defining sustainable airline expenditures in this study.

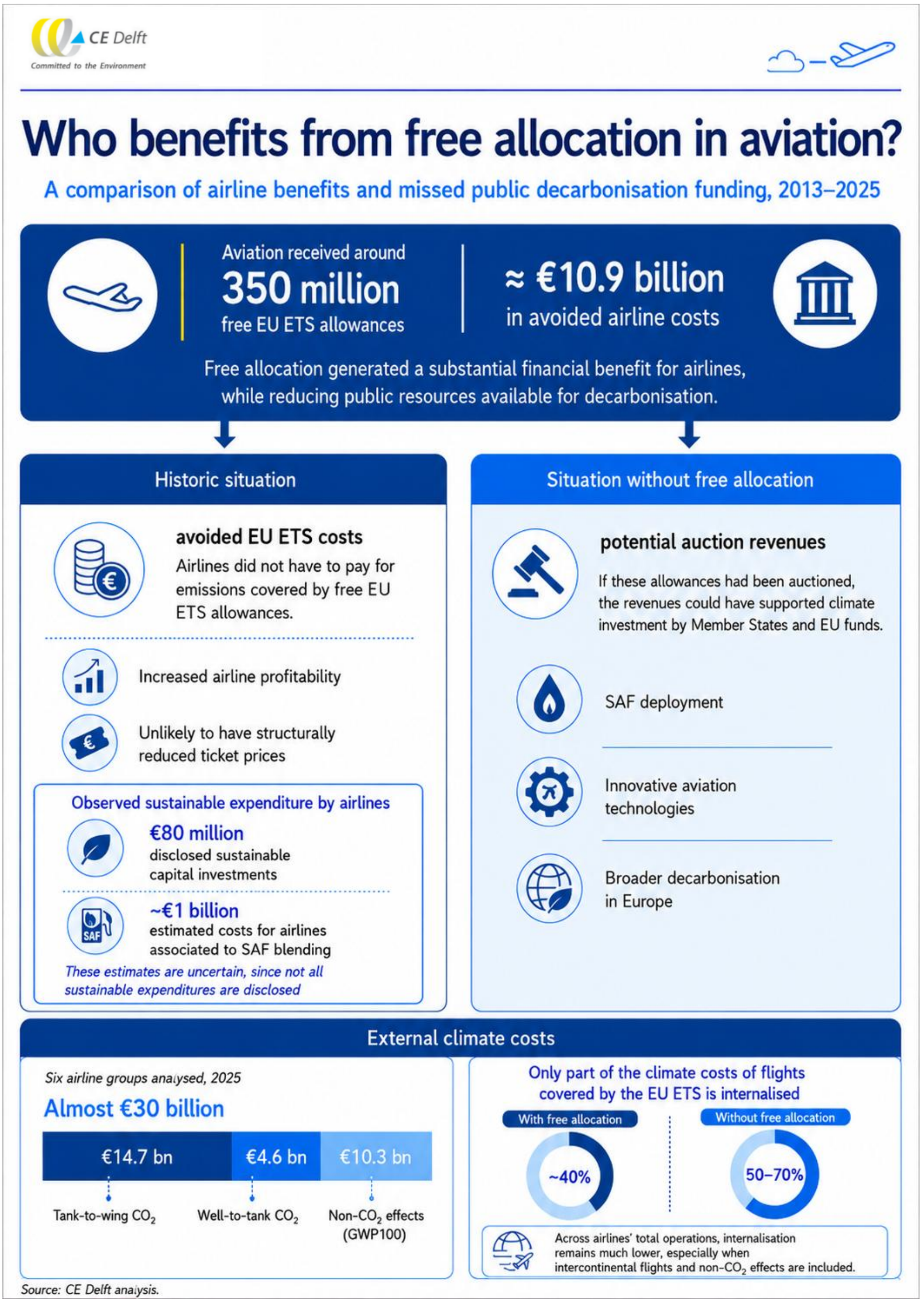
In 2025, 52.8% of reported airline capital expenditure was classified as Taxonomy-aligned. Yet only 0.13% of total capital expenditure (€ 24 million) related to genuinely sustainable activities, mainly electric ground handling equipment. The remaining 52.67% (€ 9.5 billion) consisted of transitional activities, mostly investments in new fossil-fuel-powered aircraft and aircraft maintenance. This suggests that, for aviation, the Taxonomy largely certifies business-as-usual fleet renewal rather than additional sustainable investment.

A similar issue applies to operational expenditure: 30.4% was classified as aligned, but entirely consisted of transitional maintenance, repair, short-term leasing and day-to-day fleet servicing costs. Expenditures related to actual SAF purchases, by contrast, are not covered by the Taxonomy. Aviation therefore stands out from other sectors: more than half of reported capital expenditure is classified as transitional, while genuinely sustainable expenditure remains negligible.

We therefore use an alternative definition of sustainable expenditure. This excludes transitional activities but includes SAF purchases and investments in SAF production, hydrogen aviation and electric aviation. Under this definition, sustainable capital investments by the six airline groups amount to around € 80 million over the period analysed, while sustainable operational expenditure related to historic SAF purchases is estimated at about € 1 billion. All historic SAF purchases were bio-SAF, the only type available on the market. It should be noted that different types of SAF differ substantially with respect to sustainability, scalability and cost.

Content

Figure 1 – Summary of the main findings of this study



1 Introduction

1.1 Background

Aviation has received a significant amount of freely allocated European Aviation allowances (EUAAs). These free allowances were introduced to protect competitiveness of the EU aviation sector whilst at the same time preventing carbon leakage.

In the 2023 EU ETS review, it was agreed that the phase-out of free allocation of EU ETS allowances for aviation would be accelerated. As a result of this change, from 2026 there is no more free allocation of allowances in aviation. Another review of the EU ETS takes place in 2026. The legislative proposal by the European commission contains several important proposals with respect to aviation (European Comission, 2026).[1]

- Several changes to the basic design of the EU ETS are proposed, such as changes to the linear reduction factor, inclusion of technical carbon removals and modifications to the market stability reserve.
- In its legislative proposal related to the 2026 EU ETS revision, the European Commission proposed to extend the EU ETS-scope to departing extra-EEA flights to aerodromes situated closer than 5,000km from Frankfurt. Also, third countries can choose to participate in the EU ETS ‘as a service’. For routes where CORSIA also applies, a cost ratio rule is proposed to avoid double pricing of emissions. Some changes to the exclusion of small emitters are also proposed.
- Several support mechanisms for the aviation sector are proposed. SAF allowances are continued until 2040, with adjusted support levels compared to the current situation. In the proposal, the support is conditional on the fuels being produced in countries which are part of the EU ETS, countries with their own linked ETS and countries that have opted into EU ETS as a service. Support for contrail avoidance is also proposed. Furthermore, the innovation fund is continued.
- No changes to the auctioning method for aviation are proposed, meaning that the phase-out of free allocation in aviation is foreseen.

This study consists of a backward-looking analysis of the impact of free allocation in the EU ETS. We therefore do not analyse the legislative proposals related to the 2026 EU ETS review. Instead, the focus of this study is on the 3rd and 4th trading periods.

[1] This is not an exhaustive summary of the proposals relevant for aviation, but rather a concise summary of the most relevant aspects.

1.2 Objective and research questions

This study quantifies how free ETS allocation has benefited airline groups in Europe and how these profits compare with their profitability, their investments in decarbonisation and the external cost of their activities. We also benchmark against other sectors.
We investigate this by answering the following questions:

- **What actually happened?** We answer this question by analysing the historic profits from free allocation, the investments in sustainability by airline groups and the external climate costs of airline groups based on available data.
- **What was the impact of free allocation?** We answer this question by analysing the counterfactual situation in which there would have been no free allocation (economic impact on airlines, impact on sustainability investments and external climate costs) and comparing this to the actual situation with free allocation.
- **How does the EU aviation sector compare to other industries?** A benchmark with other sectors shows how aviation compares on these elements to other industries.

1.3 Scope

This study focusses on the historic situation in Phase 3 and Phase 4 of the EU ETS (2013-present).[2] Different scopes are used in the analysis, since data availability is not equal for all aspects of the analysis. The following scopes are used:

- The general rule is that we made an analysis for all relevant airlines groups. For example, we analyse the value of free allocation for all airlines that reported under the EU ETS.
- In the analysis of profitability, we focus on the thirteen airlines that have their headquarter in the EEA: Aegean Airlines, Air France-KLM, Croatia Airlines, Deutsche Lufthansa, Easyjet, Enter Air, Icelandair, International Consolidated Airlines, Jet2, Norse Atlantic, Norwegian Air Shuttle, Ryanair and Wizz Air.
- The analysis of the reporting under the EU Taxonomy focusses on those eight airlines that submitted an EU Taxonomy report for the year 2025: Aegean Airlines, Air France-KLM, Croatia Airlines, Deutsche Lufthansa, Icelandair, International Consolidated Airlines, Norwegian Air Shuttle and Ryanair.
- For specific in-depth analyses for which it was necessary to do detailed analyses of the yearly reports of individual airlines, we focussed on six of the largest airline groups in the EEA: Ryanair, Lufthansa, Air France-KLM, EasyJet, Wizz Air and IAG.

We specified for each table or figure which airline groups were included in the analysis.

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[2] This excludes only the first year in which aviation was part of the EU ETS (2012). Including this year as well would be complicated since it was part of the second trading period and the stop-the clock discussions were still ongoing.

1.4 Outline of the report

The structure of this report is as follows:

- **Chapter 2** contains an analysis of the value of free allocation for airline groups. Section 2.1 gives an overview of the historic free allocation, Section 2.2 analyses the economic value of these free allowances, Section 2.3 assesses the impact of free allocation on ticket prices and demand and Section 2.4 assesses the impact on airline profitability.
- **Chapter 3** contains an analysis of sustainable expenditures by airlines and governments. In Section 3.1 we define sustainable expenditures. We first consider the EU Taxonomy and then propose our own definition. Based on this definition, Section 3.2 describes the historic sustainable expenditures of airline groups and Section 3.3 describes how the EU and national governments have historically used EU ETS revenues. Finally, in Section 3.4, we compare the sustainable spending of airlines and of governments to arrive at an assessment of the overall impact of free allocation on spendings related to sustainability.
- **Chapter 4** contains an analysis of the internalisation of external costs, with a focus on climate costs. Section 4.1 explains what external costs are. Section 4.2 describes different underlying mechanisms that determine what part of the external climate costs are internalised. Section 4.3 gives an overview of the historic internalisation of external climate costs in the aviation sector and Section 4.4 analyses the impact of free allocation on the internalisation of external climate costs.

Three annexes contain detailed information that is not covered in the main text:

- **Annex A** gives an overview of the CO_2 emissions, climate costs and financial performance of the six major European airline groups.
- **Annex B** describes the EU Taxonomy for aviation in detail.
- **Annex C** gives a detailed summary of how EU ETS revenues have been utilised by the EU and national governments.
- **Annex D** includes some more detailed analyses related to the calculated price gap between SAF and fossil kerosene as well as verified emissions and free allocation in the UK ETS and the CH ETS.

2 The value of free allocation

Summary

This chapter shows that the aviation sector received € 350 million EU ETS allowances between 2013 and 2025. Multiplying this by the market shows that airlines avoided **€ 10.9 billion** in EU ETS costs due to free allocation. Economic literature suggests that airlines pass through (part of the) ETS costs to passengers regardless of whether allowances are received for free or purchased at auction. This implies that the amount of free allocation did not influence ticket prices and demand. Empirical data do not support the assertion that the reduction in free allowances has materially damaged EU airline profitability.

Key messages

- The avoided costs for airlines due to free allocation of EU ETS allowances amounted to € 10.9 billion in the period 2013-2025.
- The avoided costs were highest in the years 2022-2024, as EU ETS prices were relatively high in these years. Since 2024, the accelerated phase-out of free allowances has reduced the yearly avoided costs. From 2026, there is no more free allocation in aviation.
- Most likely, free allocation, as the method of allocation did not impact ticket prices, due to the opportunity costs associated to freely allocated allowances. Therefore, we assess that free allocation did not significantly impact ticket prices and demand for air travel.
- Without free allocation, airlines would have been less profitable. However, free allocation accounted for about 17% of profitability for the five major European airline groups that were profitable in the period 2013-2025. For Air France-KLM, free allocation dampened the losses in this period by 10%.
- Furthermore, despite the phase-out of free allocation in recent years, gross profitability of airlines is comparable to pre-COVID-19 levels. From this it is plausible that the aviation sector would have therefore been able to financially absorb the costs of full auctioning instead of free allocation.

2.1 Historic allocation of free allowances

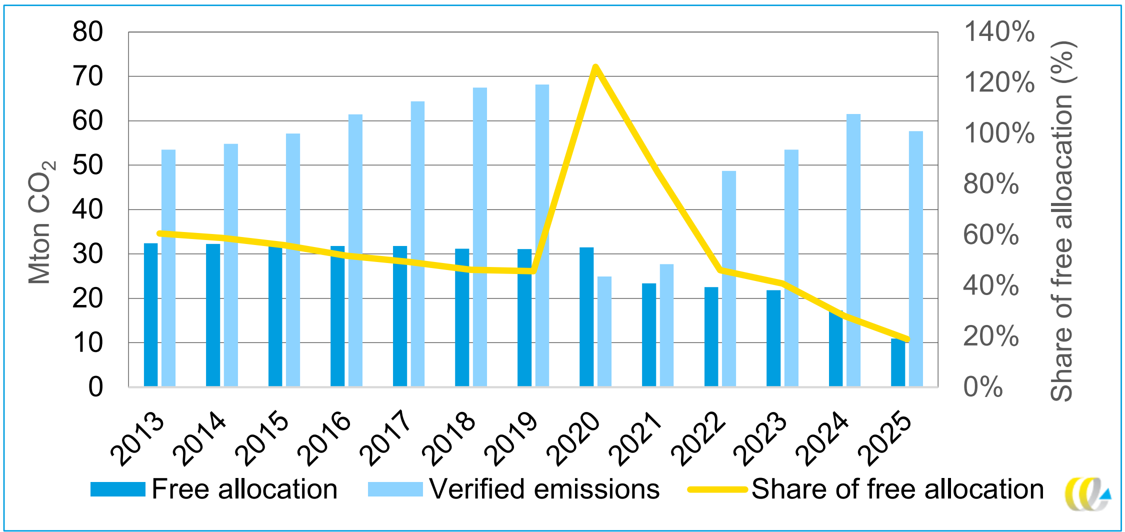
In the period 2013-2025, a total of 350 million free EU ETS allowances have been allocated within aviation, covering half of the 700 million tonnes of CO_2 verified aviation emissions during this period (EEA, 2025a). This concerns only the emissions that were covered by the EU ETS, which are intra-EEA flights and flights to the UK and Switzerland.

The methodology to determine the amount of freely allocated allowances has changed twice during this period:

- In Phase 3 (2013-2020), 82% of EUAA's were freely allocated. The cap of EUAA's was fixed at 95% of the average aviation emissions in the period 2004-2006, although the actual quantity issued was scaled down to reflect the temporarily reduced scope of the aviation ETS.
- In Phase 4, there were two distinct periods. In 2021-2023, the same share of free allowances compared to the EUAA cap was issued. However, a linear reduction factor of 2.2% per year was introduced for the yearly cap of EUAAs. From 2024 onward, the share of free allowances has been reduced more quickly, with 2025 being the last year in which free allowances are distributed.

Figure 2 shows the verified emissions, free allocation and the share of free allocation per year. The share of free allowances has been steadily declining, with a significant surge during the COVID-19 years. This surge can be explained by the sudden reduction in aviation activity, which had a very large impact on the verified emissions and did not affect the amount of freely allocated allowances. In the years before 2020, the diminishing share of free allowances was mainly caused by an increase of verified emissions, while in the years 2023 and 2024 the reduction of free allowances was the main driver.

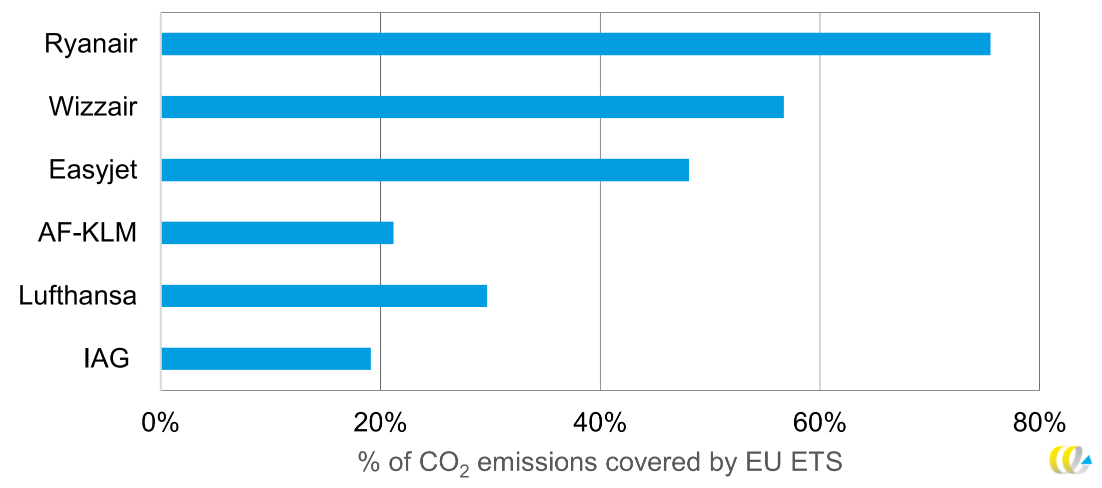
Figure 2 – Verified emissions and freely allocated allowances under the EU ETS



Source: CE Delft based on (EEA, 2025a). All airlines that reported under the EU ETS are included.

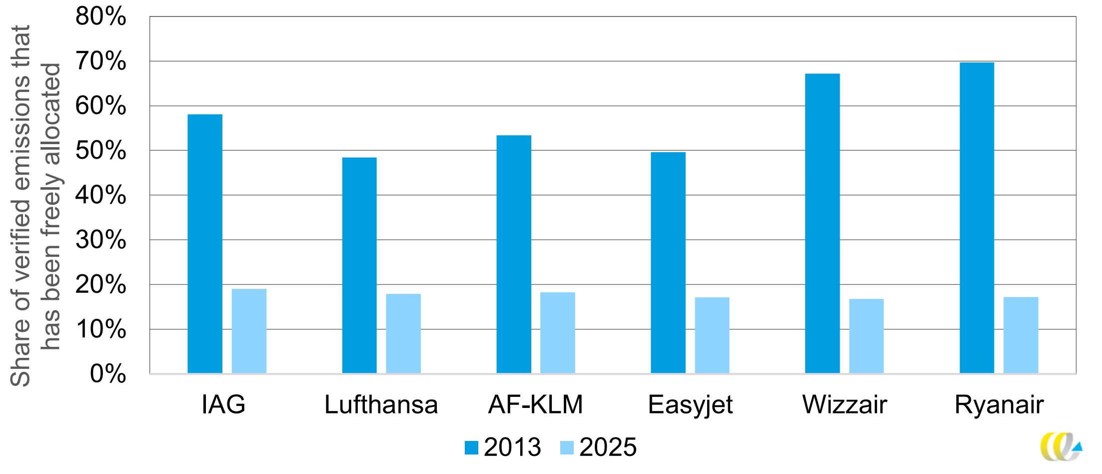
There are significant differences between airline groups. Figure 3 shows differences in the exposure to the EU ETS – calculated as the share of total reported CO_2 emissions compared to the verified emissions under the EU ETS – in the year 2025. Low-cost carriers have a relatively high share of exposure to the EU ETS and legacy carriers, with a large intercontinental operation, have a lower exposure. For non-European airlines, the exposure to the EU ETS is very low, as most of them do not service routes between European airports at all. Figure 4 breaks down the share of free allocation per airline group for 2013 (the first year in the analysis) and 2025 (the last year in the analysis). In 2013, the low-cost carriers had a slightly higher share compared to legacy carriers. In 2025, the airline groups all received between 15 to 20% of the allowances for free.

Figure 3 – Exposure to the EU ETS (share of CO_2 emissions covered) per airline group in 2025



Source: CE Delft based on (EEA, 2025a) and annual reports of the airline groups.

Figure 4 – Share of free allocation (compared to verified emissions) per airline group in 2013 and 2025

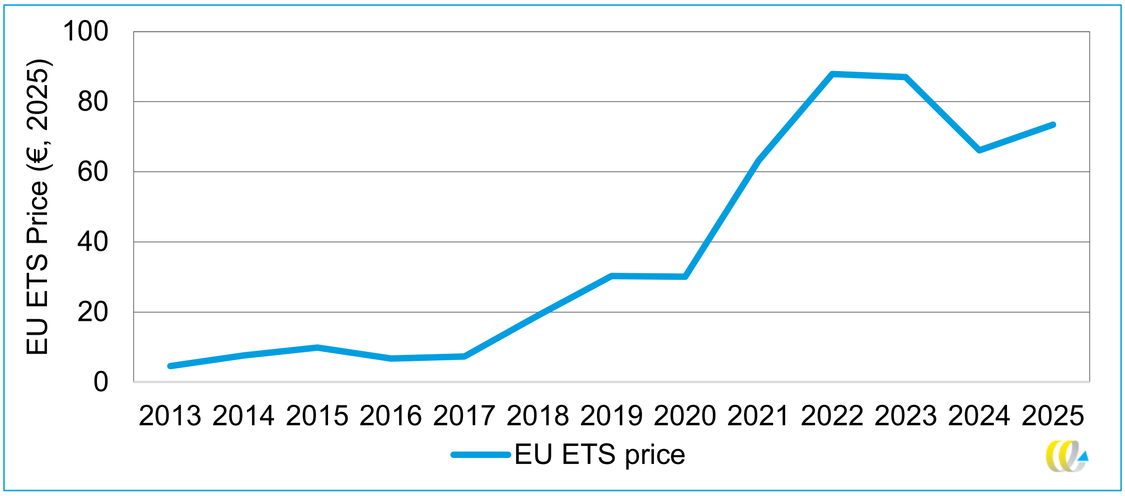


Source: CE Delft based on (EEA, 2025a).

2.2 The economic value of free allocation

Yearly average market prices for allowances (in 2025 prices) have increased from € 4.56 per tonne in 2013 to € 73.43 per tonne in 2025, peaking at € 87.90 per tonne in 2022 (Instrat Foundation, 2026). Figure 5 shows the development of the EU ETS price per year.

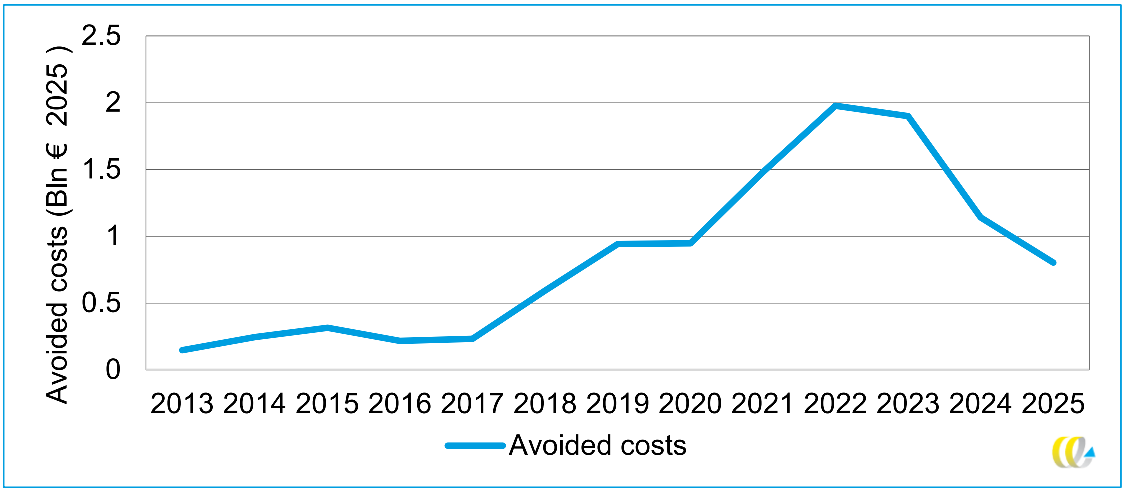
Figure 5 – Development of the EU ETS price per year



Source: (Instrat Foundation, 2026).

Figure 6 shows the yearly avoided costs, calculated by multiplying the number of free allowances per year by the market price. We estimate that airlines avoided € 10.9 billion in EU ETS costs due to the free allocation of allowances over this period (in 2025 price level). The highest benefits from free allocation ere in 2022 and 2023, with high EU ETS prices and still considerable shares of free allocation.

Figure 6 – Yearly avoided costs due to free allocation (all airlines that reported under the EU ETS)



Source: CE Delft, by combining data from Figure 2 and Figure 5.

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2.3 Impact on ticket prices

In this section we examine the impact of the method of allocating ETS allowances on ticket prices and demand. To begin with, price setting in the aviation sector is complex and differs aspects from other ETS sectors. For example, the quantity of flights and seats in aviation is more or less fixed and airlines use dynamic pricing to optimise profits. Cost pass-through rates vary strongly between passengers, with pass-through rates ranging from 15-100% between market segments (CE Delft, 2026).

Economic theory suggests that the allocation method (auctioning or free allocation) does not affect ticket prices (CE Delft, 2007; Coase, 1960; Tietenberg, 1985). This is because airlines base ticket prices on the market value of allowances (which is independent of the allocation method) rather than on the amount they actually paid for them. Because allowances can be sold, they carry an opportunity cost equal to their market value. This opportunity cost arises regardless of whether allowances are received for free or are purchased. Profit-maximizing firms, when faced with higher operating costs, will increase prices.

The example in Text box 2 illustrates the impact of allocation on ticket prices.

Text box 2 – Example of opportunity costs related to free allocation

Opportunity costs related to free allocation

An airline sells a ticket for € 90. Under the EU ETS, each ticket has a € 5 carbon cost. We assume for the purpose of this example that all of these costs can be passed-through:

- if the airline buys the allowance (auctioned), it pays € 5 and raises the ticket price to € 95;
- if the airline gets the allowance for free, it can sell it for € 5, so it still treats not selling the free allowance as a € 5 opportunity cost and can and will raise the ticket price to € 95.

In both cases, the ticket price increases by € 5, because the market value of the allowance (not how it's allocated) determines the final cost.

Empirical evidence for the assumption that the opportunity costs of freely allocated allowances are (partly) passed through is given by Verde et al. (2019) and Sijm et al. (2006): they have confirmed that in the power sector the costs of freely obtained allowances have indeed been (partially) passed through.

Verde et al. (2019) also give two exceptions of this way of price setting. Firstly, when extra-EU competition is very steep, such as in manufacturing, prices may be raised less when rights are freely allocated compared to when they are paid for. Secondly, the allocation method can influence price setting and production decisions for smaller emitters.

These firms tend to be less active participants in the ETS market and may therefore pay less attention to the opportunity costs of holding and using allowances.

Regarding the first exception, as all intra-EU flights face the same EU ETS costs, airlines do not face significant extra-EU competition on these routes[3]. Regarding the second point, while some airlines may qualify as relatively small emitters within the ETS, the aviation sector generally consists of larger and more commercially active market participants.

To date, however, to our knowledge no ex-post studies on the impact of free allocation on cost pass-through in the European aviation sector have been conducted. As such, it cannot be proven with full certainty that the allocation method does not impact ticket prices. However, based on the available evidence in other sectors and on economic theory we expect no significant impact on ticket prices if all allowances had been auctioned.

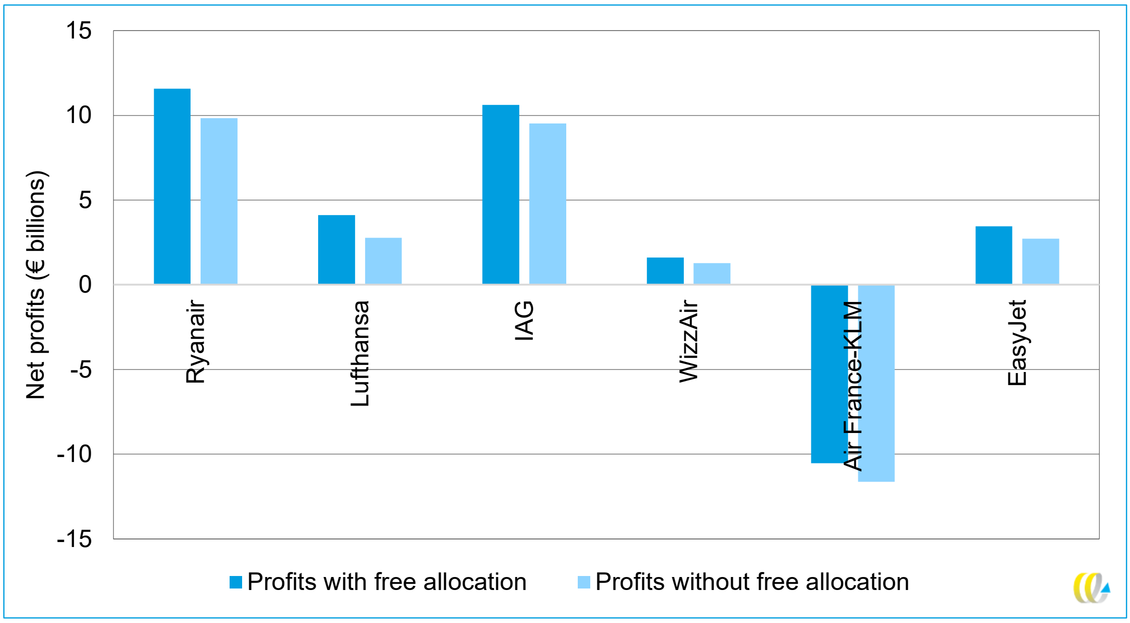
2.4 Impact on airline profitability

In this section, we analyse the impact of free allocation on airline profitability. We do so by comparing the reported net profits of the six airlines in scope with the counterfactual scenario in which allowances would have been fully auctioned. We also assess how the gradual phase-out of free allocation has affected profitability in 2024 and 2025 and compare airline profitability with that of airlines operating in other major markets, such as China and the United States.

Figure 7 shows the net profits of the six airlines, in a scenario with and without free allocation, for the period 2013-2025. Reported net profits are taken from the airlines' annual reports. Net profits in the scenario without free allocation are calculated by subtracting the estimated value of freely allocated allowances from reported profits. Figure 7 shows the impact of free allocation on airline profitability. Free allocation accounted for about 17% of profitability for the five major European airline groups that were profitable in the period 2013-2025. For Air France-KLM, free allocation dampened the losses by 10%.

[3] Airlines do face competition from competitors with lower exposure to the EU ETS on their entire operation. This is especially the case for hub-carries with a significant intra-EEA as well as extra-EEA operation.

Figure 7 – Cumulative net profits for the period 2013-2025 six airline groups[4]



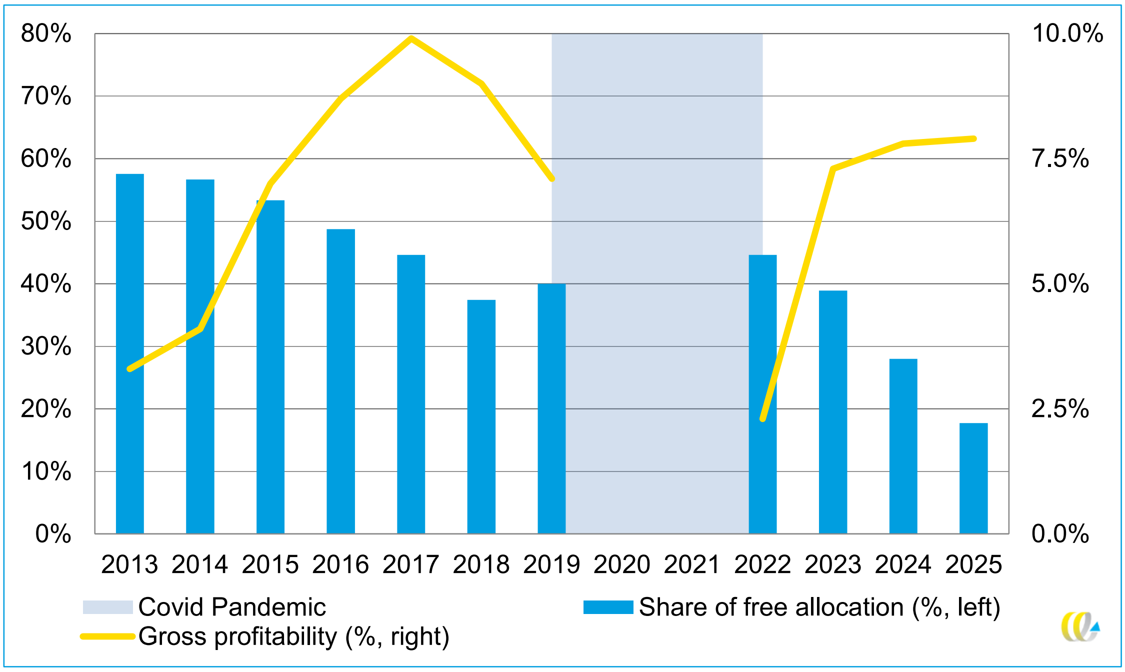
Source: CE Delft based on EEA (2023) and annual reports of the six airline groups.

Figure 8 and Figure 9 present the profitability of European airlines alongside the decline in free allocation, and benchmarks EU profitability against US and Chinese carriers respectively. The data do not appear to support the assertion that the reduction in free allowances has materially damaged EU airline profitability. European airline margins in 2023 to 2025 are broadly comparable to pre-COVID-19 levels, despite free allocation declining sharply over the same period. The regional comparison reinforces this: while EU carriers faced steep reduction in free allowances, their post-pandemic profitability recovery has outpaced both US and Chinese peers, with the US in particular seeing a pronounced decline from its pre-COVID-19 margins of 13-18%.

It should be noted that post-COVID-19 profitability dynamics across all regions are shaped by confounding factors, including pent-up demand, capacity constraints, and in the Chinese case, prolonged COVID-19-related disruptions which make it difficult to isolate the effect of free allocation specifically. Nevertheless, the available evidence provides no indication that the phase-out of free allowances has undermined the profitability of European airlines.

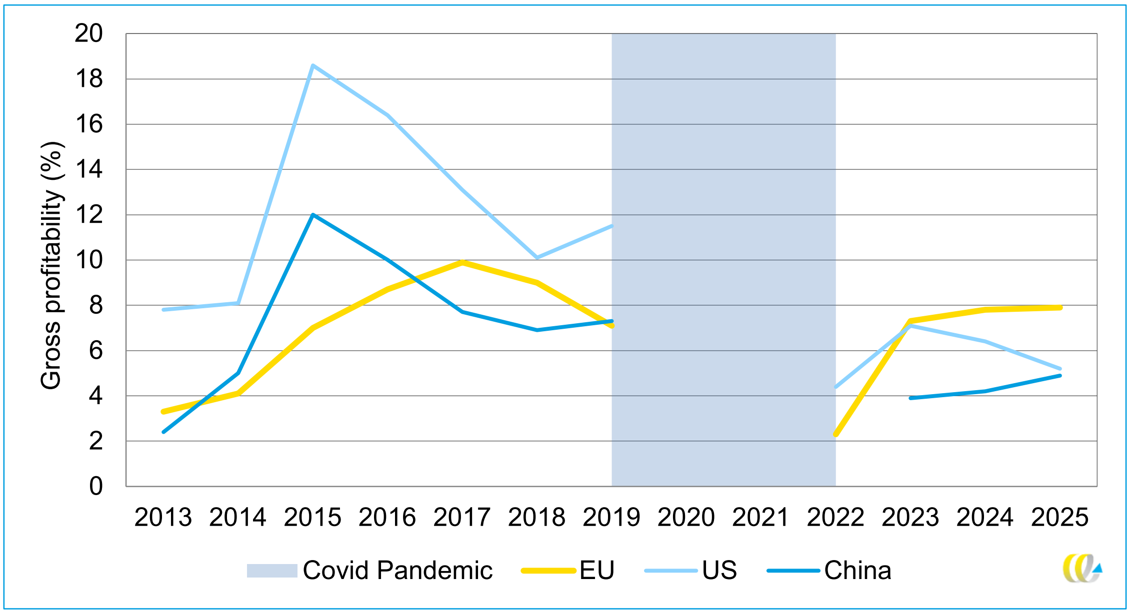
4 The cumulative losses of Air France-KLM over 2013-2025 are concentrated in three periods: 2013-2014, driven by structural cost pressures and losses at Air France-KLM, 2020-2021, when the COVID-19-crisis led to combined losses of around € 10.3 billion; and 2024-2025, reflecting new cost pressures, particularly rising labour costs.

Figure 8 –Free allocation versus profitability, excluding years 2020 and 2021 due to the COVID-19 pandemic



Source: CE Delft based on (EEA, 2025a) and LSEG.

Figure 9 – Gross profitability of European, US and Chinese airlines between 2005 and 2025



Source: LSEG, based on the 13 EU, 9 Chinese and 17 US airline groups covered in the database.

Finally, Text box 3 shows the investment rates of airline groups over the years. Based on this data, it can be concluded that – even though the COVID-19-crisis had a massive impact in the years 2020-2022 – the lower share of free allowances has not significantly impacted the investment rates in most recent years: the investment rates have recovered and grown to above pre-COVID-19 levels in 2023-2025.

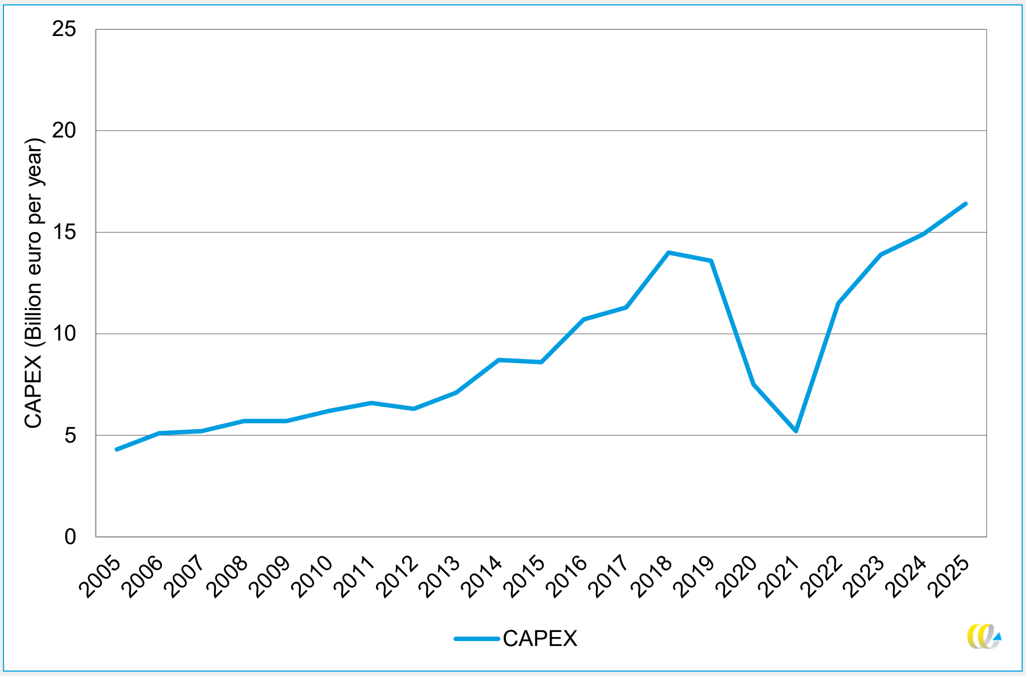
Text box 3 – Investment rates by airline groups

Growth in European airline capital expenditures

Figure 10 presents the total annual capital expenditure (CapEx) of European listed airlines between 2005 and 2025, based on LSEG financial data. Noting that the reported CAPEX in the financial reports captures only purchased assets and excludes aircraft acquired through lease contracts, which differs to the EU Taxonomy definition of capital expenditures which includes lease contracts.

However, the conclusion can be drawn that the capital expenditures of European airlines have recovered to and even grown beyond pre-COVID-19 capital expenditures. The pandemic caused a sharp contraction, with investment falling to € 5.2 billion in 2021. However, the subsequent recovery has been substantial: by 2025, capital expenditure has reached € 16.4 billion, exceeding the pre-COVID-19 peak of € 14.0 billion in nominal terms.

Figure 10 – Yearly reported Capital Expenditures for European Airlines, 2005 to 2025



Source: CE Delft based on LSEG.

Content

3 Sustainable expenditures

Summary

Historic sustainable expenditures by airlines have been low relative to their profitability and the value of the free allocation. Furthermore, there is no strong reason to suspect that airlines would have spent less on sustainability if there had been no free allocation. EU ETS revenues on the other hand are mostly used for the decarbonisation of the European economy. We conclude that, without free allocation, significantly more funds would have been dedicated to the decarbonisation of the European economy.

Key messages

- Historic sustainable expenditures by airlines have been relatively low (about € 1 bln) relative to their profitability (about € 21 bln) and the value of the free allocation (about € 6 bln). The allocation method of allowances has no significant impact on sustainable expenditures by airlines.
- Auction revenues allocated to Member States and EU Funds are invested in sustainability with a reasonable degree of certainty. However, transparency of Member States' spending is low.
- The extra EU ETS revenues without free allocation could have resulted in 4.7-50 Mton extra decarbonisation between 2013 and 2025, dependent on how these funds would have been used.
- We used an own definition of sustainable expenditures, as we found that there are several issues related to the definitions of aligned activities according to the EU Taxonomy:
  - Of the reported capital expenditures under the EU Taxonomy, over 52.8% is classified as aligned. Only 0.1% is sustainable, the other 52.7% consists of transitional activities. This mainly consists of the acquisition of new conventional fossil-fuel powered aircraft.
  - Of the reported operational expenditure, 30.4% is aligned. All of this is transitional business-as-usual maintenance, repair, short-term leases and day-to-day servicing costs of the fleet. At the same time, expenditures related to SAF purchasing are not covered.
  - The EU Taxonomy regime is materially more generous toward aviation than toward other sectors, since aviation is the only sector in which more than 50% of total capital expenditure is classified as an aligned transitional activity. Where alignment in other sectors requires a genuine change in what is invested in, aviation's criteria appear calibrated around investments that would have been undertaken regardless: routine fleet renewal through the acquisition of new, more fuel-efficient fossil-fuelled powered aircraft.

3.1 What is a sustainable expenditure?

When analysing ‘sustainable expenditures’ by airlines, it is important to have a clear definition of what a sustainable expenditure is. We first analyse the definitions given by the EU Taxonomy (Section 3.1.1) to derive the level of sustainable investments and operational expenditures and then arrive at our own definitions (Section 3.1.2).

In general, we categorise expenditures that contribute to low-carbon solutions such as electric- and hydrogen aviation and SAF as sustainable. When it comes to SAF, there are significant differences between sustainable aviation fuels. Three main categories that are relevant for the European SAF market can be discerned:

- **HEFA**, which is made mostly from used cooking oil and animal fats (Annex IXB bio-SAF of the Renewable Energy Directive), is the only type of SAF that has been produced at scale so far. Therefore, all purchased SAF by airlines has been HEFA. This type of SAF is relatively inexpensive to produce, because the process to create this from used cooking oils and animal fats is reasonably simple.
  The scalability of this type of SAF is very limited, because most of the available feedstocks are already used for the production of biofuels for road transport, aviation or other uses (ICCT, 2024). Therefore, more use of HEFA in aviation mostly means that these feedstocks cannot be used in other sectors, which does not necessarily lead to more sustainability at a system level (T&E, 2024).
  Also, there is a risk of fraud further back in the supply chain when unused cooking oil is labelled as used cooking oil (CE Delft, 2020). Making aviation fuels from unused cooking oil is not allowed by the Renewable Energy Directive. However, the significant financial incentive from the high price of bio-SAF can make it attractive to illegally produce extra cooking oil solely for the purpose of creating jet fuel. If this is the case, the feedstock is no waste product and the actual climate impact is significantly higher (also, there are other unwanted effects such as land use change and competition with arable land for food production). These supply chain integrity issues make the sourcing of sustainable HEFA difficult for airlines.
- **Advanced biofuels**, made from waste streams such as agricultural- and forestry waste products (Annex IXA bio-SAF of the Renewable Energy Directive), is a more scalable form of sustainable aviation fuel. Kerosene can be made from these feedstocks by various production pathways, most notably the Alcohol to Jet (AtJ) and Fischer-Tropsch (FT) processes. Due to the higher costs no production at scale is available so far.
- **E-fuels** are fuels made from renewable electricity, hydrogen and CO_2. These fuels are currently most expensive to make, due to the high costs of green hydrogen and CO_2. In the long term, e-fuels are the most promising pathway towards low-carbon aviation, since the scalability is not limited by biological waste streams as feedstocks.

It is important to note that the use of SAF does not fully mitigate the climate effects of air travel. Bio-SAF must have at least 65% well-to-wing CO_2 emission reduction to meet the requirements of the Renewable Energy Directive, whereas e-SAF must have at least 70% well-to-wing CO_2 emission reduction. SAF does have a modest reduction of non-CO_2-climate effects compared to fossil kerosene, but the majority of these are not mitigated by using sustainable aviation fuels (NLR, 2025). Since the reduction in climate impact compared to the use of fossil fuels is significant, we do count it as sustainable investments in this study.

3.1.1 EU Taxonomy

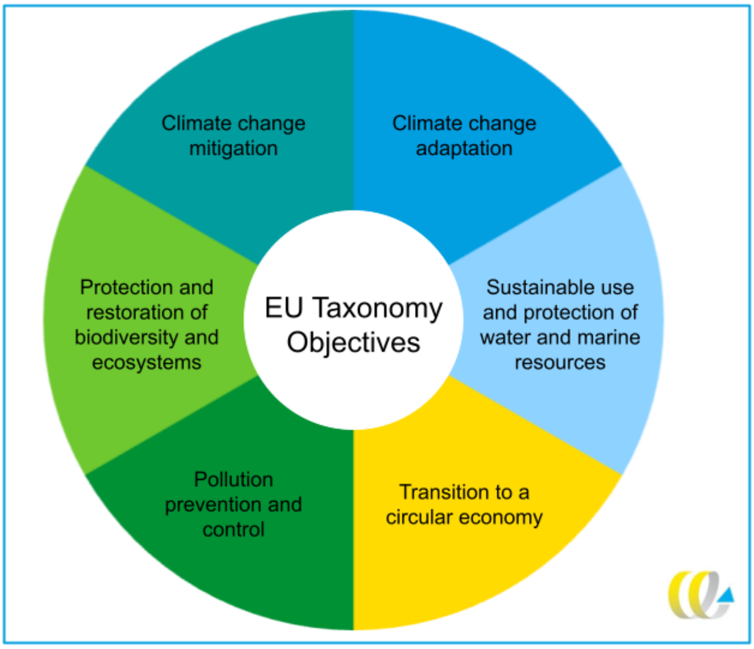
The EU Taxonomy Regulation is the European classification system to determine whether economic activities are sustainable. The Taxonomy is intended to help steer finance toward activities needed for the transition. The key categories of financial activities are:

- **Eligible activities** are activities that are within the scope of the EU Taxonomy. That is, activities for which technical screening criteria have been defined, but without implying alignment.
- **Aligned activities** are economic activities that substantially contribute to (at least) one of the six objectives of the taxonomy (see Figure 11) and do no significant harm to the others. The activities have to meet the specified technical screening criteria which are defined in delegated and implementing acts.

Activities that are taxonomy-aligned can either be sustainable or transitional:

- **Sustainable activities** are activities that fully meet the requirements.
- **Transitional activities** are a subset of sustainable activities, which is defined specifically for sectors where low-carbon alternatives are not yet available. Transitional activities may qualify only where they meet the general requirements for alignment (see above), and among other things; they do not hamper low-carbon alternatives; do not lead to lock-in of carbon-intensive assets, considering the asset lifetime; and have a credible path towards climate-neutrality.

Figure 11 – Objectives of the EU Taxonomy



Source: Visual by CE Delft.

The restrictive nature of qualifying activities as ‘transitional’ activities reflects a precautionary principle running through the taxonomy as a whole. Because taxonomy-alignment is designed to direct capital flows, the risk of over-inclusion (classifying an activity as aligned when it is not genuinely compatible with the EU's climate objectives) is significant: it channels investment toward assets that may later become stranded, while undermining the credibility of the framework itself. Article 19 of the Taxonomy Regulation reflects this asymmetry, requiring that technical screening criteria be based on conclusive scientific evidence (European Parliament & The Council of the EU, 2020). The Commission's freedom to develop such criteria through delegated acts is therefore bounded: criteria should only be introduced when ‘conclusive scientific evidence and the precautionary principle’ is met and the activity is ‘consistent with a pathway to limit the temperature increase to 1.5 °C above pre-industrial levels’.

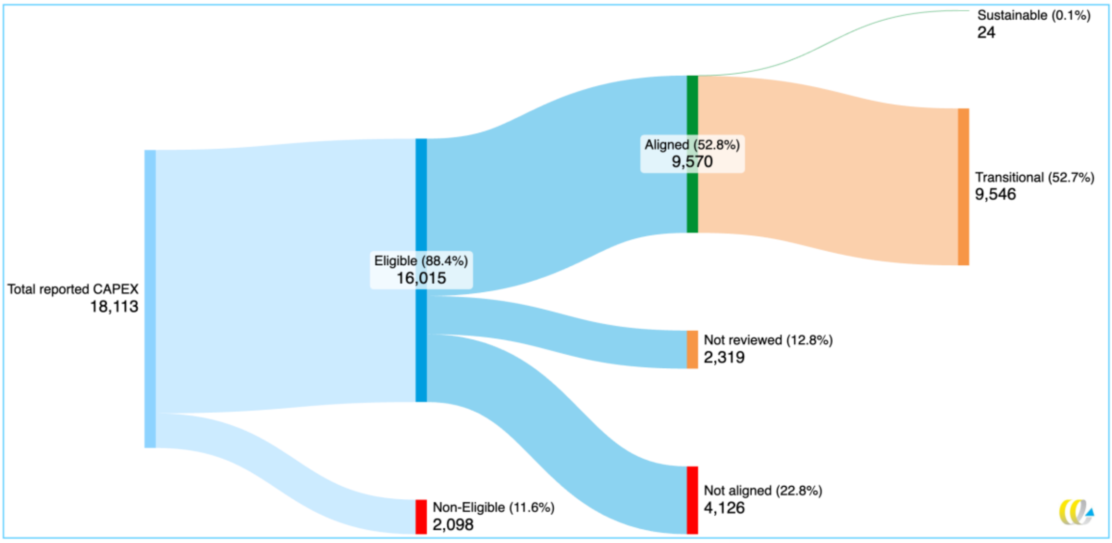
At the end of 2024, the Commission extended the taxonomy through a delegated act (EU, 2023) to cover criteria for specific aviation activities, most relevantly activity 6.19 (Passenger and Freight Air Transport), activity 3.21 (Maintenance of Aircraft) and 6.20 (Ground handling operations). Annex B explains how these activities are included in the taxonomy in more detail.

The taxonomy distinguishes financial flows in turnover, capital expenditures (CapEx) and operational expenditures (OpEx). This report focusses on CapEx and OpEx, since these are most closely related to sustainable expenditures by airlines. The following sections will further delve into the taxonomy reporting of both CapEx and OpEx by airlines, as well as their usefulness in the analysis of sustainable expenditures by airlines.

Reported capital expenditures by airlines under the EU Taxonomy
For airlines, taxonomy-eligible operating expenditure consists of capitalised expenditures associated with the purchase of aircraft, aircraft maintenance and ground handling equipment. As this section will show, the EU Taxonomy allows for fleet renewal to be counted as a transitional activity. This preferential treatment results in a high share of transitional investments, forming an outlier compared to other sectors, while genuinely sustainable expenditure remains negligible.

As a starting point, Figure 12 presents a breakdown of the capital expenditure reported by European listed airlines under the EU Taxonomy framework for financial year 2025. Of the thirteen European listed airlines, eight submitted a taxonomy disclosure.

Figure 12 – Breakdown of reported capital expenditures under the EU Taxonomy (2025), mln. €'s



Source: LSEG.

Three notable absentees are EasyJet, SAS, and Wizz Air. EasyJet, headquartered in the United Kingdom, did not include any reference to the EU Taxonomy in its latest annual report. SAS (Scandinavian Airlines System) states that following its delisting and transition to private ownership, it is no longer subject to mandatory taxonomy reporting obligations. Wizz Air, despite being incorporated in Hungary and therefore within the EU Taxonomy's regulatory scope, opted not to include a taxonomy disclosure, citing 'ongoing regulatory developments and uncertainties surrounding the implementation of the EU Taxonomy framework'.

The eight reporting airlines disclosed a combined total of € 18.1 billion in capital expenditure for financial year 2025. Of this, € 16.0 billion (88.4%) was reported as eligible under the taxonomy, meaning the expenditure falls within the scope of one or more defined taxonomy activities. The remaining € 2.1 billion (11.6%) was classified as non-eligible.

Of the eligible capital expenditure, airlines are required to assess what proportion meets all the criteria to be considered aligned, as described in the previous section. Two airlines (Ryanair and Norwegian Air) state in their annual reports that they did not proceed to assess alignment, concluding that their activities either did not meet all criteria or did not contribute substantially to climate change mitigation.[5] It is unclear for their reasoning, both Airlines purchases Boeing's 737-MAX aircraft[6], which according to research from Transport & Environment could meet the taxonomy requirements[7] (T&E, 2023b). This leaves € 2.3 billion (12.8% of total capex) unreviewed and € 4.1 billion (22.8%) actively classified as non-aligned following review.

The remaining € 9.57 billion (52.8% of total capex) was reported as aligned. The airlines reporting aligned investments are Air France-KLM, Croatia Airlines, Lufthansa and International Consolidated Airlines Group (IAG). Of this aligned investment, € 9.55 billion (52.7% of total capex, or 99.8% of the aligned expenditures) is classified as a transitional activity, predominantly aircraft acquisitions under activity 6.19 and maintenance, repair and overhaul investments under activity 3.21.

The high rate of alignment is in part a direct consequence of how the criteria are calibrated. As noted in more detail in Annex B, Transport & Environment found that the ICAO fuel efficiency threshold is met by approximately 90% of new commercial aircraft currently on order (T&E, 2023a). Airlines classifying their fleet acquisitions as taxonomy-aligned are therefore largely reporting investments that correspond to standard purchasing decisions aircraft they would, in all likelihood, have acquired regardless of the taxonomy framework.

Investment classified as sustainable amounts to € 24 million, or 0.13% of total reported capital expenditure, consisting entirely of the investments reported by Air France-KLM under activity 6.20 for electric ground handling equipment.

Benchmarking airline reported CapEx under EU Taxonomy against other sectors
To contextualise the investment patterns observed in the aviation sector, the airline taxonomy reporting is benchmarked against a broader group of 1,266 listed companies across 115 industry sectors, classified at the industry level using the Thomson Reuters Business Classification (TRBC) framework.

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5 RyanAir stated: "Ryanair has assessed compliance towards minimum safeguards and DNSH criteria and concluded that for FY25, it did not meet all the criteria set by the Taxonomy. Therefore, Ryanair did not proceed to determine its Taxonomy aligned Turnover/CapEx/OpEx for FY25." (Ryan Air Annual report 2025). Norwegian Air Shuttle writes: "The economic activity does not contribute substantially to climate change mitigation based on the technical screening criteria specified in section 3.21 point (b). Accordingly, the DNSH criteria have not been reviewed." (Norwegian Air Shuttle Annual Report 2025)

6 Ryan Air stated in their 2025 annual report: "During FY25, Ryanair took delivery of 30 new Boeing 737-8,200 "Gamechangers" (4% more seats, 16% less fuel & CO_2)". Norwegian Air stated: "Our fleet renewal continued at pace..., including 35 modern and fuel-efficient Boeing 737 MAX 8 aircraft".

7 Meaning, they exceed they exceed ICAO's New Type fuel efficiency by the required margin.

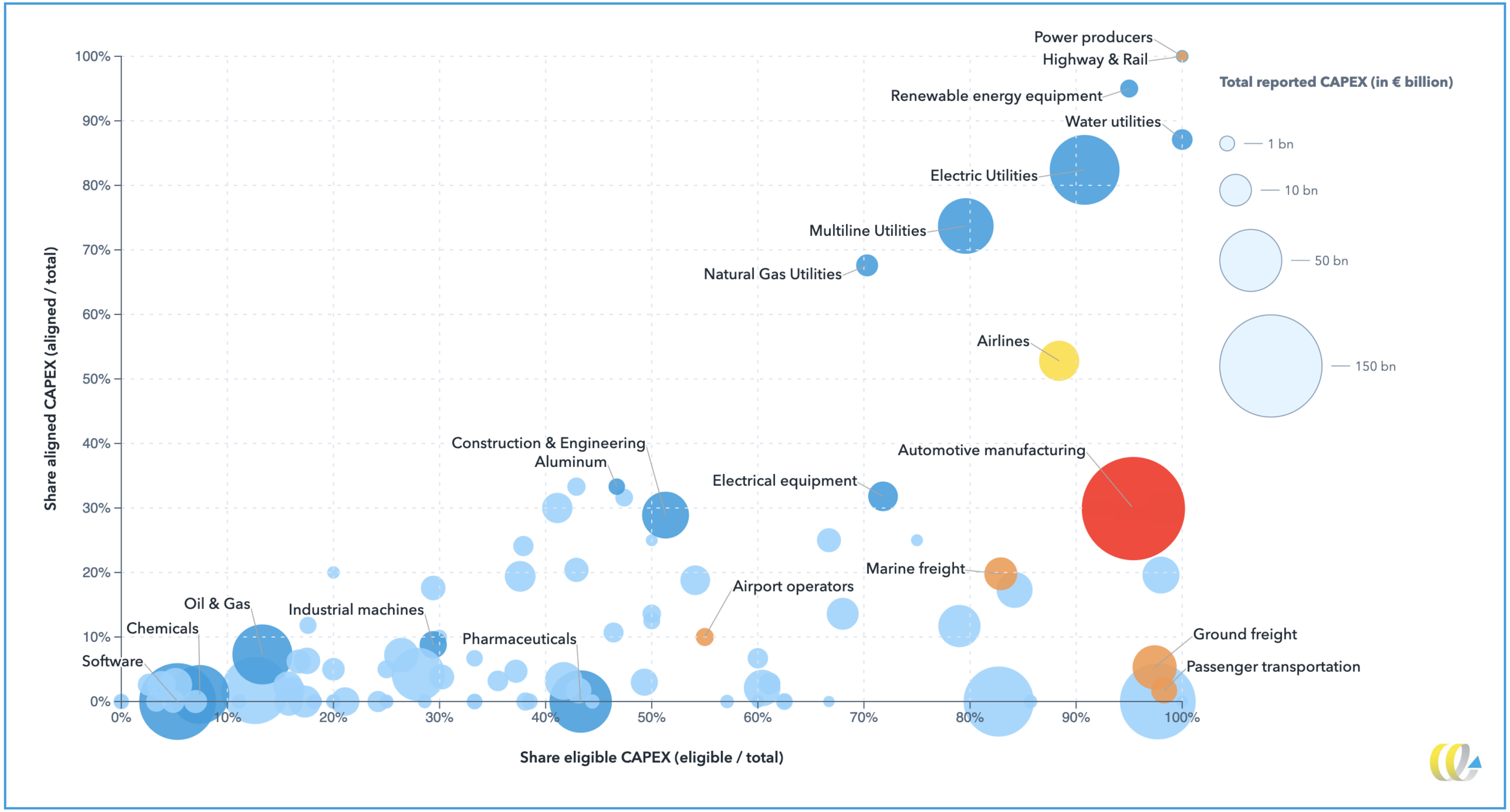
Figure 13 plots the share of eligible capital expenditure against the share of aligned capital expenditure for each sector, with bubble size representing total capital expenditure volume. Two dimensions stand out. First, the aviation sector reports one of the highest shares of eligible capex across the entire sample, reflecting the Commission's decision to bring the majority of airline investment activity within the taxonomy's scope. Second, and more strikingly, aviation converts a large proportion of that eligible capex into aligned capex. This distinguishes it from sectors such as automobile and truck manufacturing, which report comparably high eligibility rates but lower alignment rates.

The gap between eligibility and alignment is where the real test of the criteria's rigour lies. The automotive and truck manufacturing sector, for instance, reports an even higher eligibility rate than aviation, yet converts a significantly smaller share of that eligible investment into aligned investment. For aviation, that gap is smaller. The criteria, once met for eligibility, appear to pose fewer additional obstacles for alignment.

Figure 14 examines the composition of aligned investment, plotting the share of aligned capex against the share of that aligned capex classified as transitional rather than sustainable. Here, aviation is a clear outlier: it is the only sector in the sample in which more than 50% of total capital expenditure is classified as a transitional activity. In all other sectors with significant aligned investment, a meaningful share of that investment corresponds to genuinely sustainable activities. For airlines, aligned investment is almost entirely transitional, fossil-fuel powered aircraft acquisitions that satisfy the taxonomy's procedural criteria but are not zero-emission by design.

The contrast with other sectors is instructive. Where high alignment rates elsewhere (e.g. in renewable energy generation) reflect a genuine compositional shift toward zero-emission technology, aviation's alignment rests almost entirely on assets that will operate on fossil fuels for decades. In doing so it classifies a large share of the sector's investment base as aligned. Taken together, these two observations point to a taxonomy regime that is more generous towards aviation than toward other sectors – not as a reflection of the sector's climate performance, but, as a consequence of how the criteria have been calibrated relative to existing investment patterns. No other sector achieves alignment predominantly through transitional activities, in a classification of capital expenditure that would have been undertaken regardless. If alignment does not alter what airlines invest in and merely provides a framework for labelling existing investment plans, then the taxonomy functions in this sector less as an instrument of additionality and more as a certification of business as usual.

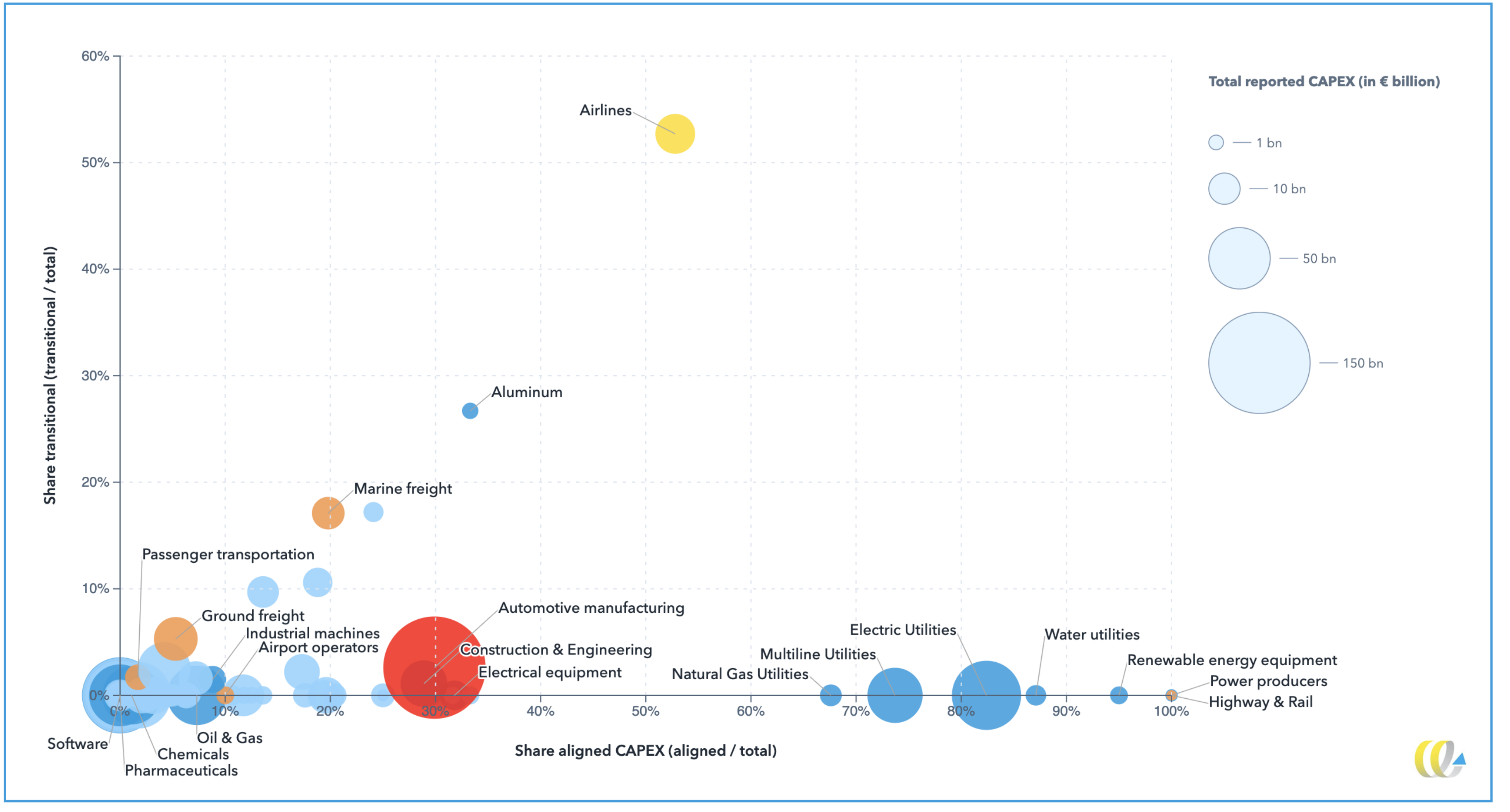
Figure 13 – Reported capital expenditures, share eligible versus aligned by industry



Source: LSEG. Selected industries: Airlines (yellow), Automotive (red), Transportation (orange).

Content

Figure 14 – Reported capital expenditures, share transitional versus aligned by industry



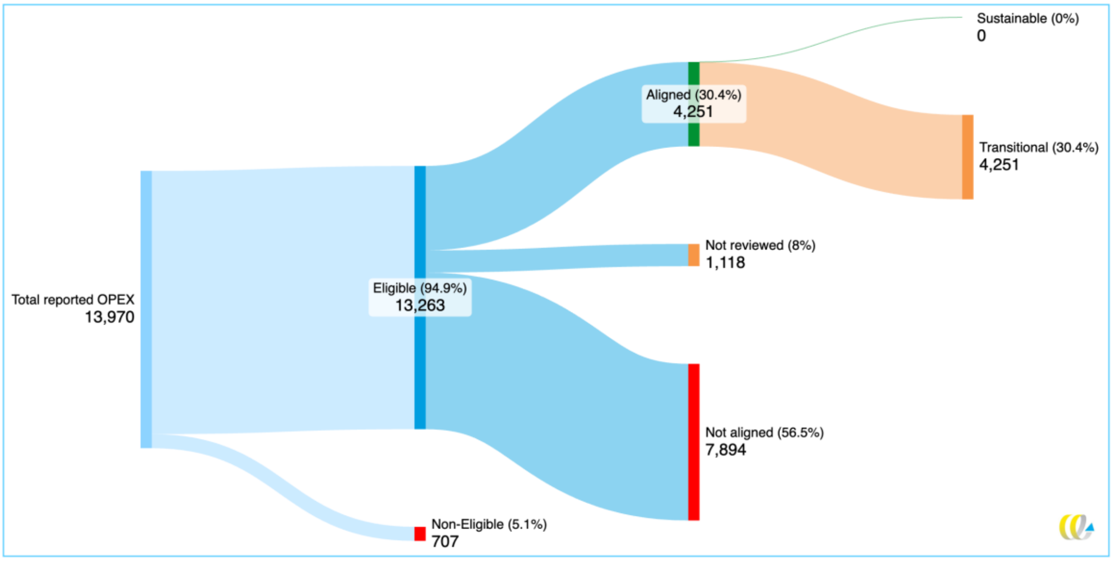
Source: LSEG. Selected industries: Airlines (yellow), Automotive (red), Transportation (orange).

Reported operational expenditures by airlines under the EU Taxonomy
Alongside capital investment, the EU Taxonomy also provides a framework for classifying operating expenditure to designate how much of their operational spending can be designated as sustainable. However, as this section will show, this part of the framework is not useful in analysing 'sustainable expenditures' by airlines because it does not include airline purchases in SAF.

To start, for airlines, taxonomy-eligible operating expenditure consists of direct, non-capitalised costs associated with the maintenance and repair (activity 3.21) and operation of aircraft that meet the criteria (under activity 6.19).

Figure 15 presents a breakdown of the operating expenditure reported by European listed airlines under the EU Taxonomy for financial year 2025. As we shown for capital expenditures, not all airlines have chosen to report on the taxonomy, and not all airlines have chosen to fully analyse their alignment. Of the € 4.3 billion aligned, € 3.2 billion is attributed to activity 6.19 (Passenger and Freight Air Transport) and € 1.1 billion to activity 3.21 (Aeronautical Maintenance). Due to the nature of the criteria, all aligned expenditure is classified as a transitional activity; no operating expenditure was classified as sustainable.

Figure 15 – Breakdown of reported operational expenditures under the EU Taxonomy (2025), mln. €'s



Source: LSEG.

The criteria explicitly define the 'operation of aircraft' as a taxonomy-eligible activity. However, supplementing regulations limits eligible operational expenditure to maintenance, repair, short-term leases and day-to-day servicing costs (European Union, 2021). As such, the bulk of the reported aligned operational expenditures is non-capitalised maintenance. SAF purchases by airlines is *not* included in the EU taxonomy framework.

Furthermore, there are two other flaws in the framework, as specified in detail in Annex B, that make this data reported no usable for analysing the sustainable expenses:

- The SAF compliance threshold is calculated at fleet level rather than at the level of individual aircraft. An airline can attribute its entire SAF purchasing volume against a designated subset of compliant aircraft, irrespective of whether those aircraft actually operated on SAF. The metric therefore reflects a financial ratio rather than actual fuel use.
- The taxonomy does not distinguish between alternative fuels, like other legislation. The EU Refuel Aviation Regulation, for example, distinguishes between synthetic SAF produced from renewable energy; bio SAF from HEFA; or advanced bio-SAF from waste streams (EC, 2023). Given the documented scalability constraints and supply chain integrity concerns associated with HEFA-based bio-SAF, inclusion of this into the taxonomy risks over-inclusion of activities whose long-term sustainability basis are considerably uncertain.

These reported OPEX figures are thus a collection of non-capitalised maintenance costs artificially allocated to a subset of the fleet. Or, as IAG notes in its 2025 annual report, the taxonomy operational expenditures "*does not reflect the economic reality of operating a taxonomy-aligned asset.*"

For these reasons, we turn in the next section to an alternative estimate of sustainable operational spending based on airline SAF purchases.

3.1.2 Our definition of sustainable expenditures

Based on our analysis of the EU Taxonomy we find that this is not directly usable for our analysis of sustainable investments by airlines. Therefore, we use a different categorisation of sustainable investments in this analysis, in which the following activities are included:

- **Capital expenditures and investments** that are classified as ‘sustainable’ under the EU Taxonomy (i.e. excluding the transitional activities) as well as other investments (for example in R&D) in the development of technologies such as SAF plants or for hydrogen- and electric aviation.
- **Operational expenditures** that are classified as ‘sustainable’ under the EU Taxonomy (i.e. excluding the transitional activities) as well as purchasing of sustainable aviation fuels (SAFs) that are aligned with the criteria from the Renewable Energy Directive and ReFuelEU Aviation. This includes bio-SAF with at least 65% well-to-wing CO_2 emission reductions and e-SAF with at least 70% well-to-wing emission reductions compared to fossil kerosene. In practice, HEFA has been the only type of SAF which was available on the market in the period which we analyse in this study. We only consider the additional costs compared to the purchase of fossil kerosene (after correcting for the EU ETS price difference) as sustainable investments, since the aircraft operator would have had to make the fossil fuel costs anyway.

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3.2 Sustainable expenditures by airlines

3.2.1 Sustainable capital expenditures and investments

In line with our definition of sustainable investments, we have gathered information on sustainable investments that airlines have reported on in their annual reports. Table 1 summarises the investments that we have found and (if disclosed) the invested amount or euros. We find that airlines have reported investments totalling € 80 million.
Other sustainable investments were made in SAF producers (€ 34 million) and in a university partnership (€ 4 million). In this table, we have included the capital investments reported by the six airline groups as 'sustainable' under the EU Taxonomy. This is a total of € 42 million related to electrification of electric ground equipment.

The expenditures listed are not an exhaustive overview, as airlines might not have disclosed (the costs of) all capital expenditures that could be classified as sustainable and we might not have found all disclosed capital expenditures during the desk research for this study. The order of magnitude of the investments presented in this table does give an idea of order of magnitude of sustainable investments and should be interpreted as such.

Table 1 – Disclosed sustainable investments from 2013 to 2025 (nominal prices)

Airline group	Investment in	Million € invested	Year
Air France-KLM	Electric ground equipment[8]	42	2025 and 2024
Air France-KLM	DG Fuels (bio-SAF producer)	5	2023
IAG	Oxccu (e-SAF producer)	24	2025
RyanAir	Sustainable Aviation Research Centre - Trinity College Dublin	4	2024 and 2021
WizzAir	Firefly (bio-SAF producer)	5	2023
Air France-KLM, Lufthansa, IAG, EasyJet, WizzAir	Airbus ZeroE participant (hydrogen-powered aircraft)	Undisclosed	
Air France-KLM	SkyNRG (bio-SAF producer)	Undisclosed	2016
IAG	Nova Pangaea (bio-SAF producer)	Undisclosed	2023
IAG	Wastefront (bio-SAF producer)	Undisclosed	2025
IAG	ZeroAvia (hydrogen-powered aircraft)	Undisclosed	2022

[8] Capital expenditures as reported under the EU Taxonomy. € 18 million in 2024, € 24 million in 2025.

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Airline group	Investment in	Million € invested	Year
EasyJet	Airbus hybrid and electric aircraft research agreement	Undisclosed	2019
EasyJet	Electric auxiliary power unit Milan Malpensa	Undisclosed	2025
WizzAir	CleanJoule (bio-SAF producer)	Undisclosed	2023
Total disclosed		**80**	

Source: annual reports of the airline groups.

3.2.2 Sustainable operational expenditures

We here discuss the sustainable operational expenditures by airlines. Airlines did not report sustainable operational expenditures in the EU Taxonomy in 2024 or 2025. Therefore, the analysis in this section consists of our own assessment of the sustainable operational expenditures related to the purchasing of SAF.

Table 2 – HEFA-based bio-SAF purchases as reported by the six airline groups in the period 2013-2025

Airline	Unit	Before 2021	2021	2022	2023	2024	2025
Air France-KLM	Millions of € (since 2022), kton SAF (2021 and before)	8 (kton)	4 (kton)	57 (mln €)	172	170	226
Lufthansa	Fossil ktCO_2 reduced Scope 1	0	23[9]	40	39	64	440
IAG	Kton SAF	0	2	10	53	162	291

Source: annual reports of the airline groups.

For purchasing of SAF in the years 2024 and 2025, we also need to account for the incentive in the form of SAF allowances (see Annex C.5). Airlines can apply for SAF allowances for SAF that is used for flights covered by the EU ETS. We assume that the airlines have been granted SAF allowances for 50% of the remaining price gap (which is the percentage applicable for HEFA). We have no precise insights in the SAF allowances requested or granted per airline, so we use the exposure of the airline groups to the EU ETS from Table 9 in Annex A.1 and the share of their CO_2 emissions covered by the EU ETS to estimate the share of SAF for which they received SAF allowances.[10]
Even though there are uncertainties in these numbers, the order of magnitude of additional expenditures related to SAF is robust.

[9] Scope 1 was not separately reported here and was calculated using the ratio between Scope 1 and Scope 1 and 3 emissions from 2022.

[10] The total calculated benefits for SAF allowances are € 91 million for the years 2024 and 2025 combined, which is well below the available funds. This suggests that it is no overestimation of the received benefits.

Table 3 estimates the resulting additional costs of purchasing SAF per airline per year. In cases where the costs were reported, these values are directly used. When volumes of SAF were used, we estimate the costs based on Table 14 in Annex D.1. There is a significant uncertainty in this calculation, for the following reasons:

- SAF contracts and associated costs differ per airline and per fuel supplier, with significant regional differences in prices.
- Often, SAF purchasing by airlines has been related to SAF-programmes, in which governments or corporates pay for the price difference. In these cases, there are no actual SAF-costs for the airlines.
- Depending on the airport or country, there may be additional incentives next to the EU ETS price difference that are not accounted for in this calculation. For example, Schiphol Airport has a SAF-incentive that in 2024 amounted to € 7.5 mln in 2024 and covered € 300 per tonne SAF (Schiphol, 2024).

Even though there are uncertainties in these numbers, the order of magnitude of additional expenditures related to SAF is robust.

Table 3 – Rough estimate of additional SAF purchasing costs in millions of euros per year, in $€_{2025}$

Airline	Before 2021	2021	2022	2023	2024	2025	Total
Air France-KLM	17	8	36	105	83	117	366
Lufthansa	-	12	20	18	16	103	169
IAG	-	5	19	94	171	278	567
RyanAir	-	-	-	-	-	-	0
Easyjet	-	-	-	-	-	-	0
WizzAir	-	-	-	-	-	-	0
Total	**17**	**25**	**75**	**117**	**270**	**498**	**1,002**

- Means that no SAF purchases are disclosed in the specific year.

3.3 Sustainable investments of EU ETS revenues by governments

3.3.1 Overall view on investments by governments

Since 2013, the EU ETS generated over € 258 billion in auction revenues. In this section we summarise how these revenues are being spent. We pay special attention to spendings on decarbonisation in aviation. The section shows that auction revenues are distributed between Member States and dedicated EU Funds. Member States have to use the money for climate and energy transition related purposes. The Innovation Fund, one of the main EU Funds, already supported three aviation-related projects. More detailed information can be found in Annex C.4.

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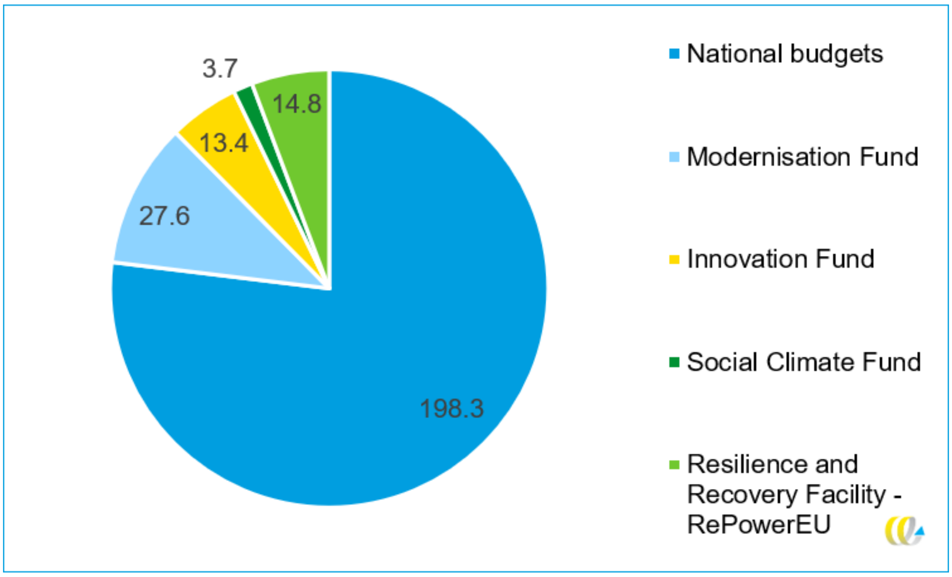
3.3.2 Distribution to Member States and EU Funds

The EU ETS directive (2023/959) describes how ETS revenues should be distributed. The majority of revenues are distributed to Member States, another part is reserved for European funds. In 2013-2025 more than 75% of ETS-revenues went to the national budgets. The remaining revenues went to specific European Funds. Figure 16 shows the distribution between 2013 and 2025.

Figure 16 – Distribution of EU ETS Auction revenues, 2013-2025, billion €



Source: (EC, 2025b).

3.3.3 Spending by Member States

As of 2024, Member States are obliged to spend 100% (50% until 2023) of the auction revenues for climate and energy transition related purposes. Between 2013-2024 in total € 125 billion was allocated towards these goals, e.g. by supporting energy efficiency, energy supply and social support for a just transition. Revenues are added to national budgets, but are not earmarked. This makes it difficult to trace them and to show that expenses lead to additional CO_2 emission reduction (enabling extra investments that would otherwise not have taken place). It is therefore also difficult to determine what portion of ETS-revenues is spent on the decarbonisation of aviation. Recent discussions around the upcoming EU ETS review, expected in 2026, increasingly focus on strengthening reporting requirements and improving traceability of ETS-funded expenditures.

3.3.4 Spending by the European Union

Contributions to research programmes
The EU has committed approximately € 3.0 billion to its two main research and innovation programmes for developing climate-neutral aviation technologies. This includes € 1.8 billion for Clean Sky 2 (EU, 2021), which ran between 2014 and 2024 under Horizon 2020, and € 1.2 billion for the Clean Aviation Joint Undertaking for the period 2022-2025 (Clean Aviation, 2026). Clean Aviation is the successor to Clean Sky 2 and supports the development of technologies such as hydrogen-powered aircraft, hybrid-electric propulsion systems and highly efficient aircraft designs. The EU has committed a total of € 1.7 billion for the Clean Aviation Joint Undertaking for the period 2022-2031 (Clean Aviation, 2026).

Spending by EU Funds
Since 2013 almost € 60 billion of ETS-revenues has been allocated to four dedicated EU funds. All funds have a direct link with supporting decarbonisation and sustainability.
The innovation fund, and to a lesser extent the Modernisation Fund and Recovery and Resilience Fund Facility, give room for investments in decarbonisation of the aviation sector. Between 2020 and 2025, € 13.4 billion of ETS-revenues has been allocated to the Innovation Fund (EC, 2025b). In total € 342 million of the innovation fund was approved to support the three aviation-related projects. This means that roughly 3% of resources from the Innovation Fund have been used for aviation purposes. Additional aviation investments financed through the Innovation Fund are to be expected. In 2025, the European Commission presented the Sustainable Transport Investment Plan (STIP) strategy, which includes a plan to mobilise € 153 million for four synthetic aviation fuel projects and a call for hydrogen bank for the production of SAF (EC, 2025c).

3.3.5 SAF allowances

Between 2024 and 2030, up to 20 million EU ETS allowances (worth about € 1.5 billion at current EU ETS prices of about € 75 per tonne) are set aside to help compensate aircraft operators for the price difference between fossil kerosene and eligible aviation fuels, including SAF, used on flights covered by the EU ETS. The support comes on top of the existing EU ETS benefit that qualifying alternative fuels can be zero-rated, meaning operators do not need to surrender allowances for the use of SAF. The specific level of support is calculated as a percentage of the price difference with fossil kerosene after correcting for the zero-rating of SAF and possible differences in taxation between SAF and fossil.

3.4 Impact of free allocation on sustainable expenditures

This section examines how airline sustainability investments might have differed in the absence of free allocation. It also explores how governments could have used the additional ETS revenues and assesses the implications for decarbonisation.
Finally, we come to an overall assessment of the impact of free allocation on expenditures related to sustainability.

3.4.1 Investments by airlines

The cumulative value of free allowances received by airlines in the past is estimated to be € 10.9 billion. A common argument is that free allocation is needed because airlines would otherwise have fewer financial resources available for sustainability investments. At the same time, there is an opposite perspective: if airlines had not received free allowances, they would have faced higher ETS costs and therefore would have had a stronger incentive to reduce emissions. To assess the role of free allocation, we consider both perspectives.

The first perspective is that removing free allocation would reduce sustainable expenditures because airlines would have less money available. Large decarbonisation investments often require substantial upfront capital expenditures, while the benefits materialise over a longer period. It is true that, without free allocation, airline profitability would have been lower over the period 2013-2025 (as was shown in Figure 7). However, the same figure also shows that profits (or losses) would have remained largely intact without free allocation.

We estimate that total sustainable expenditures (purchasing of SAF, investments in the development of technologies such as SAF plants or for hydrogen- and electric aviation) amounted to 6% of total airline net profits for the period 2013-2025. Without free allocation, this share would have increased to 9%. These figures suggest that airlines, in case of no free allocation, would still have had sufficient financial resources to undertake the sustainable expenditures observed during this period.

The opposite perspective is that removing free allocation would increase sustainable expenditures because airlines would face a stronger carbon price signal. This perspective is also difficult to support. Whether an allowance is received for free or purchased at auction, using it to cover a ton of CO_2 entails the same economic cost: the airline either pays for the allowance (in case of auctioning) or gives up the opportunity to sell it (in case of free allocation). As a result, the incentive to invest in decarbonisation is determined by the ETS price itself, not by the allocation method. Airlines therefore face the same marginal incentive to reduce emissions under free allocation as under auctioning.

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A striking example is that Air France-KLM was the only unprofitable major European airline group during this period (see Figure 7), whereas its disclosed sustainable capital expenditures and SAF purchases are relatively high compared to its competitors (see Section 3.2). This demonstrates that there is no observable relation between profitability and sustainable expenditures.

Taken together, airlines would probably not have spent significantly more or significantly less without free allocation. This conclusion is supported by empirical evidence from Reguant and Ellerman (2008) finding no systematic relationship between free allocation and production decisions, and Zaklan (2016), who found no evidence that switching from free allocation to auctioning changed the behaviour of firms overall.

3.4.2 Investments by governments

Section 3.3 shows that since 2013, the EU ETS generated over € 258 billion in auction revenues. Most revenues went to Member States, whilst an increasing share is added to specific EU Funds. Auction revenues could have been € 10.9 billion higher if all airline allowances were auctioned. We explore the potential emission reduction for three (hypothetical) scenarios, see Table 4. We explain the results below the table.

Table 4 – Hypothetical historical emission reduction per scenario

Scenario	**Result: hypothetical CO_2 reduction**
1a. All revenues were used to buy SAF (HEFA)	18 Mt + innovation potential
1b. All revenues were used to buy SAF (synthetic)	4.7 Mt + innovation potential
2. All revenues were allocated to the Innovation Fund	Up to 815 Mt + innovation potential
3. All revenues were allocated in line with historical distribution	Unknown, but rough estimation of at least 12.5 Mt + broader welfare benefits

We conclude that hypothetical CO_2 reductions are between 4.7 and 815 Mt.
As a reference: between 2013 and 2025 yearly average verified EU ETS emissions from aviation were 53.7 Mt (range 25 Mt in 2020 and 68 Mt in 2019).

1. **All revenues were used to buy SAF**
   If all revenues were used to buy HEFA-based bio-SAF, this could have resulted in a tank-to-wing emission reduction of over 18 Mton in 2013-2025. If revenues were used to buy synthetic aviation fuels, tank-to-wing emissions reductions could have been 4.7Mt. The difference between synthetic and HEFA is explained by higher costs for synthetic fuels. These estimations are based on SAF cost estimates by EASA (2025) for 2023, 2024 and 2025. For earlier years we use the estimate for 2023. In accordance with EU ETS, we use 0 TTW emissions from SAF. We acknowledge that this calculation has several limitations. In particular, there is uncertainty regarding the historical availability and price of SAF, as well as ongoing debates about the sustainability of some feedstocks.

Nevertheless, the analysis provides useful insight into the potential contribution of SAF to emissions reductions. Moreover, investments in SAF should not be viewed solely in terms of their direct CO_2 reductions. By creating demand, providing investment certainty, and supporting economies of scale, such investments can also help stimulate future production capacity and drive additional emissions reductions over the longer term.

2. **All revenues were allocated to the Innovation Fund**
   The Innovation Fund is one of the world's largest funding programmes for the demonstration of innovative low carbon technologies. It already supported three aviation related projects. Projects supported by the Innovation Fund are selected based on multiple criteria, including their degree of innovation, scalability, maturity, and cost efficiency. The potential cost efficiency of the Innovation Fund was evaluated in 2026 (Ramboll, 2026)]. The evaluation shows an average cost efficiency of € 13.36 budget spent per expected tCO_2e avoided. This cost-effectiveness was calculated by comparing the Innovation Fund's contribution to the project's total expected CO_2 reductions. This implies that, without this funding, the projects would not proceed and the associated CO_2 reductions would not be realised.

   Applying this average number to the auction revenues shows that the available funding could have delivered 815 Mt of CO_2 reductions.[11] These reductions could have taken place in all sectors, not only aviation. The actual emissions reduction potential is likely to be lower, as € 13.36/tCO_2 represents an average level of cost-effectiveness rather than a marginal outcome and full additionality is implied. Moreover, since a limited number of projects is operational so far, cost effectiveness is based on projected emission reductions rather than realisations. On the other hand, the impact of Innovation Fund support is not limited to the direct emissions reductions achieved by the funded projects. By helping innovative technologies reach the market and scale up, the fund may also contribute to future cost reductions and additional emissions reduction

3. **All revenues were allocated in line with historical distribution**
   In the past years around 75% of the auction revenues were allocated to Member States, the other 25% were distributed to the EU funds. Member States had to use 100% of the airline auction revenues for climate related projects. This implies that if 75% of € 10.9 billion was allocated to Member States, they had over € 8 billion to spend on climate related projects. In Section 3.3.3 we show that traceability of Member States' revenues is difficult, and therefore additionality is hard to prove. For most EU Funds, we do not know the average abatement costs. Most funds use cost effectiveness as a ranking criterium but don't set a minimum. If we use the threshold value of € 200/tCO_2

[11] The Innovation Fund was introduced in 2020. For earlier years, we assume that money was banked and spent later.

from the Innovation Fund as a proxy it will lead to an additional carbon reduction of around 12,5 Mt. This is a very rough estimate.

3.4.3 Overall assessment

We conclude that the absence of free allocation would not significantly have reduced or increased sustainable expenditures by airlines: the historic expenditures in sustainable capital or operations have been modest compared to the avoided costs in free allowances or their profitability and there is no strong reason to assume that these expenditures would have been different had they not received the free allowances. However, the additional EU ETS revenues would have led to significant additional decarbonisation due to sustainable expenditures by EU funds and national governments. The exact comparison is difficult to make due to the uncertainty related to the 'what if' character of this comparison, but the likely difference is so large that it can be assessed with certainty that the absence of free allocation is beneficial for the decarbonisation of the European economy.

4 External costs

Summary

In this chapter we analyse the impact of free allocation on the internalisation of external costs in the aviation sector, with a focus on climate costs. Aviation causes substantial external climate costs through tank-to-wing CO_2 emissions, well-to-tank emissions from fuel production, and non-CO_2 climate effects. For the six airline groups analysed, total external climate costs amounted to almost € 30 billion in 2025. These costs are only partly internalised through the EU ETS and CORSIA.

Within the EU ETS scope, the internalisation of tank-to-wing CO_2 by the EU ETS has increased over time, mainly because EU ETS prices have risen and free allocation has been phased out. However, free allocation substantially reduced the rate of internalisation in earlier years. Without free allocation, the internalisation rate would have been higher in all years and would have reached around 50-70% in the period 2022-2025. When non-CO_2 climate effects are included, the rate of internalisation remains substantially lower.

When also considering flights outside of the EU ETS coverage, the internalisation of external costs is low for the whole period. This is a result of the marginal internalisation of climate impacts of intercontinental flights, which account for 68% of the climate impacts of the airline groups that we analysed.

Key messages:

- Aviation's external climate costs are substantial: for the six airline groups analysed they amounted to € 14.7 billion in 2025 (almost € 30 billion when including well-to-tank and non-CO_2 costs).
- The EU ETS has internalised only a fraction of the external costs of EU ETS-scope CO_2 emissions until 2022, because of high shares of free allocation and low EU ETS prices.
- Since 2022, the rate of internalisation of these CO_2 emissions by the EU ETS has been around 40% for tank-to-wing CO_2 emissions and 9-27% including non-CO_2 climate impacts.
- Without free allocation, the internalisation of tank-to-wing CO_2 costs within the EU ETS-scope would have been higher in every year and around 50-70% in 2022-2025.
- The rate of internalisation for intercontinental flights was about 5% in 2024 if only considering tank-to-wing CO_2 emissions. The total rate of internalisation for the six airline groups was 16% when considering only CO_2 emissions and 4-10% when also considering non-CO_2.

4.1 Methodology

In this chapter we analyse the impact of free allocation on the internalisation of external climate costs in the aviation sector. To determine the climate costs, we have analysed the annual reports of six major European airline groups: Ryanair, Lufthansa, Air France-KLM, EasyJet, Wizz Air and IAG. The analyses in this chapter therefore correspond to the total of these airline groups and do not cover other airlines.

4.1.1 What are external costs?

External costs are effects of activities, such as air travel, that are harmful to other people, animals or plants. Since the person who exercises the activity is not the one experiencing the negative consequences, he or she does not take into account the negative effect in the decision making. In air travel, climate costs, air pollution and airport noise are some of the most important externalities. These effects can be monetised by assigning a monetary value to the effect corresponding to the importance of this effect.

In this study, we focus on external climate costs. The external costs due to climate change aviation consists of different components:

- The direct **tank-to-wing (TTW)** CO_2 emissions due to the combustion of kerosene in the aircraft. The climate effects of CO_2 are long-term, with a significant share of the climate impacts persisting for ages or even millennia.
- The **well-to-tank (WTT)** greenhouse gas emissions related to the production of kerosene. These are mainly CO_2 emissions and to a lesser extent other greenhouse gases such as methane.
- The **non-CO_2 climate effects**, resulting from atmospheric processes such as contrail formation and NO_x emissions at cruise altitudes. These are generally short-term climate forces (hours to weeks) and therefore have a strong climate effect in the near future and no less impact on longer time horizons. Because the impacts depend on the operational circumstances, such as flight altitude, atmospheric conditions and time of day, there is no one factor that relates the CO_2 emissions of a flight to a corresponding non-CO_2 climate impact. However, at the aggregate fleet level, such comparisons can be made. The uncertainties related to the magnitude of the non-CO_2 climate impacts are relatively high compared to those related to the climate impacts of CO_2 emissions;
- Other **life-cycle emissions** related to for example the production and end-of-life of the aircraft, airport infrastructure, maintenance, in-flight services, etc.

4.1.2 Assumptions related to external climate costs

We discuss the TTW emissions, the WTT emissions and the non-CO_2 climate effects here. Other (life cycle) emissions, such as the emissions related to the production of the aircraft or the recycling of its parts, are out of scope of this analysis.

To calculate the external costs, we have collected the official CO_2 emissions as reported by the airlines in their annual reports. A breakdown per airline group can be found in Annex A.2. The following methodology was used to calculate the climate costs from the reported CO_2 emissions:

- To determine the external climate costs, a CO_2 price of 128 $€_{2025}$ per tonne was used. This is an inflation-corrected estimate based on the 100 $€_{2016}$ value recommended by the European commission for the years that are part of this analysis based on the EU Handbook on the external costs of transport (CE Delft, INFRAS, TRT, & Ricardo, 2019).
- We estimated tank-to-wing CO_2 emissions based on a well-to-wing CO_2 emission factor of 94g/MJ (EC, n.d.) and a tank-to-wing CO_2 emission factor of 71.5 g/MJ (PBL, 2025).
- To account for the differences in duration, climate metrics can be used to compare the emissions of CO_2 to non-CO_2 climate effects. We calculated non-CO_2 climate impacts in GWP_{100}, assuming an average of 0.7 tonnes CO_2-eq. non-CO_2 climate impacts for each tonne of tank-to-wing CO_2 emissions (Lee et al., 2021). We also show the non-CO_2 impact in GWP_{20}, since this is the other end of the bandwidth of metrics which is used to calculate non-CO_2 climate impacts in the EU ETS.
  In GWP_{20} there are 3.0 tonnes CO_2-eq. non-CO_2 climate impacts for each tonne of tank-to-wing CO_2 emissions (Lee et al., 2021).

Apart from climate costs, there are also other external costs that are not included in this study. Similarly, the study does not analyse all taxes and charges that are of relevance for the aviation sector. We do include the emission trading systems of the United Kingdom (UK ETS) and Switzerland (CH ETS), as these are comparable systems to the EU ETS. We also included the international off-setting scheme CORSIA of ICAO in the analysis. This is a very different system, but also results in some costs related to CO_2 emissions for airline groups.

Text box 4 gives an overview of all external costs and the rate of internalisation for flights departing from major European airports in the year 2016. This is a somewhat older year, but it is the most recent year for which a comprehensive analysis was done at the EU level. In the remainder of this chapter, we focus on the climate costs.

Text box 4 – Total (internalisation of) external costs by airlines

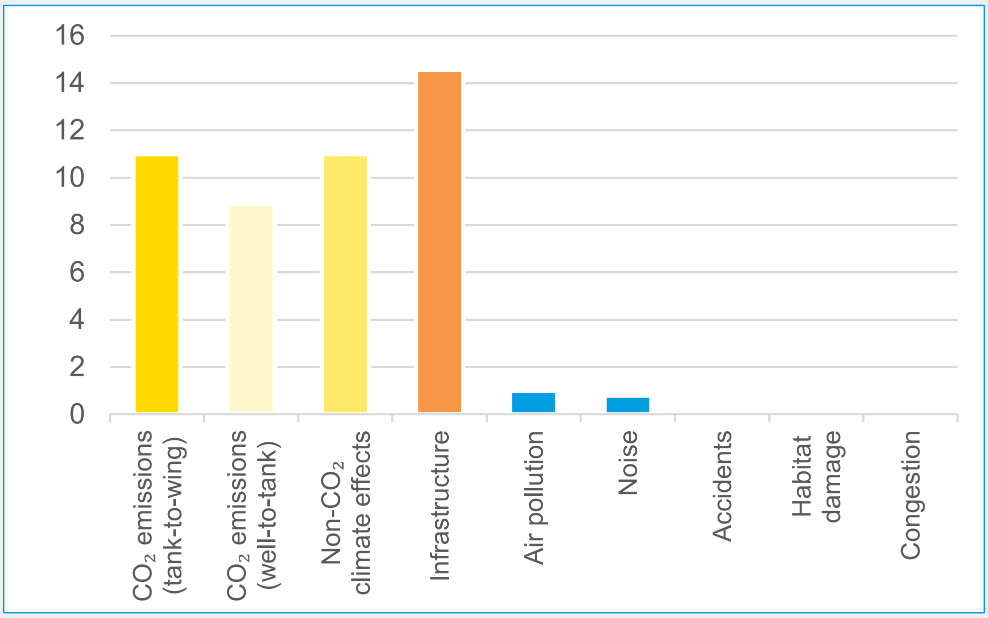
Total internalisation of external costs

This study focusses on external costs related to climate change and the internalisation of these costs. However, there are other external (and infrastructure) costs associated to air travel. At the same time, there are other taxes and charges, such as airport charges and national aviation taxes, that (partly) internalise these costs. We here give a brief overview of the situation in 2016, based on (CE Delft, INFRAS, TRT, & Ricardo, 2019; CE Delft, INFRAS, TRT, Ricardo, et al., 2019; CE Delft, TRT, et al., 2019).

Figure 17 is a breakdown of the total external- and infrastructure costs of aviation for the year 2016. About two third of these costs were climate costs, with tank-to-wing and non-CO_2 climate costs having an equal share of 23% each and another 19% of the costs related to well-to-tank emissions.[12] Infrastructure is responsible for 31% and the other costs represent relatively small shares of the total.

The same study investigated the total amount of taxes and charges levied to offset external- and infrastructure costs. In 2016, on average 32% of external- and infrastructure costs were internalised by taxes and charges, which means that 68% of the costs were not paid for by the polluter (CE Delft, INFRAS, TRT, Ricardo, et al., 2019).

Figure 17 – Breakdown of external- and infrastructure costs of aviation for the year 2016



Source: (CE Delft, INFRAS, TRT, & Ricardo, 2019; CE Delft, INFRAS, TRT, Ricardo, et al., 2019; CE Delft, TRT, et al., 2019).

[12] Well-to-tank emissions also includes some air pollution costs. However, the majority of these costs are climate costs.

4.2 What determines the rate of internalisation?

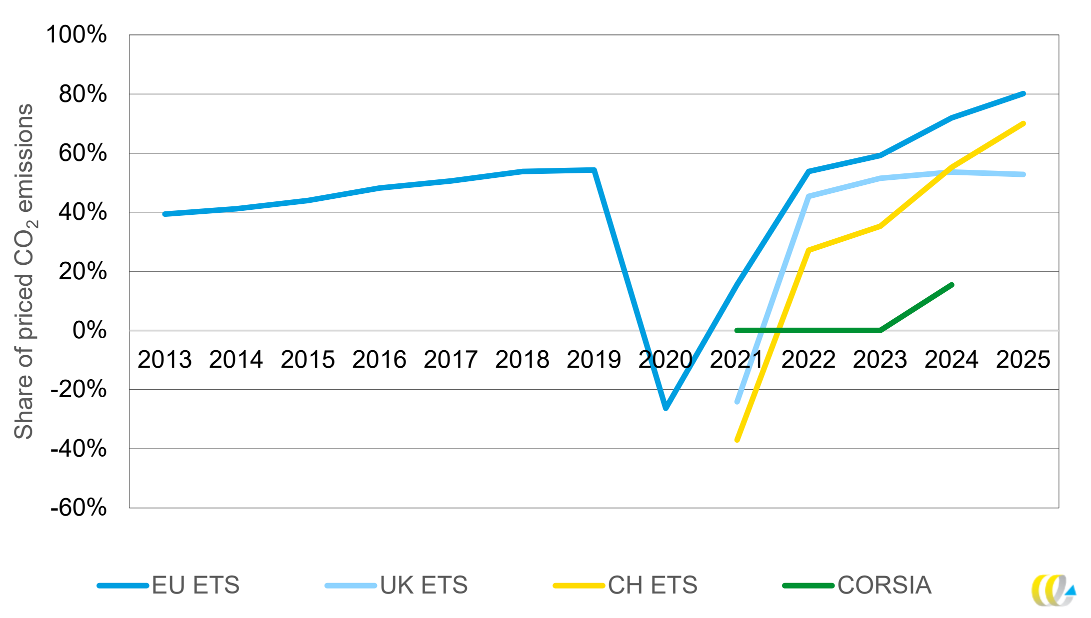
In this section, we analyse the rate of internalisation of external costs by emission trading systems (EU ETS, UK ETS, CH ETS and CORSIA). There are four possible reasons that can explain differences between the external costs and the pricing by these systems:

- free allocation of allowances;
- difference between the price paid per tonne CO_2 and the external costs;
- incomplete pricing of climate effects;
- incomplete geographic scope coverage.

As we will see later in this section, all four mechanisms play a role. We here briefly consider each of these options.

Free allocation in the EU ETS was analysed in detail in Section 2.1. In the UK ETS and CH ETS, there has also been free allocation of allowances (as detailed in Annex D.2). CORSIA is a different system in which there are no free allowances.
However, a significant share of CO_2 emissions remain unpriced due to the system design which only requires offsetting for emissions above the baseline, which is set at 85% of the 2019 CO_2 emissions. The percentage of emissions that need to be offset is determined using a *sector growth factor*, which expresses the growth of CO_2 emissions covered by the CORSIA system compared to the baseline. CORSIA exists since 2021 but had a zero sector-growth factor in each year of the pilot phase (2021-2023). The required amount of offsetting for the first phase of CORSIA (2024-2026) is only determined after the whole period has ended. 2024 was the first year for which a non-zero sector growth factor of 15.4% was reported (ICAO, 2025a). The sector growth rate for 2025 is not available yet, but similar or higher sector growth factors for the year 2025 and 2026 compared to 2024 can be expected.

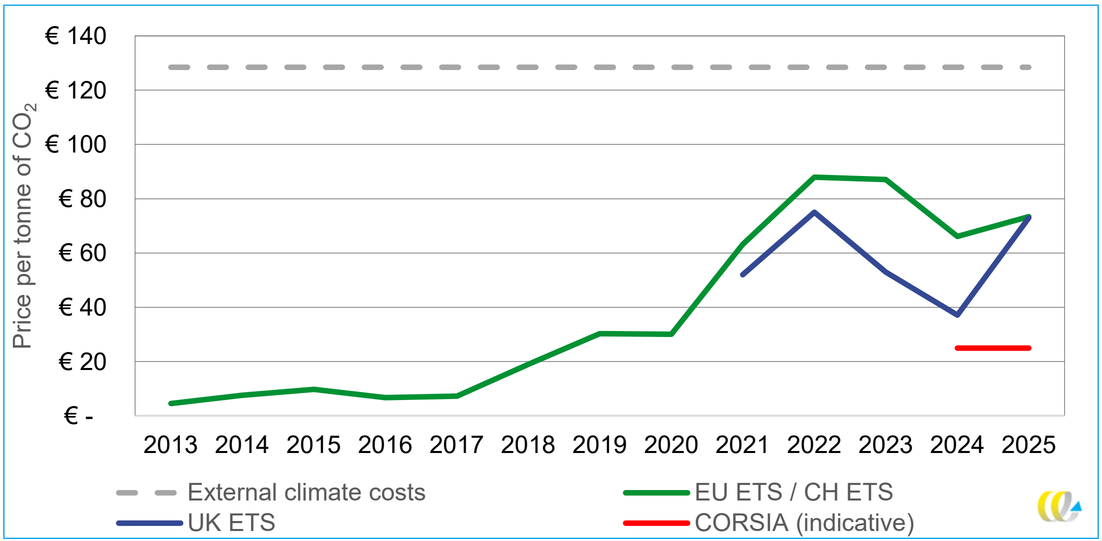
Figure 18 – Share of CO_2 emissions priced by EU ETS, CH ETS, UK ETS and CORSIA



Sources: ICAO (2025a), EEA (2025a), UK Emissions Trading Registry (2026).

Price fluctuations in the emission trading systems are another possible explanation for variations in the internalisation of external costs. The EU ETS price (which is equal to the CH ETS price) and UK ETS price have fluctuated over time. Unlike the EU ETS, which has one price at a given moment, the costs of offsetting or use of SAF differ per airline. During the first phase of CORSIA, the prices of CORSIA eligible emission units were estimated at 10-40 USD per tonne CO_2 (ICAO, 2025c). Based on this range, we used an estimate of € 25 tonne in 2025 price level to calculate the costs of CORSIA compliance.

Figure 19 – Comparison of the CO_2 prices of the EU ETS, UK ETS, CH ETS and CORSIA to the external climate costs of CO_2 (all prices in 2025 level)



The third possible reason that explains differences in the internalisation of external climate costs is incomplete coverage of climate effects. Non-CO_2 emissions are the most significant climate effects that are not included in any of the emission trading systems. Measured in GWP100, these correspond to 70% of the climate costs of CO_2, whereas measured in GWP20 they correspond to 300% of the climate costs of CO_2.

The last reason for differences between the external climate costs and the internalisation of climate costs is incomplete geographic coverage. The geographic coverage of the four emission trading systems is complex with many details, which we have not exhaustively summarised in this text. The most important aspects of the scope coverage are:

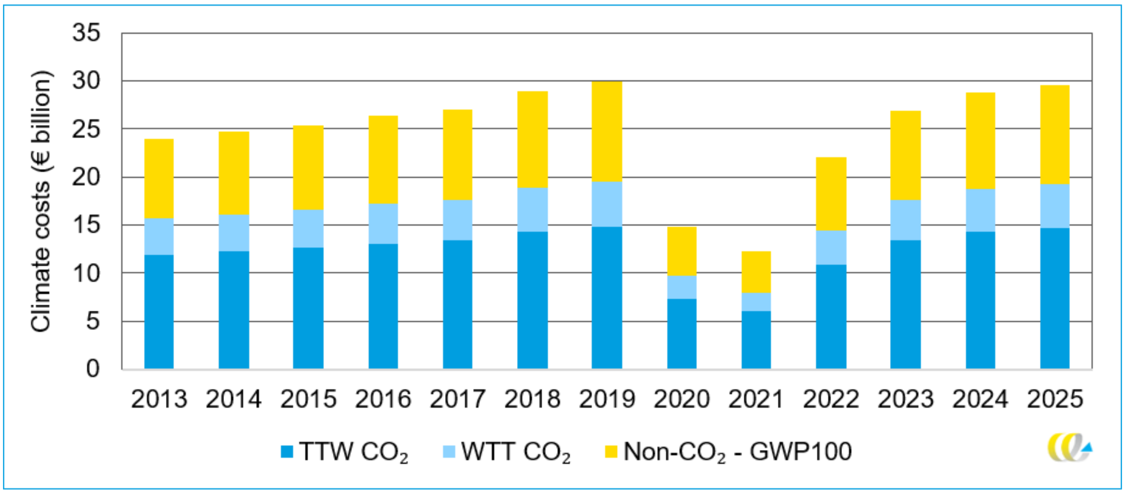
- **EU ETS** is temporarily limited to a reduced scope which encompasses aviation within the European Economic Area (EEA), plus flights departing the EEA to Switzerland and (since Brexit) the UK. The original EU ETS scope also included intercontinental flights to and from European airports. Due to geopolitical pressure, the scope has temporarily been reduced by the stop the clock derogation. As part of the 2026 EU ETS review, a scope extension to intercontinental flights may be proposed by the European commission.
- **UK ETS** covers UK domestic flights, flights between the UK and Gibraltar, and flights departing the UK to the EEA and Switzerland.
- **CH ETS** overs domestic Swiss flights and flights from Switzerland to the EEA and the UK. Flights in the opposite direction are generally covered by the EU ETS or UK ETS.
- **CORSIA** applies globally on a route-pair basis to international flights between participating ICAO States; routes are covered when both the departure and destination States participate. As of 2026, 130 ICAO Member States participate in CORSIA for the purposes of determining covered “State pairs” for offsetting. ICAO has 193 Member States, so this means 63 ICAO Member States are not participating in the 2026 voluntary phase (ICAO, 2025b). Some large aviation markets that have not formally chosen to participate by 2026 are China, India, Brazil, the Russian Federation, South Africa, Argentina, Chile, Colombia, Egypt and Pakistan. In our analysis we make the simplifying assumption that all emissions not covered by the EU ETS, UK ETS or CH ETS are covered by CORSIA. This is a slight overestimation of the actual carbon pricing by CORSIA.

4.3 External climate costs of six airline groups

4.3.1 Total external climate costs

In 2025, the external costs due to climate change from kerosene combustion by the six airline groups amounted to almost € 30 billion. Broken down by component, the external costs of tank-to-wing CO_2 emissions were € 14.7 billion, the well-to-tank CO_2 emissions were € 4.6 billion, and, measured in GWP_{100}, the non-CO_2 climate costs were € 10.3 billion.[13] This has been relatively constant since 2012, with all external costs in the range of € 20 and 30 billion per year, except for the COVID-19 years 2020 and 2021, when aviation volumes were significantly lower due to a large drop in demand as a result of the travel restrictions. These external costs reflect both the emissions covered by the EU ETS and emissions not covered by the EU ETS (intercontinental flights, non-CO_2, well-to-tank[14]).

Figure 20 – Total climate costs of the six airline groups taken together



Source: CE Delft based on airline group annual reports, external costs calculated as described in Section 4.1.2.

4.3.2 Internalisation of external climate costs

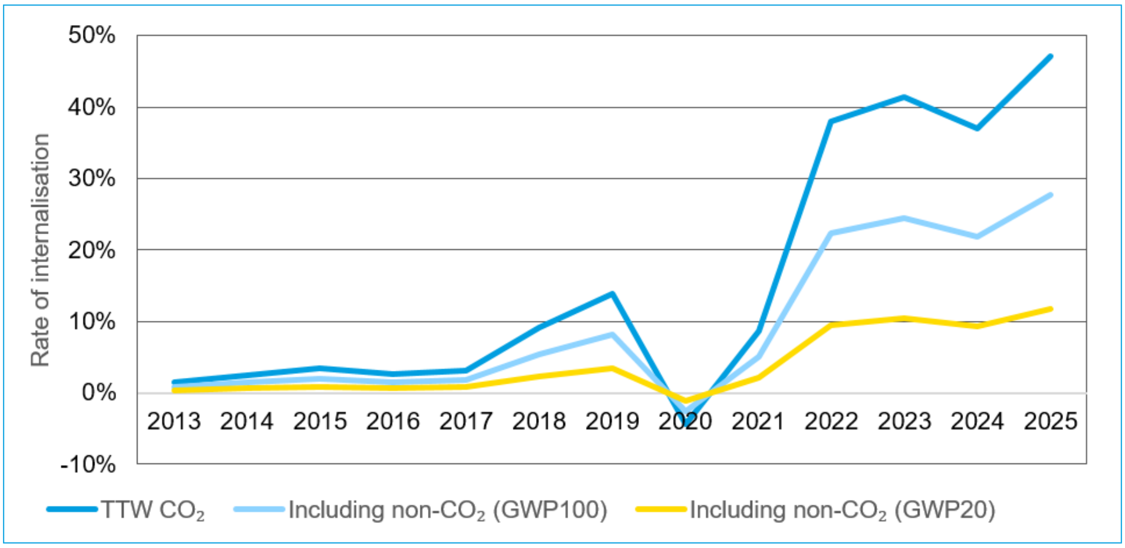
In this section, we analyse the extent to which the external climate costs have been internalised by EU ETS for flights covered by the EU ETS (mainly intra-EEA flights). Well-to-tank emissions are not included in this analysis, since they are (partly, depending on whether the location of fuel the fuel production is in the EEA) covered by the EU ETS for the energy sector. This analysis also does not include other taxes or charges that can be related to the internalisation of external climate costs, such as aviation taxes at the

[13] Measured in GWP_{20}, the non-CO_2 climate costs would be € 43 billion.
[14] Well to tank CO_2 emissions are included in the EU ETS if the emissions are in the EEA. However, these are not assigned to aviation but to industry. Since we here analyse the impact of EU ETS in the aviation sector, this is not analysed in detail.

Member State level (Text box 4 in the preceding section does give a complete overview of the internalisation of external costs in the year 2016).

Figure 21 summarises the internalisation of the climate costs of climate effects within the reduced EU ETS scope by EU ETS costs. Until 2017, the rate of internalisation was close to 0%. This was a result of the large share of free allocation (see Figure 18) and the relatively low EU ETS prices (see Figure 19). In the years 2017-2019, the rate of internalisation of tank-to-wing CO_2 emissions gradually went up to about 14% due to higher CO_2 prices. Including non-CO_2 climate effects, the rate of internalisation was 3-8% in 2019. During the COVID-19 years, the rate of internalisation became very low again and even negative in 2020, as airlines received more free allowances than their verified emissions in that year. Since 2022, the rate of internalisation has been around 40% for tank-to-wing CO_2 emissions and 9-28% including non-CO_2 climate impacts, with relatively stable high CO_2 prices and decreasing free allocation. Without free allocation, the rate of internalisation of climate costs of climate effects within the reduced EU ETS scope by EU ETS costs are purely determined by the ratio between the external costs of CO_2 and the EU ETS price.

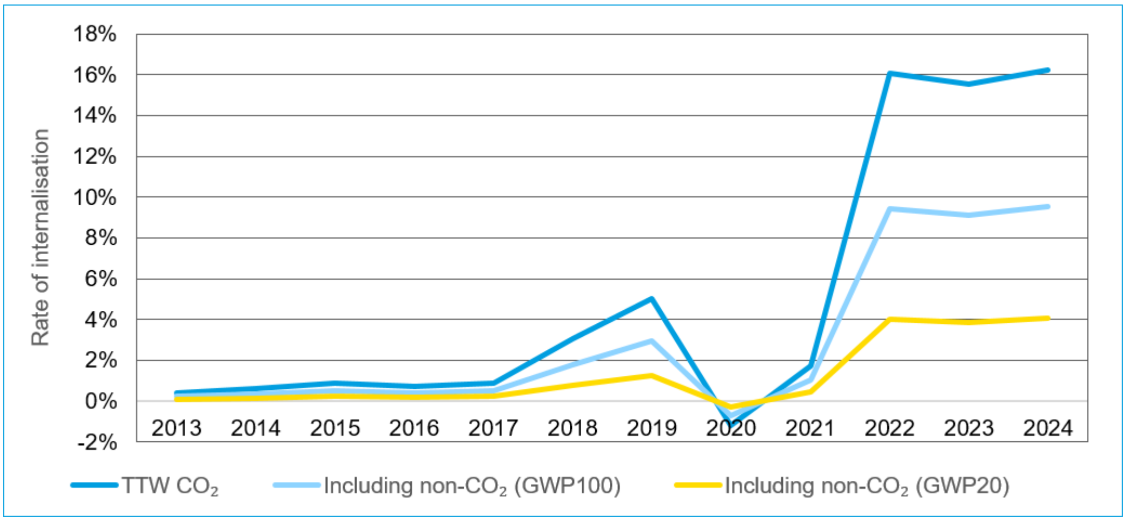
Figure 21 – Internalisation of tank-to-wing CO_2 costs covered by EU ETS



Source: CE Delft based on information presented earlier in this study.

Figure 22 shows the rate of internalisation of tank-to-wing climate costs due to the EU ETS and CORSIA, CH ETS and UK ETS for the entire operation of the airlines (including intercontinental flights). Because the flights covered by the EU ETS scope only amount to about 32% of the climate impact of these airlines, the results are strongly influenced by the intercontinental flights. These have been largely unpriced, since CORSIA has only had a non-zero sector growth factor in the year 2024: the rate of internalisation for intercontinental flights was about 5% in 2024 if only considering tank-to-wing CO_2 emissions. The total rate of internalisation for the six airline groups was 16% when considering only CO_2 emissions and 4-10% when also considering non-CO_2.

Figure 22 – Internalisation of climate costs related to TTW CO2 emissions by EU ETS and CORSIA, CH ETS and UK ETS



Source: CE Delft based on information presented earlier in this study.

4.4 The impact of free allocation on the internalisation of external costs

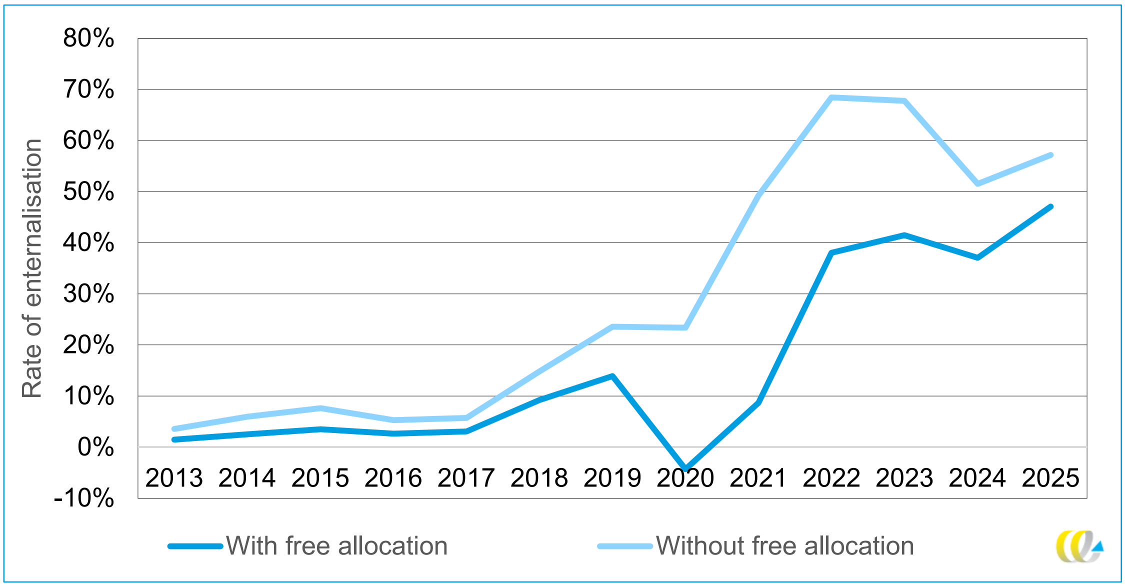
4.4.1 Impact on the internalisation of climate costs

Had there been no free allocation, airlines would have had more EU ETS costs. This would have resulted in a higher rate of internalisation. We concluded in Section 2.3 that the absence of free allocation would not have significantly impacted ticket prices and demand and therefore would not have significantly impacted the climate impact of the aviation sector. Therefore, the external costs would have been unchanged in this scenario.

Figure 23 shows how the rate of internalisation would have changed without free allocation. In all years, the rate of allocation would have been higher. In early years (roughly until 2020), the rate of internalisation remains relatively low, due to the low EU ETS price in those years. In 2022-2025, the rate of internalisation becomes 50-70%.

Without free allocation, the only factor determining the rate of internalisation therefore is the difference between the EU ETS price and the external costs of a tonne CO_2 (see Figure 19).

Figure 23 – Internalisation of tank-to-wing CO_2 costs covered by EU ETS



Source: CE Delft based on information presented earlier in this study.

5 Conclusions and recommendations

Conclusions

This study assessed who benefited from free allocation in aviation under the EU ETS. It analysed the value of free allocation, its impact on airline profitability and ticket prices, the extent to which airlines and governments invest in sustainability, and the degree to which aviation's external climate costs are internalised.

The overall conclusion is that free allocation generated a substantial financial benefit for airlines, while reducing public revenues that could otherwise have supported climate investment.

Free allocation created a substantial financial benefit for airlines. Between 2013 and 2025, airlines have received around 350 million EU ETS allowances for free. These allowances had a market value of approximately € 10.9 billion in 2025 prices. This amount represents avoided EU ETS costs for airlines and, from a public finance perspective, foregone auction revenue. The value of free allocation was not evenly distributed over time. In the early years of aviation's inclusion in the EU ETS, allowance prices were low and the financial value of free allocation was therefore limited. As allowance prices increased, the value of free allocation rose substantially. The benefit was therefore particularly relevant in the years in which EU ETS prices were high and free allocation had not yet been fully phased out.

Free allocation should not be interpreted as a mechanism that structurally lowered ticket prices for passengers. EU ETS allowances have an opportunity cost: even if airlines receive allowances for free, they can sell them at the market price. Therefore, the relevant cost for price-setting is the market value of the allowance, not the price paid by the airline. This implies that airlines can be expected to pass through carbon costs regardless of whether allowances are auctioned or allocated for free. In that case, free allocation increases airline profits rather than reducing ticket prices.

European airline profitability has recovered to levels broadly comparable to the pre-COVID-19 period, even as free allocation declined sharply. Without free allocation, airlines would have been less profitable. However, free allocation accounted for about 17% of profitability for the five major European airline groups that were profitable in the period 2013-2025. For Air France-KLM, free allocation dampened the losses in this period by 10%. Despite the phase-out of free allocation in recent years, gross profitability of airlines is comparable to pre-COVID-19 levels. From this it is plausible that the aviation sector would have therefore been able to financially absorb the costs of full auctioning instead of free allocation.

Airline sustainability expenditures are modest compared to the benefits from free allocation. We found that disclosed sustainable capital investments by the six airline groups amounted to around € 80 million over the period analysed. We estimate that SAF purchasing costs are estimated at around € 1 billion, concentrated mainly in recent years. These amounts are meaningful but remain small compared with the € 10.9 billion value of free allocation or their profitability. Furthermore, it stands out that the one airline group that has not been profitable in this period is the one that has relatively many disclosed sustainable expenditures. The evidence therefore does not suggest that airlines their profitability or the avoided costs due to free allocation to generate a comparable increase in sustainable investment.

The share of taxonomy-aligned expenditures by airlines is heavily influenced by fleet renewal, which allows business-as-usual investments in conventional fossil-fuel powered aircraft to be labelled as taxonomy-aligned. It predominantly consists of investments in new conventional fossil-fuel powered aircraft and maintenance activities. These aircraft are more fuel-efficient than older aircraft, but they will continue to operate predominantly on fossil kerosene for decades. In 2025, only € 24 million of reported airline capital expenditure for electric ground handling equipment was classified as sustainable under the EU Taxonomy, equivalent to around 0.13% of total reported capital expenditure. This raises a broader concern about the application of the EU Taxonomy to aviation.
In aviation, the taxonomy appears to classify a large share of routine fleet renewal as aligned. Yet fleet renewal is a normal part of airline business models and would likely have continued without the taxonomy. In this respect, the taxonomy risks functioning less as a tool to redirect capital toward genuinely sustainable activities and more as a certification system for business-as-usual investment.

Free allocation reduced public climate investment potential. The € 10.9 billion benefit to airlines can be understood as foregone auction revenue for governments and EU funds. EU ETS auction revenues are intended to support climate and energy transition objectives. Most revenues are allocated to Member States, while a growing share is allocated to dedicated EU funds such as the Innovation Fund, the Modernisation Fund and the Social Climate Fund. Member States are required to use ETS revenues for climate-related purposes, although the traceability and additionality of this spending remain insufficiently transparent. EU-level funds provide a clearer link between auction revenues and decarbonisation investment.

If the foregone auction revenues from aviation free allocation had been used to support SAF deployment, they could hypothetically have delivered around 18 $MtCO_2$ of reductions using HEFA-based SAF or around 4.7 $MtCO_2$ using synthetic fuels, with additional innovation and scale-up benefits. If allocated to the Innovation Fund, the same revenues could have delivered up to 815 $MtCO_2$ of emissions reductions across sectors based on the Fund's minimum cost-effectiveness threshold. These scenarios are illustrative and subject to uncertainty, amongst others concerning SAF availability and prices, but they show that free allocation reduced the resources available for public climate investment.

Free allocation has contributed to a low rate of internalisation of external climate costs in the aviation sector. Aviation causes substantial external climate costs. For the six airline groups analysed, these costs amounted to almost € 30 billion in 2025. These costs include tank-to-wing CO_2 emissions, well-to-tank emissions from fuel production and non-CO_2 climate effects. In the early years of the EU ETS for aviation, the rate of internalisation was very low because allowance prices were low and a large share of allowances was allocated for free. Since 2022, the internalisation rate has increased to approximately 40% when considering CO_2 emissions within the EU ETS scope. When also considering intercontinental aviation, the total rate of internalisation of CO_2-related costs was only 16% in 2025. These rates of internalisation become substantially lower when non-CO_2 climate effects are included, since this is a large share of the total climate impact that is entirely unpriced. Without free allocation, the internalisation rate would have been higher in every year. In the period 2022-2025, it would have reached around 50-70% for tank-to-wing CO_2 emissions within the EU ETS scope.

Recommendations

Drawing from the results of the analyses conducted in this study, we formulated the following recommendations:

- The phase-out of free allocation can be absorbed by the aviation sector and is expected to have positive effects on the amount of public funding available to support decarbonisation. At the same time, the impact on airlines' investment capacity is likely to be limited. Phasing out free allocation therefore supports the effective decarbonisation of the EU economy and strengthens the application of the polluter pays principle.
- The phase-out of free allocation will increase EU ETS revenues. These revenues should be fully directed towards the decarbonisation of the EU economy and should primarily be used to support technologies that are not yet developing at sufficient scale under current market conditions. In the aviation sector, this particularly concerns the production of e-SAF and the development of hydrogen and electric aviation. These technologies have the potential to contribute to genuinely CO_2-neutral aviation in the longer term.
- At present, the EU Taxonomy for aviation includes several elements that make it difficult to use as a robust benchmark for sustainable investment in the aviation sector. We recommend reviewing the classification of transitional activities on a two points:
    - First, a large share of fleet renewal can be classified as a transitional activity. As a result, business-as-usual investments in conventional fossil-fuel powered aircraft can be labelled as taxonomy-aligned, which is arguably not in line with the 'do no significant harm' principle and the precautionary principle.
      The most straightforward solution would be to remove investments in conventional fossil-fuel powered aircraft from the Taxonomy as a transitional activity altogether.
    - Second, there are problems with the way operational expenditure is treated within the taxonomy framework.
- The appropriation of operational expenses through an administrative allocation of SAF use by airlines across a section of their fleet distorts the analysis of sustainable operational expenses. In practice, airlines have limited influence over the specific flights or aircraft on which SAF is physically used. It would therefore appear more appropriate to distribute SAF use evenly across the fleet.
  More fundamentally, it is questionable whether this is the right way to classify operational expenditure as transitional. SAF blending is only indirectly related to the aircraft operating costs currently included in the taxonomy framework.

- SAF purchases themselves are not included in the taxonomy. This is likely the largest operational expenditure category for airlines that could reasonably be considered sustainable. Consideration could therefore be given to including e-SAF purchases in the taxonomy, provided that only the additional cost of e-SAF compared with fossil kerosene is counted. The use of scalable SAF pathways that currently struggle to reach commercial deployment, such as e-SAF and alcohol-to-jet fuels, should ideally be incentivised more strongly than the use of HEFA-based bio-SAF.
- Finally, EU ETS revenues flowing back to national governments must, since recent reforms, be spent fully on climate and energy-related purposes. In practice, however, there remains considerable uncertainty and limited transparency regarding whether this requirement is being met. Strengthening the rules and reporting requirements in this area could help ensure that EU ETS revenues are fully used to support the decarbonisation of Europe.

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A Analysis of individual airline groups

This annex summarises the data that was gathered, or sometimes estimated, for six airline groups.

A.1 CO_2 emissions and free allocation

Here we summarise the data gathered related to CO_2 emissions and free allocation (Table 6 to Table 9).

Table 5 – Total CO_2 emissions per airline group per year (megatonnes)

Airline group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
IAG	23.7	25.2	26.4	28.3	28.8	30.0	30.7	11.0	10.9	21.1	25.7	27.2	27.5
Lufthansa	27.6	27.8	28.6	29.3	28.9	32.8	33.3	11.5	13.8	23.2	26.8	29.2	29.6
Air France-KLM	27.7	27.7	27.6	27.4	27.6	27.6	28.3	14.0	16.3	22.6	25.0	25.7	26.1
Easyjet	5.5	5.9	6.1	6.5	7.1	7.6	8.3	4.2	2.1	6.4	7.5	8.1	8.7
Wizzair	1.1*	1.3*	1.5*	1.9*	2.2*	2.6*	3.3	3.8	1.3	2.6	4.8	5.8	5.8
Ryanair	7.3*	7.6*	7.9*	8.7*	9.9	11.0	11.8	12.7	2.9	9.2	14.3	15.4	16.5
Total	**93**	**95**	**98**	**102**	**104**	**112**	**116**	**57**	**47**	**85**	**104**	**111**	**114**

Sources: Annual reports of the airline groups.

* For these years, the airline did not report total CO_2 emissions. We have estimated the CO_2 emissions based on statistics that were reported.

Table 6 – Verified emissions per airline group under EU ETS (megatonnes CO_2)

Airline group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
IAG	5.7	6.0	6.4	6.8	6.9	7.3	7.3	2.2	2.1	4.4	5.1	5.4	5.3
Lufthansa	5.9	5.4	5.4	5.8	6.9	8.5	8.5	2.6	3.4	6.9	8.0	8.8	8.8
Air France-KLM	4.8	4.8	4.9	5.1	5.4	5.4	5.7	2.6	3.3	4.9	5.2	5.6	5.6*
Easyjet	0.2	0.2	0.2	0.2	0.2	3.4	6.6	1.9	1.5	3.2	3.5	4.0	4.2
Wizzair	1.1	1.3	1.5	1.8	2.1	2.3	2.6	1.4	1.3	2.4	2.8	3.1	3.3
Ryanair	6.6	6.6	7.4	8.4	9.3	10.2	11.0	4.3	5.0	9.5	10.5	12.4	12.5
Total	**24.3**	**24.3**	**25.9**	**28.3**	**30.8**	**37.3**	**41.7**	**14.9**	**16.5**	**31.4**	**35.0**	**39.3**	**36.8**

* Air France and Transavia France have not reported their verified EU ETS and CH ETS emissions in 2025 as of June 2026. Therefore, we have estimated these by multiplying the verified emissions in 2024 by the ratio of the worldwide emissions by Air France-KLM group in 2025 compared to 2024.

Table 7 – Free allocation per airline group (megatonnes CO_2)

Airline group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
IAG	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.4	2.3	2.3	2.2	1.6	1.0
Lufthansa	2.8	2.8	2.8	2.8	2.8	2.8	2.8	3.2	2.7	3.2	3.1	2.5	1.6
Air France-KLM	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.8	2.6	2.6	2.5	1.6	1.0
Easyjet	0.1	0.1	0.1	0.1	0.1	0.1	3.0	3.1	1.8	1.8	1.7	1.1	0.7
Wizzair	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.9	0.6
Ryanair	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	3.6	3.5	3.4	3.4	2.1
Total	**14.1**	**14.1**	**14.1**	**14.1**	**14.1**	**14.1**	**17.1**	**17.7**	**13.6**	**13.9**	**13.6**	**11.0**	**7.0**

Table 8 – Share of verified emissions that has been freely allocated per airline group

Airline group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
IAG	58%	55%	51%	48%	48%	45%	45%	152%	112%	52%	44%	29%	19%
Lufthansa	48%	52%	53%	49%	41%	33%	33%	121%	79%	46%	39%	28%	18%
Air France-KLM	53%	54%	53%	51%	48%	47%	45%	108%	80%	53%	49%	28%	18%
Easyjet	50%	42%	40%	40%	42%	2%	46%	162%	122%	55%	50%	28%	17%
Wizzair	67%	58%	47%	40%	35%	31%	28%	54%	47%	25%	21%	28%	17%
Ryanair	70%	69%	62%	55%	50%	45%	42%	108%	71%	37%	32%	27%	17%
Total	**58%**	**58%**	**55%**	**50%**	**46%**	**38%**	**41%**	**119%**	**82%**	**44%**	**39%**	**28%**	**18%**

Content

Table 9 – Share of total CO_2 emissions covered by the EU ETS

Airline group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
IAG	24%	24%	24%	24%	24%	24%	24%	20%	19%	21%	20%	20%	19%
Lufthansa	21%	20%	19%	20%	24%	26%	26%	23%	24%	30%	30%	30%	30%
Air France-KLM	17%	17%	18%	19%	20%	20%	20%	18%	20%	22%	21%	22%	21%
Easyjet	3%	3%	4%	3%	3%	45%	79%	45%	70%	50%	46%	49%	48%
Wizzair	101%	96%	101%	97%	97%	90%	80%	36%	98%	90%	59%	54%	57%
Ryanair	90%	87%	94%	97%	93%	93%	94%	34%	172%	103%	74%	80%	76%
Total	**26%**	**25%**	**26%**	**28%**	**29%**	**33%**	**36%**	**26%**	**35%**	**37%**	**34%**	**35%**	**32%**

A.2 External climate costs

We here list the climate costs related to CO_2 emissions per airline group for all flights in their operation (Table 10) and within the EU ETS-scope (Table 11). We did not include separate tables including well-to-tank and non-CO_2 effects, as these can be calculated with the factors compared to the CO_2 emissions as presented in Section 4.1.2.

Table 10 – Total external climate costs due to tank-to-wing CO_2 emissions per airline group (million euros 2025)

Airline group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
IAG	3,040	3,240	3,391	3,630	3,694	3,852	3,949	1,416	1,403	2,714	3,298	3,494	3,532
Lufthansa	3,546	3,571	3,674	3,757	3,719	4,212	4,284	1,478	1,776	2,976	3,445	3,746	3,797
Air France-KLM	3,558	3,558	3,551	3,520	3,541	3,550	3,634	1,804	2,098	2,906	3,207	3,300	3,356
Easyjet	706	758	784	835	912	976	1,069	546	272	825	966	1,042	1,118
Wizzair	138	168	197	242	277	335	425	486	167	340	618	741	749
Ryanair	942	977	1,012	1,115	1,272	1,413	1,516	1,631	373	1,181	1,833	1,975	2,124
Total	**11,931**	**12,271**	**12,609**	**13,099**	**13,415**	**14,338**	**14,876**	**7,361**	**6,088**	**10,942**	**13,366**	**14,298**	**14,676**

Table 11 – Climate costs due to CO_2 emissions per airline group per year covered by the EU ETS (million euros 2025)

Airline group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
IAG	729	770	827	878	888	934	934	283	269	570	654	694	675
Lufthansa	753	698	694	750	891	1,095	1,095	336	433	891	1,024	1,131	1,128
Air France-KLM	622	615	627	655	691	700	732	332	425	632	663	719	711
Easyjet	22	26	28	27	26	443	845	244	189	411	444	511	537
Wizzair	140	161	199	235	268	302	339	175	165	305	362	402	425
Ryanair	850	854	951	1,085	1,189	1,316	1,418	549	642	1,218	1,353	1,587	1,604
Total	**3,116**	**3,123**	**3,325**	**3,631**	**3,952**	**4,789**	**5,362**	**1,919**	**2,122**	**4,028**	**4,500**	**5,044**	**4,723**

A.3 EU Taxonomy

Table 12 and Table 13 summarise the reported capital expenditures per airline group under the EU Taxonomy.

Table 12 –Breakdown of 2025 reported capital expenditure by airline group

Airline group	Total capital expenditures	Is the reported capex eligible?		Is the reported capex aligned?			Is the aligned capex sustainable or transitional?	
		Eligible	Non-Eligible	Not reviewed	Not aligned	Aligned	Transitional	Sustainable
Air France-KLM	6,007	5,520	487	0	1,945	3,575	3,551	24
Lufthansa	5,453	5,126	327	0	1,366	3,760	3,760	0
IAG	3,599	2,603	996	0	445	2,158	2,158	0
Norwegian Air Shuttle	1,268	1,144	124	1,144	0	0	0	0
Ryanair	1,251	1,175	76	1,175	0	0	0	0
Aegean Airlines	347	259	88	0	259	0	0	0
Icelandair	99	99	0	0	99	0	0	0
Croatia Airlines	89	89	0	0	12	77	77	0
Total	**18,113**	**16,015**	**2,098**	**2,319**	**4,126**	**9,570**	**9,546**	**24**

Table 13 –Breakdown of 2025 reported operational expenditure by airline group

Airline group	Total operational expenditures	Is the reported opex eligible?		Is the reported opex aligned?			Is the aligned that is sustainable or transitional?	
		Eligible	Non-Eligible	Not reviewed	Not aligned	Aligned	Transitional	Sustainable
Air France-KLM	4,259	3,701	558	0	2,643	1,058	1,058	0
Lufthansa	3,885	3,846	39	0	2,561	1,285	1,285	0
IAG	2,850	2,758	92	0	884	1,874	1,874	0
Norwegian Air Shuttle	648	642	6	642	0	0	0	0
Ryanair	476	476	0	476	0	0	0	0
Aegean Airlines	451	439	12	0	439	0	0	0
Icelandair	1,346	1,346	0	0	1,346	0	0	0
Croatia Airlines	54	54	0	0	20	34	34	0
Total	**13,969**	**13,263**	**707**	**1,118**	**7,894**	**4,251**	**4,251**	**0**

B The EU Taxonomy for air transport

This annex contains a detailed description of the airline specific activities that fall under the taxonomy, as well as the main points of critique. Relevant legislation is the EU Taxonomy regulation 2020/852 of 18 june 2020[15] describing the overall framework, within which the European Commission has the delegated power to set criteria to include activities. Three airline specific activities have come into effect from 2024 onwards, through the Delegated Regulation (EU) 2023/2485 (EU, 2023).

B.1 Activity 6.19: Passenger and Freight Air Transport

For airlines, the majority of capital expenditure eligible under the taxonomy falls under activity 6.19, which covers investment in newly acquired aircraft, whether purchased or leased. The regulation distinguishes between three activities, of which two are investments, in brief:

- 1: Investment in aircraft with zero direct (tailpipe) CO_2 emissions, such as hydrogen or electric aircraft, is classified as a sustainable investment.
- 2: Investment in conventional fossil-fuel powered aircraft until 2030 can be classified as a transitional investment if they exceed ICAO's New Type fuel efficiency standards by between at least 1.5% (for long-haul) or 11% (for short-haul), and the aircraft replaces another aircraft in the fleet.
- 3: Operations of any fossil-fuel powered aircraft that run on 11% SAF in 2025 (increasing the threshold 2% by each subsequent year) can be classified as a transitional activity.

[15] Regulation (EU) 2020/852

- Furthermore, going forward, the criteria include the provision that from 2028 onwards only fossil-fuel powered aircraft that are fully certified to run on SAF. More changes could be expected as article 19 of the Taxonomy regulation specifies that technical screening criteria for transitional activities must be reviewed at least every three years and, where appropriate, be amended in line with scientific and technological developments.
- Two points are worth noticing on the investment and operations of fossil-fuel powered aircraft.
- First, the investments in conventional fossil-fuel powered aircraft are limited to aircraft exceeding ICAO's New Type fuel efficiency by a threshold (between 1.5% for long-haul to 11% for short-haul aircraft). However, this threshold is already met by the large majority of new commercial aircraft currently in production. Transport & Environment (2023) found that approximately 90% of Airbus's existing order book satisfies this criterion, suggesting that for most airlines, meeting the fuel efficiency requirement does not necessitate a departure from standard fleet renewal decisions.
- Second, the investments in conventional fossil-fuel powered aircraft are limited by a replacement criterion. The application of these criteria involves significant complexity and, in some cases, contested interpretation. Lufthansa, for instance, noted in its annual report of 2024 that "*some interpretations of the requirements are disputed, which results in uncertainty when determining whether economic activities are taxonomy-aligned.*" Airlines must assess, on an aircraft-by-aircraft basis, whether a newly acquired aircraft constitutes a genuine replacement or a net addition to the fleet. Where a replaced aircraft is decommissioned, the investment can be fully counted as aligned. Where the replaced aircraft is sold to another operator and thus remains in service globally, the EU Commission has introduced a system-level replacement rate, published annually, reflecting the ratio of aircraft globally decommissioned relative to those newly commissioned averaged over the last ten years. For 2024, this rate stood at 0.461, meaning that for every two new aircraft entering the global fleet, approximately one is retired and one is added to the global fleet as growth. Consequently, where a sold aircraft remains in global service, an airline may count only approximately 46% of the corresponding investment as taxonomy-aligned, with the remainder treated as net fleet growth at the global level.

Furthermore, where the first two activities specifically steer capital flows to investments (CapEx) the third criteria is set to classify Airline's revenue and operational expenditures (OpEx). Three points must be made.

First, the criteria only applies to fossil-fuel powered aircraft complaining to a minimum usage of SAF (11% in 2025, increasing 2% per year afterwards). However, it is worth mentioning how the SAF compliance is to be calculated. The 11% threshold is not assessed at the level of the individual aircraft but across the operator's fleet as a whole. It states:

> *"The SAF use requirement referred to in points (d) and (e) is calculated with reference to the total aviation fuel used by the compliant aircraft and SAF used at the fleet level. Operators calculate compliance as the ratio of the quantity (expressed in tonnes) of SAF purchased at the fleet level divided by the total aviation fuel used by the compliant aircraft multiplied by 100."*
>
> *- Delegated Regulation (EU) 2023/2485*

This means an airline can attribute its entire SAF purchasing volume against a designated subset of its fleet, irrespective of whether those specific aircraft actually operated on SAF. Notably IAG states in their latest annual report the unclarity of this interpretation, "*the EU Taxonomy Regulation permits the allocation of SAF to non-compliant aircraft to make them compliant if a minimum of 11% of the fuel consumption is SAF. The EU Taxonomy Regulation does not provide any guidance as to how to undertake this allocation*" (International airlines group, 2026). The criterion therefore measures a financial and administrative ratio rather than the actual fuel composition of individual flights.

Secondly, a structural asymmetry exists in how operational costs are treated under the taxonomy. The criteria explicitly defines the 'operation of aircraft' as a taxonomy-eligible activity. However, supplementing regulation limits eligible operational expenditure to maintenance, repair, short-term leases and day-to-day servicing costs (ACER, 2022). This means that all revenue generated from operating a SAF powered aircraft counts as aligned turnover, while SAF purchases are excluded from aligned opex. IAG flags this asymmetry explicitly in its 2025 annual report, noting that the opex KPI definitions "*do not reflect the economic reality of operating a taxonomy-aligned asset"* and that SAF expenditure is excluded despite being a direct cost of operating the very aircraft the taxonomy designates as aligned.

Third, and lastly, the criteria do not meaningfully distinguish between alternative fuels, like other legislation. For example, the EU Refuel Aviation sub-mandate distinguishes between renewable fuels of biogenic sources (bio-SAF, HEFA based) and non-biogenic origin synthetic fuels (e-SAF and green hydrogen), since it acknowledges that e-SAF, even though it currently has relatively high costs, is essential for the long-term decarbonisation of air transport (EC, 2023). The Renewable Energy directive distinguishes between the environmental performance of different fuels with use of well-to-wing emission factors that represent the environmental performance of the specific fuel.

A more differentiated approach towards SAF could help steer the aviation sector to those SAF types (mainly e-SAF) with a strong climate performance and long term scale-up potential.

B.2 Activity 3.21: Maintenance of Aircraft

Activity 3.21 covers the maintenance, repair and overhaul (MRO) of aircraft with zero direct tailpipe emissions, or of aircraft meeting the ICAO New Type fuel efficiency standard. For the purposes of this report, which focuses on capital investment, only capital expenditure reported under this activity is considered, not (MRO) revenues or operational expenses.

Reported investment under this activity reveals a notable inconsistency in how airlines apply the criteria. Both Air France-KLM and Lufthansa operate large MRO divisions, yet their reported taxonomy-aligned capital expenditure under activity 3.21 differs sharply.

- Air France-KLM, with MRO revenues of € 5.5 billion in 2025, reports € 404 million in taxonomy-aligned capital expenditure and € 1.058 million in operation expenditures, reflecting its approach of capitalising maintenance work.
- Lufthansa, with MRO revenues of € 8.0 billion in 2025, reports only € 8 million in taxonomy-aligned capital expenditure and € 11 million in operational expenditures, limiting its scope to intangible assets, technical equipment, and other operating and office equipment.

The difference in reported figures therefore appears to reflect divergent accounting interpretations rather than differences in underlying investment activity, illustrating the degree to which taxonomy reporting in this activity remains inconsistent across the sector.

B.3 Activity 6.20: Ground handling equipment

Activity 6.20 covers investments in ground handling vehicles with zero direct tailpipe emissions, for example electric and hydrogen-powered vehicles.

By investment volume, this is the smallest of the three taxonomy activities relevant to airlines. Of the airline groups examined, Air France-KLM is the only group reporting capital expenditure under this activity, disclosing € 24 million in 2025. For the remaining airline groups, no aligned investments are reported under this activity.

C Spending of EU ETS revenues by governments

C.1 Introduction

ETS revenues are distributed both to Member States and EU funds. Member States are required to spend all revenues on climate action and related activities.
However, these revenues typically enter general government budgets as non-earmarked funds, making it difficult to demonstrate additionality (enabling extra investments that would otherwise not have taken place). In practice, governments may report that ETS revenues finance climate-related expenditures that would likely have been implemented regardless of the availability of ETS revenues. It is therefore also difficult to determine what portion of ETS-revenues is spent on the decarbonisation of aviation.

The spending of EU funds is more transparent. The Innovation Fund, in particular, has supported aviation-related projects, such as those focused on sustainable aviation fuels and hybrid electric aircraft. The Modernisation Fund has not yet approved aviation-related projects, though there are plans to use its funding for biofuel production, including SAF.

C.2 Distribution of ETS revenues

EU ETS directive (2023/959) describes how ETS revenues should be distributed.
The majority of revenues are distributed to Member States, another part is reserved for European funds. Since 2013, 78% of revenues are distributed to Member States (EC, 2026b). In recent years, the share of ETS revenues allocated to European funds has increased. One reason is the expansion of EU-level funding instruments financed through ETS revenues, such as the introduction of the Social Climate Fund.

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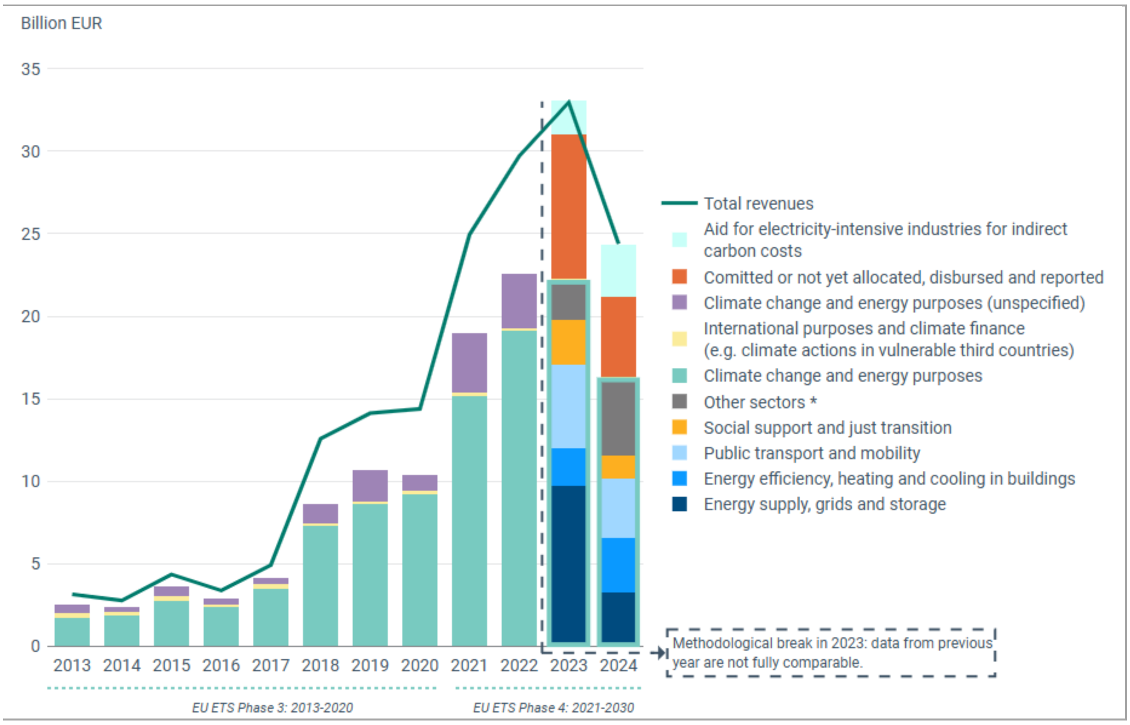
Another reason is that the intake of allowances by the Market Stability Reserve (MSR) in recent years, reduces the volume of allowances allocated to Member States, while the allocation of allowances to EU-level funds is fixed in absolute terms. ETS revenues allocated to European funds have increased from 24% in 2023 to 44% in 2025 (Dutch Emission Authority, 2024, 2026).

C.3 Spending by Member States

Member States are flexible in how they may spend the auction revenues, but spending has to be related to climate action, energy transformation and social purposes. Since June 2023 Member States have to spend 100% of the revenues for these purposes[16]; before June 2023 it was at least 50%. Member States have to report on their spendings and the European Commission monitors this. The budget does not need to be spent in full in the same year that the revenue is generated.

Figure 24 shows the Member States' spending in 2013-2024, based on EEA data. In total € 125 billion was allocated to fund climate and energy related actions, which equals 73% of total ETS-revenues allocated to Member States (€ 172 billion).

Figure 24 – Member State auctioning revenues and reporting usage, 2013-2024, EU-27, bio EUR



Source: (EEA, 2025b).

16 Revenues spend in aid for electricity-intensive industries for indirect carbon costs are excepted.

Although Member States are formally required to use ETS auction revenues for climate- and energy-related purposes, these revenues typically enter general government budgets as non-earmarked funds (Ministerie van EZK, 2023). This makes it difficult to demonstrate additionality. In practice, governments may report that ETS revenues finance climate-related expenditures that would likely have been implemented regardless of the availability of ETS revenues.

Text box 5

Addressing the problem of additionality under upcoming ETS Review

Article 10(3) of the EU ETS Directive requires Member States to use ETS auction revenues, or an equivalent financial value, for climate-, energy- and social-related purposes. However, because the provision allows revenues to flow into general government budgets rather than dedicated climate funds, concerns have emerged about the transparency and additionality of reported spending. Recent discussions around the upcoming EU ETS review, expected in 2026, increasingly focus on strengthening reporting requirements and improving traceability of ETS-funded expenditures. The European Commission is discussing relatively concrete measures such as more detailed reporting templates and clearer disclosure of which projects are financed through ETS revenues and whether these expenditures are additional to existing climate spending (EC, 2026b). In a joint letter coordinated by Carbon Market Watch, NGO's argue that Article 10(3) should be revised to include stricter earmarking requirements, explicit additionality criteria and stronger enforcement provisions (Carbon Market Watch, 2024).

C.4 Specific European Funds

In 2013-2025 more than 75% of ETS-revenues went to the national budgets.
The remaining revenues went to specific European Funds:

- **Innovation Fund:** supporting breakthrough low-carbon technologies in energy-intensive industries, renewable energy, and carbon capture.
- **Modernisation Fund:** supporting modernisation of energy systems and improve of energy efficiency in lower-income Member States.
- **Recovery and Resilience Fund Facility:** the RePowerEU part is financed by EU ETS to accelerate the green transition, reduce dependency on Russian oil and gas, and support investments in renewable energy, energy efficiency, and infrastructure.
- **Social Climate Fund:** fund to protect vulnerable households and small businesses from the social impacts of carbon pricing.

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All funds have a direct link with supporting decarbonisation and sustainability.
The innovation fund, and to a lesser extent the Modernisation Fund and Recovery and Resilience Fund Facility give room for investments in decarbonisation of the aviation sector.

C.4.1 Spending of funds allocated to Member States on decarbonisation of the aviation sector

Due to a general lack of earmarking it is unclear what amount of auction revenues for government budgets is spent on decarbonisation of the aviation sector. What we do know is that:

- In 2024, Member States allocated 22% of their ETS revenues to clean public transport and mobility (2023: 23%), which includes investments in rail transport, cycle paths, electric vehicle infrastructure, and other low-carbon mobility solutions such as aviation. Member States have the flexibility to spend their ETS revenues on any climate-related purpose, and there is no mandatory allocation for aviation. As a result, it is not specified what portion of revenues was specifically spent on aviation decarbonisation investments (EC, 2026a).
- In 2024, 20 million allowances (worth around € 1.5 billion) were reserved within the EU ETS to support the use of SAF. This reservation means that these allowances are not available for Member States' general budgets but are instead earmarked for SAF incentives. In 2025, € 100 million from this reserve was distributed among 53 aircraft operators from EU Member States and two from Norway.
  The remaining € 1.4 billion has not yet been fully allocated or spent, as the mechanism is still being implemented (EC, 2026a).

C.4.2 Spending of EU funds on decarbonisation of the aviation sector

The spending of EU funds is more transparent. The most important fund for the aviation sector is the Innovation Fund, which covers up to 60% of eligible project costs of innovative projects.

- Until 2025 the Innovation fund approved three aviation-related projects:
  - **HERMES:** a € 95 million grant to support the market introduction of a hybrid electric 19-seater Aircraft (France). The European Commission estimates that the commercialisation of this aircraft could deliver cumulative emissions avoidance of 10.1 Mt CO_2-eq. over a ten-year period. (EC, 2026c).

- **BioOstrand:** a € 167 million grant to support the first commercial scale deployment biorefinery producing sustainable aviation fuel (Sweden). According to the European Commission, the BioÖstrand project could achieve cumulative emissions avoidance of 8.7 Mt CO_2-eq. over its first ten years of operation. (EC, 2025a).
- **HySkies:** a € 80 million grant to support the built of a SAF and renewable diesel facility (Sweden). According to the European Commission, the HySkies project could deliver cumulative emission avoidance of 2.7 Mt CO_2-eq. over the first ten years. The project is paused because of unfavourable market conditions (EC, 2022; Vattenfall, 2024).

Between 2020 and 2025 the Innovation Fund raised € 13.4 billion (EC, 2025b). In total € 342 million of the innovation fund was approved to support the abovementioned three aviation-related project. This means roughly 3% of resources from the Innovation Fund have been used for aviation purposes.

Additional aviation investments financed through the Innovation Fund are to be expected. In 2025, the European Commission presented the Sustainable Transport Investment Plan (STIP) strategy. Part of this plan is to mobilise € 153 million for four synthetic aviation fuel projects and to open a call for a hydrogen bank with a budget of € 300 million for the production of SAF and SMF, both under the Innovation Fund (EC, 2025c).

The Modernisation Fund did not approve aviation related projects until now. Romania is planning on using € 500 million of funding from the Modernisation Fund for investments in biofuel production, including SAF(SAF Investor, 2026).

C.5 Phase IV EU ETS: free allowances available for SAF allowances

Between 2024 and 2030, up to 20 million EU ETS allowances (worth about € 1.5 billion at current EU ETS prices of about € 75 per tonne) are set aside to help compensate aircraft operators for the price difference between fossil kerosene and eligible aviation fuels, including SAF, used on flights covered by the EU ETS. The support comes on top of the existing EU ETS benefit that qualifying alternative fuels can be zero-rated, meaning operators do not need to surrender allowances for the use of SAF. The specific level of support is calculated as a percentage of the price difference with fossil kerosene after correcting for the zero-rating of SAF and possible differences in taxation between SAF and fossil (see Figure 25).

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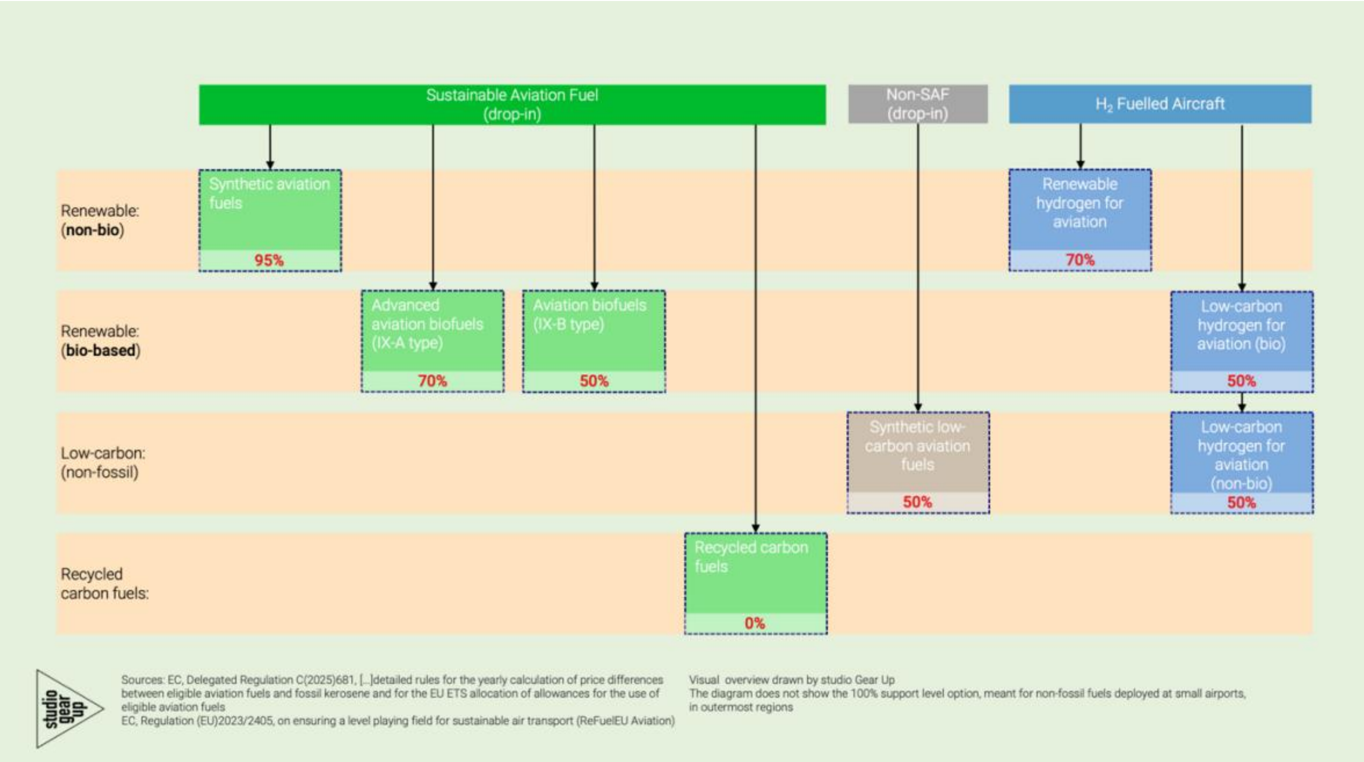
Figure 25 – Differentiation of SAF allowances per type of fuel



Source: (Studio Gear Up, 2025).

D Detailed analyses

D.1 Assumed price-gap between SAF and fossil kerosene

We estimated the price difference between fossil kerosene and SAF using the ReFuelEU Reference prices (EASA, 2025, 2026). For years before 2023, we used the 2023 estimate for the extra costs. The resulting cost difference estimates are summarised in Table 14.

Table 14 – Estimates of the additional costs of SAF per year

SAF type	Year	EU reference prices (€/tonne fuel)	Costs compared to fossil kerosene (€/tonne fuel)	Avoided EU ETS costs compared to using fossil kerosene (€/tonne fuel)	Marginal abatement costs (€/tonne fuel)
Fossil kerosene	2023	816	-	-	-
	2024	734	-	-	-
	2025	640	-	-	-
Aviation biofuels (HEFA)	2023	2,768	1,952	261	1,691
	2024	2,085	1,351	205	1,146
	2025	1,925	1,285	230	1,055
Advanced aviation biofuels	2023	2,675	1,859	261	1,598
	2024	2,715	1,981	205	1,776
	2025	2,760	2,120	230	1,890
Synthetic aviation fuels	2023	7,500-8,225	6,684-7,491	261	6,423-7,148
	2024	7,695-8,470	6,961-7,736	205	6,756-7,531
	2025	7,520-8,625	6,880-7,985	230	6,650-7,755

D.2 Verified emissions and free allocation in the UK ETS and CH ETS

We collected data about verified emissions and free allocation for the UK ETS and the CH ETS (EEA, 2025a; UK Emissions Trading Registry, 2026).

Table 15 – Compliance costs for CH ETS, UK ETS and CORSIA for the six airline groups (millions of euros, 2025 price level)

Scheme	Category	2020	2021	2022	2023	2024	2025
CH ETS	Verified emissions	0.3	0.3	0.5	0.7	0.7	0.7
	Free allocation	0.4	0.4	0.4	0.5	0.3	0.2
UK ETS	Verified emissions	-	3.5	7.8	8.8	9.0	8.6
	Free allocation	-	4.3	4.2	4.3	4.2	4.1