EU ETS Phase 4 Analysis

ICF Report for IenW

February 2024

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1. Introduction

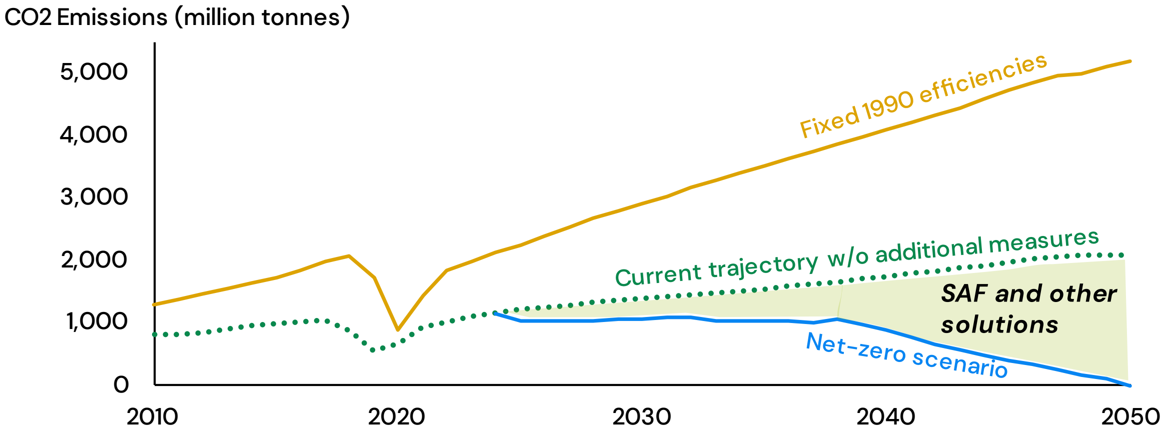
1.1. Project Context

Aviation Decarbonisation Global Context

About 3% of global greenhouse gas emissions come from the aviation industry, and this percentage is expected to continue growing significantly as air travel demand continues to increase and as other sectors continue to decarbonise. Aviation's contribution to global emissions could rise to 22% by 2050 without industry-wide decarbonisation solutions[1]. Recognising this, ICAO, IATA, and ACI have committed to achieve net-zero aviation emissions by 2050[2], representing nations, airlines, and airports respectively.

There are multiple decarbonisation measures that the industry can take to reach the ambitious goal, including replacing current fleets with next generation aircraft (e.g. more efficient conventional, electric and hydrogen propulsion systems), improving flight operations, adopting carbon offsets and removals, and the use of sustainable aviation fuel (SAF). Figure 1 below outlines the deployment of decarbonisation basket of measures for achieving net-zero in the aviation industry by 2050.

Figure 1: Without additional decarbonisation solutions, the aviation sector's emissions will continue to grow[3]



SAF is vital to decarbonise aviation. As a drop-in fuel, SAF can be blended with conventional aviation fuel (CAF) and utilised today in current aircraft, engines, and ground infrastructure.

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[1] Making Net-Zero Aviation Possible, Energy Transitions Commission

[2] States adopt net-zero 2050 global aspirational goal for international flight operations, IATA Commitment to Fly Net Zero by 2050

[3] ATAG Waypoint 2050 report

However, SAF production volumes are currently limited, resulting in a high cost compared to the fossil fuel industry, and reinforcing the need for policy to address the premium. The current difference between global production and the net-zero trajectories presents a challenge to achieving the required decarbonisation.

European Aviation Decarbonisation Ambition

Tackling the impact of aviation on climate change and aligning with Paris Agreement are at the core of the European Green Deal. Decarbonising the aviation sector is a small but important factor to achieve the Union target of reducing net greenhouse gas emissions by at least 55% compared to 1990 levels by 2030 and becoming climate-neutral by 2050. To achieve these targets and comply with European Climate Law, the 'Fit for 55' package includes a set of proposals that affect a range of sectors such as construction, energy, and transport. For aviation, in addition to the amendments to the European Union Emission Trading System (EU ETS), it included a proposal called ReFuelEU to accelerate the uptake of sustainable aviation fuels. The regulation has been recently approved in October 2023[4].

Under ReFuelEU, fuel suppliers will be required to deliver increasing blends of SAF and synthetic aviation fuel to airports in scope. The mandate will start in 2025 with a blending target of 2% SAF, increasing to 70% SAF in 2050 with a sub-mandate for synthetic aviation fuels, increasing from 1.2% in 2030 to 35% in 2050.

The regulation will require aircraft operators to avoid tankering and refuel only with the fuel that will be necessary for the flight. ReFuelEU also implements the Union labelling system about the environmental performance for aircraft operators that will help consumers make informed flight ticket purchasing decisions and promote greener flights.

1.2. European Context

EU ETS Overview

The European Union's Emissions Trading System (EU ETS) is the flagship climate policy tool for the Bloc. Implemented in 2005, the system sits across the 27 EU Member States and the European Free Trade Association (EFTA) countries as well as to power plants in Northern Ireland (EU ETS) and applies to most operators providing electricity and heat generation, many energy-intensity industry sectors, some maritime transport, and the elements of aviation discussed further in this report. The system sets a limit and put a price, in line with the "polluter pays" principle, on emissions.

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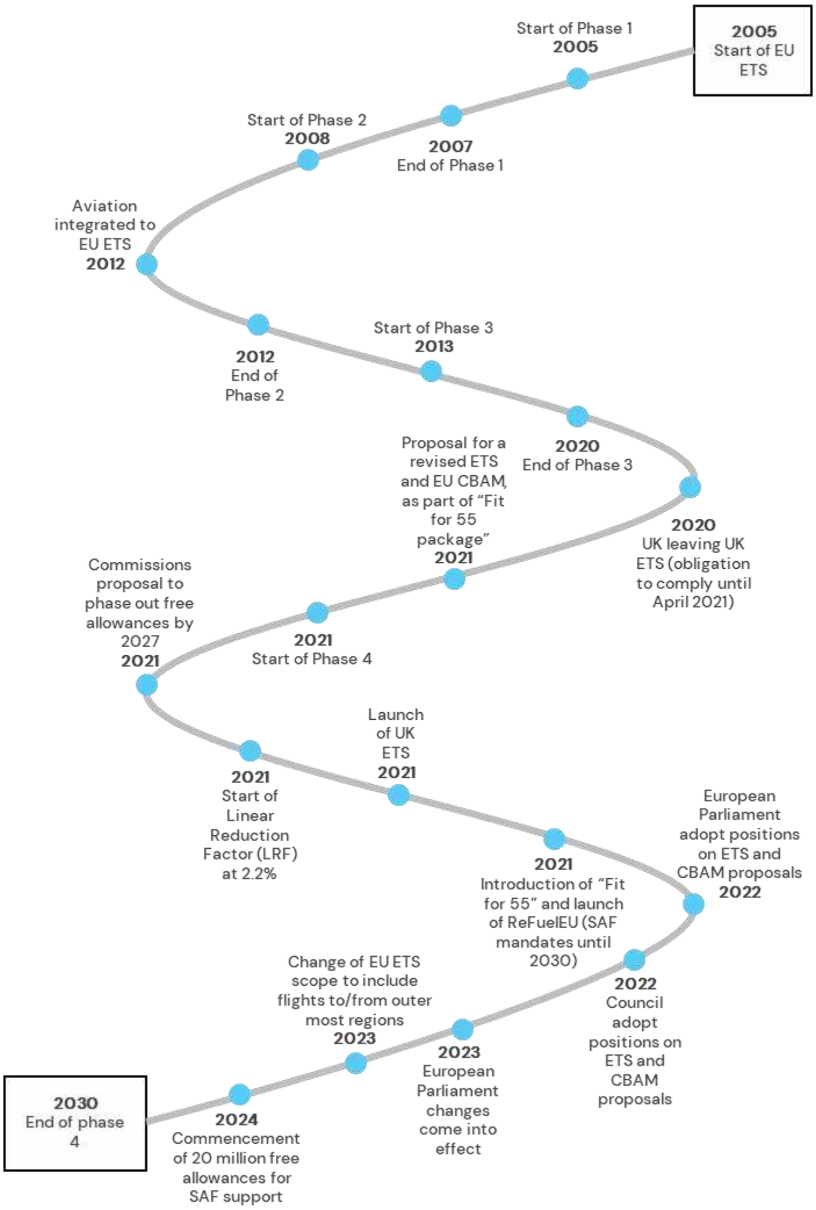
[4] *Regulation (EU) 2023/2405 - adopted by the co-legislators on 18 October 2023 - seeking to ensure a level playing field for sustainable air transport*

Aviation was first added to the scope of the EU ETS in 2012. While the original intention was to cover all outgoing flights and all incoming flights to the EEA, in 2013 the EU temporarily limited the ETS obligations to flights within the EEA to support the development of a global market-based measure by the International Civil Aviation Organization (ICAO). This global carbon offsetting scheme became known as CORSIA and entered the Pilot phase in 2021.

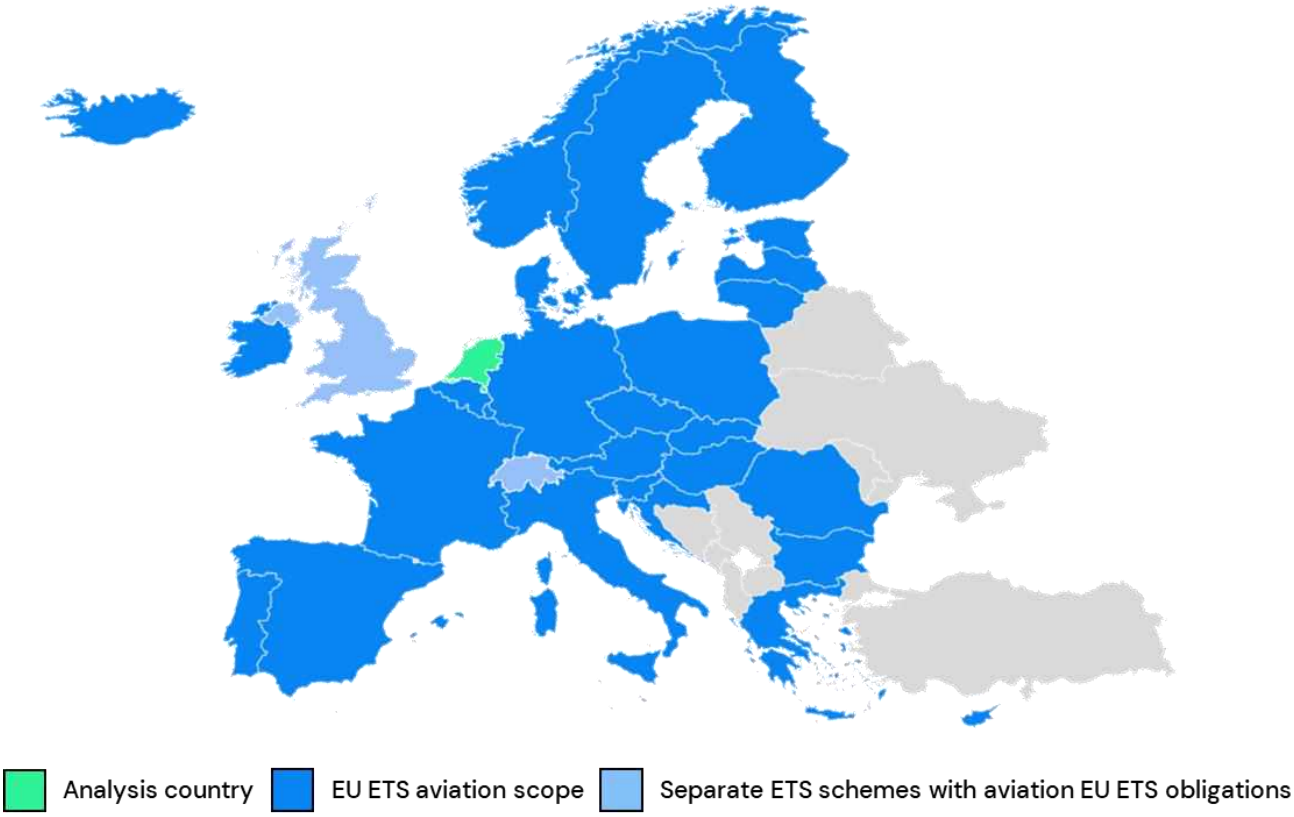
Figure 2: Key milestones in the EU ETS development timeline, highlighting aviation sector specific milestones



As of 1 January 2020, the EU ETS covers emissions from outgoing flights to Switzerland and the Swiss ETS applies to flights departing to EEA airports. As of 1 January 2021, the EU

ETS applies to outgoing flights to the UK and the UK ETS applies to flights departing to EEA airports. In terms of scope, from January 2024 emissions from most flights to and from the EU's nine outermost regions will be covered by the EU ETS as well as departing flights from the outermost regions to Switzerland and the UK. Flights between an aerodrome in an outermost region in one Member State and an aerodrome in the same Member State continue to be subject to a derogation until 2030.

Figure 3: EU ETS aviation reporting scope



Under the EU ETS, aircraft operators, are required to monitor, report and verify their emissions, and to surrender the equivalent allowances. They receive tradeable allowances covering a certain level of emissions from their flights per year. In 2022, the EU ETS applied to 390 aircraft operators flying between airports in the European Economic Area (EEA) and from the EEA to Switzerland and the UK. The emissions from these flights amounted to 49.1 million tonnes, almost 76% higher than in 2021 and closer to pre-COVID 2019 emission levels. In total, 27.3 million aviation allowances were issued, out of them 23.35 million were given for free.

Amendments to the EU ETS rules for aviation have been implemented in 2023 to help achieve the Union's objectives of reducing net greenhouse gas emissions by at least 55 % by 2030 and becoming climate-neutral by 2050. A key change for aviation is the end to free allowances by 2026, with a decrease of 25% for 2024 and 50% for 2025. The changes also affect the allocation system of the free allowances, which will be distributed proportionately to each operator's share of verified emissions from aviation activities reported for 2023, instead of the previous allocation based on the operator's 2010 tonne kilometre data (2014 for new entrants and fast-growing operators).

The EU ETS currently provides a slight incentive for aircraft operators to use SAF compliant with the sustainability criteria of the Renewable Energy Directive (RED), by attributing them zero emissions, thus reducing operators' reported emissions and the ETS allowances they need to purchase. A new component of the new EU ETS Directive for aviation is the reserve of 20 million allowances to finance sustainable aviation fuel (SAF) use in intra EEA flights. This aims to close the price gap between SAF and conventional fuel, depending on the type of fuel used and where it is used, and provides an additional incentive to SAF use and claim under the scheme.

1.3. Report Objectives

This has been prepared for the Dutch Ministry of Infrastructure and Water Management (IenW) with the goal of providing comprehensive analysis on the impacts of EU ETS amendments and FitFor55 on the Dutch aviation sector. Investigating the implications of the proposed and agreed upon changes to ET ETS on the Dutch aviation sector post 2024, this report provides the required insight and analysis to support policy development, parliamentary debate, and engagement with the Dutch aviation value chain.

The report has been strcutured to answer the following three key questions:

1. What are the fiscal and allowance purchasing implications of increasing the annual carbon cap reduction from 2.2%/yr to 4.2%/yr from 2024?
2. What are the fiscal and allowance purchasing implications of accelerating the termination aviation's free allowances under EU ETS? Quantified through a comparative analysis of ending free allowanced 2026, 2027, and 2030.
3. Quantifying the level of support the EU's 20 million free allowance SAF package provides airlines. How far does the fund go? What benefit can airlines expect to receive?

As agreed with the IenW team, for the purposes of this report, the Dutch aviation sector shall be defined as passenger carriers who's EU ETS obligations are registered within The Netherlands and are managed by The Dutch Emissions Authority (Nederlandse Emissieautoriteit-Nea). The carriers included are: KLM (inclusive of CityHopper), Transavia, TUI Airlies Netherlands, and Corendon Dutch Airlines.

1.4. Report Structure

This report consists of seven main sections outlined below:

1. Introduction
2. Carbon Forecasting
3. EU ETS Policy Scenarios
4. Policy Impact Cost Analysis
5. SAF Support
6. Movement Scenario Comparative Analysis
7. Conclusion

This report starts with introducing the decarbonisation ambitions of The Netherlands and the EU, followed by a high-level forecast of activity (passengers and ATMs) and carbon emissions in the Dutch aviation sector. The report will then introduce different policy scenarios under Phase 4 of the EU ETS, exploring free allocation and auctioning requirements and other regulations. A cost analysis due to policy impacts will be outlined next, which starts with a pricing forecast and sensitively analysis, followed by cost assessments under different scenarios and policy phases. The section afterwards will focus on regulatory support on SAF uptake, specifically in The Netherlands, The EU and globally. The report will end with two movement scenario comparative analysis, namely the 1.5% CAGR and No Additional Movements scenarios, which is then followed by a conclusion.

2. Carbon Forecasting

Forecasting emissions for Dutch carriers is crucial to understand the impact of Phase 4 EU ETS alterations on the quantity of free allowances allocated, auctioning requirements and carrier EU ETS price exposure. The emissions forecast must account for movement growth, fleet renewal and sustainable aviation fuel (SAF) uplift, to quantify the volume of CO_2 for which allowances must be surrendered in the remaining years of Phase 4 (2024-2030).

The following section outlines the methodology deployed in baselining and forecasting Dutch carrier emissions to calculate allowance obligations.

2.1. Estimating the Baseline Emissions for Dutch Aviation

Forecasting emissions of Dutch carriers requires a movement and fleet composition baseline. Establishing the number of EU ETS applicable movements and the aircraft deployed enables the calculation of carrier fuel burn and emissions.

Utilising OAG [5]schedule data provided a detailed breakdown of the total number of trips and distance flown on EU ETS applicable routes by aircraft type. Conducting this analysis for the four carriers within this study provided an average trip distance by aircraft type by airline.

For each airline/aircraft type combination, the typical fuel burn and CO_2 emissions were calculated using EUROCONTROL's aviation Small Emitter Tool (SET) based on the average trip length. Figure 4 below provides the SET inputs for KLM. This process was then repeated for each of the other carriers.

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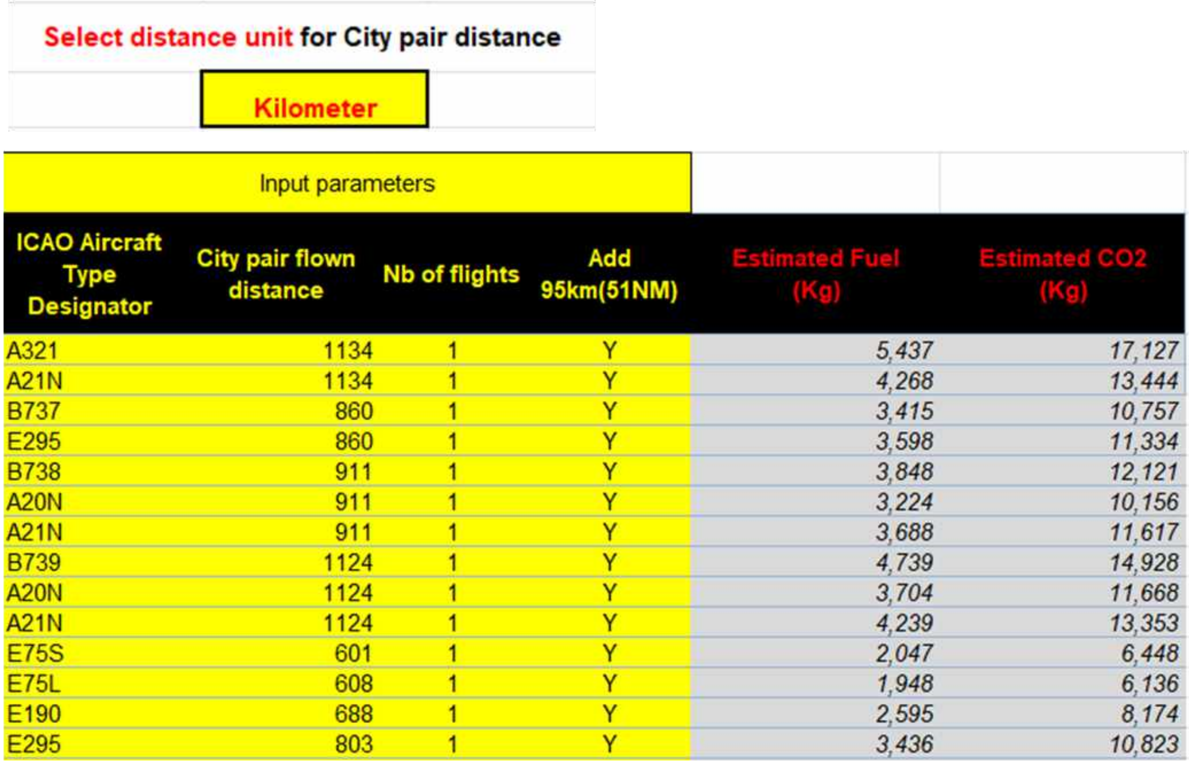
[5] OAG is the world's leading provider of digital flight information, intelligence and analytics for airports, airlines and travel tech companies. OAG provides air passenger traffic data across markets for route and capacity planning and forecasting.

Figure 4: Small Emitters Tool (SET) inputs for KLM to determine baseline fuel and CO_2 per aircraft type per movement



Select distance unit for City pair distance

Kilometer

Input parameters					
ICAO Aircraft Type Designator	City pair flown distance	Nb of flights	Add 95km(51NM)	Estimated Fuel (Kg)	Estimated CO2 (Kg)
A321	1134	1	Y	5,437	17,127
A21N	1134	1	Y	4,268	13,444
B737	860	1	Y	3,415	10,757
E295	860	1	Y	3,598	11,334
B738	911	1	Y	3,848	12,121
A20N	911	1	Y	3,224	10,156
A21N	911	1	Y	3,688	11,617
B739	1124	1	Y	4,739	14,928
A20N	1124	1	Y	3,704	11,668
A21N	1124	1	Y	4,239	13,353
E75S	601	1	Y	2,047	6,448
E75L	608	1	Y	1,948	6,136
E190	688	1	Y	2,595	8,174
E295	803	1	Y	3,436	10,823

The baseline average fuel burn and CO_2 per trip by aircraft type, were then multiplied by the total number of trips that each aircraft type flew in a select year, delivering total fuel burn and CO_2 figures for a carrier's specific aircraft type in a given year.

This analysis was repeated for each carrier in the years spanning 2019-2023. The results from the carrier fuel burn and CO_2 are contained below in Figure 5 and Figure 6.

Figure 5: OAG aligned carrier fuel burn baseline calculated through the SET

		Phase 3			Phase 4	
Airline	Units	2019	2020	2021	2022	2023
Corendon Dutch Airlines	Tonnes Jet A-1	15,658	5,062	8,470	12,822	8,455
KLM		626,832	312,586	379,714	547,678	612,574
Transavia		259,115	119,876	159,911	239,396	256,178
TUI Airlines Netherlands		16,352	5,110	23,423	24,451	25,831
Total		917,957	442,634	571,518	824,347	903,039

Figure 6: OAG aligned carrier CO2 baseline calculated through the SET

		Phase 3			Phase 4	
Airline	Units	2019	2020	2021	2022	2023
Corendon Dutch Airlines	Tonnes CO_2	49,322	15,945	26,682	40,388	26,633
KLM		1,974,521	984,645	1,196,100	1,725,184	1,929,608
Transavia		816,213	377,608	503,719	754,098	806,962
TUI Airlines Netherlands		51,508	16,097	73,781	77,021	81,368
Total		2,891,564	1,394,296	1,800,283	2,596,692	2,844,572

2.1.1. Comparison of OAG estimates with reported EU ETS emissions

Assessing the total distance flown, fuel utilised, and CO_2 emitted by each airline's fleet on EU ETS routes from OAG data, provided the basis for determining an annual emissions baseline. This baseline served as the basis for forecasting Dutch sector aviation annual emissions out until 2030. To ensure the methodology for calculating fuel burn and emissions for future years was robust, the baseline OAG aligned carbon estimates were compared against EU ETS validated carbon data for the years 2019-2022. Conducting this sense check served to validate the methodological approach for carbon estimation, which has been utilised to forecast carbon emissions for the remainder of Phase 4.

Figure 7 shows by airline and cumulatively, the difference between the emissions calculated using OAG data and the emissions reported under the EU ETS for the years 2019 and 2022[7].

Figure 7: Comparison of OAG aligned emissions data with EU ETS verified emissions data

Airline	EU ETS 2019		EU ETS 2022	
	OAG aligned tonnes CO_2	EU ETS verified tonnes CO_2	OAG aligned tonnes CO_2	EU ETS verified tonnes CO_2
Corendon Dutch Airlines	49,322	63,015	40,388	44,505
KLM	1,974,521	1,889,344	1,725,184	1,444,881
Transavia	816,213	861,113	754,098	796,243
TUI Airlines Netherlands	51,508	91,872	77,021	84,625
Total	2,891,564	2,905,344	2,596,692	2,370,254
Difference	13,780		226,438	

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[7] EU ETS verified data provided by NEa, covering allowances surrendered and carbon emitted by carrier for 2019 and 2022

The difference is small but non-negligible, with the EU ETS verified emissions data 1% lower in 2019 and 9% higher in 2022 compared to the OAG-based methodology used in this report. In carrying out the allowance allocation analysis, the EU ETS verified emission figures and the corresponding free allowance allocation for 2019-2022 have been utilised[8]. Where EU verified carrier emission data is unavailable (2023-2030), the analysis has deployed the OAG aligned methodology. This process consisted of taking average route distances by aircraft type and multiplying the fuel burn and emissions figure by total number of flights operated by aircraft. The following section provides a detailed overview of how future movement growth, fleet renewal and aircraft retirements, and SAF uplift where integrated into the emissions forecasting analysis.

2.2. EU ETS Phase 4 Emissions Forecast

This section provides a comprehensive overview of the emissions forecast, covering the remainder of EU ETS Phase 4 (2023-2030). Calculating annual carrier emissions is essential to determine the quantity of allowances that Dutch carriers will be obligated to surrender, the proportion of allowances which will be freely allocated, and the quantity which will need to be purchased. From the calculated and reported baseline emissions, there are three drivers of carrier emissions:

- The number of passenger movements
- Fleet renewal and retirements
- Sustainable aviation fuel (SAF) uplift

The following sections detail the methodology for calculating the carbon impacts and/or abatement derived from movement growth, fleet renewal, and SAF uplift for it is these three factors which are set to dictate carrier allowance obligations.

2.2.1. Movement Growth

Carrier allowance surrendering obligations for the remainder of Phase 4 is primarily driven by activity forecast assumptions. For this analysis, two activity scenarios were considered:

- **No Additional Movements:** The number of EU ETS applicable routes Dutch carriers fly remains fixed at 2023 levels through 2030.
- **1.5% Compounding Annual Growth Rate (CAGR)[9]:** Aligned with the EUROCONTROL's forecast, stating that flight growth is expected to grow on average 1.5% per year through 2029.

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[8] NEa provided data has been reinforced with the EU Policy ETS Registry Verified Emissions 2022 database

[9] *EUROCONTROL Forecast 2023-2029*

The level of carbon savings delivered through fleet renewal and SAF uplift are directly correlated to the activity of the four carriers within each growth scenario. For this analysis, the emissions forecast, and subsequent allowance obligations and free allowance allocation calculations have primarily been based on the 1.5% CAGR scenario, serving as the analysis base case. The No Additional Movements scenario provides an alternative scenario to assess the implications of the EU ETS Phase 4 changes. The allowance surrendering and cost difference of the two scenarios are explored in Chapter 6 and serves to highlight the carbon and cost savings which would be gained if aviation activity within The Netherlands were to be capped.

No Additional Movements

Under the no additional movement scenario, the number of EU ETS applicable routes Dutch carriers fly remains at 2023 levels in each year until 2030. The scenario of no additional flights has been informed by the local Dutch decarbonisation and flight cap context. Despite the proposed Amsterdam Schiphol Airport (AMS) flight cap being scrapped[10], this analysis considers the carbon and EU ETS allowance implication of the cap being implemented. The cap would have reduced flight capacity to 440,00 flights per year down from its current level of 500,000 flights[11]. The cap would represent a 12% reduction in flights compared to the current cap and a 19% reduction from proposed growth plans. Simultaneously, KLM has expanded its rail partnerships to reduce the number of passengers flying on certain routes. As part of KLM's Action Plan for Rail and Air Services[12], the carrier aims to provide international train travel as an alternative to flying at six priority destinations (Brussels, Paris, London, Düsseldorf, Frankfurt and Berlin).

However, rather than a reduction in annual movements from 2023, this scenario assumes that Dutch carriers as a response would increase service at Eindhoven (EIN), Rotterdam, The Hague (RTM), Maastricht Aachen (MST), and Groningen (GRQ) to offset the capacity reduction and increased competition for slots at Schiphol (AMS).

Despite freezing the number of EU ETS applicable flights served by Dutch carriers at the 2023 figure of 249,580, the no additional movements scenario does not inhibit passenger growth. Demonstrated in Figure 8 and Figure 9, from 2023-2030 Dutch carriers will see a 5.7% increase in the number of available seats on EU ETS routes.

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[10] *Dutch government scraps plan to cap flights at Schiphol next year*

[11] *Dutch government presses ahead with Schiphol flight cap as airlines protest*

[12] *KLM and Thalys make train travel more appealing to intercontinental and European transfer passengers*

Figure 8: Forecasted seat growth relative to passenger movements under a no additional movements scenario

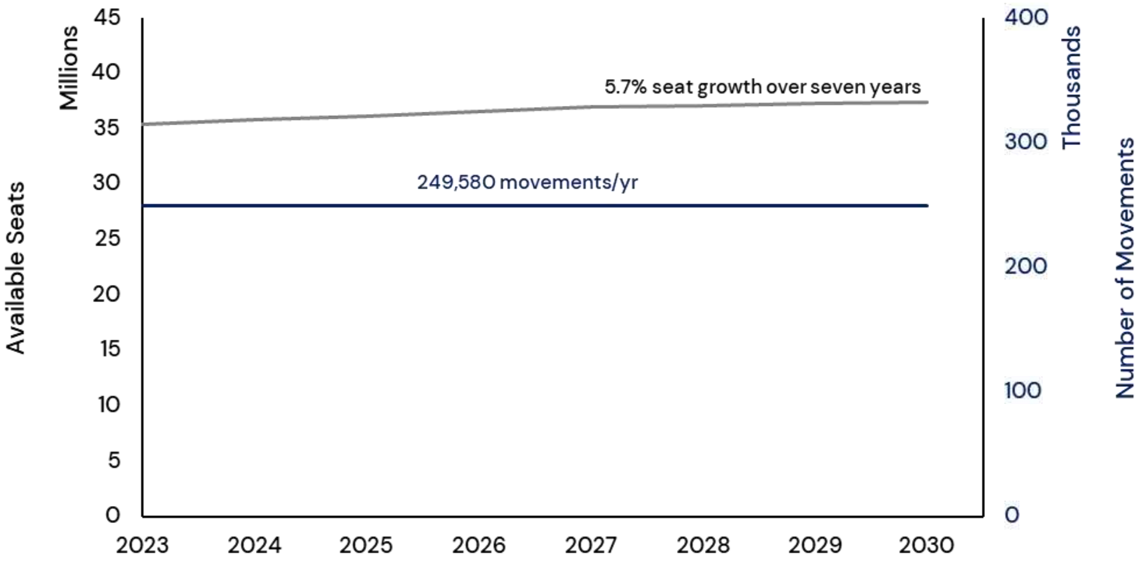


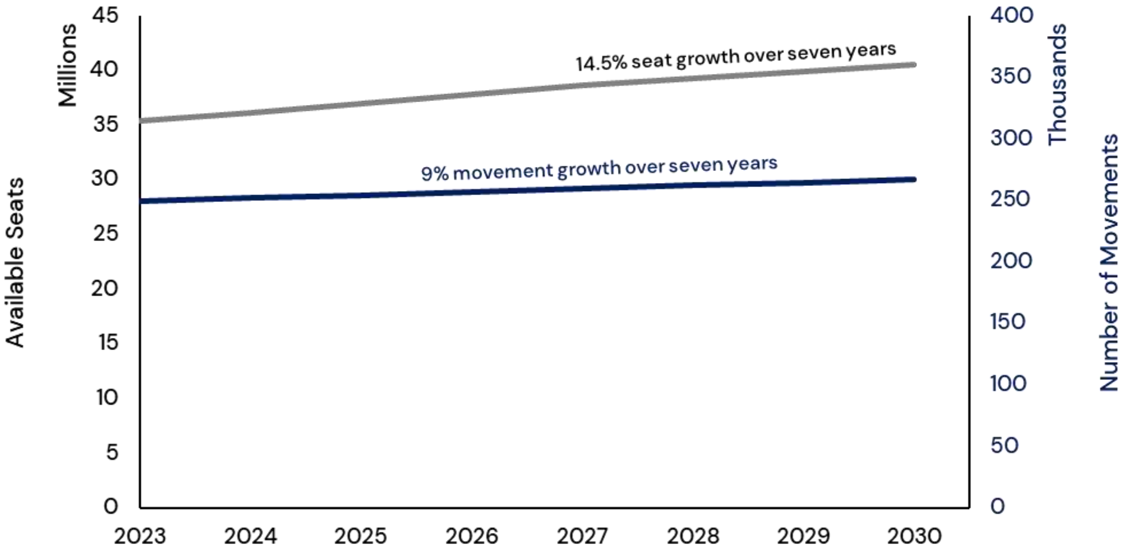
Figure 9: Forecasted seat growth by carrier under a no additional movements scenario

This seat growth occurs while the number of movements remains consistent. In passenger numbers, this growth equates to approximately 2 million seats added from 2023-2030. In this scenario, passenger growth and movement growth have been decoupled where passenger growth is being driven by the introduction of higher density aircraft through fleet renewal and increased load factors.

1.5% Annual Growth Rate Scenario

In Summer 2023, EUROCONTROL published its latest European flight growth forecast. In this publication, EUROCONTROL estimated base-case to average 1.5% per year[13]. The European aviation industry, in its Covid-19 recovery has rebounded in line with EUROCONTROL's base scenario and growth projections. Furthermore, EUROCONTROL's growth forecast reflects previous ambitions of growing capacity at Schiphol to 540,000 flights annually[14]. The decision to utilise the 1.5% CAGR scenario as the analysis' central movement scenario was solidified when the Dutch government announced its decision to scrap the Schiphol movement cap[15]. As depicted in Figure 10 and Figure 11, a 1.5% CAGR from 249,580 flights in 2023, annual movements increase by 9% over the seven years to 272,146 in 2030.

Figure 10: Forecast seat growth relative to passenger movements under a 1.5% CAGR movement scenario



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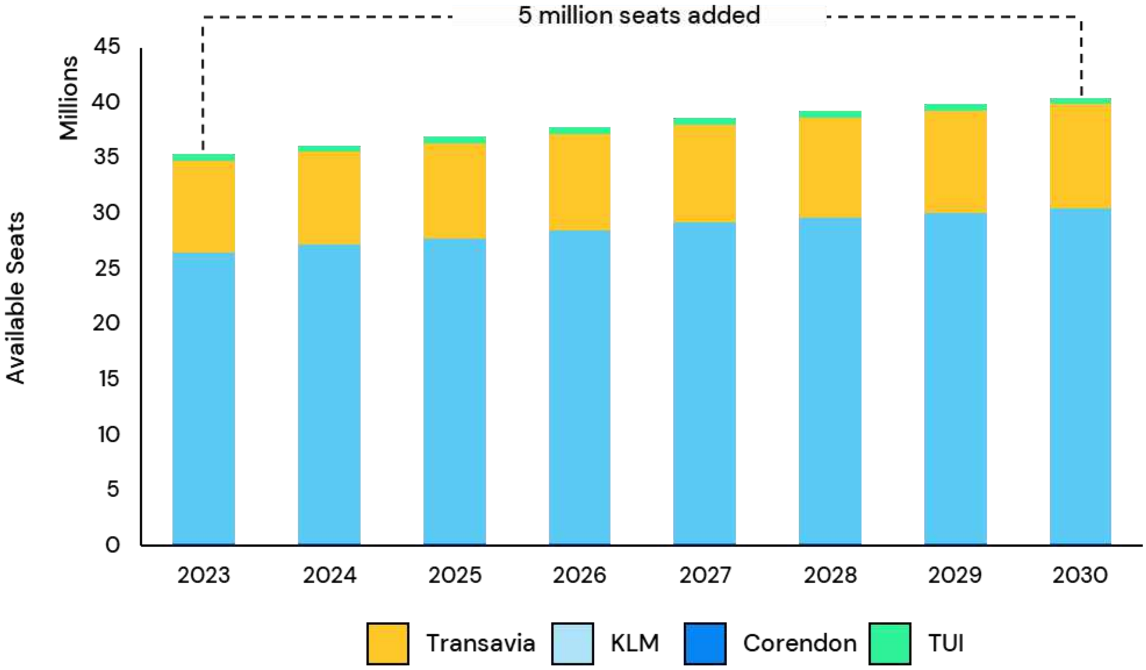
[13] EUROCONTROL Forecast 2023-2029

[14] New Amsterdam Schiphol Airport Flight Cap Coming 2024

[15] Dutch government scraps plan to cap flights at Schiphol next year

Figure 11: Forecast seat growth by carrier under a 1.5% CAGR movement scenario



The 9% movement growth corresponds to a 14.5% increase in available seats, an increase of approximately 5 million seats over the seven-year period. As with the no additional movement scenario, available seat growth is initially driven by the introduction of higher capacity aircraft, however, with the 1.5% CAGR scenario, the introduction of additional capacity significantly contributes to the increase in available seats. For reference, under the 1.5% CAGR scenario, 40,503,476 seats are available on EU ETS routes in 2030 while that figure stands at 37,402,714 seats in the no additional movement scenario, a difference of approximately 3.1 million seats.

2.2.2. Fleet Renewal

Fleet modernisation will continue to drive improvements in airline fuel efficiency, with next generation aircraft types delivering improvements of between 10% and 15%. In this section, the fleet composition of each carrier is projected using airline announcements and confirmed orders. This information is then used to model the implication for each airline's emissions.

Corendon Dutch Airlines

In 2023, Corendon Dutch Airlines[16] operated a fleet comprised solely of Boeing 737-800s[17][18] on its EU ETS applicable routes. Beginning in 2024, the carrier is to take delivery

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[16] *Corendon Airlines Out fleet*

[17] *CAPA Profiles – Corendon Dutch Airlines*

[18] *Corendon Dutch Airlines Fleet Details and History*

of 737 MAX 9[19] aircraft which will over the course two years come to be the only type in operation. While the carrier took delivery of its first MAX in May 2019, the carrier currently operates the MAX 9 on routes from The Netherlands which fall outside the scope of EU ETS.

Given that Corendon Dutch Airlines have not explicitly stated when the 737-800 will be phased out, 2026 has been assumed given the small scale of the carrier Dutch operations. Figure 12 outlines the percent share and number of flights which will be operated by each aircraft type for the remainder of Phase 4.

Figure 12: Corendon Dutch Airlines fleet renewal – 2023 baseline and future fleet composition

Airline	2023 Fleet Composition	Renewal	Units	2023	2024	2025	2026	2027	2028	2029	2030
Corendon	737-800	737-800	trip share	100%	75%	50%	0%	0%	0%	0%	0%
		737 MAX 9		0%	25%	50%	100%	100%	100%	100%	100%

▨ Aircraft currently in use 🟦 Replacement aircraft

KLM & KLM CityHopper

In 2023 KLM's (inclusive of KLM Cityhopper) EU ETS utilised fleet was comprised primarily of 737 and Embraer family aircraft[20].

In December 2021, Air France-KLM placed an order for 100 A320neo-family aircraft[21], to replace KLM's aging 737 fleet. Deliveries are to commence in July 2024 to replace Boeing 737-800 and Boeing 737-900. KLM have not publicly shared the breakdown of 320neos to 321neo aircraft. As a result, a 50:50 split share of 320s and 321s will be assumed to replace the 737-800s and 737-900s respectively. Furthermore, Air France-KLM have not disclosed how long its 737 phase out is expected to take. Subsequently, an assumption has been made that KLM will retire its 737s by the start of 2027.

In respect to KLM Cityhopper which operate the 737-700 and Embraer aircraft. In June 2019, the carrier placed a firm order of 15 with an option of 20 addition 195 E2s[22] with the carrier slated to replace its -700 with the Embraer 195 E2[23]. Regarding the E175 and E190, there is no publicly available information regarding the carrier's plan to replace the types. As a result, it is assumed that the type remains within the fleet until the end of Phase 4.

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[19] *ALC Announces Placement of Nine Boeing 737 MAX Aircraft with Corendon Airlines*

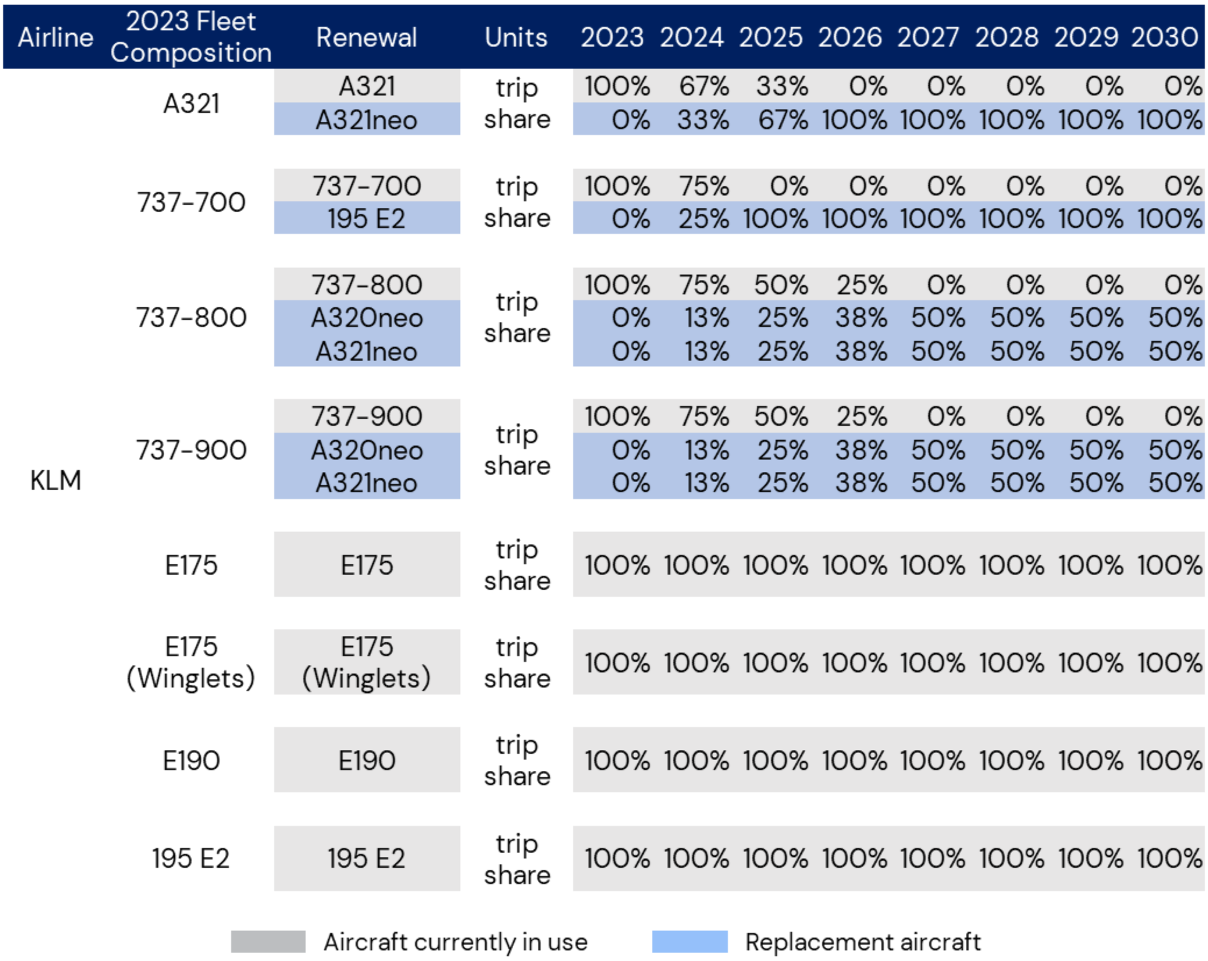
[20] *KLM Royal Dutch Airlines Fleet Details and History*

[21] *Air France-KLM orders 100 Airbus A320neo family aircraft*

[22] *Dutch airline KLM orders up to 35 planes as it looks to refresh Cityhopper fleet*

[23] *KLM receives its first Embraer E195-E2*

Figure 13: KLM fleet renewal - 2023 baseline and future fleet composition



Airline	2023 Fleet Composition	Renewal	Units	2023	2024	2025	2026	2027	2028	2029	2030
KLM	A321	A321	trip share	100%	67%	33%	0%	0%	0%	0%	0%
		A321neo		0%	33%	67%	100%	100%	100%	100%	100%
	737-700	737-700	trip share	100%	75%	0%	0%	0%	0%	0%	0%
		195 E2		0%	25%	100%	100%	100%	100%	100%	100%
	737-800	737-800	trip share	100%	75%	50%	25%	0%	0%	0%	0%
		A320neo		0%	13%	25%	38%	50%	50%	50%	50%
		A321neo		0%	13%	25%	38%	50%	50%	50%	50%
	737-900	737-900	trip share	100%	75%	50%	25%	0%	0%	0%	0%
		A320neo		0%	13%	25%	38%	50%	50%	50%	50%
		A321neo		0%	13%	25%	38%	50%	50%	50%	50%
	E175	E175	trip share	100%	100%	100%	100%	100%	100%	100%	100%
	E175 (Winglets)	E175 (Winglets)	trip share	100%	100%	100%	100%	100%	100%	100%	100%
	E190	E190	trip share	100%	100%	100%	100%	100%	100%	100%	100%
	195 E2	195 E2	trip share	100%	100%	100%	100%	100%	100%	100%	100%

▨ Aircraft currently in use 🟦 Replacement aircraft

Transavia

In 2023 Transavia's EU ETS applicable routes were primarily served by 737 family aircraft[24]. As part of the Air France-KLM group, Transavia will be receiving A320neo[25] aircraft from the Group's 2021 order to replace its aging 737s.

In a 2021 interview with then CEO Mattijs ten Brink[26], it was revealed that the fleet renewal program is expected to take eight years, which is represented in Figure 14. From 2023, when the carrier received its first A321neo, eight years takes the renewal timeline to 2031. Subsequently, a linear reduction has been applied to the -700 and -800 over the course of Phase 4 to ensure complete phase out by 2031. In the same interview, Brink stated that the split between A321neo/A320neo will be around 60:40. This is represented below with the 321neo taking a larger proportional share of trips over the 320neo during the 737 phase out.

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[24] *Transavia Fleet Details and History*

[25] *Air France-KLM orders 100 Airbus A320neo family aircraft*

[26] *Transavia in 2023 – A year of big change*

The OAG data below indicated that the carrier has already begun receiving A321neo aircraft as represented in the 48 flights the type operated in 2023. The table included in section two of the appendix outlines the percent share and number of flights which will be operated by each aircraft type for the remainder of Phase 4.

Figure 14: Transavia fleet renewal - 2023 baseline and future fleet composition

Airline	2023 Fleet Composition	Renewal	Units	2023	2024	2025	2026	2027	2028	2029	2030
Transavia	A320	A320	trip share	100%	100%	100%	100%	100%	100%	100%	100%
	A321neo	A321neo	trip share	100%	100%	100%	100%	100%	100%	100%	100%
	737-700	737-700	trip share	100%	88%	75%	63%	50%	38%	25%	13%
		A320neo		0%	5%	10%	15%	20%	25%	30%	35%
		A321neo		0%	8%	15%	23%	30%	38%	45%	53%
	737-800	737-800	trip share	100%	88%	75%	63%	50%	38%	25%	13%
		A320neo		0%	5%	10%	15%	20%	25%	30%	35%
		A321neo		0%	8%	15%	23%	30%	38%	45%	53%

▨ Aircraft currently in use 🟦 Replacement aircraft

TUI Airlines Netherlands

In 2023, TUI Airlines Netherlands operated a fleet primarily consisting of 737 family aircraft[27]. The carrier also, on occasion, wet leased A320s to operate 348 flights within the scope of EU ETS. Under EU ETS aviation guidelines, carriers are obligated to surrender allowances stemming from wet leased operated flights.

In a press release issued by TUI in 2018[28], the carrier stated that it expected to compete the replacement of its 737-800s by 2023. However, given MAX delivery delays which commenced in 2019, the assumption has been made that TUI's 737 renewal will be completed by 2025[29].

Regarding the carrier's 767-300s, TUI is set to retire the type by the beginning of 2024[30][31]. Routes served by the 767 are expected to be replaced by the more fuel efficient 787 which already sees utilisation on a handful of EU ETS applicable routes.

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[27] *TUI fly Netherlands Fleet Details and History*

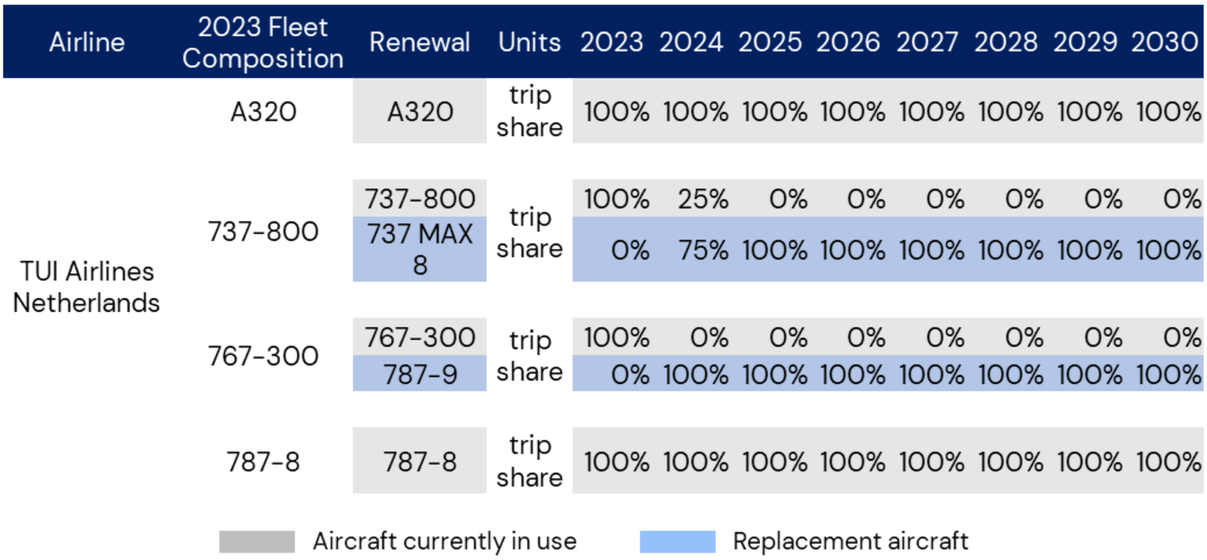
[28] *Fleet renewal – TUI is receiving new modern and efficient aircraft*

[29] *TUI Group Sticks with Boeing for Fleet Renewal Despite Delivery Delays*

[30] *TUI fly (Netherlands) to end B767 ops by YE23*

[31] *TUI says goodbye to the Boeing 767*

Figure 15: TUI Airlines Netherlands fleet renewal: 2023 baseline and future fleet composition



Airline	2023 Fleet Composition	Renewal	Units	2023	2024	2025	2026	2027	2028	2029	2030
TUI Airlines Netherlands	A320	A320	trip share	100%	100%	100%	100%	100%	100%	100%	100%
	737-800	737-800	trip share	100%	25%	0%	0%	0%	0%	0%	0%
		737 MAX 8		0%	75%	100%	100%	100%	100%	100%	100%
	767-300	767-300	trip share	100%	0%	0%	0%	0%	0%	0%	0%
		787-9		0%	100%	100%	100%	100%	100%	100%	100%
	787-8	787-8	trip share	100%	100%	100%	100%	100%	100%	100%	100%

▨ Aircraft currently in use 🟦 Replacement aircraft

Fleet Renewal Carbon Impacts

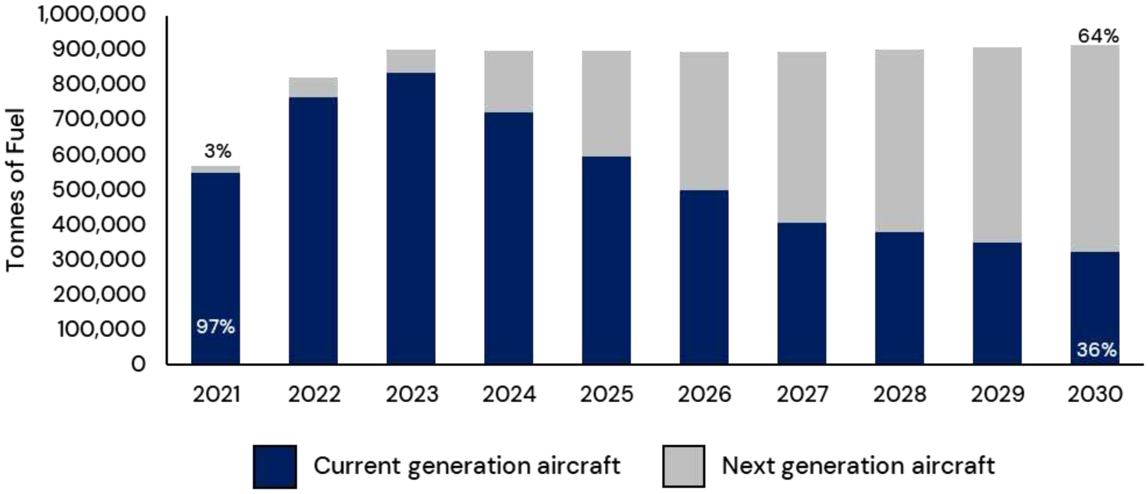
Following the fleet renewal assessment, the methodology deployed to calculate baseline fuel burn and carbon emissions was replicated for 2024-2030 to forecast the impact of fleet renewal on fuel burn and carbon emissions.

Average trip distance by aircraft type by airline was inputted into EUROCONTROL's aviation Small Emitter Tool (SET). However, unlike the baselining calculation, this process was undertaken with each carrier's new annual fleet composition. This process provided fuel burn and emission figures associated with fleet renewal and the corresponding efficiency gains. The generated figures (average fuel burn and CO_2 by aircraft by airline) were then multiplied by the corresponding number of trips said aircraft type was forecasted to make in each year spanning 2024-2030, in line with the 1.5% CAGR scenario.

Figure 16 below shows the fuel burn usage distribution of current- vs next-generation aircraft over the course of Phase 4. The graph shows, that in the 1.5% CAGR scenario, despite the carbon abating impacts of fleet renewal and the introduction of more efficient aircraft, Dutch carrier fuel burn on EU ETS applicable routes increases by 38,820 tonnes to 941,859 in 2030 from 903,039 in 2023, a 1.4% increase.

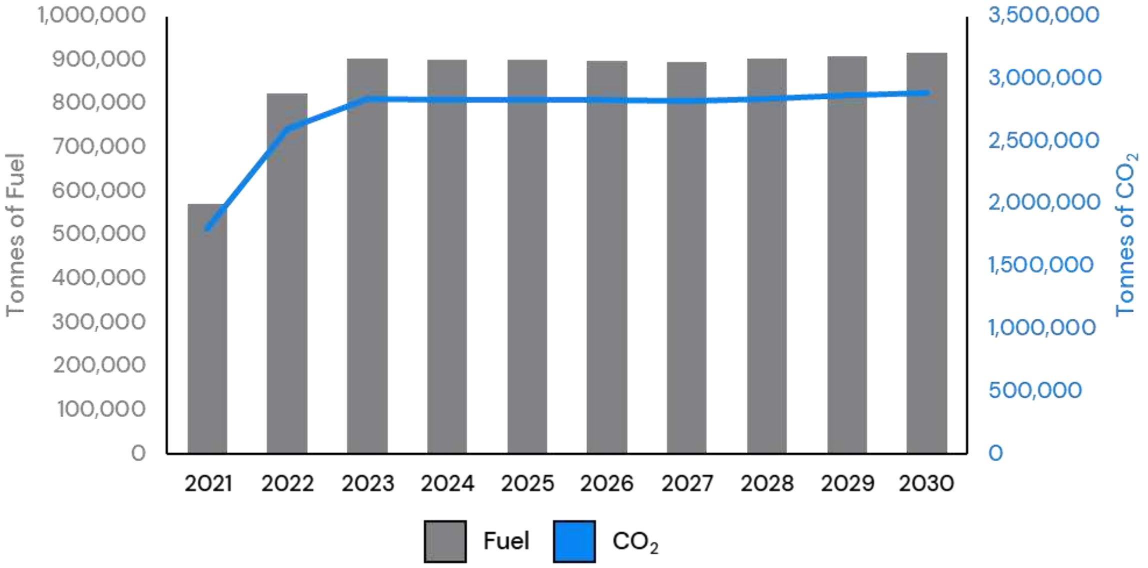
Over the course of Phase 4, next generation fuel burn increases by 2,975% from 19,919 tonnes in 2021 to 612,703 tonnes in 2030. Over the course of Phase 4, current generation aircraft associated fuel burn declines by 41% from 551,600 tonnes in 2021 to 325,159 tonnes in 2030.

Figure 16: Annual fuel burn distribution by aircraft generation following fleet renewal under a 1.5% CAGR movement scenario



The impact of fleet renewal on national emissions can be seen in Figure 17. On a national basis, fleet renewal and improved fuel efficiency of the aircraft operating EU ETS applicable routes under a 1.5% CAGR scenario leads to emissions increasing by 122,283 tonnes of CO_2 from 2,844,572 tonnes in 2023 to 2,966,855 tonnes in 2030. This corresponds to a 4% increase over the seven-year period. Over the Phase 4 period, inclusive of fleet renewal, the four carries will cumulatively emit 27,487,997 tonnes of CO_2.

Figure 17: Fleet renewal impacts on annual fuel burn and CO_2 emissions under a 1.5% CAGR movement scenario



2.2.3. Sustainable Aviation Fuel (SAF) Use

Following fleet renewal, SAF provides carriers with an additional mechanism for decarbonisation, and for reducing their EU ETS obligations. Despite only making up 0.1% of global fuel uplift in 2022[32], efforts to expand production are well underway with governments passing SAF mandates and subsidies to mature the market.

An Introduction to SAF

SAF is a drop in fuel, to be blended with conventional aviation fuel i.e. Jet A1. Its origins cover a diverse spectrum with multiple production methods and feedstocks, comprising of two core categories:

- **Biogenic SAF:** Produced from a variety of biological feedstocks, including waste oils, fats, agricultural products, woody biomass, and municipal residues. As a drop-in fuel, SAF can seamlessly integrate into existing infrastructure and aircraft, requiring no alterations.
- **Power to Liquid SAF (PtL):** This pioneering production approach harnesses the power of renewable electricity and hydrogen as primary feedstocks. PtL holds the promise of alleviating constraints stemming from bio-feedstock availability, though it currently comes with higher costs.

At the point of use SAF emits the same level of CO_2 as conventional aviation fuel (CAF), however, carbon intensity reductions are gained throughout the fuels lifecycle.

- Jet A-1 total emissions: 89 gCO_2/MJ
    - Scope 1 emissions: 71.591 gCO_2/MJ
    - Scope 3 emissions: 17.409 gCO_2/MJ
    - Per the ICAO global standard, with other regions deploying different values
- SAF can reduce the lifecycle impact of CAF by 65% to 85%, even surpassing 100%, depending on feedstocks, production pathways, and deployed technologies
    - Carbon savings over CAF represent sustainability from feedstock origination, production, and transportation
- Under the EU ETS all SAF is given an 100% emissions reduction to the neat part of a biomass-based fuel for aviation (biofuel) that is compliant with the RED II EU criteria.
    - Biofuel eligible in EU ETS must comply with the RED II criteria of a 65% carbon reduction compared to a fossil fuel baseline of 94 gCO_2/MJ

Under the European Union's Fit for 55 target to reduce net greenhouse gas emissions by at least 55% by 2030, legislators have introduced the ReFuelEU SAF mandate within the

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[32] *Rocky Mountain Institute*

EU to align the aviation industry with the Union's target. Under ReFuelEU jet fuel suppliers will be obligated to blend 2% SAF to their jet fuel supply in 2025 and 6% by 2030.

Carrier SAF uplift in The Netherlands is shaped by both mandate compliance and voluntary targets. In assessing the carbon savings achieved through SAF uplift, the percent share of SAF to be used was calculated against each carrier's forecasted fuel burn derived from the fleet renewal analysis. KLM[33] (inclusive of KLM Cityhopper) and Transavia[34] have set voluntary targets, aiming surpass mandated requirements, at 10% SAF uplift by 2030. Corendon Dutch Airlines and TUI Airlines Netherlands have not announced voluntary SAF targets above the mandated levels and as such the share of SAF to be uplifted is in line with ReFuelEU. The individual carrier targets and anticipated SAF percent shares of total fuel use on EU ETS applicable routes is shown in Figure 18 below.

Figure 18: SAF percent share of total fuel burn by carrier throughout Phase 4

Airline	Units	2025	2030
Corendon Dutch Airlines	SAF share of EU ETS fuel	2%	6%
KLM		2%	10%
Transavia		2%	10%
TUI Airlines Netherlands		2%	6%

The varying technological processes and feedstocks used in the production of SAF yield a range of carbon savings, from a 65% savings on the low end (reflected in carbon reduction eligibility criteria in the EU), rising to 90% and in some cases carbon negative SAF can be produced by carbon capture technology. However, for this analysis, the SAF uplifted by Dutch carriers is assumed to deliver a 100% carbon reduction per neat SAF over the course of Phase 4 to ensure alignment with EU ETS guidelines. The 100% carbon reduction for SAF under EU ETS is captured within the guidance for the Monitoring and Reporting for Aircraft Operators[35] The carbon savings of SAF compared to convention aviation fuel (CAF) are shown in Figure 19 below.

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[33] *Sustainable Aviation Fuel (SAF) Information Sheet*

[34] *How Transavia is becoming more sustainable*

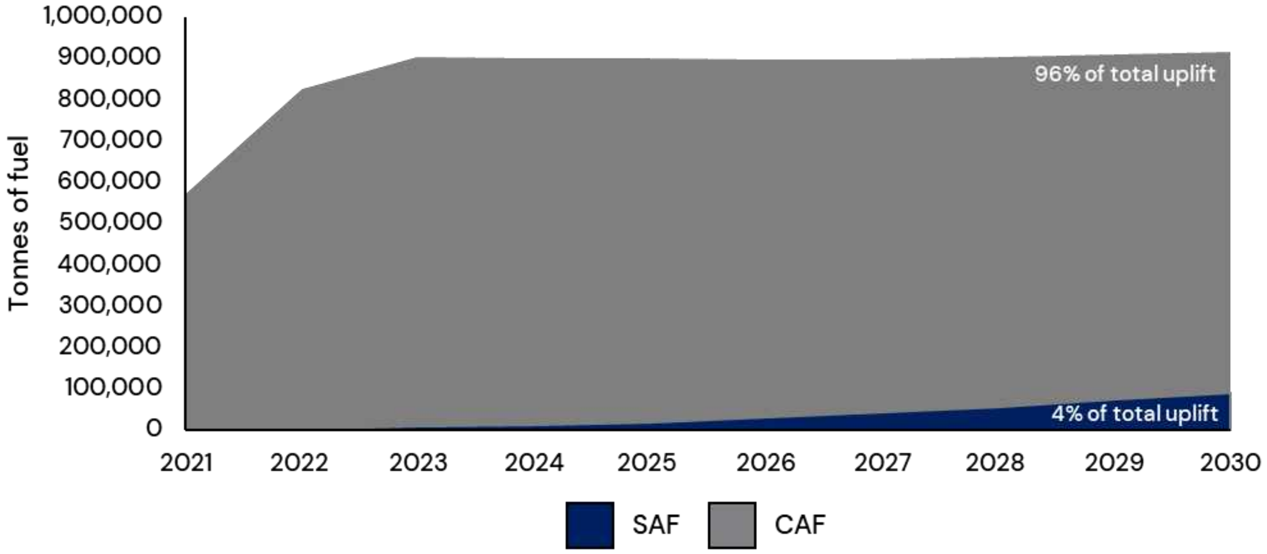
[35] *Commission Implementing Regulation (EU) 2023/2122 of 17 October 2023 amending Implementing Regulation (EU) 2018/2066 as regards updating the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council*

Figure 19: SAF carbon reduction attributes under EU ETS

Fuel	Units	Impact
Conventional Aviation Fuel	CO_2 per kg fuel	3.16 kg
Sustainable Aviation Fuel	carbon reduction	100%
Sustainable Aviation Fuel	CO_2 per kg fuel	0.00 kg

On a national level, under a 1.5% CAGR scenario, Dutch carriers will uplift 342,284 tonnes of SAF representing 4% of cumulative fuel uplift in Phase 4. This volume of SAF will deliver 1,300,679 tonnes of carbon savings over the course of Phase 4, assuming an 100% CI carbon intensity (CI) reduction compared to CAF. The volumetric distribution of the two fuel types across Phase 4 are captured below in Figure 20.

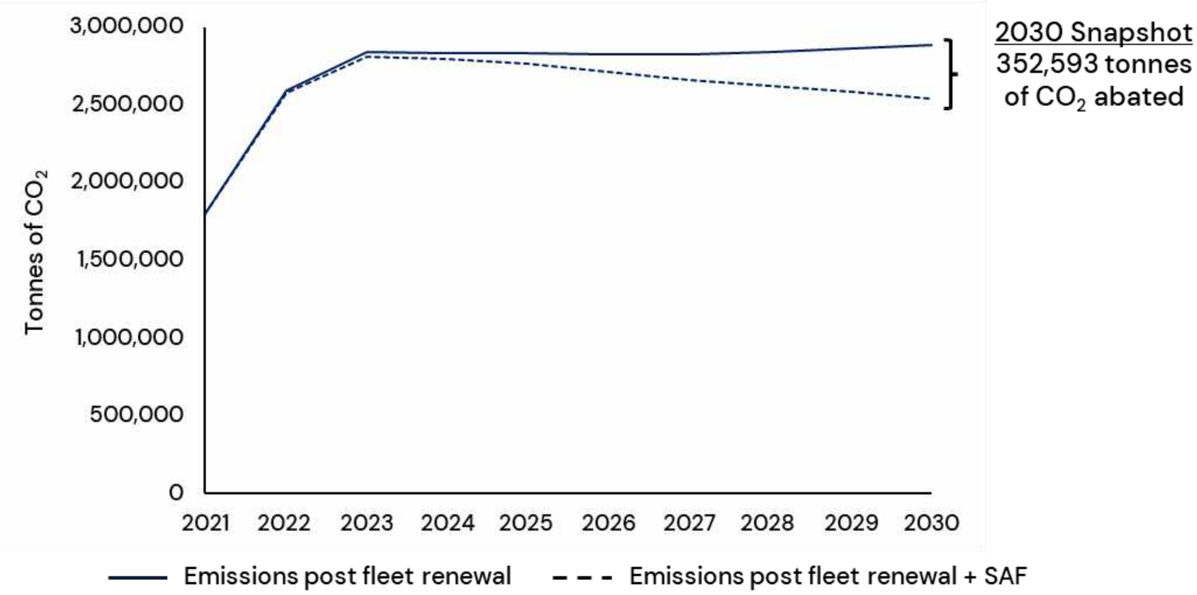
Figure 20: Volumetric distribution of SAF vs. CAF across Phase 4, leading to 342,284 tonnes of SAF use across Phase 4



	2021	2025	2030
National SAF tonnes	0	18,144	92,788

Figure 21 below depicts the cumulative CO_2 emissions of the four Dutch carriers following the integration of SAF into the fleet renewal analysis. Over the course of Phase 4, the 342,284 tonnes of SAF uplifted delivers 1,300,679 tonnes of carbon savings.

Figure 21: SAF uplift abates 1,300,679 tonnes of CO_2 following fleet renewal across the duration of Phase 4

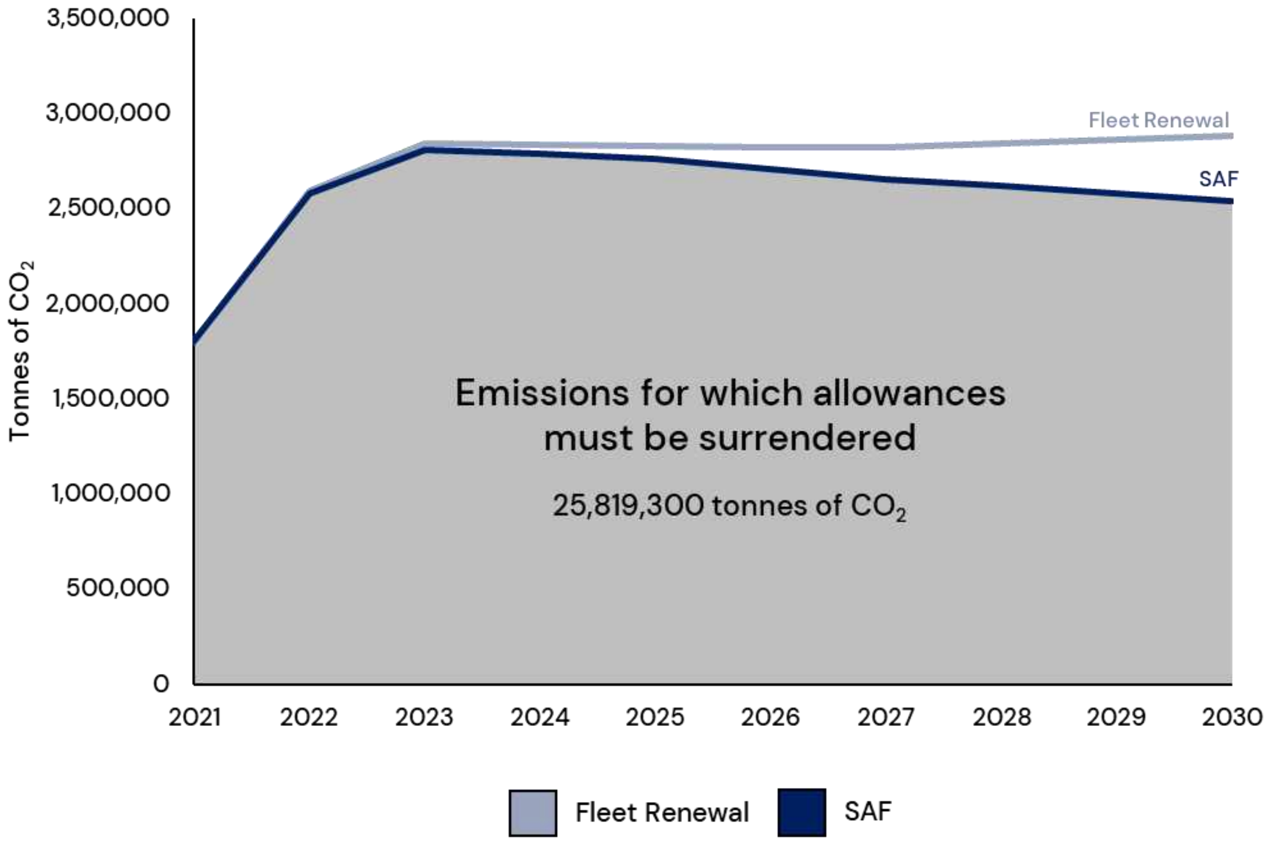


2.3. Emission Forecast Results

The introduction of fleet renewal and sustainable aviation fuels (SAF) enable Dutch carriers to decarbonise their operations. The carbon savings achieved through more efficient aircraft and lower-carbon fuels in turn reduces the volume of emissions for which EUAA/EUA allowances must be surrendered.

In Figure 22 below, the shaded area represents the residual emissions following fleet renewal and SAF for which allowances must be surrendered, 25,819,300 tonnes of CO_2.

Figure 22: National CO_2 emissions following fleet renewal and SAF uplift for which allowances must be surrendered totals 25,819,300 across Phase 4



Utilising national and carrier emissions, following fleet renewal and SAF uplift, the following section assesses allowance obligations, free allowance allocation, allowance auctioning requirements and EU ETS costs, under three policy scenarios:

- The original EU ETS Phase 4 2030 free allowance reduction
- The European Commission proposed 2027 free allocation phase out
- Approved Parliamentary 2026 free allocation phase out.

Key Messages
Chapter 2: Carbon Forecasting

Chapter 2 provided the emission forecast necessary to undertake EU ETS Phase 4 analysis. The chapter explored the carbon emission implications of movement growth, fleet renewal and SAF uplift for the Dutch aviation sector. Conducting this forecast through the end of Phase 4 (2030), established both the annual and cumulative EUA/EUAA surrendering obligations for Dutch carriers.

Key Takeaways

- The National policy landscape will play a central role in shaping allowance obligations. From 2023, if the Dutch aviation sector is permitted to grow at an annual rate of 1.5%, the additional ≈22,500 movements will increase national allowance obligations.
- If the Dutch aviation sector were to grow by 1.5% annually from 2023, emissions would increase by 122,000 tonnes by 2030, a 4% increase. This is contrary to 7% movement growth over the same time period as a result of the fuel efficiencies provided by fleet renewal.
- If KLM and Transavia are to achieve their voluntary 10% SAF target, in addition to ReFuelEU mandates, Dutch carriers will uplift over 340,000 tonnes of SAF through the end of Phase 4, delivering over 1.3 million tonnes of carbon abatement.
- Under the Original Phase 4 structure, 25,819,300 EUA/EUAAs would have to have been surrendered to address all Dutch carrier EU ETS applicable emissions.
- Over the entirety of Phase 4 of EU ETS, following fleet renewal and SAF, approximately 26 million EUA/EUAAs will have to be surrendered to cover Dutch sector aviation emissions.
- Forecast results were tabulated using publicly available information and sector outlooks. Delays in aircraft deliveries, the re-introduction of a Schiphol movement cap, and varying success of voluntary SAF targets could all impact results, altering allowance obligations.

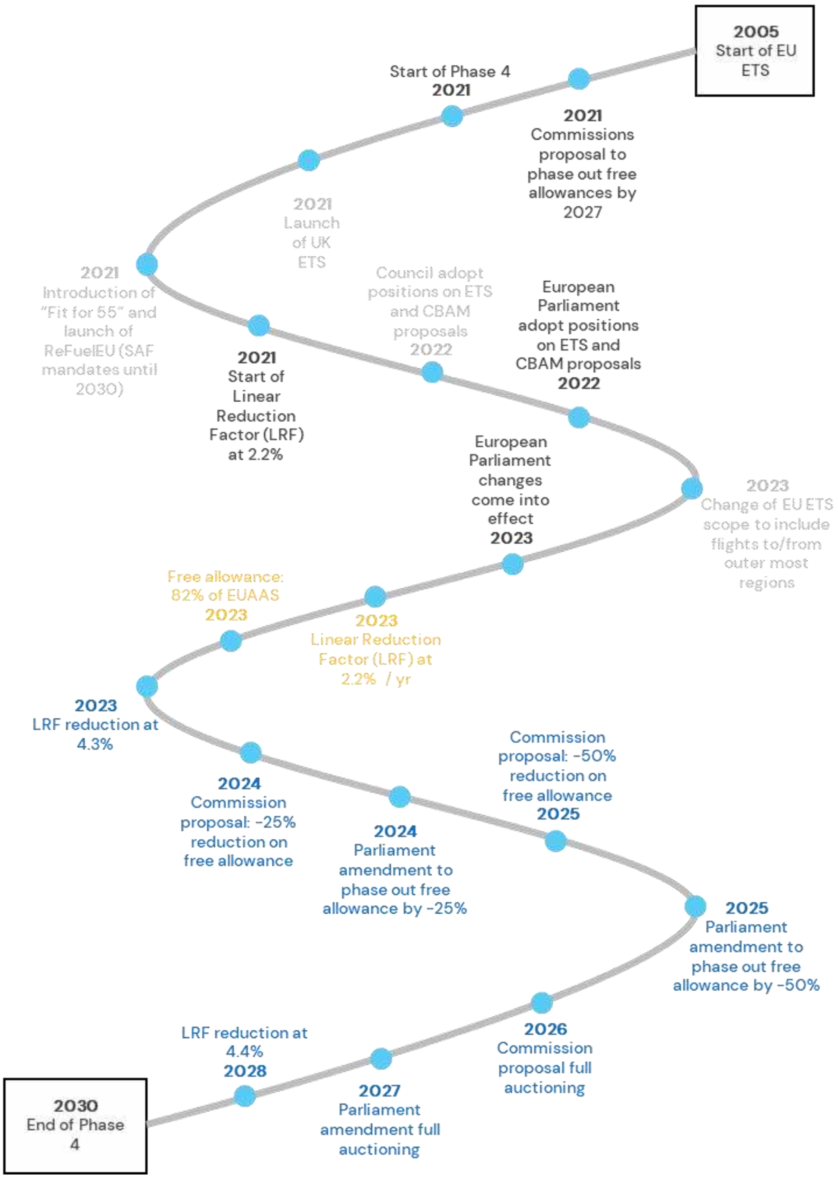

Departures

3. EU ETS Policy Scenarios

3.1. Phase 4 EU Aviation Allowance Generation

Entering Phase 4 of the EU ETS in 2021, the aviation specific allowance cap and free allowance allocation was set to mirror that of the broader EU ETS. An annual linear reduction factor (LRF) of 2.2% was applied to the total volume of European Aviation Allowances (EUAAs) for the duration of Phase 4 (2021-2030), with 82% of the aviation's cap to be freely allocated to carriers. In December of 2022, however, the European Parliament and the Council reached an agreement to modify the EU ETS mechanisms for aviation and the new Directive was published in May 2023. The timeline below presents the structural evolution of Phase 4 of EU ETS for the aviation sector.

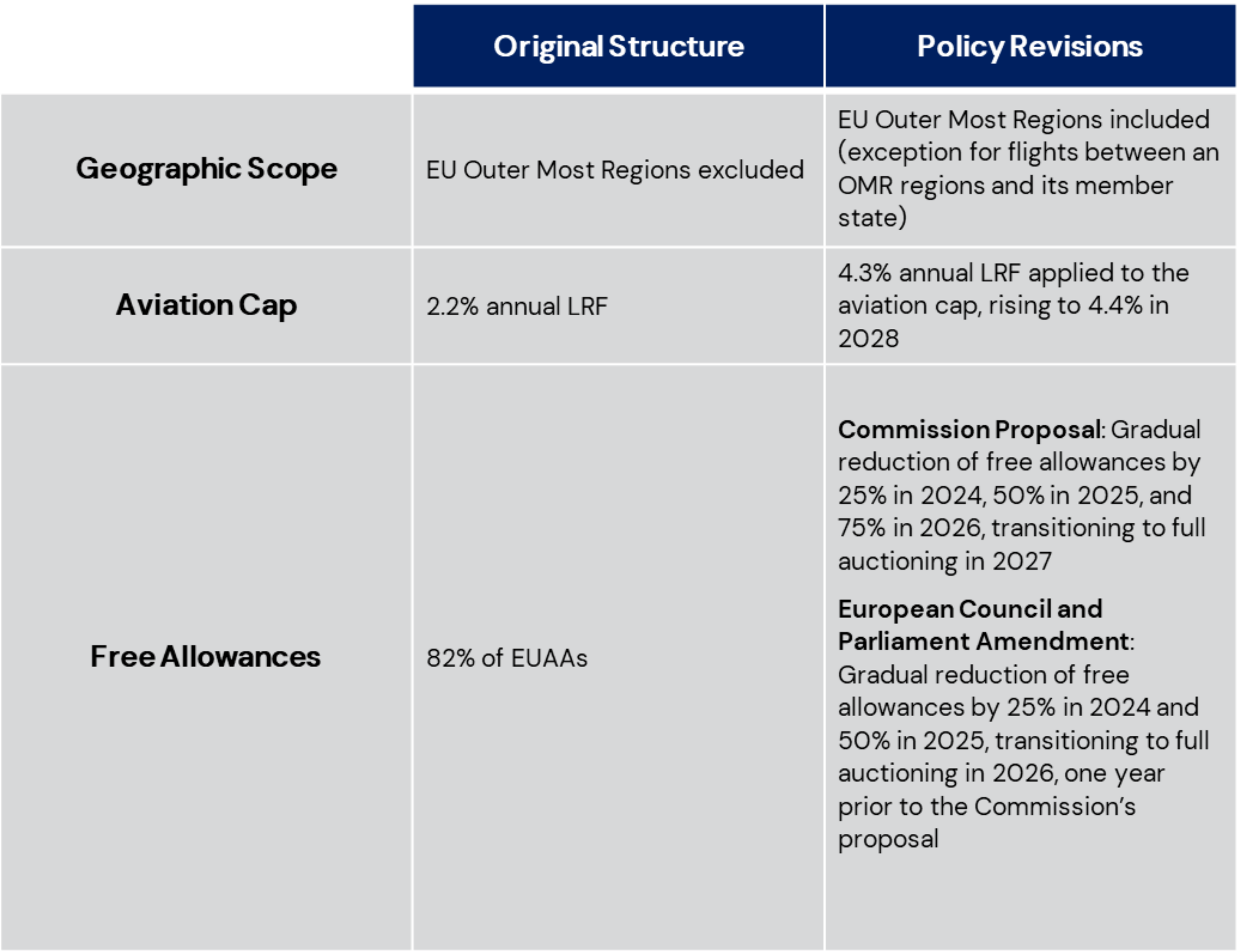
Figure 23: EU ETS aviation Phase 4 structural evolution



The amendments to the EU ETS from 2024 include a progressive phase-out of the free allowances distributed to aircraft operators from 2024 (25% in 2024, and 50% in 2025) with a complete phase-out from 2026 onwards. To meet the more stringent 2030 emission target, the cap is reduced by 4.3% annually from 2024 and by 4.4% by 2028, instead of the previous 2.2%

Given these changes that will be in place from 2024, Phase 4 periods can be broken in two : 2021-2023 and 2024-2030 which are outlined in Figure 24. For the purposes of the analysis, the table shows the two different approaches for the gradual phase out of free allowances, as proposed by the European Commission and the agreed one by the European Parliament and Council.

Figure 24: Aviation EU ETS structure under varying policy iterations



	Original Structure	Policy Revisions
Geographic Scope	EU Outer Most Regions excluded	EU Outer Most Regions included (exception for flights between an OMR regions and its member state)
Aviation Cap	2.2% annual LRF	4.3% annual LRF applied to the aviation cap, rising to 4.4% in 2028
Free Allowances	82% of EUAAs	**Commission Proposal**: Gradual reduction of free allowances by 25% in 2024, 50% in 2025, and 75% in 2026, transitioning to full auctioning in 2027 **European Council and Parliament Amendment**: Gradual reduction of free allowances by 25% in 2024 and 50% in 2025, transitioning to full auctioning in 2026, one year prior to the Commission's proposal

From 2024, carriers will be subject to revisions made by the European Council and EU Parliament. However, examining the intersection of carrier forecasted emissions with the revisions to aviation's EU ETS, this section presents the evolving allowance obligations, free allowance provision, and auctioning requirements under various Phase 4 policy iterations.

Assessing the various allowance and auctioning requirements under the Phase 4 policy iterations 4 will frame the increasing obligations and carbon cost burden to Dutch carriers. This section outlines the implications of the most recent EU ETS amendments for the Dutch aviation sector.

3.2. Free Allocation and Auctioning Requirements

The Dutch carrier emissions forecast conducted in Chapter 2 outlines the annual emissions for which allowances must be surrendered following activity growth, fleet renewal, and SAF uplift (Figure 22).

This section applies the three Phase 4 policy iterations to the emissions forecast to ascertain the allowance obligation and cost impacts of said policies. The analysis will highlight the changes to the free allowance distribution and auctioning requirements from the policy revisions.

The analysis conducted in the following chapter is based on the 1.5% CAGR movement scenario with the results from the no additional movements scenario presented in Chapter 6: Movement Scenario Comparative Analysis.

To recap the results from the emissions forecasting analysis, under a EUROCONTROL aligned 1.5% CAGR movement scenario, 25,819,300 allowances will have to be surrendered by the four Dutch carriers during Phase 4 of EU ETS (2021-2030), as indicated by the shaded area in Figure 22.

3.2.1. Original Phase 4 EU ETS Policy

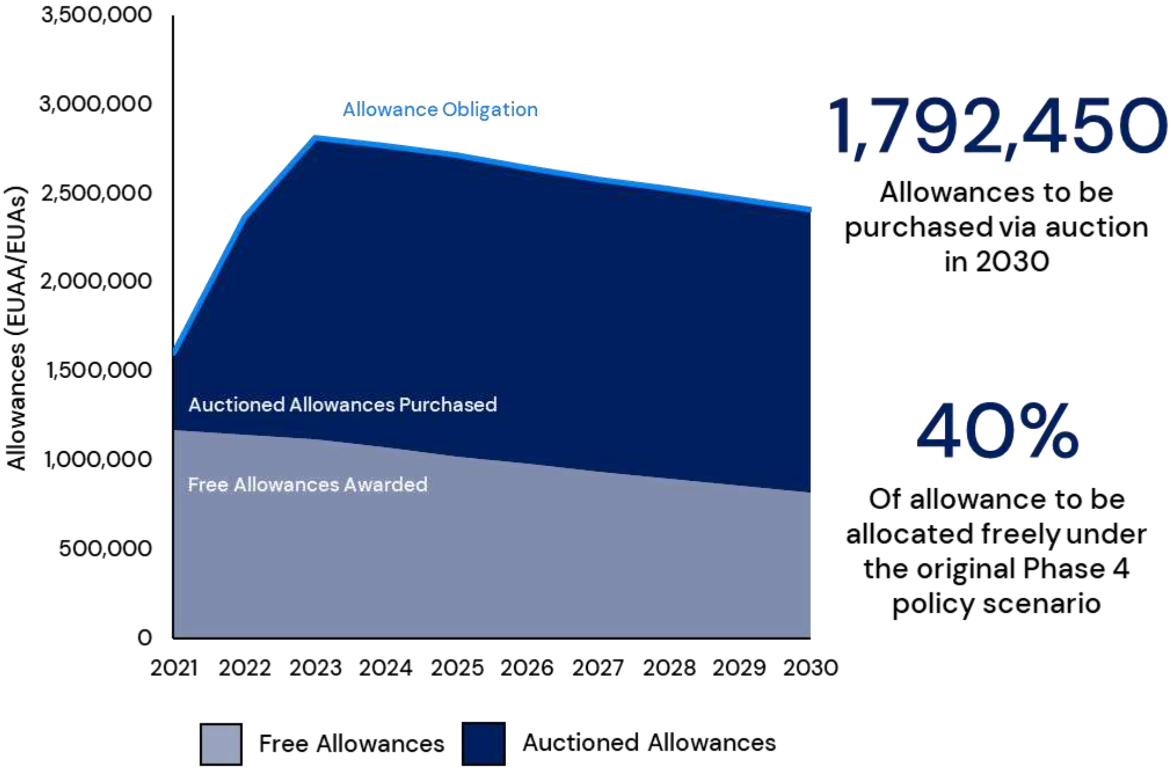
Under Phase 4's original structure, the quantity of total EUAAs and freely allocated EUAAs was tied to the LRF. Total allowances and free allowance allocation in Phase 3 was fixed for aviation, Phase 4 was to have the allowance cap and subsequently free allocation decline by 2.2% annually. Within Phase 4, the exemption of surrendering allowances for emissions generated on flights to and from the OMRs was to be continued. The initial structure of Phase 4 provided minimal external pressure to carriers to decarbonise as the scope of EU ETS would not be expanded and free allocation would remain a significant proportion of allowances surrendered. The following analysis outlines the allowance obligation implications for the Dutch aviation sector and carriers had Phase 4 not been revised to align with FitFor55. This section frames both the Commission's and Parliament's EU ETS amendments.

Carriers were not to receive 82% of their allowance obligations for free, rather 82% of EUAAs from the cap were to be distributed for free based on carrier 2010 tonne-kilometre data. Leveraging the EU policy ETS registry of verified emissions data, carrier free allocation and allowances surrendered was provided for 2021 and 2022. For the remainder of Phase 4 (2023-2030), the emissions forecasting analysis outlined in Chapter 2 was deployed to inform allocation obligations and distribution.

Despite 82% of EUAAs being distributed for free, outside of Covid-19 impacted years (2021 and 2022), carriers' allowance obligations have significantly exceeded their free allowance due to the fact that the industry's emissions have exceeded the EUAA Cap, necessitating purchases from outside the industry.

This phenomenon is shown in Figure 25, where free allowances do not comprise 82% of the Dutch sector's allowance obligations. Over the course of Phase 4, under the original EU ETS policy scenario, free allowances represent 40% of all allowances surrendered by Dutch carriers. The total cumulative allowance obligation under the original policy scenario stood at 25,819,300 with free allowances issued standing at 10,045,217 over Phase 4.

Figure 25: Allowance distribution to meet EU ETS obligations under Phase 4's original free allocation reduction



Under the original structure of Phase 4, the percentage share of free allowances comprising of total allowances surrendered, peaked at 73% in 2021 before declining to 31% by 2030.

As a result, despite 82% of EUAAs within the cap being freely distributed to Dutch carriers in 2030, equating to 821,812 EUAAs, in 2030 Dutch carriers would have been obligated to purchase 1,792,450 additional allowances via auction to ensure EU ETS compliance. In 2030, auctioned requirements would comprise of 69% of allowances surrendered.

3.2.2. EU ETS Policy Scenarios

Beginning in 2021, aviation's EU ETS underwent a review and revision process. During this process, two new iterations of Phase 4 were produced, the first, which was delivered by the Commission, was later revised by the Parliament. While differing in their specifics, both the Commission's and Parliament's amendments introduced three structural changes to the sector's EU ETS methodology:

1. Gradual Phase-out of free allowances allocated to aircraft operators from 2024 in proportion of their 2023 verified emissions, with:
    a. Full auctioning by 2027 under the Commission's proposal
    b. Full auctioning by 2026 under the Parliament's amendments
2. Expansion of the reporting scope to include emissions stemming from flights to and from the EU's OMRs when those flights are not between an aerodrome located in an outermost region of a Member State and an aerodrome located in the same Member State outside that outermost region,
3. From 2023, an increase in the LRF from 2.2% annually to 4.3%, rising to 4.4% in 2028 until 2030.

In May 2023 the new rules of EU ETS applicable to aviation were published through Directive 2023/958 of the European Parliament Council. However, the Commission's and Parliament's proposals to amend the EU ETS for the aviation sector serve as the second and third policy scenarios for this analysis. The updates to EU ETS must be quantified in terms of allowance obligations and free allowance distribution to ascertain the financial impact that said changes will have on Dutch carries through 2030. This section assesses the implications of the three key structural changes to Phase 4 while highlighting how the two revised iterations of Phase 4 differ in terms of free allocation distribution and auctioning requirements at a National and carrier level.

Impacts of the Expanded Geographic Scope

Under the revised policy scenarios, the inclusion of flights to the EU Outermost Regions impacts the quantity of allowances which Dutch carriers will have to surrender under Phase 4 of EU ETS.

Figure 26: Flights to the EU Outer Most Regions (OMR) regions are excluded from the ETS reporting scope until 2024

Expanding the geographical scope of EU ETS in turn increased the number of eligible EU ETS flights while simultaneously increasing average trip distance for a handful of the carriers which comprise this analysis. Figure 27-Figure 30 below capture the changes in the emissions forecast underlying data, reflecting the geographical scope expansion of OMR inclusion.

Figure 27: Total number of trip changes by carrier under the revised EU ETS Phase 4 scope (2024-2030)

Airline	Number of Trips Original Iteration	Number of Trips Policy Scenarios	Impact of Expanded Policy Scope
Corendon Dutch Airlines	8,533	9,535	+1,002
KLM	1,491,543	1,491,905	+362
Transavia	331,237	349,951	+18,714
TUI Airlines Netherlands	23,413	43,165	+19,752

Figure 28: Average trip distance (km) change by carrier under the revised EU ETS Phase 4 scope (2024-2030)

Airline	Average Trip Distance Original Iteration	Average Trip Distance Policy Scenarios	Impact of Expanded Policy Scope
Corendon Dutch Airlines	2,099	2,229	+130
KLM	900	900	0
Transavia	1,491	1,564	+73
TUI Airlines Netherlands	2,240	2,624	+384

Figure 29: Total fuel burn (tonnes) change by carrier under the revised EU ETS Phase 4 scope (2024-2030)

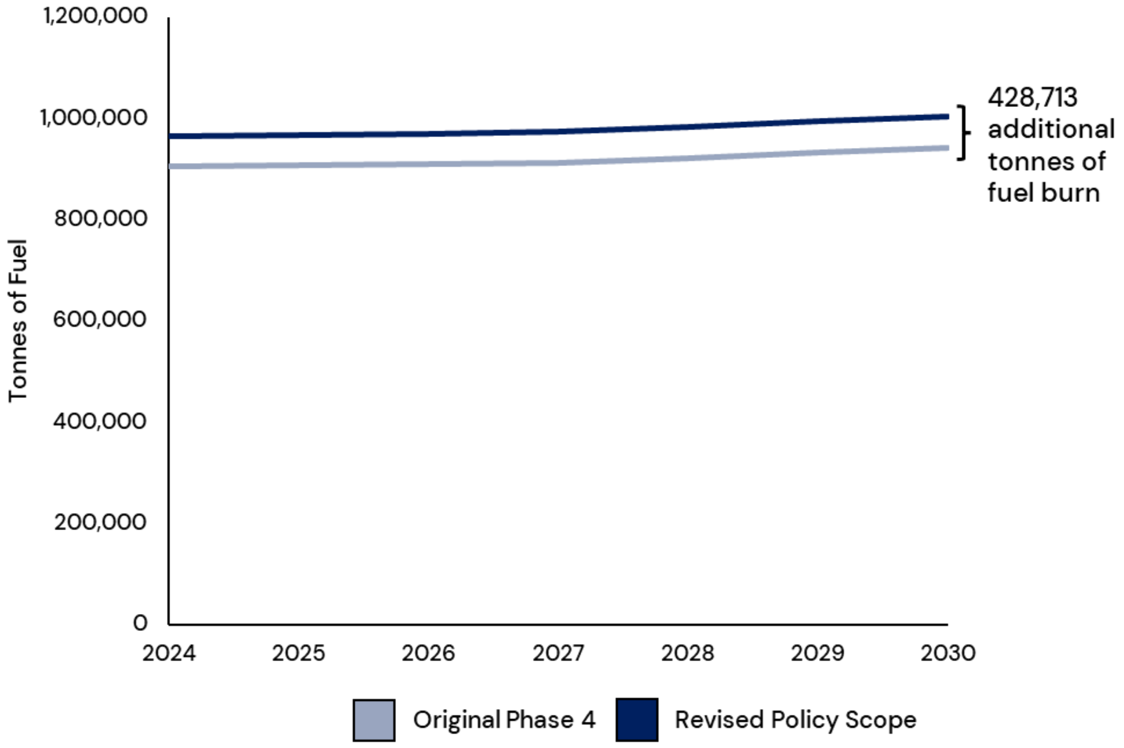
Airline	Total Fuel Burn Original Iteration	Total Fuel Burn Policy Scenarios	Impact of Expanded Policy Scope
Corendon Dutch Airlines	60,689	71,560	+10,871
KLM	4,390,533	4,392,076	+1,543
Transavia	1,801,743	2,008,340	+206,597
TUI Airlines Netherlands	174,479	384,181	+209,702

Figure 30: Total CO_2 (tonnes) change by carrier under the revised EU ETS Phase 4 scope (2024-2030)

Airline	Total EU ETS CO_2 Original Iteration	Total EU ETS CO_2 Policy Scenarios	Impact of Expanded Policy Scope
Corendon Dutch Airlines	191,171	225,413	+34,242
KLM	13,830,179	13,835,040	+4,861
Transavia	5,675,491	6,326,272	+650,781
TUI Airlines Netherlands	549,610	1,210,172	+660,562

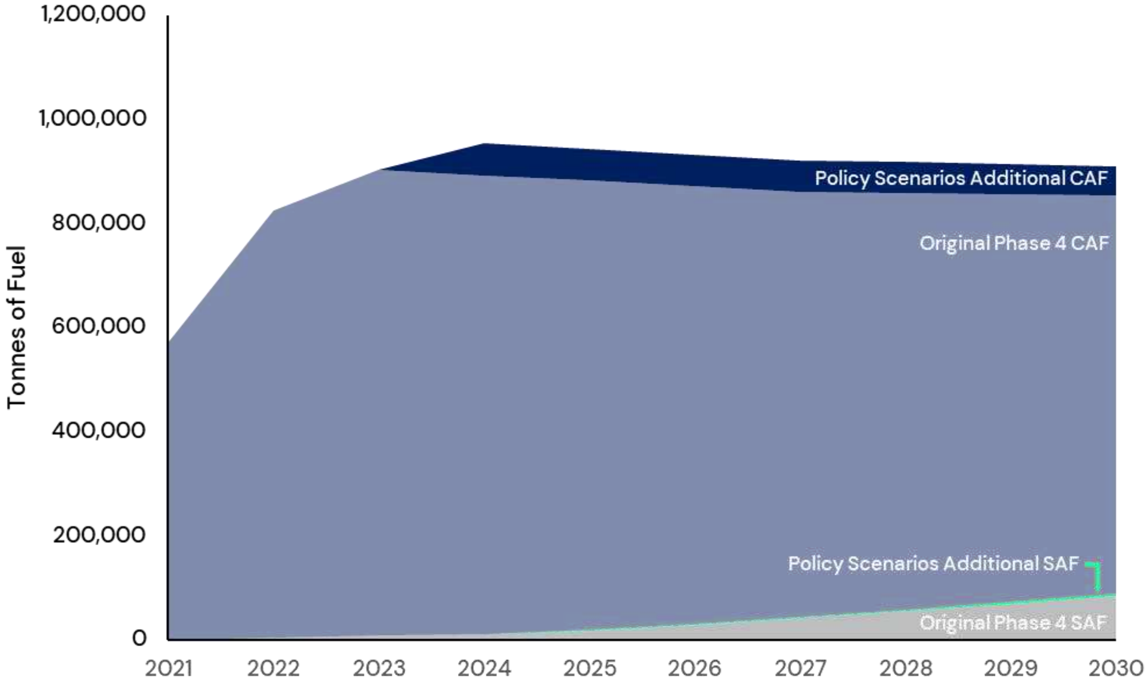
The subsequent changes impact EU ETS applicable fuel burn, SAF uplift, and emissions. The graph below reflects the increase in national fuel burn resulting from the revision of geographical scope. From 2024 (from when the changes are to be implemented) to the end of Phase 4 in 2030, there is a 428,713 tonne increase in national fuel burn as the result of these changes. Figure 31 reflects the fuel burn changes, post fleet renewal, which are the result of OMR inclusion within the EU ETS Phase 4 scope.

Figure 31: The inclusion of flights to/from the OMR from 2024 increases cumulative fuel burn from 6,427,445 tonnes to 6,856,158 tonnes by 2030



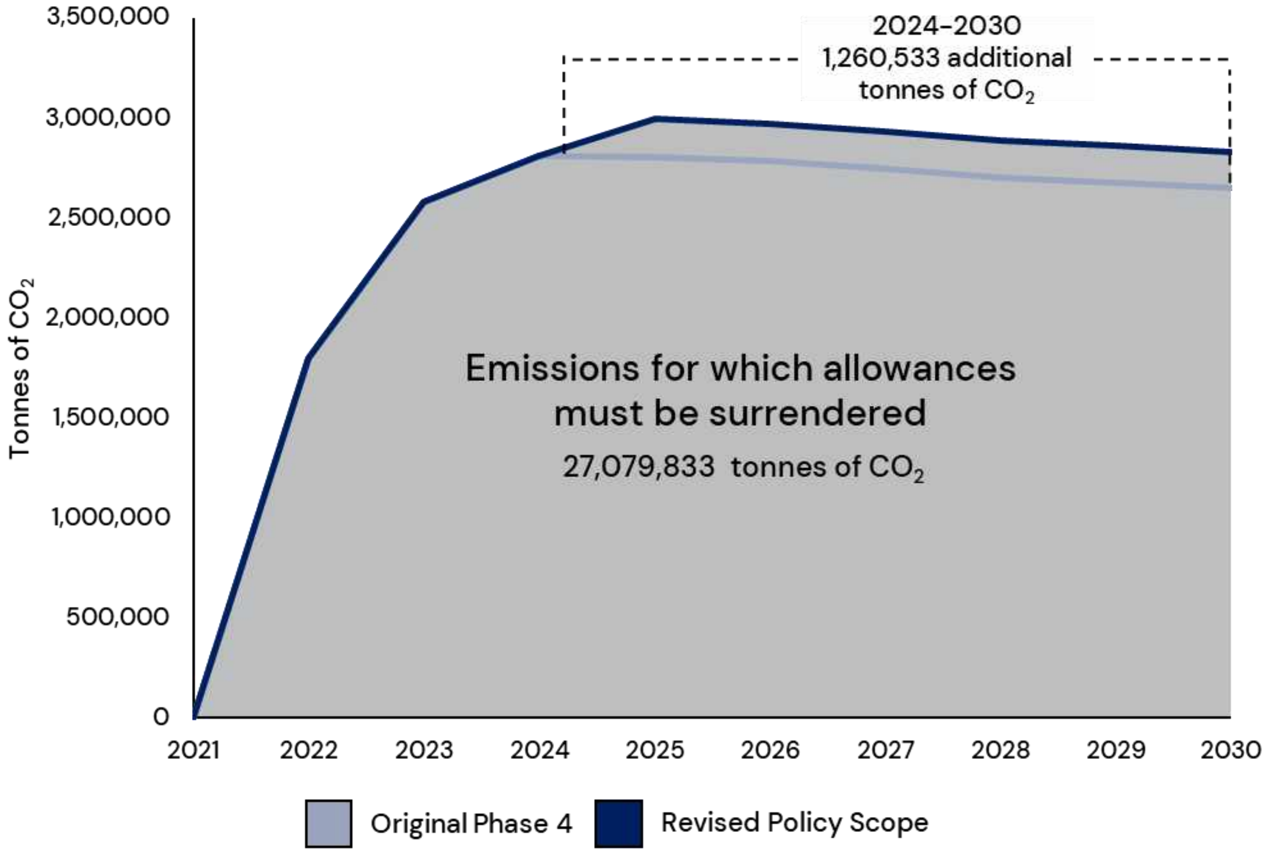
While the expansion of the EU ETS scope leads to an increase in fuel burn, the volume of SAF to be offtaken by carrier also increases. As the ReFuelEU mandate and voluntary SAF targets are set in terms of percent share of carrier fuel use a higher overall volume of SAF will be utilised from 2024. Figure 32 below depicts the increase in SAF volumes which carriers will use on EU ETS applicable routes and the corresponding overall CAF use increase, tied to the graph above. From 2024-2030, as a result of the expanded scope, SAF use will increase by 17,662 tonnes, if Transavia and KLM meet their respective 2030 10% SAF targets. As for conventional aviation fuel, uplift increased by 411,050 tonnes over the same period. While SAF use does increase as a result of the OMR inclusion, the increased carbon mitigation is offset by the corresponding increase in CAF fuel burn.

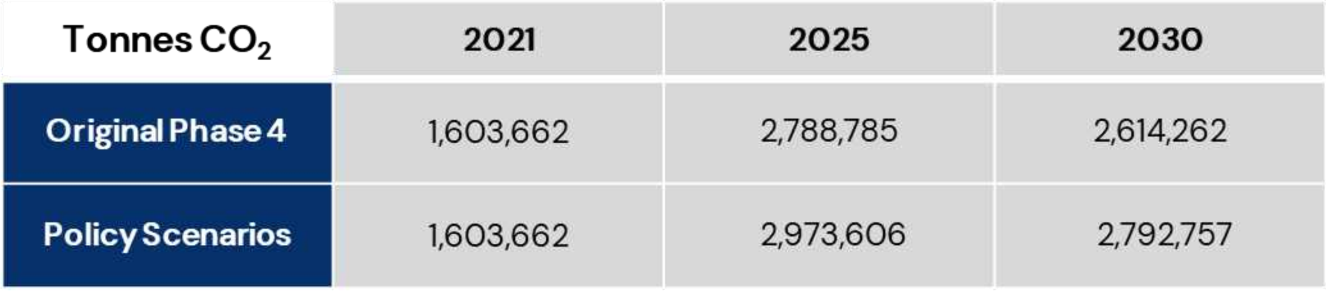
Figure 32: Despite the volume of SAF increasing increases due to OMR inclusion, CAF use increase and at a higher rate



The changes in fuel burn and SAF use directly corresponds to varying CO_2 forecasts for the original Phase 4 and revised policy scenarios (2026 and 2027 free allocation phase out). Under the expanded scope, Dutch carriers will emit 27,079,833 tonnes of CO_2 for which allowances must be surrendered. This represents a 1,260,533 increase from the emissions which were forecasted under the original Phase 4 iteration and is depicted in Figure 33 below. The largest annual delta between the two ETS scopes is in 2024 with a difference of 189,381 tonnes of CO_2.

Figure 33: National emission forecast following fleet renewal and SAF under the original and expanded EU ETS policy scope





Tonnes CO_2	2021	2025	2030
Original Phase 4	1,603,662	2,788,785	2,614,262
Policy Scenarios	1,603,662	2,973,606	2,792,757

For the following analysis, variations in the quantity of free allowances to be surrendered and auctioned is in part influenced by the expansion of geographic scope. As the analysis above has demonstrated, the allowance obligations vary across the policy scenarios and are directly tied to the emissions forecast analysis. Increasing the number of applicable EU ETS flights which raises average flight distance will ultimately impact the cost burden of EU ETS compliance for the Dutch aviation sector. This impact will be explored in Chapter 4.

Free Allocation Phase Out

Under both scenarios, it is important to note that, as mentioned in point 1.2, the cap for 2024 is to be based on the total number of allowances that were allocated to all active aircraft operators in the EU ETS in the year 2023, reduced by the linear reduction factor. This cap, according to the recent decision from the European Commission[36], amounts to 28,866,578 allowances in 2024. The Decision also establishes the amount of free allocation which would have taken place in 2024 under the rules for free allocation in force prior to the amendments. This amounts to 24,536,591 allowances and it is used to define the total amount available for free allocation, which is the amount reduced by 25% in 2024[37]. This means 75% of those 24,536,591 allowances are to be distributed to aircraft operators in 2024. This amounts to 18,402,443 carbon allowances to be distributed in proportion to the operators' verified emissions in 2023.

There is no clear guidance on how the total quantity of allowances to be allocated in respect of aircraft operators in the EU ETS will be for 2025. In our understanding, the cap will be reduced again by 4.3%, to 27,473,466. We assume that the amount of free allocation which would have taken place in 2025 under the rules for free allocation in force prior to the amendments would be 23,352,446, being this amount reduced by 50% in 2025 to define the total amount available for free allocation. This amounts to 11,676,223 carbon allowances to be distributed in proportion to the operators' verified emissions in 2023. The amendments to the EU ETS in aviation bring therefore a change in the benchmark for the free allocation of carbon allowances, which makes 2023 verified emissions the key element in the distribution, in comparison to the previous 2010 and 2014 TKM.

It is estimated that emissions reported under the EU ETS for 2023 will be approximately 63,370,200 tonnes CO_2 (Extrapolating the EUROCONTROL forecast of 93% growth in traffic over 2019 levels, in a base scenario). This would mean that, 29% of the overall verified emissions in EU ETS in 2023 will be allocated for free in 2024. In 2025, free allowances will amount to 18% of the overall verified emissions in EU ETS in 2023.

The scenarios diverge in 2026. Under the amendments approved by the Parliament and Council, operators will not receive any free allowance from 2026 (except for the free allowances reserved for SAF claims). Under the previous Commission proposal, only 9% of the reported emissions in 2023, which it is estimated to amount to 5,542,075 carbon allowances, would be for free allocation.

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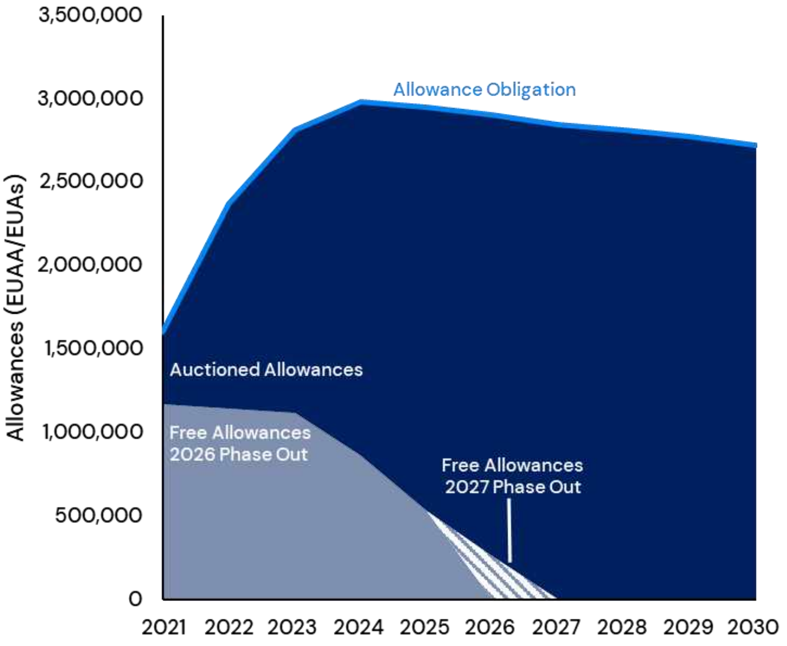
[36] *https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302440*

Figure 34 below depicts the allowance requirements and free allocation distribution at a national and carrier level for the two scenarios.

In 2024 and 2025, Dutch carriers are set to receive 868,586 and 535,249 free allowances respectively, where under the 2027 phase out scenario, 263,965 allowance are allocated for free in 2026. At the end of Phase 4, in 2030, Dutch carriers will be purchasing 100% of their allowance obligations via auction, to the sum of 2,792,757 allowances.

Figure 34: Allowance distribution to meet EU ETS obligations under the 2026 & 2027 free allocation phase out policy scenarios



2,792,757

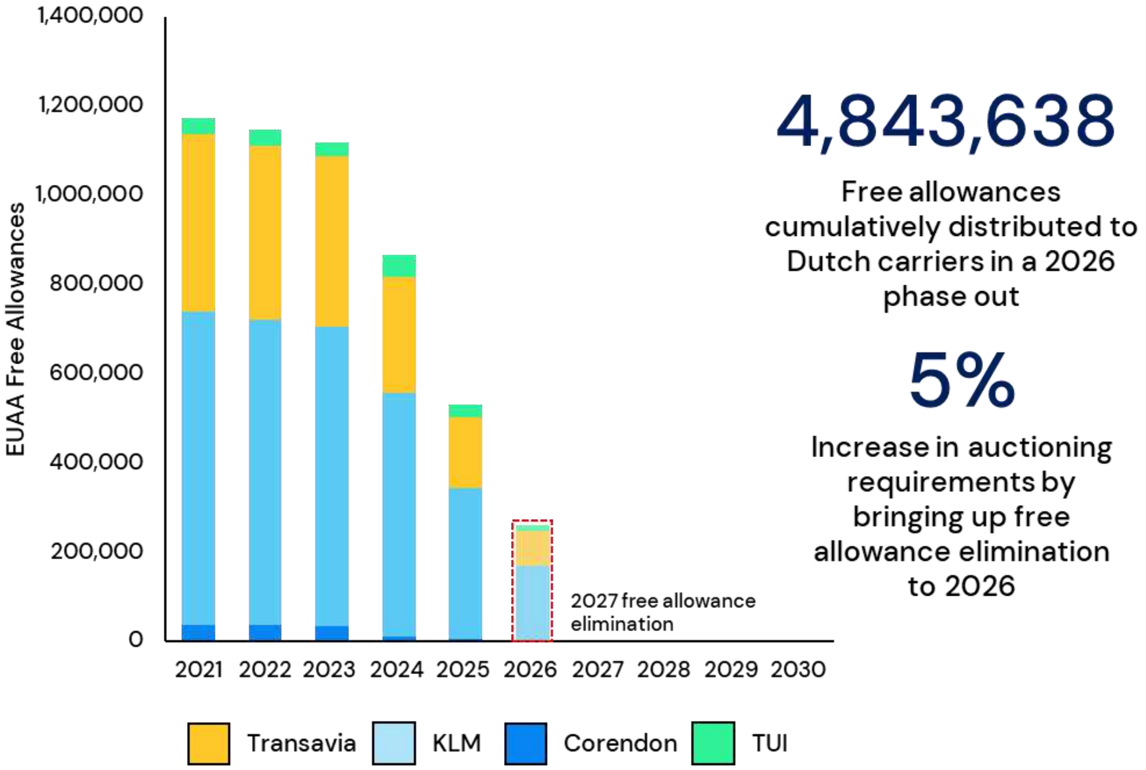
Allowances to be purchased via auction in 2030

263,965

Increase in auctioning requirements by phasing out free allocation by 2026 rather than 2027

Despite Parliament phasing out free allowance one year prior to the Commission's proposal (2026 rather than 2027), there is only marginal variability in the number of free allowances allocated to Dutch carriers in Phase 4. Under the 2026 phase out scenario, 4,843,638 free allowances are allocated to Dutch carriers compared to 5,107,603 in the 2027 phase out scenario, a difference of 262,965 EUAAs. Figure 35 highlights the free allowances allocated to Dutch carriers under both scenarios. Highlighted in red, shortening the phase out of free allowances by one year increases auctioning requirements by 262,965 allowances, increasing auctioning requirements by 5% in 2026.

Figure 35: Carrier free allowance distribution across the 2026 and 2027 policy scenarios differs by 5%



3.2.3. Policy Comparative Analysis

This section provides a comparative analysis of the three EU ETS policy iterations presented in the prior sections. Providing a comprehensive overview of the policy iteration impacts on allowance obligations, free allocation, and auctioning requirements lays the foundation for forecasting the cost implications of EU ETS's Phase 4 to Dutch carriers and for understanding what these policy changes mean in tangible terms.

Figure 36 and Figure 37 highlight the cumulative differences between the original Phase 4 and the revised Phase 4 (Commission's proposal and Parliament's amendments). When comparing the effects of the three methodologies, the inclusion of flights to and from the EU's OMRs in 2024, increases Phase 4 total allowance obligations by 1,283,278 EUA/EUAAs. Furthermore, the share of free allowances represented within total allowances surrendered varies quite significantly between the three EU ETS scenarios. Under Phase 4's original methodology, freely allocated allowances comprised of 40% of total allowances surrendered between 2021 and 2030, whereas for the 2027 phase-out it free allowances comprise 19% of total allowances surrendered and the 2026 phase out scenario that figure drops to 18%.

Figure 36: Cumulative Phase 4 allowance distributions under the three policy iterations (2021-2030)

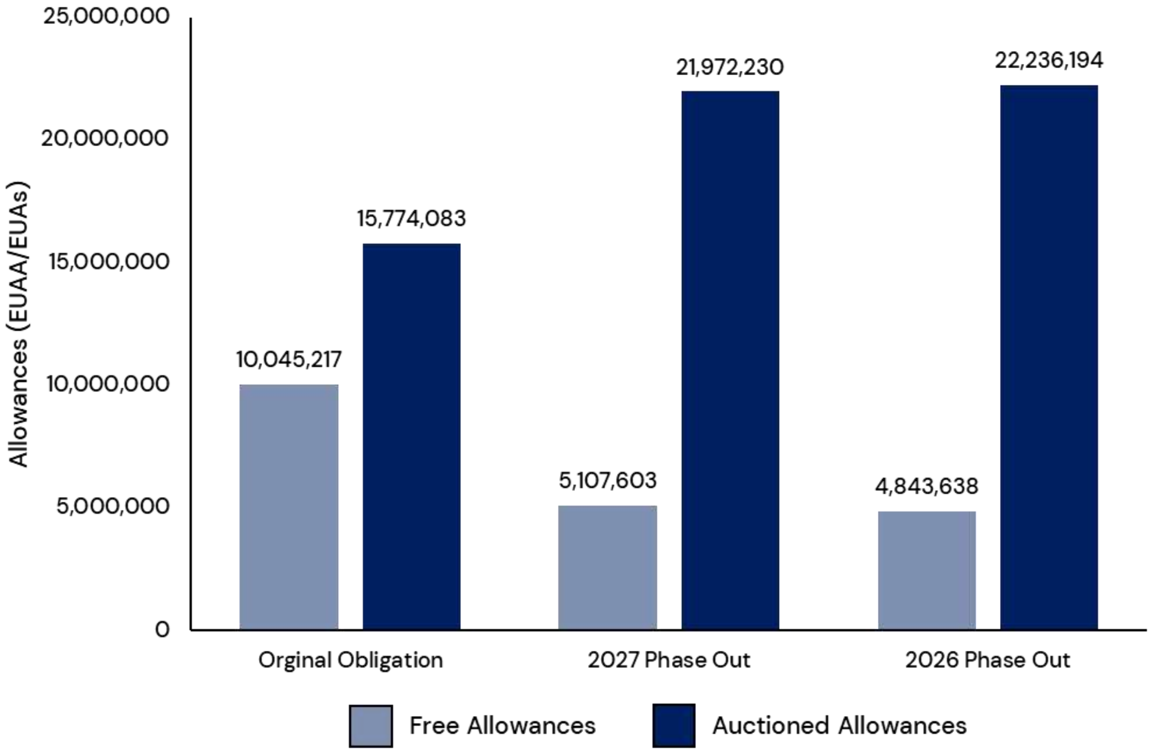
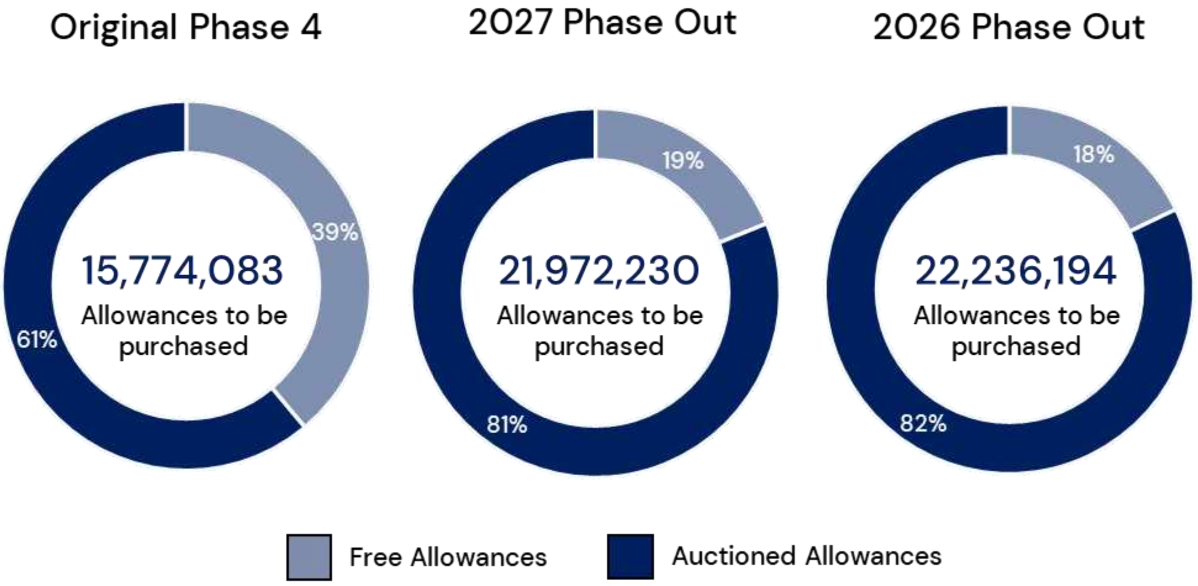
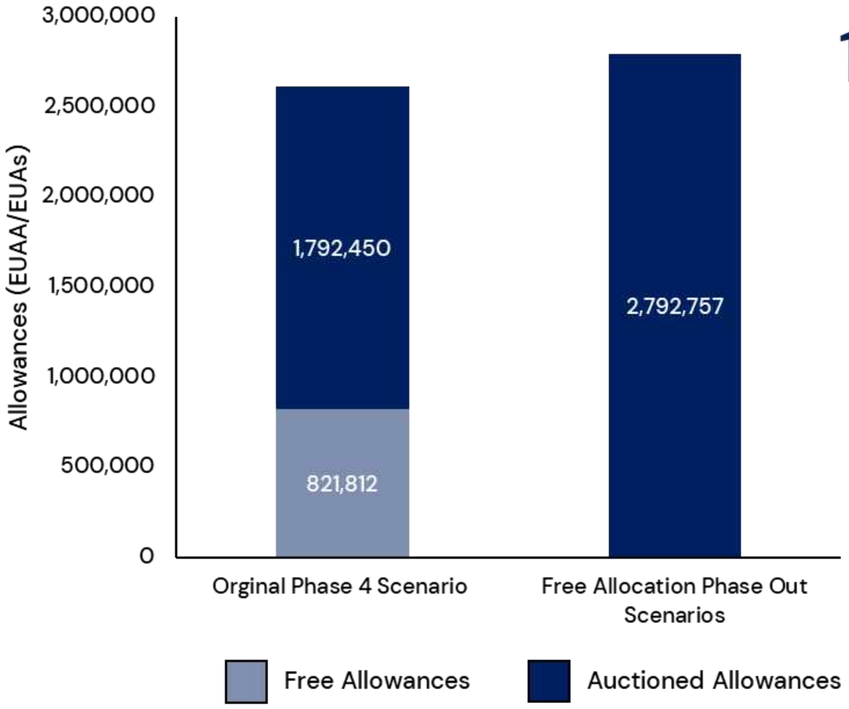


Figure 37: Comparative allowance distribution under the original Phase 4, 2027, and 2026 free allocation phase out scenarios



The scope expansion and free allocation differences between the two scenarios drive a significant increase in auctioning requirements for carriers. Figure 38 below provides a 2030 snapshot of the increased auctioning requirements stemming from those structural differences. In 2030, Dutch carriers will have to surrender an additional 178,495 due to scope expansion. In terms of auctioning requirements, under the original Phase 4 scenario, carriers would have been required to purchase 1,792,450 allowances as 31% of allowances were to have been allocated freely. However, under the free allocation phase out scenarios, the auctioning requirement increases by 1,000,307 EUA/EUAAs to 2,792,757.

Figure 38: 2030 Snapshot – Allowance distribution comparative analysis between free allocation phase out versus elimination under the policy scenarios



1,000,307

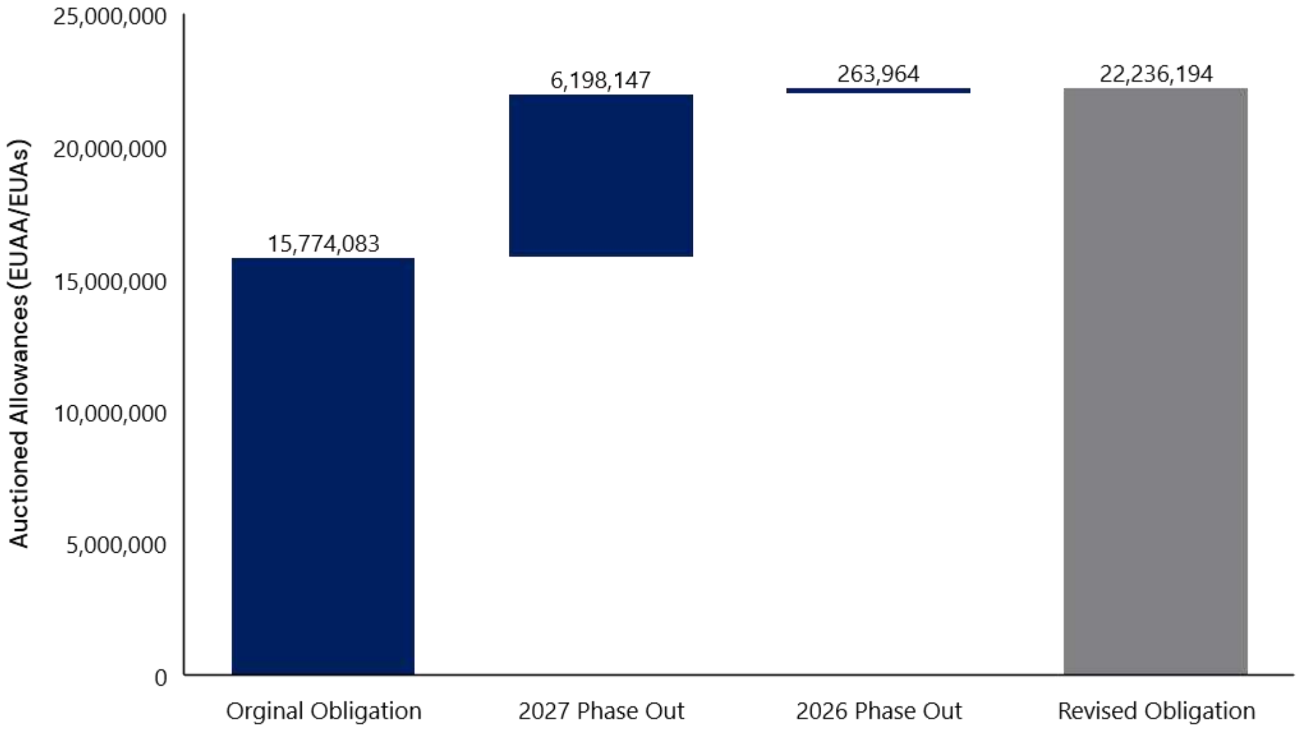
Increase in auctioning requirements in 2030 due to free allocation elimination

178,495

Allowance obligation delta between the two scenarios in 2030

Assessing the EU ETS policy iterations, the most significant change in terms of allowance purchasing implications to Dutch carriers, relates to the introduction of the Commission's amendments. The initial changes to aviation's EU ETS methodology, of expanding the reporting scope and eliminating free allowances by 2027, increased auctioning purchasing requirements by 4.9 million allowances by the end of Phase 4. By comparison, the Parliament's amendment of bringing forward free allocation elimination by one year to 2026, only increases the auctioning burden by 262,965 allowances. This is because under the Commission's restructuring of EU ETS, in 2026, 25% of the original 82% of free allowances to be allocated under a 4.3% LRF would have been made available to carriers. Parliament moving to 100% allowance auctioning by 2026, does not introduce a material change to the structure of aviation's EU ETS. Figure 39 below shows the additional cumulative auctioning impact that each iteration of Phase 4 presents to the Dutch aviation sector. The 22,236,194 allowances under the Revised Obligation represents the auctioning obligation for Phase 4 as the EU ETS exists today.

Figure 39: Additional allowance auctioning progression across Phase 4's policy iterations



Under both the 2026 and 2027 free allocation phase out scenarios, the increased auctioning requirements to carriers is driven by the inclusion of the OMRs and free allocation elimination. It is these two changes that will ultimately drive-up EU ETS compliance costs to carriers from 2024 onwards.

One noteworthy takeaway from this analysis is that the alterations to the LRF are not impactful from 2026. To recall, the LRF reduce the quantity of EUAAs made available (i.e. the aviation cap) and through the cap the LRF dictates the quantity of free allowances to be made available. However, given that free allowances are to be phased out from 2026 under the Parliament's approved amendments, and that carriers are allowed to purchase non-aviation designated allowances to meet their obligations, the LRF and subsequently the aviation cap will no longer play a direct role in shaping how carriers meet their EU ETS obligations. From the changes introduced to the EU ETS, the elimination of free allowances has by far the most significant implications to how carriers navigate and manage their EU ETS obligations.

Key Messages
Chapter 3: EU ETS Policy Scenarios

Chapter 3 covered the varying allowance obligations for the Dutch aviation sector under Phase 4's policy evolutions. The analysis centred around how changes to Phase 4's geographic scope, the aviation specific cap, and free allowance allocation impacted total surrendering and auctioning obligations. Under Phase 4's original form, flights to and from the EU's Outer Most Regions were excluded where for the policy revisions, they have been included and associated emissions must have allowances surrendered. Additionally, the aviation specific cap's linear reduction factor was increased from 2.2% under the original Phase 4 structure to 4.3%, rising to 4.4% in 2028 under the revised policy scenarios. Lastly, free allowances having been allocated at 82% of the aviation cap under Phase 4's original structure have been phased out. The phasing out of free allowances subsequently created two sub-scenarios which were compared.

- The Commission's Proposal: Gradual reduction of free allowances by 25% in 2024, 50% in 2025, and 75% in 2026, transitioning to full auctioning in 2027
- European Council and Parliament Amendment: Gradual reduction of free allowances by 25% in 2024 and 50% in 2025, transitioning to full auctioning in 2026, one year prior to the Commission's proposal

Key Takeaways

- The expansion of Phase 4's geographic scope to include Outer Most Regions added 39,830 trips over a 7-year period increasing cumulative fuel burn by approximately 423,700 tonnes.
- Following SAF uplift, the expansion of EU ETS for Phase 4 adds an additional 1,282,330 tonnes of CO_2e for which emissions must be surrendered from 2024-2030.
- The total cumulative allowance obligation under the original policy scenario for Phase 4 totalled 25,819,300 where under the policy scenarios Dutch carrier obligations rose to 27,079,833 from 2021-2030.
- Under the Original Phase 4, 10 million allowances were to be issued to Dutch carriers for free. Under the 2027 Phase Out Scenario, total free allowances to Dutch carriers were reduced by 49% to 5.1 million. Transitioning to Parliament's amendments (2026 Phase Out), a further 263,965 free allowances were eliminated for a total of 4.8 million across the duration of Phase 4.
- Allowances to be purchased by Dutch carrier via auction under the Original Phase 4 policy iteration stood at 61% of total obligations where under the revised policy scenarios that percent share increased to 81% and 82% under the Commission and Parliament scenarios respectively.

4. Policy Impact Cost Analysis

4.1.Pricing Forecast and Sensitivity Analysis

Chapter 4 presents a financial impact analysis of the EU ETS to the Dutch aviation sector. Under three potential EUAA/EUA cost scenarios, the analysis offers a forecast of the annual and cumulative costs of EU ETS to the Dutch sector under varying policy scenarios. In the following chapter, the cost impact of the EU ETS policy iterations is presented in absolute and per passenger terms.

4.2. Cost Assessment

4.2.1. EUA Price Forecast and Scenario

While there is a distinction within the EU ETS on allowance types, EUA being general EU Allowances and EUAAs being EU Aviation Allowances, they can be auctioned and surrendered interchangeably. As such, for this analysis the costs of allowances are assumed to be the same across both types.

Three allowance cost scenarios have been developed to capture the historic and future price variability of EU ETS allowances: €85, €95, and €105 per allowance. The three scenarios are derived from historical EUA pricing trends seen in Figure 40 and anticipated availability driven pricing fluctuations.

Figure 40: EUAA/EUA historical price data: January 2021 – September 2023

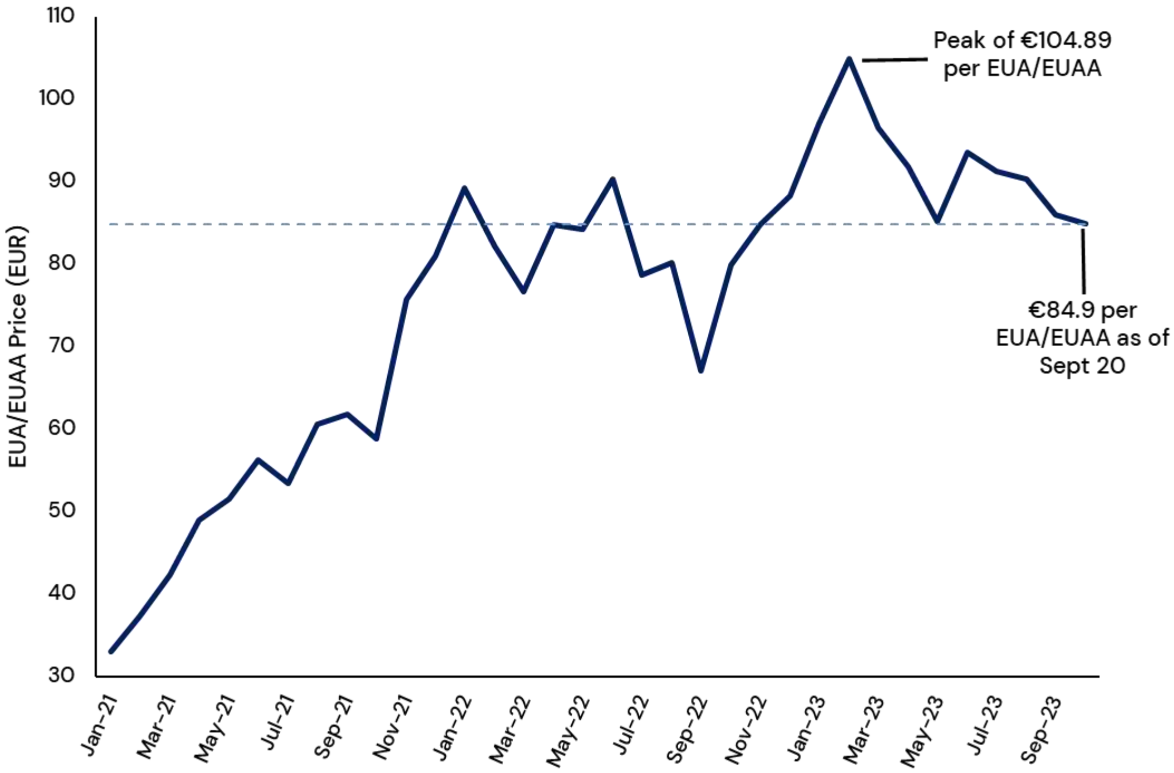


Figure 41: Phase 4 pricing forecast underpinned by three EUA/EUAA pricing assumptions

Business-as-Usual Scenario **€85 per allowance**	• Price of EUA (18th Sep 2023): €85.53 • Mean price per allowance from start of Phase 4 (Jan 2021) to present (Sep 2023): €83 • Assumption: Price of allowances will remain in-line with historic averages despite peaks and lows
Median Scenario **€95 per allowance**	• Price range of EUA: €58-95 • €95 over Phase 4 to reflect current pricing trends • Assumption: EU-wide decarbonisation efforts minimise demand-induced price spikes caused from decreased allowance availability and free allocation phase outs
High Price Scenario **€105 per allowance**	• EUA price in February 2023: €105.73 • Assumption: EUA price >€100 per allowance for the rest of Phase 4 due to decreased in aviation and general EU ETS caps and available allowances reduction

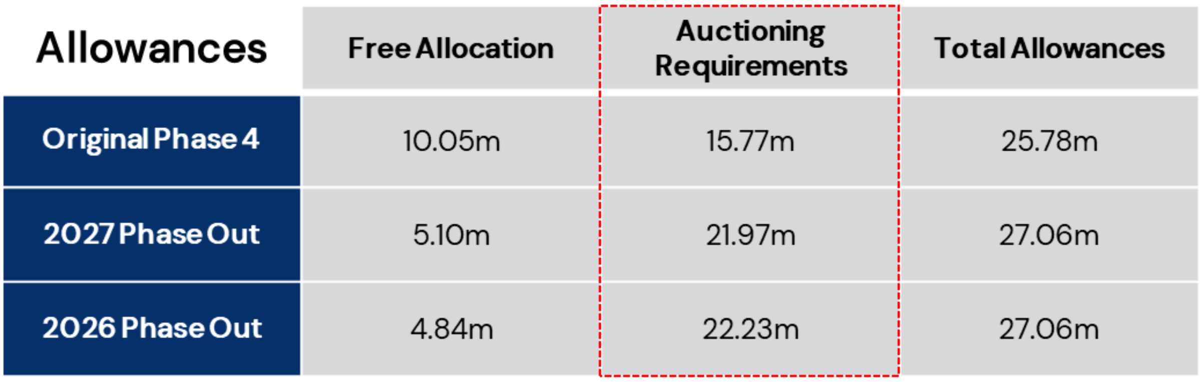
An important note regarding the High Price Scenario, is that the current penalty is €100 for failing to surrender an EUAA/EUA for a tonne of carbon which has been emitted. Under this scenario, the price of an EU ETS allowance will surpass the penalty costs requiring an alteration to the compliance mechanism.

In the following analysis, the quantity of allowances which must be purchased under each policy iteration is consistent across pricing scenarios. The key takeaway within each policy scenario should be the general pricing trends rather than the specific cost forecasts themselves given the uncertainty of how EUA/EUAA prices will evolve from today through 2030.

4.2.2. EU ETS Phase 4 Cost Forecast

In the previous chapter, the distribution of allowances Dutch carriers will receive through free allocation and the quantity of allowances to be purchased under the 1.5% CAGR movement scenario was presented and is summarised in Figure 42 below.

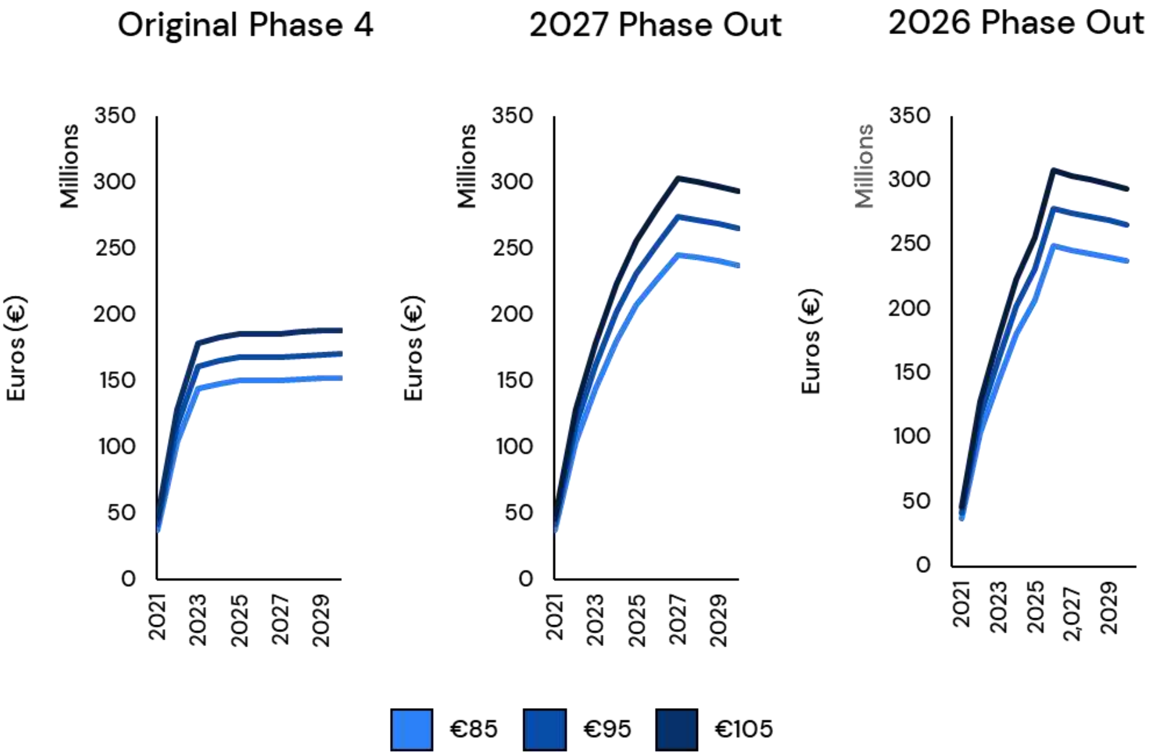
Figure 42: Auctioning requirements across the three Phase 4 policy iterations informs the EU ETS cost forecast



Allowances	Free Allocation	Auctioning Requirements	Total Allowances
Original Phase 4	10.05m	15.77m	25.78m
2027 Phase Out	5.10m	21.97m	27.06m
2026 Phase Out	4.84m	22.23m	27.06m

Utilising the three allowance cost sensitivity scenarios, the annual and cumulative auctioning requirement costs have been forecasted and are represented below. Figure 43 presents the annual EU ETS cost obligations for the Dutch aviation sector under the three allowance pricing scenarios.

Figure 43: National annual aviation EU ETS costs under three policy scenarios



Under the Original Phase 4 scenario, annual costs are substantially lower than the two phase out policy scenarios. This is due to a higher proportion of free allowances comprising of National allowances surrendered. Under this policy scenario, costs peak in 2023 at €144,456,317, €161,451,178, and €178,446,039 under the €85, €95, and €105 cost scenarios, respectively.

As for the 2026 and 2027 phase out scenarios, costs peak relative to the free allocation phase out year. For the 2027 phase out scenario, National costs peak at €245,567,419, €274,457,704, and €303,347,988 under the €85, €95, and €105 cost scenarios, respectively. For the 2026 phase out scenario, costs peak at €249,299,989, €278,629,400, and €307,958,811 under the €85, €95, and €105 cost scenarios, respectively.

Figure 44 below captures the price variations under the three allowance cost scenarios for each EU ETS policy iteration. Focusing on three key years (2021, 2026, and 2030), provides insight into the cost implications of free allocation phase out. The key takeaway from the tables below is that in the 2027 and 2026 phase out scenarios, auctioning costs only diverge in 2026. This is due to the EU Parliament brining the elimination of free allowances forwards by one year. From 2027, the costs of the two policy scenarios reconverge and are identical through 2030.

Figure 44: Annual national EU ETS costs for each of the three policy iterations across the EUA/EUAA price scenarios

€85 per EUA	2021	2026	2030
Original Phase 4	€37.37m	€150.48m	€152.39m
2027 Phase Out	€37.37m	€226.86m	€237.38m
2026 Phase Out	€37.37m	€249.29m	€237.38m

€95 per EUA	2021	2026	2030
Original Phase 4	€41.77m	€150.49m	€152.35m
2027 Phase Out	€41.77m	€253.55m	€265.31m
2026 Phase Out	€41.77m	€278.63m	€265.31m

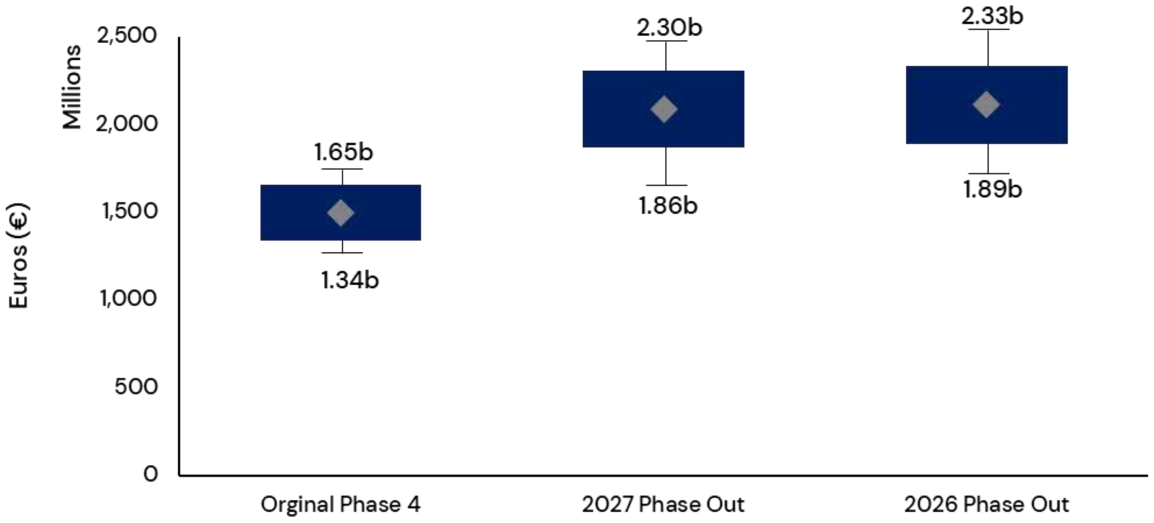
€105 per EUA	2021	2026	2030
Original Phase 4	€46.17m	€185.90m	€188.21m
2027 Phase Out	€46.17m	€280.24m	€293.24m
2026 Phase Out	€46.17m	€307.95m	€293.24m

Under the €95 pricing scenario, Parliament's amendment of expediting free allowance phase out by one year from 2027 to 2026, increases National EU ETS costs by €25 million in 2026. From 2027 onwards, the two revised policy iterations align in-terms of 100% allowance auctioning. Subsequently, in 2030, the National EU ETS cost delta between the Original Phase 4 and the revised policy scenarios is €113 million (assuming €95 per auctioned allowance).

Under the High €105 scenario, expediting free allowance phase out by one year from 2027 to 2026, increases National EU ETS costs by €27.71 million in 2026 and under the low scenario of €85 per allowance, that price delta comes in at €22.43 million in 2026.

Moving beyond, annual cost impacts, the cumulative cost range of EU ETS to the Dutch aviation sector are presented in Figure 45. Corresponding to each policy scenario is the plausible cost range of EU ETS given the three pricing sensitivities. Under the Original Phase 4 scenario, National EU ETS costs range from €1.34 billion when forecasting €85 per auctioned allowance to €1.65 billion when forecasting €105 per auctioned allowance (over the entirety of Phase 4). For the 2027 and 2026 free allowance phase out scenarios, the cumulative costs of Phase 4 EU ETS are €1.86 billion and €1.89 billion, when forecasting €85 per allowance, and €2.3 billion and €2.33 billion, when forecasting €105 per auctioned allowance, respectively (over the entirety of Phase 4).

Figure 45: Cumulative cost range of Phase 4 policy iterations under each EUA/EUAA pricing scenario



As was the case in allowance auctioning requirements, the transition from the Original Phase 4 policy iteration to the Commission's 2027 free allocation phase out scenario presents the most substantial impact to the Dutch sector. Over the course of Phase 4, the cost impact of phasing out free allowances one year prior in 2026 rather than 2027, is €22.4 million on the low end, and €27.7 million on the high end. Conversely, the difference between the Original Phase 4 free allowance reduction and the 2027 Phase out is €526.84 million on the low end and €650.80 million on the high end over the course of Phase 4 which is substantially higher.

4.3. Passenger Cost Pass Through

This section presents a passenger (PAX) pass through cost analysis, in which EU ETS costs are calculated on a per PAX basis under varying cost and policy scenarios to provide an EU ETS ticket 'surcharge' or 'tax'. It should be noted that there is no requirement or guarantee that Dutch carrier will pass the additional EU ETS costs onto their passengers. Rather, framing the potential range of Phase 4 EU ETS costs in terms of cost per PAX or additional ticket cost, provides regulators, carriers, and the flying public, with a figure which is accessible and easily quantifiable to frame the evolving impact of EU ETS.

4.3.1. Seat and Passenger Analysis

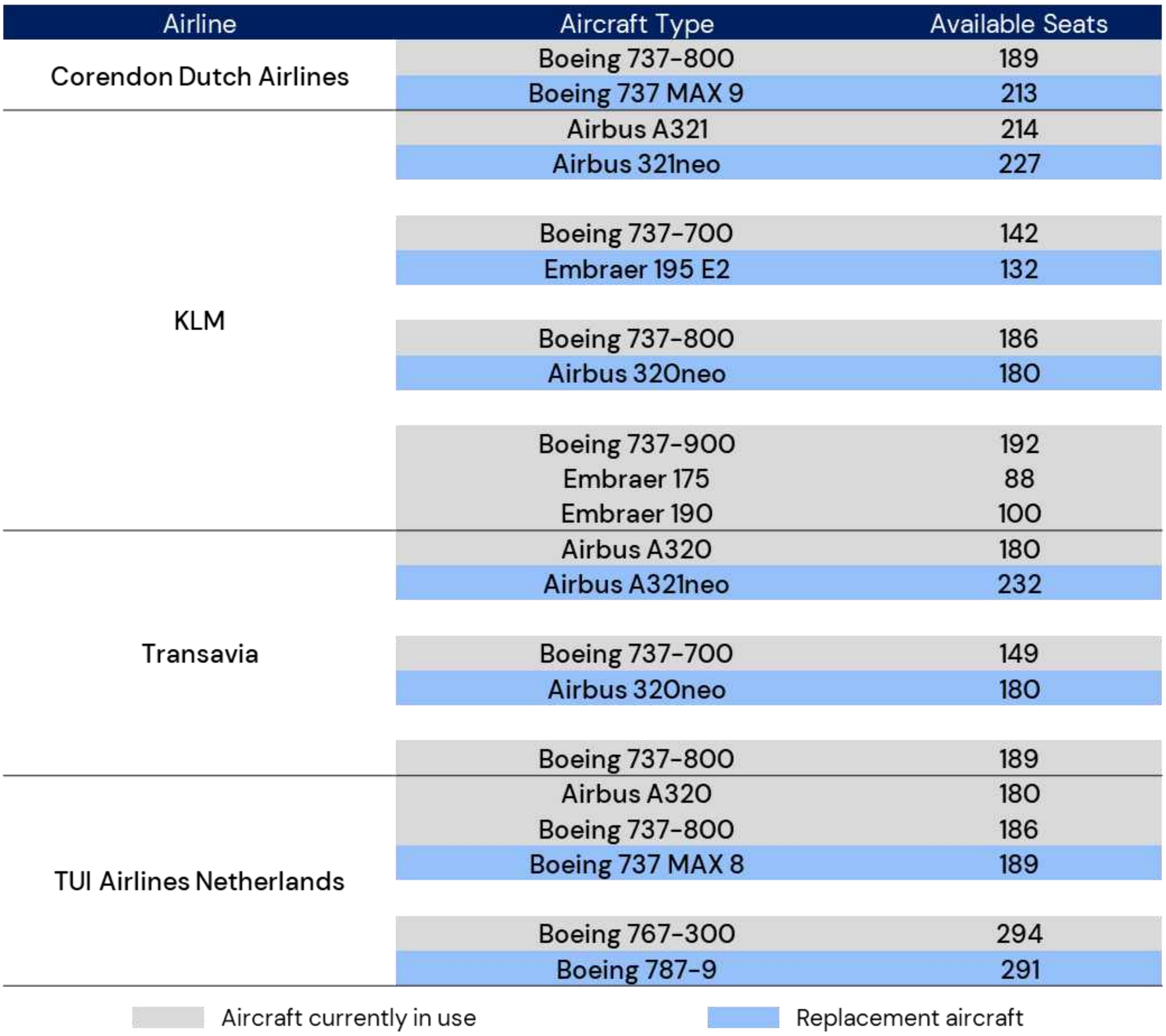
To calculate EU ETS cost on a per passenger basis, the number of passengers flown on EU ETS applicable routes by Dutch carriers over Phase 4 had to first be established. The increase of PAX is driven by two factors:

> **Expansion of the geographical scope:** The inclusion of the OMR within the reporting scope leads to more overall EU ETS applicable flights and subsequently more passengers. This analysis was undertaken in Chapter 1 and is recapped below in Figure 46.
>
> **Fleet renewal:** As seen in Figure 47, fleet renewal delivers not only efficiency gains but increased capacity across Dutch carrier EU ETS applicable networks. Even if load factors were to remain consistent the overall number of passengers travelling on EU ETS applicable routes would increase as the result of higher cabin densities.

Figure 46: Total number of trip change by carrier under the revised EU ETS Phase 4 scope (2024-2030)

Airline	Number of Trips Original Iteration	Number of Trips Policy Scenarios	Impact of Expanded Policy Scope
Corendon Dutch Airlines	8,533	9,535	+1,002
KLM	1,491,543	1,491,905	+362
Transavia	331,237	349,951	+18,714
TUI Airlines Netherlands	23,413	43,165	+19,752

Figure 47: Additional aircraft density by carrier gained through fleet renewal [38] [39] [40] [41] [42]



Airline	Aircraft Type	Available Seats
Corendon Dutch Airlines	Boeing 737-800	189
	Boeing 737 MAX 9	213
KLM	Airbus A321	214
	Airbus 321neo	227
	Boeing 737-700	142
	Embraer 195 E2	132
	Boeing 737-800	186
	Airbus 320neo	180
	Boeing 737-900	192
	Embraer 175	88
	Embraer 190	100
Transavia	Airbus A320	180
	Airbus A321neo	232
	Boeing 737-700	149
	Airbus 320neo	180
	Boeing 737-800	189
TUI Airlines Netherlands	Airbus A320	180
	Boeing 737-800	186
	Boeing 737 MAX 8	189
	Boeing 767-300	294
	Boeing 787-9	291

▨ Aircraft currently in use ▨ Replacement aircraft

Having established the number of trips by aircraft and by carrier, publicly available airline and aircraft specific seat density and configuration data (Figure 47) was used to calculate the number of available seats on EU ETS applicable routes (under the two policy scenario scopes). To forecast the number of passengers to be flown on EU ETS applicable routes over the duration of Phase 4 (2021-2030), an 80% load factor was applied to the number of available seats.

Figure 48 below presents the analysis results at a top level, with 288.16 million passengers flying on EU ETS applicable routes under Phase 4's original iteration and 294.53 million

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[38] KLM Royal Dutch Airlines Fleet Details and History

[39] KLM Cityhopper Fleet Details and History

[40] TUI fly - Our Fleet

[41] KLM and Transavia choose Recaro seats to equip their Airbus A320neo and A321neo

[42] Transavia (HV) seat maps

passengers flying with Dutch carriers on EU ETS applicable routes under the updated policy scenarios.

Figure 48: The expansion of the EU ETS scope and fleet renewal adds 6.37 million passengers on Dutch carriers flying on EU ETS applicable routes

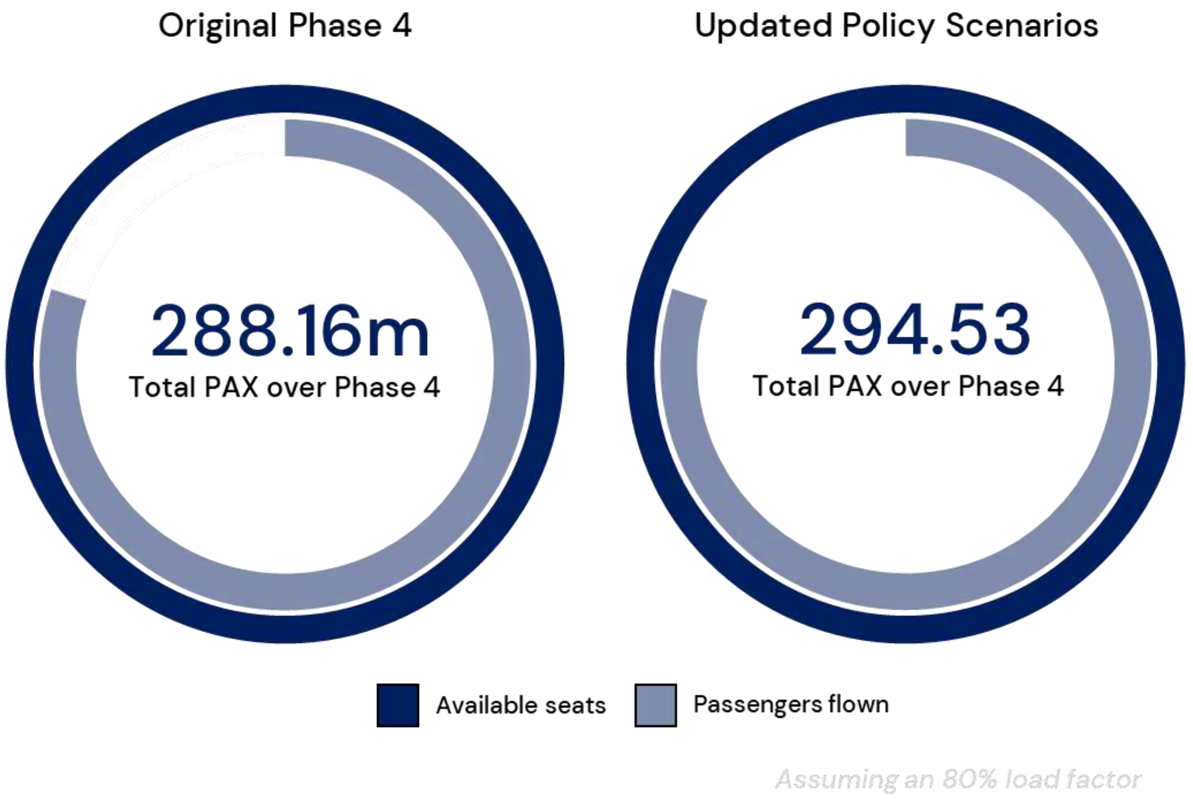


Figure 49 and Figure 50 below plot annual passenger growth (dark blue) against EU ETS auctioning costs for the €95 EUA price scenario. Mapping the annual number of passengers flown on EU ETS applicable routes against annual auctioned costs provides the basis for calculating the PAX cost passthrough. Specific cost passthrough figures are provided in the following section.

Figure 49: Annual Phase 4 passengers and original Phase 4 auctioning costs assuming €95 per allowance

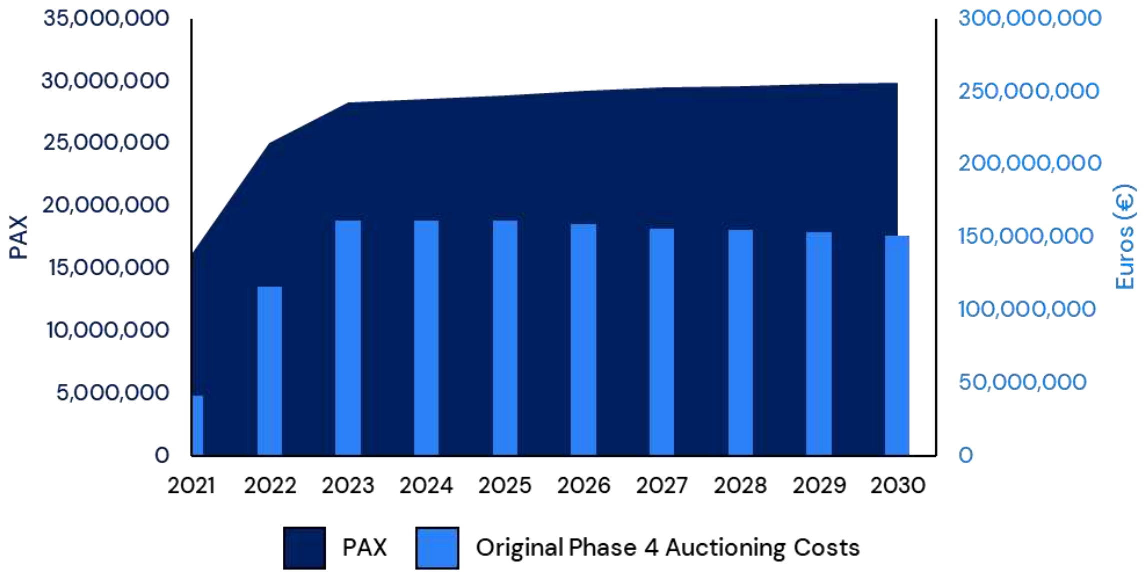
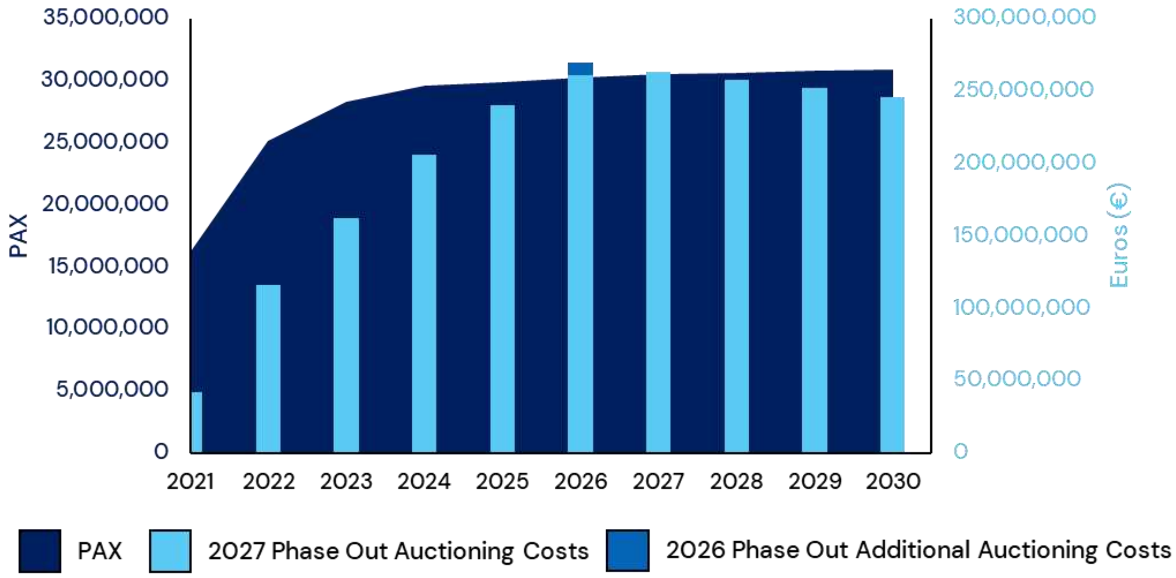


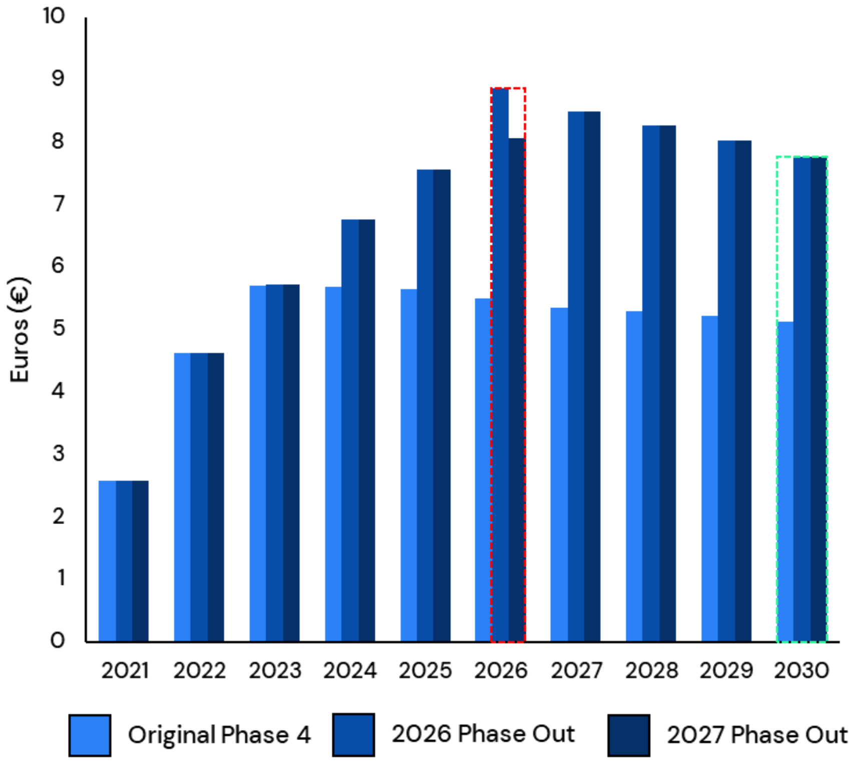
Figure 50: Annual Phase 4 passengers and auctioning costs under the expanded policy scopes assuming €95 per allowance



4.3.2. Per Passenger EU ETS Costs

Mapping annual National passenger numbers against EU ETS EUA auctioning costs given €95 per allowance, provides the EU ETS per passenger cost under the three policy scenarios. In 2026, under the Parliament's amendments to phase out free allocation, the cost of EU ETS for the Dutch aviation sector stands at €8.86 per PAX. This is compared to €8.06 per PAX under the Commission's proposal to phase out free allowances by 2027 and €5.50 under Phase 4's original structure. Figure 51 depict the varying EU ETS cost per PAX under the three policy iterations given €95 per auctioned EUA.

Figure 51: EU ETS passenger cost pass through under three policy scenarios assuming €95 per allowance



€0.80

Difference in the two policy scenarios in 2026 due to free allocation variation

€2.63

Difference between the phase out scenarios and original Phase 4 in 2030

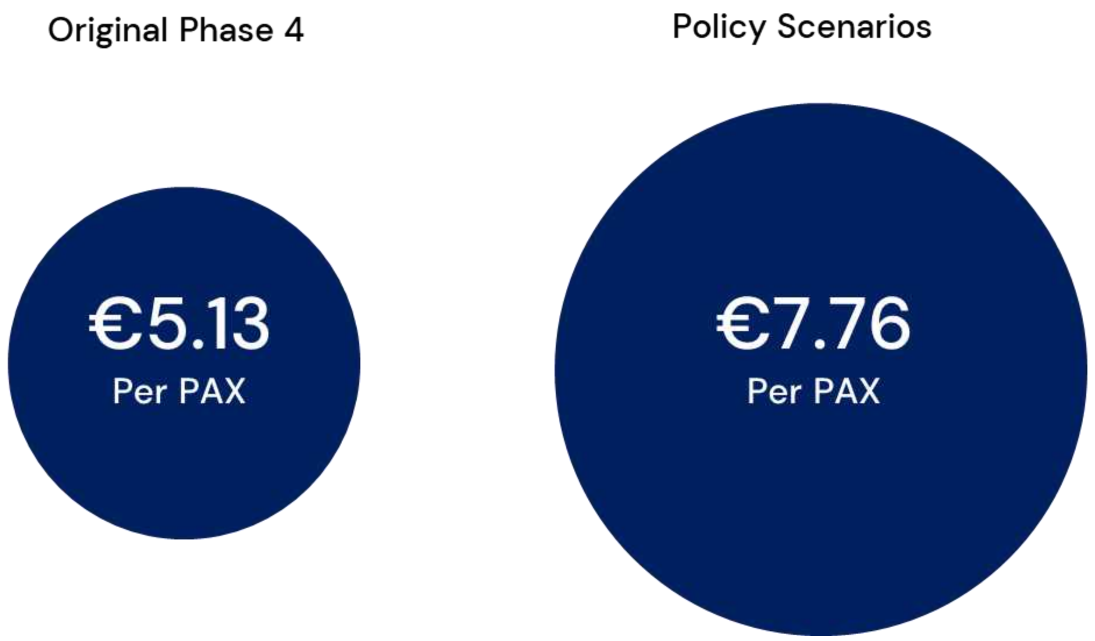
	2021	2026	2030
Original Phase 4	€2.58	€5.50	€5.13
2027 Phase Out	€2.58	€8.08	€7.76
2026 Phase Out	€2.58	€8.86	€7.76

Apart from 2026, where there is a €0.80 cost per PAX difference, the two adjusted policy scenarios share the same passenger passthrough figures. This is due to the two scenarios only diverging in the quantity of allowances to be purchased through auction in the one year of Phase 4. The €0.80 increase of the passenger passthrough is ultimately the materialisation of Parliament increasing the stringency of aviation's EU ETS obligation by one year.

Looking forward to 2030, under each of the policy scenarios, the EU ETS cost pass-through follows a depreciating trajectory from its peak due to SAF and fleet modernisation centric decarbonisation efforts. Under the Original Phase 4 iteration, per PAX costs peak in 2023 at €5.70, before declining to €5.13 in 2030.

For the two adjusted policy scenarios, costs peak in 2027 at €8.50, under the Commission's amendments, and at €8.86 in 2026, under Parliament's amendments, before both declining to €7.76 per PAX in 2030. In 2030, the per PAX cost difference stands at €2.63 between the Original Phase 4 and the free allocation phase out scenarios (assuming €95 per auctioned EUA/EUAA).

Figure 52: 2030 EU ETS cost per passenger assuming an 80% load factor and €95 per EUA/EUAA



The table below (Figure 53) presents the average allowance cost per passenger for 2023-2030 under the three cost scenarios for each policy iteration. Excluding 2021 and 2022 from this specific analysis enables a forward-looking perspective and excludes EU ETS costs which have already been paid by carriers. From 2023 until the end of Phase 4 (2030), the average per PAX EU ETS cost ranges from €4.87-6.01 under the Original Phase 4 to €6.78-8.38 under the 2027 phase out scenario, and €8.87-8.49 under the 2026 phase out scenario.

Figure 53: Average allowance cost per passenger for the remainder of Phase 4 (2023-2030) under the three policy and cost scenarios

	€85 per Auctioned EUA	€95 per Auctioned EUA	€105 per Auctioned EUA
Original Phase 4	€4.87	€5.44	€6.01
2027 Phase Out	€6.78	€7.58	€8.38
2026 Phase Out	€6.87	€7.68	€8.49

Key Messages
Chapter 4: Policy Impact Cost Analysis

Chapter 4 presented an analysis of the financial implications of Phase 4 changes for Dutch carriers. The varying Phase 4 policy iterations (varying geographic scope, cap, and free allowance phase out) creates a range of EU ETS costs for the Dutch aviation sector. Three EUA/EUAA price scenarios were developed ranging from €85 to €105 per allowance. Given allowance price uncertainty, the scenarios were developed to capture a probable Eu ETS cost exposure outlook.

Key Takeaways

- Cumulative EU ETS Phase 4 (2021-2030) cost range for the Dutch aviation sector
    - Original Phase 4: €1.34 billion - €1.65 billion
    - 2027 Phase Out: €1.86 billion – €2.30 billion
    - 2026 Phase Out: €1.89 billion – €2.33 billion
- Assuming €95 per auctioned EUA/EUAA, the average per passenger cost of the EU ETS for Dutch carries across Phase 4 equates to €7.68, up from €5.44 under the original policy scenario. This is driven by an increase in emissions under the revised policy scenarios as well as the elimination of free allowances.
- The per passenger EU ETS cost between the 2027 and 2026 Phase Out scenarios amounts to €0.80 in 2026 before converging from 2027-2030, assuming €95 per allowance.
- By 2030, the per passenger difference in EU ETS costs between the Original Phase 4 iteration and the policy scenarios will be €2.63 (€5.13 compared to €7.76, assuming €95 per allowance).

5. SAF Support

The basket of measures for decarbonising the sector consists of four tools: next generation aircraft (electric and hydrogen propulsion), operational improvements, carbon offsets & removals, and sustainable aviation fuel (SAF).

Despite the collective acknowledgment of SAF's pivotal role in decarbonising the sector, production volumes remain insufficient to contribute significant levels of carbon abatement. The current delta between global demand and supply presents a substantial challenge to achieving ambitious climate and net-zero targets set forth by airlines, regulators, and industry bodies alike. Among the solutions available, SAF is the most important lever for decarbonising aviation as it serves as a drop-in fuel and can be deployed on medium to long haul flights, providing decarbonisation where electric and hydrogen aircraft cannot.

Since SAF production costs are significantly higher than conventional jet fuel production, SAF would be economically unviable without governmental support and policies requiring SAF use or incentivising costs. Government SAF policy regulations act as a catalyst and are vital in global SAF market establishments. Reviewing the current diverse regulatory environment and landscape is key to understanding the emergence of various SAF markets and pricing dynamics, which would allow best industrial practice adaptation.

This chapter presents an overview of the SAF regulatory landscape in order to contextualise the EU ETS SAF Support scheme. The analysis contains a SAF cost forecast for Dutch carriers in line with anticipated offtake outlined in Chapter 2 before quantifying the level of support the support mechanism deliver to lessen the SAF mandate cost burden.

5.1. SAF in The Netherlands

Within The Netherlands, there have been several initiatives aimed at supporting the production and utilisation of sustainable aviation fuel. In 2020, then Minister of IenW Cora van Nieuwenhuizen sought to position The Netherlands as a SAF pioneer in Europe. The Dutch government introduced a 14% SAF compulsory blending target by 2030[43] in an effort to reduce aviation emissions at a rate which exceeded that of the EU. However, in 2023 the EU Commission ruled that the Dutch government was unable to proceed with the proposed expanded blending obligation[44], opting for a harmonised target across the EU to avoid creating an uneven playing field. Despite this setback, The Netherlands

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[43] *Minister Van Nieuwenhuizen imposes use of cleaner fuel in aviation sector*

[44] *Netherlands' climate targets at risk as EU blocks sustainable aviation fuels ambitions*

continues to provide mechanisms which support SAF development and aviation decarbonisation. As seen below in Figure , according to the ICAO SAF Facility Tracker, there are two SAF facilities which were commissioned into service in 2023 with an additional three facilities coming online between 2024 and 2027 for a total production capacity of 1,810 million litres per year. Producers have also been able to capitalise from the HBE while carriers are able to draw SAF support from Schiphol's world leading SAF support scheme, as described below.

Figure 54: Announced SAF production facilities in The Netherlands with entry into service and projected capacity figures[45]

	Entry into Service	Location	Projected Capacity (million liters/year)
Shell	2024	Vondelingenplaat	1,022.1
Synkero	2027	Amsterdam	62.5
Enerken	2025	Rotterdam	50
Neste Oil	2023	Rotterdam	550
SkyNRG	2023	Farmsum	124.9
Total	-	-	1,809.5

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[45] *ICAO SAF Facilities Dashboard*

As part of the EU, The Netherlands is expected to oblige under the EU regulations. However, imposing additional policies is expected to provide support in reducing SAF costs for carriers.

Schiphol SAF Scheme

To encourage the use of SAF, Amsterdam Airport Schiphol has announced a new initiative for airlines that refuel their aircraft with SAF. The Airport will fund a total of €15 million from 2022 to 2025, which spans across three phases between 1st April 2022 to 31st March 2025, with fundings of €2.5 million, €5.0 million and €7.5 million respectively every incentive year[46]. Fund allocation will be based on consumption in metric tonnes. Airlines will get €500 per tonne of biofuel refuelled and €1,000 per tonne of synthetic fuel.

HBE

HBE stands for Hernieuwbare Brandstof Eenheden and are renewable energy units that Dutch companies within the Energy of Transport compliance system use to comply with their annual obligations to reduce greenhouse gas emissions. One HBE represents 1 gigajoule (GJ) of renewable energy supplied to transport in the Netherlands. In the aviation context, HBEs are an economic incentive to gradually expand the use of SAF in transport and reduction of greenhouse gas emissions in the aviation industry. Under the Energy for Transport compliance system, the Dutch government uses a trading system where created HBE's can be bought and sold. Fossil fuel producers are required to purchase HBEs from green fuel producers. SAF and biofuel producers can leverage the scheme to sell generated HBEs, since revenues can be passed through as savings to carriers. However, in 2022, the Dutch government has proposed to lower the multipliers for biofuels produced from feedstocks listed in Annex IX Part A and B of the EU's Renewable Energy Directive (RED II) to 1.6 from 2 within the HBE scheme[47].

5.2. SAF Policy Overview

5.2.1. Global SAF Policy

Currently, the global regulatory environment is a patchwork, with a diverse range of approaches being adopted across different regions and within countries. For instance, the EU established a first of its kind SAF mandate as part of the Union's wider decarbonisation ambitions, while in the U.S., claiming several incentives for SAF production, while also using the fuel to reduce carbon offsetting obligations is feasible.

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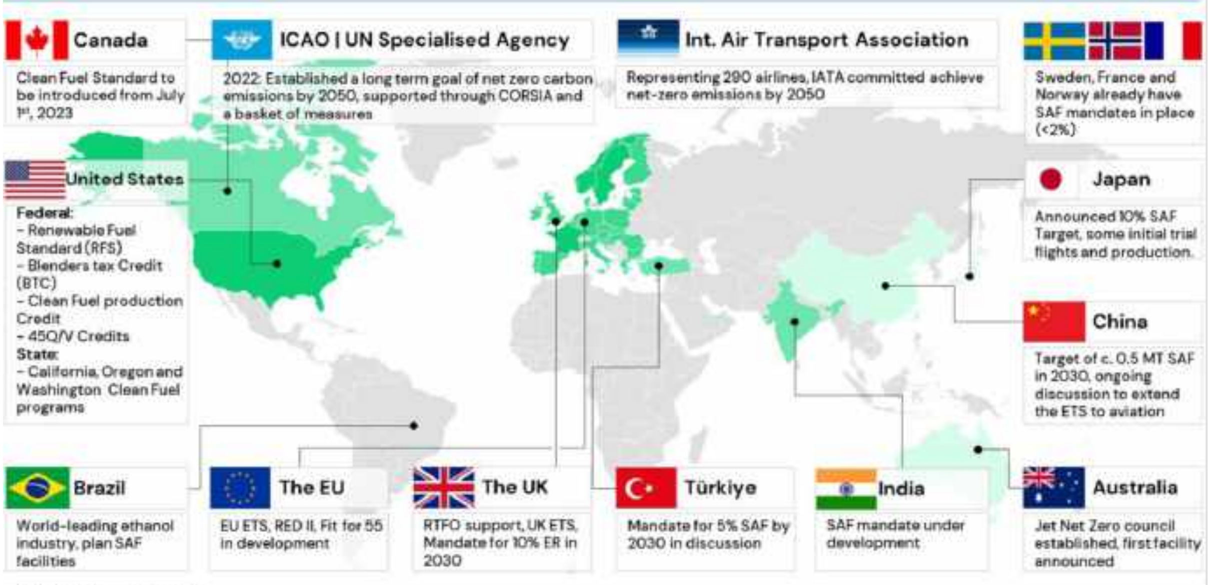
[46] Schiphol announces rise in airport charges as an incentive for use of SAF

[47] Dutch government plans to lower biofuel multipliers

Figure 55: Global SAF policies in place or under discussion



Source: ICF research

For growing national and regional SAF markets, the patchwork of regulatory frameworks can be classified according to the following three general approaches:

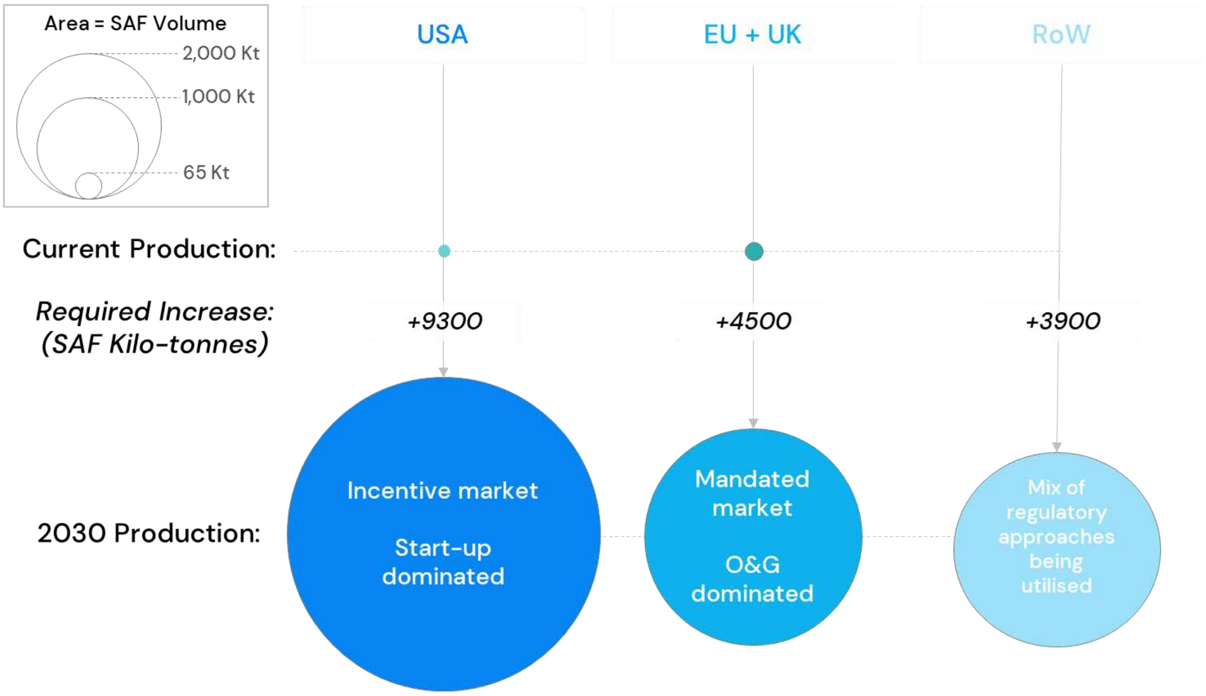
- **Demand side policy**: The aim for demand side policies is to create artificial demand by requiring the use of sustainable fuels. Required use may either be on aviation, by creating a cost to airlines, or on other sectors, which allow airlines to sell credits generated using sustainable fuels into the market, monetising sustainable fuel use. This approach is typically favoured in Europe, with most mandates imposed on the fuel provider.

- **Supply side policy**: Supply side policy is a mechanism that catalyses increased biofuel production. This approach is favoured in the U.S. and enables fuel producers and transportation organisations to meet climate ambitions while creating national employment and energy security benefits.

- **Hybrid methodologies**: The hybrid approach aims to combine both demand and supply side policies through deploying both a mandate and price stabilisation subsidies, which leverages the benefits of both policy approaches. The objective is to generate long-term SAF demand, while simultaneously reduce the financial burden brought by mandates through supporting SAF production and adoption costs for producers and carriers.

SAF will not be commercially feasible in the short- to mid-term without proper frameworks as SAF investment, production and use is driven by these policy packages and structures. Designing and adopting a suitable and balanced policy approach is vital to developing and building a robust domestic SAF industry that will meet ambitious decarbonisation targets in the long-term. ICF analysis below has identified various mandates and incentives that have directly contributed to adding 16 million tonnes (MT) of announced SAF capacity by 2030.

Figure 56: Regulations are mandating/incentivising over 16 MT of SAF production by 2030, almost all of which is additional to the negligible current capacity

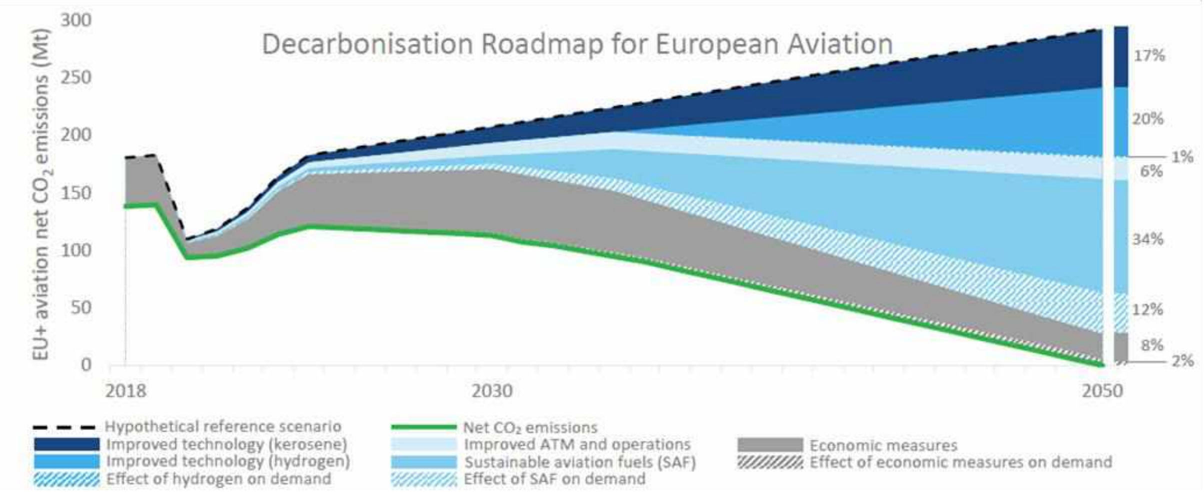


The following sections present the policy packages and structures which are shaping SAF investment, production, and use within the EU. Without the proper frameworks, SAF will simply not be commercially viable in the short- to medium-term. Getting the policy approach and balance right is so crucial to developing a domestic industry which is robust and built to deliver on decarbonisation ambitious out until 2050 and beyond.

5.2.2. European Union SAF Policy

The EU is seen to adopt demand side policies, by setting requirements for sustainable fuel use, creating artificial demands for SAF. The EU has several established and proposed SAF policies and regulations for accelerating SAF use and is outlined later in this section. EU mandates and mostly imposed on fuel providers. Most mandates provide a degree of protection to the customer by including a buy-out price to limit potential SAF costs.

Figure 57: Sustainable aviation Net Zero Carbon EU Roadmap[48]



The above roadmap highlights the importance of SAF in decarbonising the aviation industry in the EU. Demand reduction, referring to reduced air travel due to increased costs, is expected to reduce 12% of emissions by 2050, while 34% of CO_2 reduction is expected to come from SAF utilisation and uplift. Note that the above Destination 2050 roadmap is currently under review and the new version will be updated in 2024.

Fit for 55 and ReFuelEU

Fit for 55 was introduced by the EU in July 2021, and is a legislative package which ranges from 2025-2050 that has two main aims:

1. To reduce the EU's net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels
2. To achieve climate neutrality in 2050. Approved in September 2023, the ReFuelEU Aviation initiative is part of the package that aims to primarily address SAF production and use, and ensure that EU airports and aircraft operators are working towards emission reductions by introducing new requirements.

To encourage synthetic aviation development from hydrogen, a synthetic SAF sub-mandate was also included within ReFuelEU. According to SkyNRG's Fuel Market Reports and an ICCT analysis on EU feedstock availability, the regulatory package is expected to induce around 3.2 MT of SAF demand in the EU.

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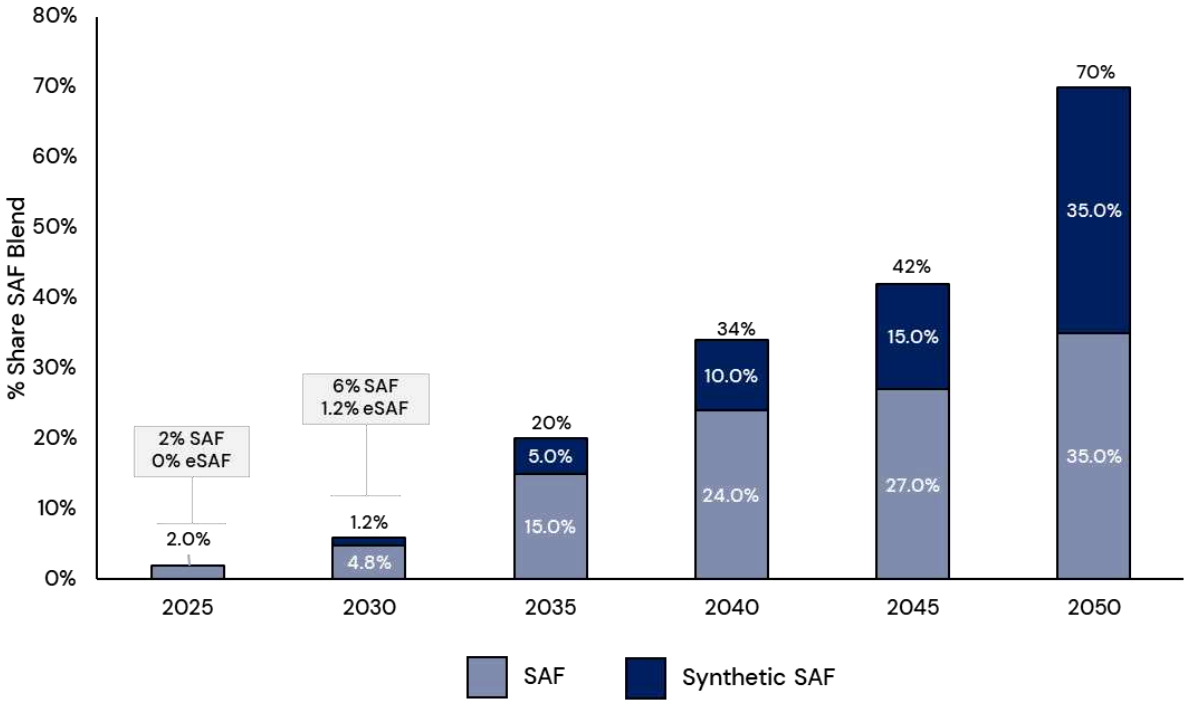
[48] Destination 2050: A route to net zero European aviation

Figure 58: ReFuelEU SAF mandate was approved in September 2023, obligating 6% SAF by 2030



	2025	2030	2035	2040	2045	2050
Total SAF % Share	2%	6%	20%	34%	42%	70%
Synthetic SAF Sub-Mandate	-	1.2%	5%	10%	15%	35%

Scope of Phase 4 analysis

EU Emission Trading System (ETS)

EU ETS adopts a 'cap and trade' system. A cap is the limit of overall amount of greenhouse gas emissions by the installations and aircraft operations covered by the EU ETS. To ensure that emissions decrease overtime, the cap is reduced annually to be in-line with EU climate targets, and companies must surrender enough allowances to fully account for their emissions.

Airlines will be responsible for purchasing allowances to cover all their intra-EU emissions from 2026. As free allowances will be phased out from 2026, SAF poses as an attractive solution to lessen airlines' financial cost burden from the EU ETS. In addition, to help offset the price differences between CAF and SAF, the EU Parliament will make 20 million free allowances available to carriers as part of the Phase 4 revisions of EU ETS.

Renewable Energy Directive (RED II)

The EU's RED II incentivises SAF consumption via member state targets to supply a minimum of 14% of energy consumed and 3.5% sub-target from advanced biofuels in the transport sector from renewable sources by 2030. SAF can be counted towards achieving the renewable energy targets under RED II. For non-food and non-feed-based SAFs, a specific multiplier of 1.2 is to be applied when calculating the SAF contribution towards renewable energy targets, which is used to generate compliance certificates that can be traded between obligated parties.

RED II limits the portion of renewable fuels produced from food and feed crops. The share of high indirect land use change (ILUC) risk fuels, such as palm oil, will be reduced to 0% by 2030 and usage will be capped to 2019 levels till then. In order to qualify as a renewable fuel under RED II, SAF produced must meet greenhouse gas saving thresholds, 65% and 70% for transport biofuels and renewable fuels respectively, against a fossil fuel baseline of 94 gCO_2e/MJ.

EU ETS SAF Support Package

The EU ETS SAF Support Mechanism is a pivotal component designed to reinforce the European Union Emissions Trading System (EU ETS) and advance the objectives of ReFuelEU, particularly in decarbonizing the European aviation industry. The scheme, spanning from 1st January, 2024, to 31st December, 2030, sets aside 20 million free allowances[49] for commercial aircraft operators, promoting the adoption of Sustainable Aviation Fuels (SAF) and other non-fossil aviation fuels.

The goal of the SAF Support Mechanism is to incentivise carriers to increase the utilisation of SAF and alleviate the financial burden associated with ReFuelEU. With the introduction of the SAF support mechanism, the EU has efficiently adopted a hybrid methodology to support the expansion of its regional SAF market. The mechanism has been structured as follows:

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[49] *Call for experts: advice on the implementation of the revised EU Emissions Trading System Directive for aviation*

Figure 59: 20 million free allowances to be made available serve to cover part or all of the price differential between CAF and the use of the eligible SAF

50%	95%	100%
of the remaining price differential between CAF and any eligible aviation fuel that is not derived from fossil fuels from biological origin	of the price differential between CAF and renewable fuels of non-biological origin	of the remaining price differential between CAF and any eligible aviation fuel that is not derived from fossil fuels at airports situated on islands smaller than 10,000 km^2 and with no road or rail link with the mainland

The EU ETS SAF Support Mechanism, by providing targeted free allowances, will play an important role in furthering the adoption of sustainable aviation fuels. However, the value of the scheme is yet to be fully understood as the methodology for allocating and valuing the free allowances has yet to be established. Section 5.4 seeks to quantify the share of SAF support which will be made available to Dutch carriers.

5.3. SAF Costs to Dutch Carriers

To quantify the value the EU ETS SAF Support mechanism could provide Dutch carriers, the cost of future SAF uplift must first be calculated. The following section provides a cost estimate of mandated and voluntary volumes of SAF which will be uplifted by the four Dutch carriers contained within the scope of this analysis (KLM + CityHopper, Transavia, TUI Airlines Netherlands, Corendon Dutch Airlines).

The following SAF cost and support mechanism analysis was conducted using the 2026 Parliament policy scenario (2026 free allocation phase out). The analysis was undertaken under this scenario as the SAF support mechanism was announced as part of the Parliament's wider EU ETS changes alongside the commitment of 2026 free allowance phase out. Approaching the analysis in this manner ensures results are aligned with the latest iteration of Phase 4.

5.3.1. Pricing SAF

As previously stated, to accurately calculate the value of the SAF Support Mechanism for Dutch carriers, it is imperative to develop a Sustainable Aviation Fuel (SAF) cost forecast. The forecast for SAF prices from 2021 to 2029 relies on World Bank biogenic feedstock price forecasts. Only feedstocks eligible for use in the European Union have been considered in the aggregation calculations (Figure 60). For 2030, an additional SAF price forecast was developed to align with the ReFuelEU's synthetic fuel sub-mandate (Figure 61). A 0.95 currency conversions rate was applied when converting from $USD to €EUR.

This approach forecasts a SAF price of €2,257.37 per tonne. For each eligible feedstock, a weighting was applied based on anticipated feedstock availability. Converting from cost per GJ to cost per tonne of SAF required applying a conversion factor of 43.

Figure 60: Bio-genic SAF cost is forecasted at €2,257.37 per tonne for mandate and voluntary uplift 2021-2029 (pre-synthetic fuel sub-mandate)[50]

	Cost Forecast ($ / GJ)	**Availability Weighting**
Crop residues (ATJ)	$79.74	16%
Forestry Residues (ATJ)	$45.75	16%
Crop residues (FT)	$58.67	16%
Forestry Residues (FT)	$48.66	16%
Waste from fats, oils, and greases (FOGs)	$56.18	20%
Municipal solid waste (MSW)	$42.32	16%
Weighted Cost	$55.26	100%

	Cost Forecast (price / GJ)	**Cost Forecast (price / tonne)**
Mandated SAF Cost 2021-2029	$55.26	$2,671
	€52.50	€2,257.37

The cost per tonne of biogenic SAF served as the base SAF price from 2021-2029. In 2030, as outlined in Figure , the introduction of a synthetic SAF sub-mandate required a recalibration of the cost of SAF per tonne.

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[50] *The Role of Sustainable Aviation Fuels in Decarbonising Air Transport, WorldBank*

The table below outlines the revised SAF cost methodology. The cost calculation was a two-step process:

1. Establishing a synthetic SAF price
2. Weighting biogenic and synthetic SAF prices to align with ReFuelEU

The synthetic fuel (Power-to-Liquid SAF), price was informed by the WEF's SAF production pathway pricing outlook[51]. The cost outlook has been adjusted to account for unit and currency changes. Furthermore, ICF has applied a cost adjustment to reflect current market dynamics as prices of synthetic fuels have failed to decrease at the rate forecasted by the WEF. A final price of $3,852 (€3,659.4) per tonne of synthetic SAF was set.

However, that price forecast is not the price of SAF per tonne in 2030 as the requirement for synthetic SAF makes up only a proportion of mandated SAF use in 2030. As outlined in Figure , in 2030, ReFuelEU mandates a 6% blend of SAF with 1.2% of the SAF being synthetic. This proportion has been reflected in the SAF cost weighting. The final weighted SAF cost in 2030 was subsequently calculated at €2,537.45 per tonne, an increase of €280.08 per tonne.

Figure 61: The introduction of the synthetic SAF sub-mandate increases the forecasted cost of SAF for mandate compliance to €2,537.45 per tonne in 2030

	Cost Forecast ($ / GJ)	**Cost Forecast ($ / tonne)**	**Weighting**
Biogenic SAF	$55.26	$2,376	80%
Synthetic SAF	$89.58	$3,852	20%
Mandated SAF Cost 2030	$62.12	$2,671	-

	Cost Forecast (price / GJ)	**Cost Forecast (price / tonne)**
Mandated SAF Cost 2030	$62.12	$2,671
	€59.01	€2,537.45

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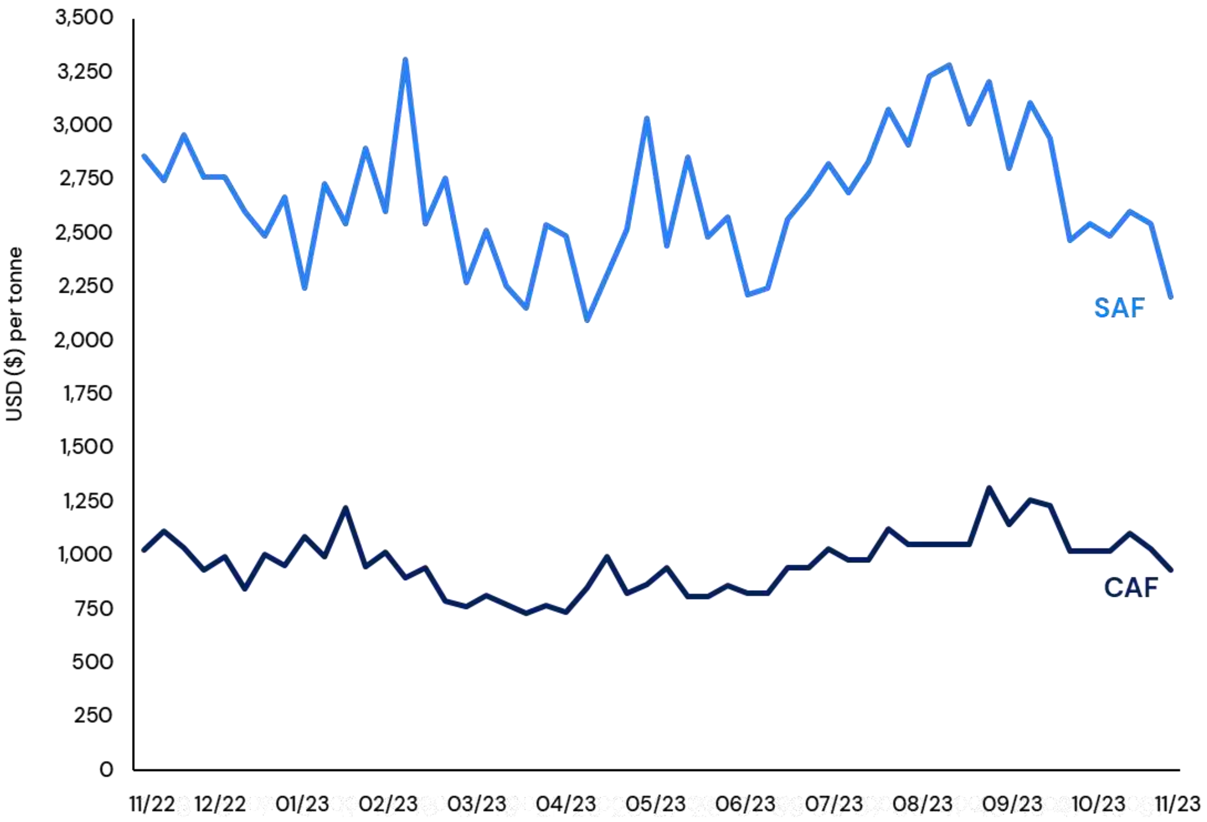
[51] *Clean Skies for Tomorrow Sustainable Aviation Fuels as a Pathway to Net-Zero Aviation Insight Report November 2020*

It should be noted that the price forecast of SAF is exactly that, a forecast. SAF is not a homogenous product and as such, its pricing and costs to airlines can vary quite drastically. Pricing SAF is based on a premium model, with the cost passed through to airlines, which can then share it with passengers. As seen in Figure below, the price of SAF fluctuates quite significantly. For the following analysis, a frozen price of SAF based on the outlined feedstock assumptions serves to provide an illustrative benchmark for calculating the value of the EU ETS Support scheme.

Figure 62: SAF vs. CAF price (November 2022-November 2023)[52]



5.3.2. SAF Cost Assessment

Revisiting the SAF uplift analysis within the Chapter 2: Carbon Forecasting, the percent share and subsequent volume of SAF to be offtaken by the Dutch carriers is shaped by voluntary targets and the ReFuelEU mandate. The table below (Figure) presents the cumulative SAF uplift by Dutch carriers over the duration of Phase 4 of the EU ETS.

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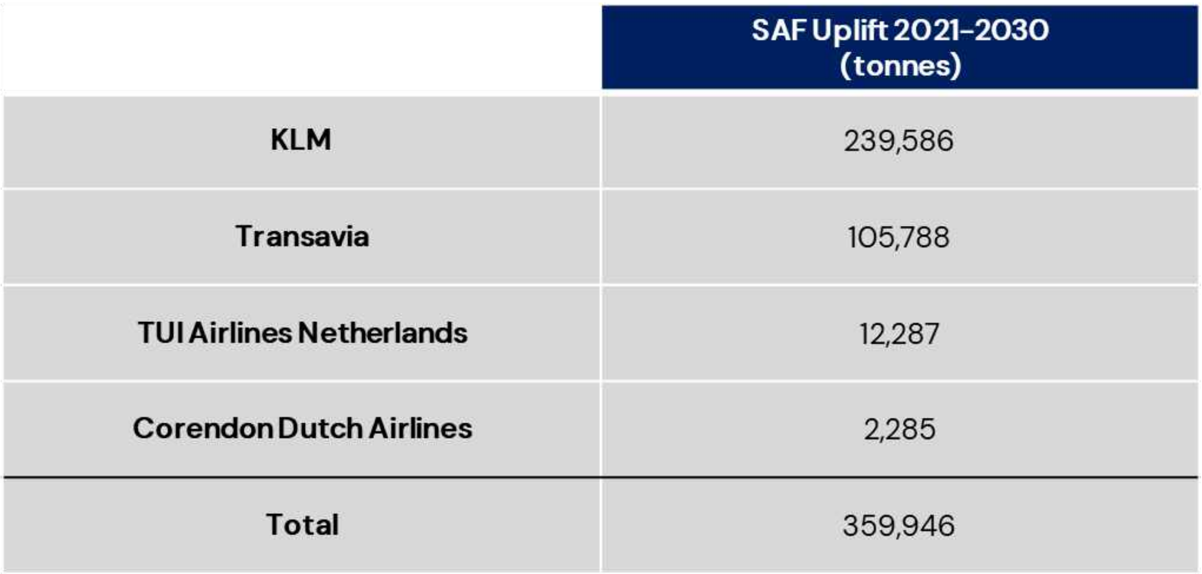
[52] *Argus Media*

Figure 63: Phase 4 cumulative SAF uplift by carrier and the Dutch sector



	SAF Uplift 2021-2030 (tonnes)
KLM	239,586
Transavia	105,788
TUI Airlines Netherlands	12,287
Corendon Dutch Airlines	2,285
Total	359,946

The table below (Figure) offers the percent share and volume of SAF Dutch carriers will uplift in key mandate years, 2025 and 2030, while capturing additional voluntary offtake from KLM and Transavia due to their 10% targets. Distinguishing offtake in 2030 from 2021-2029 enables the application of the correct SAF cost price as calculated in the prior section.

Figure 64: Dutch carrier SAF uplift under the revised policy scenario scope

	Units	2025	2030	Voluntary 2030 Target
Corendon Dutch Airlines	Percent share of total fuel	2%	6%	-
KLM		2%	6%	+4%
Transavia		2%	6%	+4%
TUI Airlines Netherland		2%	6%	-

	Units	2025	2030	Voluntary 2030 Target
Corendon Dutch Airlines	Tonnes SAF	201	637	-
KLM		12,355	38,961	25,974
Transavia		5,730	17,242	11,495
TUI Airlines Netherland		1,061	3,430	-

**SAF volumes for EU ETS applicable routes only*

Having set a SAF cost for 2021-2030, as outlined in Figure , and established the tonnage of SAF to be utilised by Dutch carriers in each year from 2021-2030, a cost forecast was established.

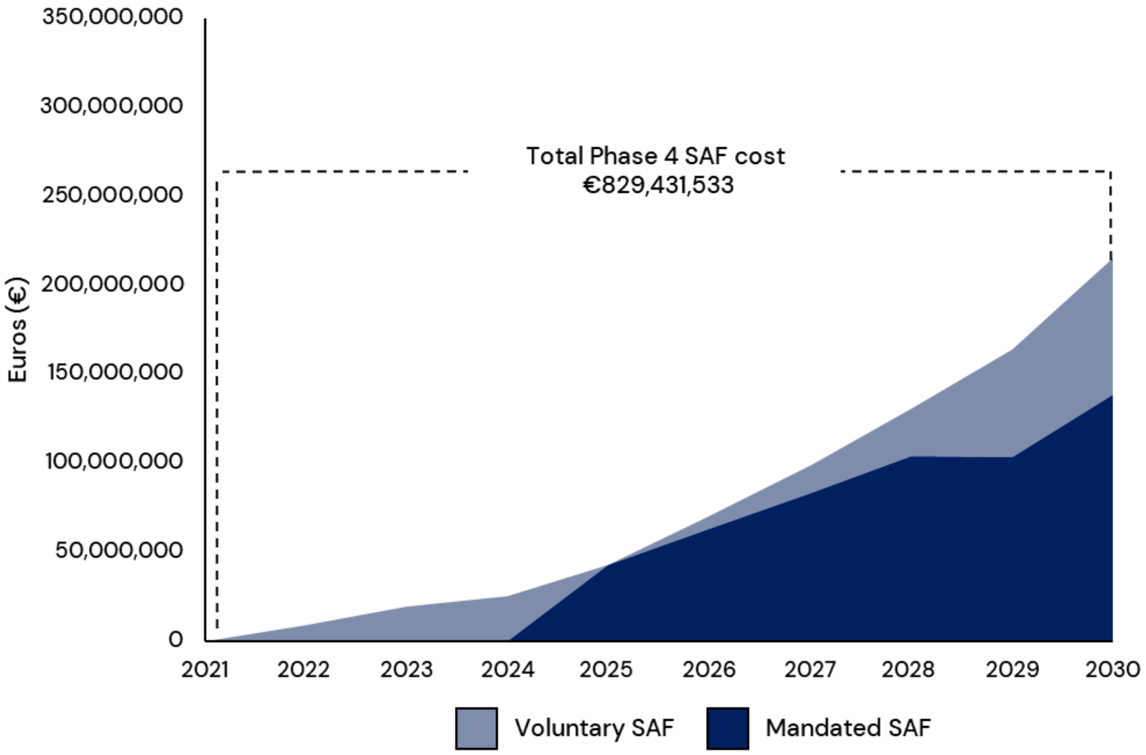
Figure 65: Forecasted SAF cost per tonne aligned with the ReFuelEU sub-mandate for 2030

	SAF 2021-2029	SAF 2030
SAF Cost (€/tonne)	€2,257.37	€2,537.45

Across the duration of Phase 4 of EU ETS, prior to the application of the SAF support scheme, the total SAF cost exposure to Dutch carriers is estimated at €830 billion. The cost is split across mandated and voluntary SAF uplift. For uplift in 2030, the synthetic price of €2,537 was applied to 6% of each carrier's forecasted EU ETS applicable fuel use. For KLM and Transavia, the biogenic SAF cost of €2,257 was applied to the 4% SAF delta required to meet their voluntary targets. The rational being, as the additional volumes in 2030 are voluntary, the two carriers will not be obligated to uplift synthetic SAF and would ideally pursue out the more affordable avenue to meet their self-imposed target i.e. biogenic ASF. The same biogenic SAF price was applied to SAF uplifted prior to the commencement of ReFuelEU (2021-2024).

The chart below (Figure) provides an illustration of the SAF costs to the Dutch sector over the course of Phase 4. In preparation for the SAF Support Mechanism analysis, the table with annual SAF costs spans 2024-2030. As such, the SAF price callouts align with the introduction of the EU ETS's SAF support and will serve to frame the annual cost reductions gained through the allocation of free allowances.

Figure 66: Total SAF costs under revised policy scenarios totals €830 billion across Phase 4



SAF Costs	2024	2025	2026	2027	2028	2029	2030
Mandated	€0	€43.67m	€65.68m	€87.84m	€110.98m	€112.17m	€152.95m
Voluntary	€25.55m	€0	€6.88m	€16.33m	€28.63m	€66.22m	€84.58m
Total	€25.55m	€43.67m	€72.56m	€104.18m	€139.61m	€178.39m	€237.53m

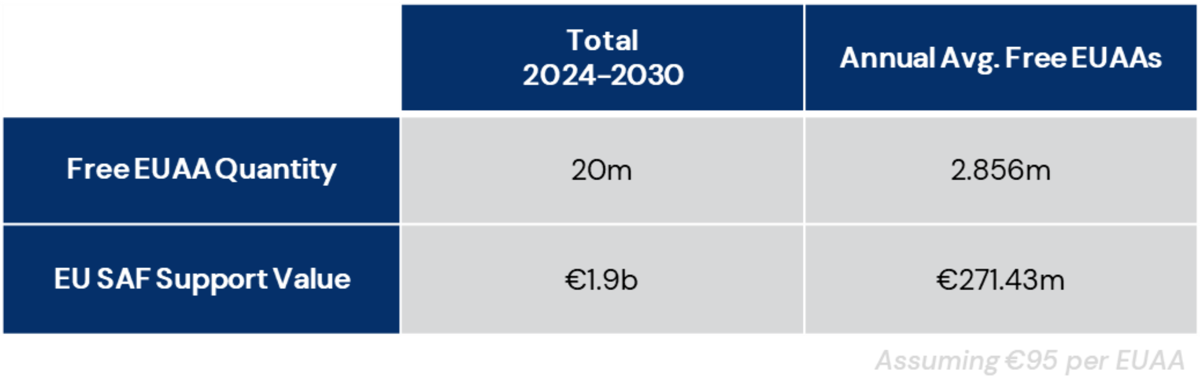
5.4. Valuing the EU ETS SAF Support Mechanism for Dutch Carriers

Establishing the annual SAF costs for the Dutch sector over the course of Phase 4 provides the basis for quantifying the level of cost reduction to be provided through the EU ETS SAF Support mechanism. As outlined in section 5.2.2, the scheme is set to provide 20 million free allowances to European carriers to offset the price delta between CAF and SAF. However, there are two central uncertainties regarding the structure of the scheme:

1. **Allowance value:** The structure of the support is that free allowances are provided to reduce the cost premium of SAF. However, there is currently no mechanism for attributing a value to these allowances. The price of EUA/EUAAs are constantly changing and there is currently no structure in place to determine at which points the EUAA/EUA traded value will be assigned to the free allowances.
2. **Allowance allocation:** The current guidelines outline that the 20 million free allowances are to be made available on a first come, first serve basis from 2024-2030. However, no allocation methodology has been developed for claiming or providing these free allowances to carriers.

A price of €95 was assumed for each free allowance. While the value of the free allowances to be distributed under the scheme will most likely fluctuate from 2024-2030, selecting €95 for the analysis aligns with the central scenario from the EU ETS price forecast in Chapter 4. As seen in Figure , assuming €95 per free EUAA values the support available for EU carriers at €1.9 billion across seven years of the program equal to €271.43 million euros per year.

Figure 67: EU ETS SAF support mechanism total allowances and allowance value 2024-2030



	Total 2024-2030	Annual Avg. Free EUAAs
Free EUAA Quantity	20m	2.856m
EU SAF Support Value	€1.9b	€271.43m

Assuming €95 per EUAA

Navigating the second uncertainty required determining a methodology for allocating a proportion of the free allowances to Dutch carriers. In 2021, The Netherlands was responsible for 4.4% of EU ETS applicable traffic. As such, the analysis has allocated 4.4% of available free EUAAs to Dutch carriers over the 2024-2030 period.

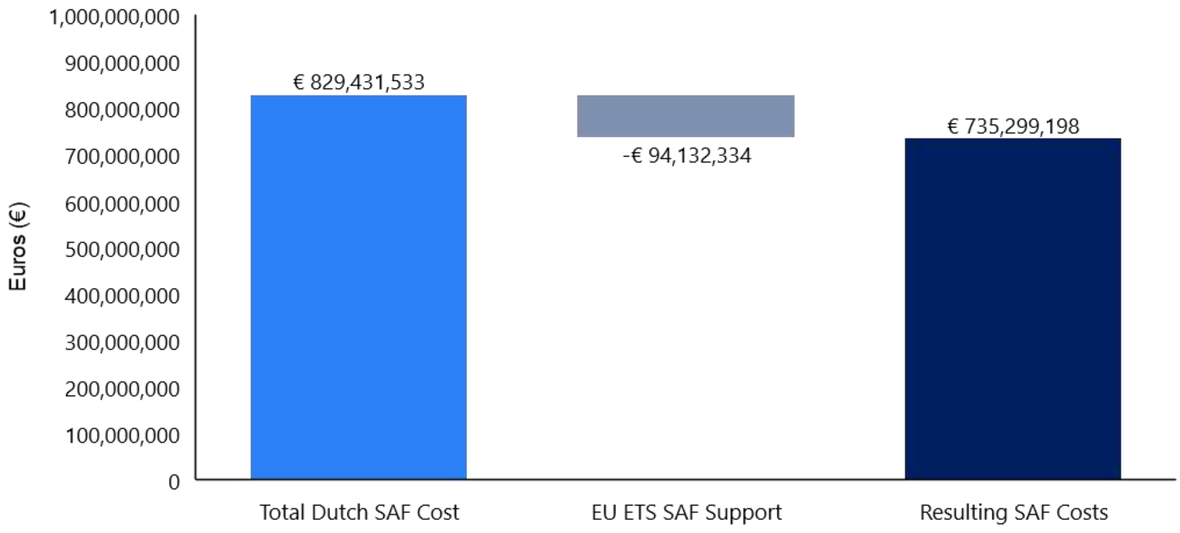
While the allocation methodology may appear to be arbitrary, without published guidance from the EU, assumptions have had to be deployed to value support on a national level. As free EUAAs will be distributed on a first come first serve basis, it is very likely that allocation to Dutch carriers will either exceed or fall under the 4.4% allotment. However, progressing with the 4.4% allocation placeholder provides an illustrative benchmark for calculating the level of support which could be made available to Dutch carriers. Figure below quantified the free allowance allocation and corresponding financial SAF support to Dutch carriers under the 4.4% allocation share assumption. Over the duration of the support scheme, 990,867 free allowances will be issues to Dutch carriers with a value of €94.13 million (assuming €95 per EUAA). The overall level of support annualised totals 141,552 free EUAAs per year at a forecasted value of €13.48 million.

Figure 68: EU ETS SAF support mechanism allocation to the Dutch aviation sector 2024-2030

	Total 2024-2030	Annual Avg. Free EUAAs
Free EUAA Quantity	990,867	141,552
EU SAF Support Value	€94.13m	€13.48m

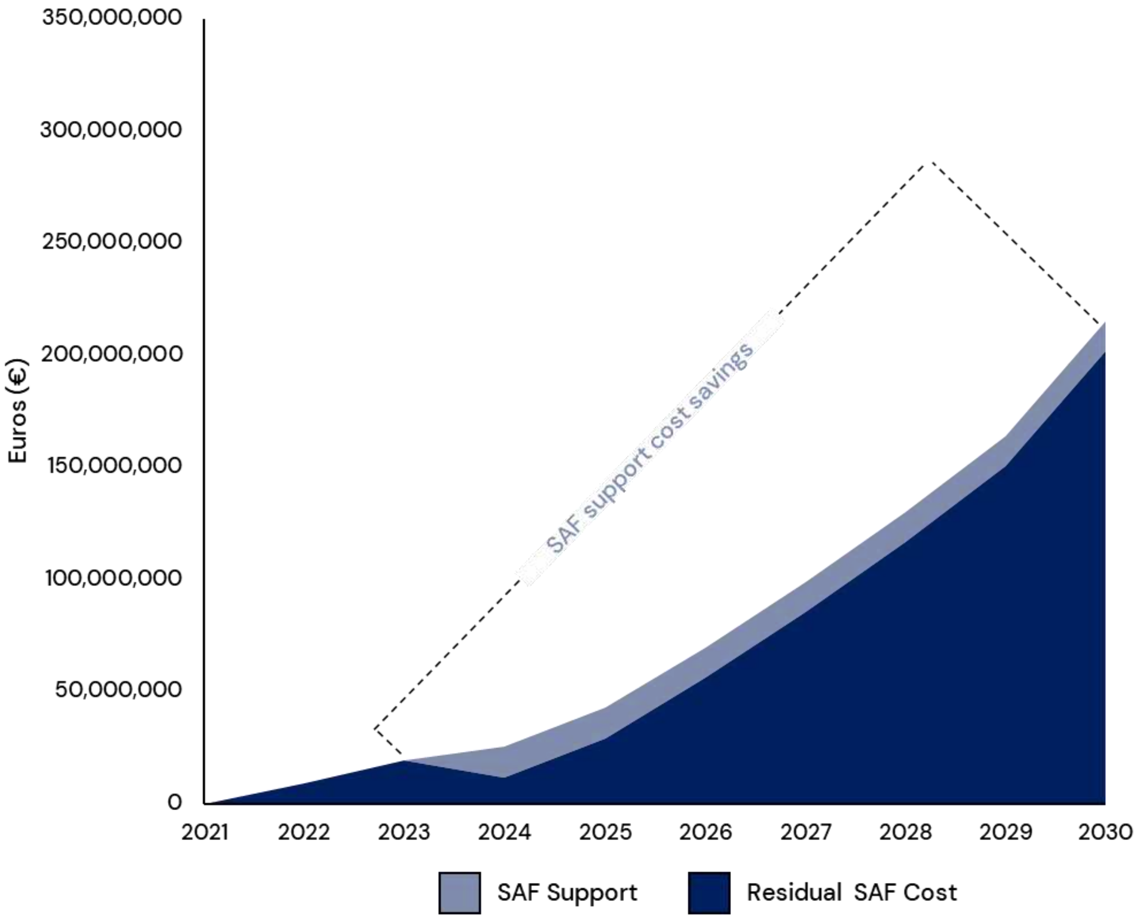
Figure 69 and 70 presents the cumulative and annual cost savings the EU SAF Support mechanisms could provide Dutch airlines. Utilising the SAF price forecasts (Figure) and the total volume of SAF uplift (Figure), the cost of SAF uplifted across Phase 4, pre-support, totals €830 million. With the €94 million of support potentially available to Dutch carriers, that figure is reduced to €735 million, a decrease of 11%.

Figure 69: Cumulative value of EU ETS SAF support to Dutch carriers (2024-2030)



In Figure 70, the light blue column represents the total SAF costs which are negated through the allocation of free EUAAs. With the introduction of SAF support, the average cost of SAF for Dutch carriers is reduced by €445 per tonne from €2,282 to €1,837.

Figure 70: Annual value of EU ETS SAF support scheme to Dutch sector



	2024	2025	2026	2027	2028	2029	2030
SAF Cost	€25.55m	€43.67	€72.56m	€104.18m	€139.61m	€178.39m	€237.53m
SAF Support	€13.44m	€13.44m	€13.44m	€13.44m	€13.44m	€13.44m	€13.44m
Residual SAF Cost	€12.102m	€30.22	€59.12m	€90.73m	€126.16m	€164.95m	€224.08m

€2,282

Avg SAF cost per tonne without policy support

€1,837

Avg SAF cost per tonne inclusive of the EU ETS SAF support package

Key Messages
Chapter 5: SAF Support

Chapter 5 served to quantify the level of support EU ETS could provide Dutch carriers in alleviating the cost burden of SAF. As part of the revisions to EU ETS Phase 4, 20 million free allowances have been set aside for commercial aircraft operators to offset SAF costs. While there has yet to be an approved methodology for allocating or valuing these allowances, this analysis supposes a national allocation methodology proportional to total EU ETS applicable activity.

Key Takeaways

- Total Dutch sector Phase 4 SAF costs were forecasted to total approximately €830 million. This figure is underpinned by a SAF cost of €2,257 per tonne from 2021-2029 and €2,537 per tonne in 2030. SAF price forecasts were developed in-line with WorldBank estimates while considering the introduction of the ReFuelEU synthetic fuel sub-mandate which commences in 2030.
- Assuming a value of €95 per free allowance, the total EU ETS SAF support package is values at €1.9 billion from 2024-2030 with €271 million being made available annually to EU member states.
- With The Netherlands responsible for 4.4% of EU ETS applicable traffic in 2021, the analysis allocated 4.4% of available free EUAAs to Dutch carriers over the 2024-2030 period. This methodology earmarked 990,867 free EUAAs to Dutch carriers over the lifetime of the scheme with a value of €94 million. Annualised, the support package for Dutch carriers totalled 141,552 EUAAs with an approximate value of €13.5 million.
- The EU ETS SAF support package reduces the total Phase 4 SAF cost exposure for Dutch carriers from €830 million to €735 million, an 11% reduction.
- The average SAF price per tonne over the duration of Phase 4 is subsequently reduced by €445, from €2,282 per tonne to €1,837 per tonne.

6. Movement Scenario Comparative Analysis

For this analysis, the emissions forecast, SAF uplift, allowance obligations and EU ETS cost analysis have been based on a 1.5% CAGR movement scenario. However, assessing the changes to Phase 4 under an a No Additional Movements scenario provides an alternative framing to assess the potential implications of the EU ETS changes under a differencing policy and sector outlook landscape. To recap, the two movement scenarios are as follows:

- 1.5% Compounding Annual Growth Rate (CAGR)[54]: Aligned with the EUROCONTROL's forecast, stating that flight growth is expected to grow on average 1.5% per year through 2029.
- No Additional Movements: The number of EU ETS applicable routes Dutch carriers fly remains fixed at 2023 levels through 2030.

This section provides a comparative analysis of the two scenarios, quantifying the impacts differing sectorial outlooks could have on the Dutch aviation sector for EU ETS obligations. The following comparative analysis was conducted using the 2026 phase out scenario. Undertaking this analysis with only one of the policy scenarios serves to align the results with the latest and approved ETS iteration.

Figure 71 and Figure 72 below, outline the flight variance between the two movement scenarios. In the no additional movement scenario, flight numbers were capped at 2024 figures and totalled 2,411,846 where the 1.5% CAGR flights totalled 2,516,598 across the duration of Phase 4. The 1.5% CAGR from 2024 results in an increase of 104,753 flights with EU ETS obligations. The dark blue area in Figure 71 presents the annual movement delta attributed to the 1.5% CAGR scenario.

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[54] *EUROCONTROL Forecast 2023-2029*

Figure 71: Additional annual movements under the 1.5% CAGR scenario compared to the no additional movements scenario

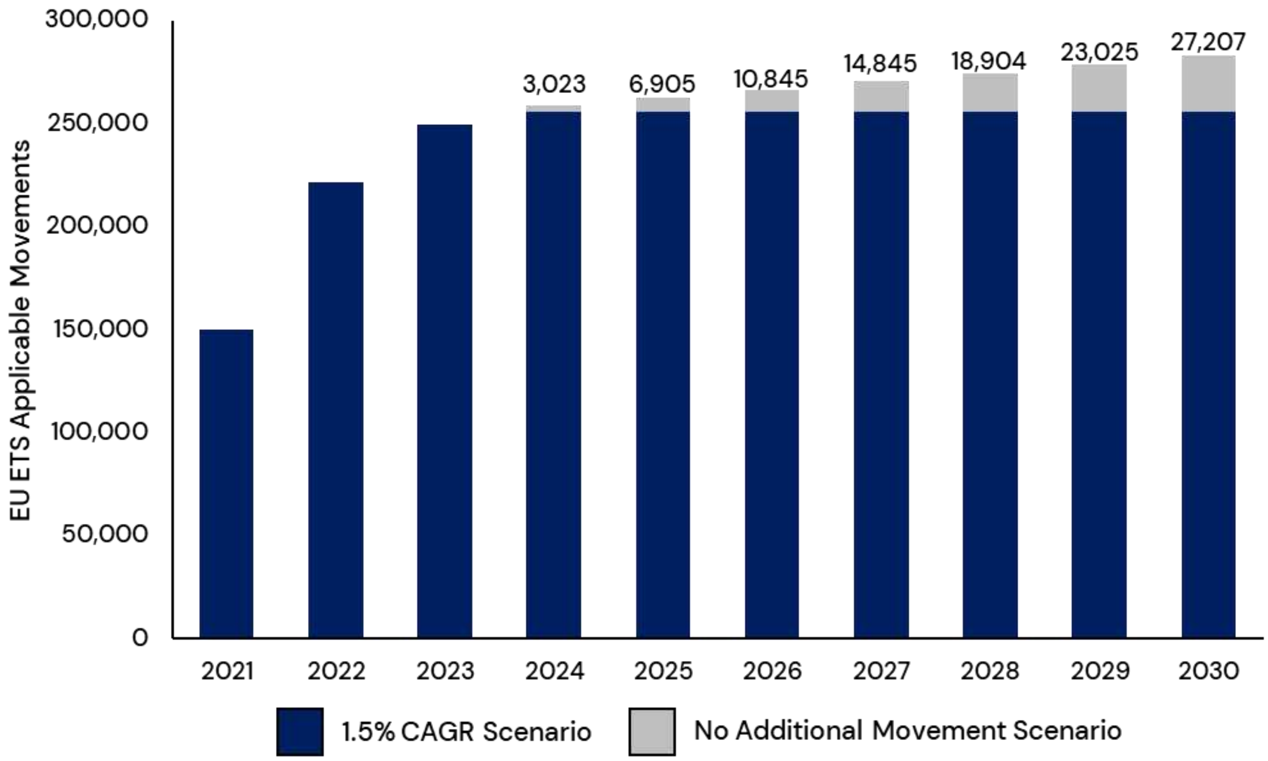
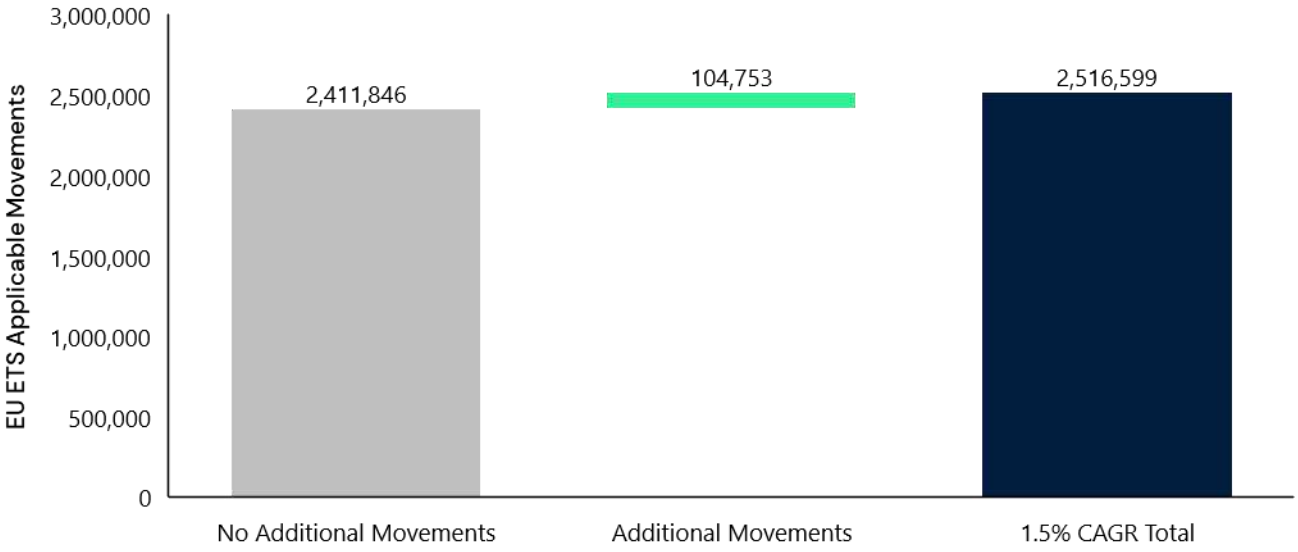
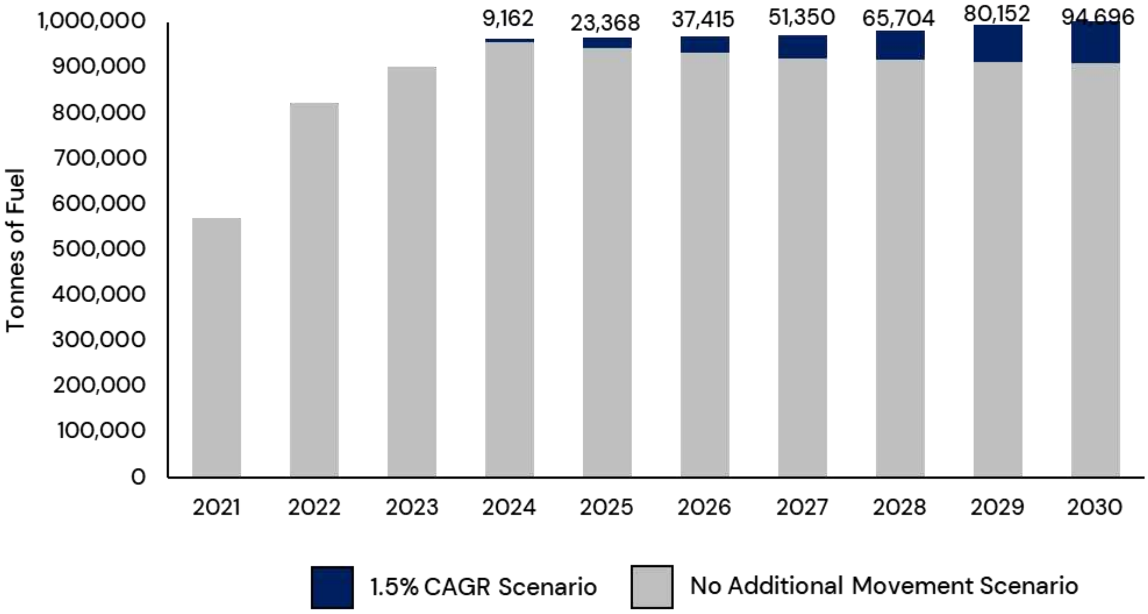


Figure 72: Cumulative movement difference under the two growth scenarios totals 104,000 across Phase 4



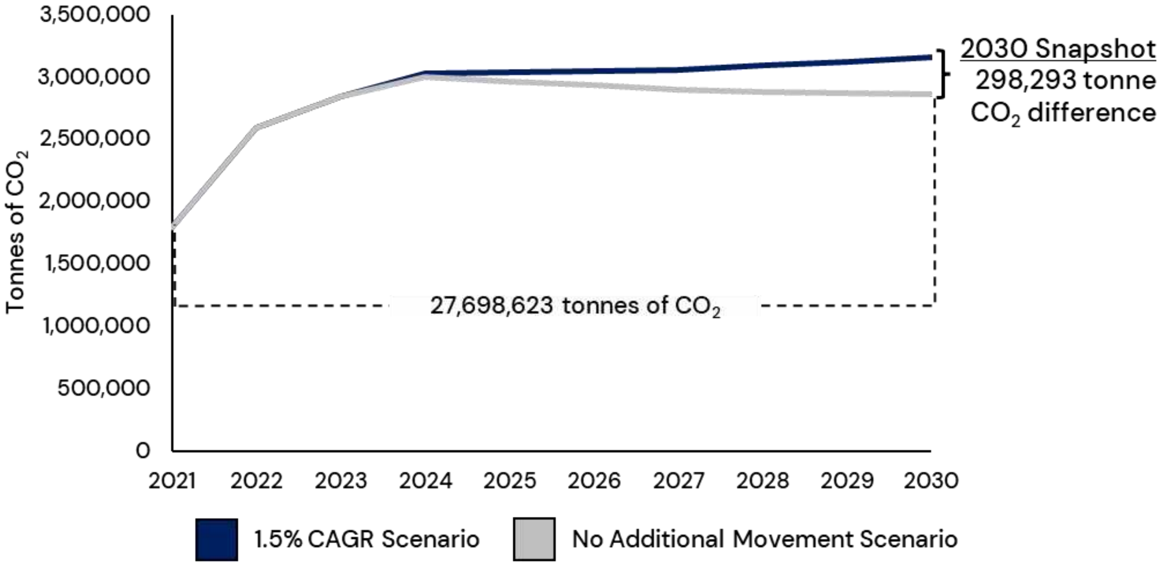
The fuel burn delta following fleet renewal of the two movement scenarios (1.5% CAGR and No Additional Movements) is captured in Figure 73 below. From 2024, when the analysis begins to account for fleet renewal, the cumulative fuel burn difference between the two scenarios is 361,847 tonnes of fuel. The annual additional fuel burn requests under the 1.5% CAGR scenario is represented by the dark blue bar chart additions.

Figure 73: Additional annual Dutch fuel burn under the 1.5% CAGR scenario compared to the no additional movements scenario following fleet renewal



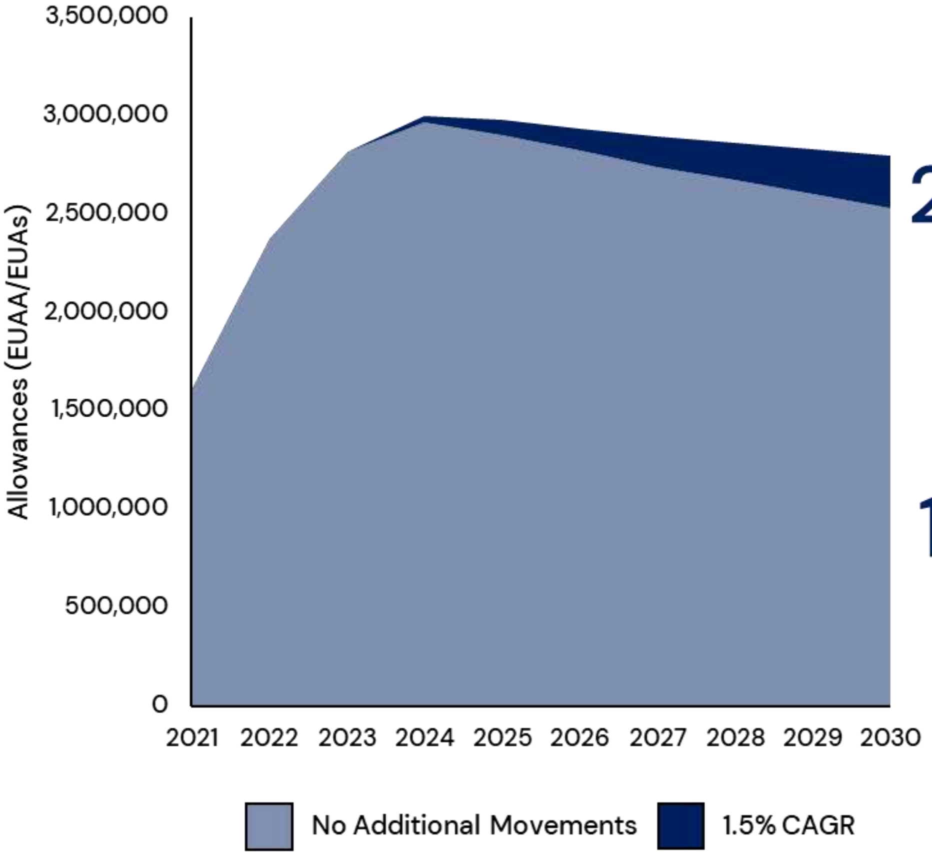
The variance in fuel burn has a corresponding impact on carbon emissions. As seen in Figure 74, under a no additional movement scenario, cumulative Phase 4 carbon emissions is 1,139,819 tonnes less than the 1.5% CAGR scenario, prior to the use of SAF. The total emissions following fleet renewal in a no additional movements scenario is 27,698,623 tonnes of carbon over Phase 4 compared to 28,838,442 tonnes in the 1.5% CAGR scenario. In the no additional movement scenario, despite there being no impact to the overall number of flights, annual fuel burn decreases from 2024-2030. This is the direct result of fleet modernisation and the introduction of more fuel-efficient aircraft. Over that time, CO_2 is reduced by 143,404 tonnes, a nearly 5% savings compared to the 1.5% growth scenario where CO_2 increases by 4%.

Figure 74: Cumulative carbon emissions delta following fleet renewal under two movement scenarios across Phase 4 is 1,139,819 tonnes of CO_2



As stated, from 2023 to the end of Phase 4 in 2030, the impact of the 1.5% movement CAGR scenario compared to the no additional movement scenario results in an additional 104,753 flights. These additional movements, while leading to a higher utilisation next generation aircraft and increased SAF uptake (359,946 tonnes in the 1.5% CAGR scenario compared to 335,880 tonnes in the no additional movements scenario), increases the EUAA/EUA obligation of Dutch carriers by 1,048,368 to a total of 27,079,833 from 26,031,465. The allowance obligation delta is captured in the graph below, with the obligations under the 1.5% scenario increasing over time.

Figure 75: National allowance obligations under varying movement growth scenarios given 2026 free allocation phase-out



26,031,465

Cumulative allowance obligation under the No Additional Movement scenario

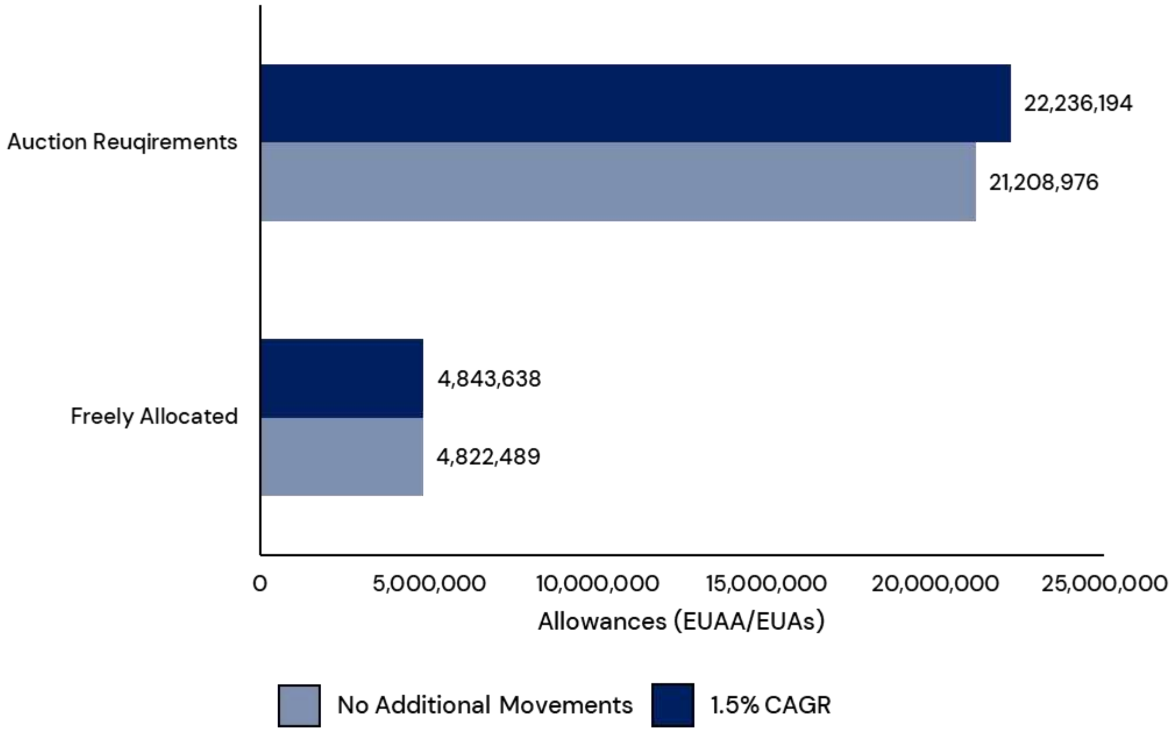
1,048,368

Additional allowance obligation under the 1.5% CAGR scenario

From the peak of allowance obligations of 2,966,782 in 2024, SAF and fleet renewal serve to reduce obligations under the no additional movement scenario by 16% by 2030 whereas allowance obligations decrease from their 2024 peak by 7% if Dutch carrier movements followed EUROCONTROL's forecasted 1.5% CAGR.

Within this comparative analysis, the quantity of free allowances provided to carriers, remains relatively static, despite the increased growth. This is due to the free allocation mechanism not being correlated to carrier emissions or activity. Figure 76 below illustrates the allowance distribution under the two scenarios. Moving from the no additional movements to the 1.5% CAGR adds 1,027,218 auctioning obligations for Dutch carriers.

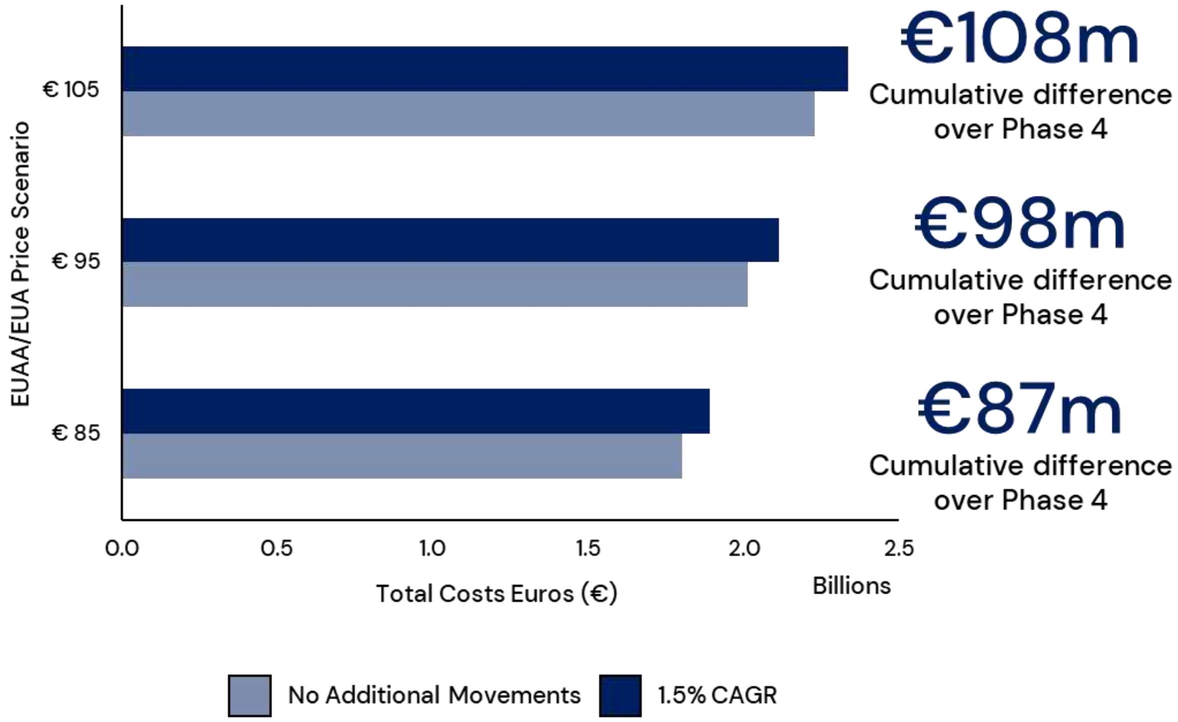
Figure 76: Cumulative national allowance distribution under varying movement growth scenarios given 2026 free allocation phase-out



Based on the above analysis, under the 1.5% CAGR movement scenario, each additional movement generates approximately ten allowance obligations which will have to be purchased through auction. While ten allowances per movement may not appear overly significant, a conservative price estimate is that each of those additional movements would cost between €850 and €1,050 (assuming a EUAA/EUA price range of €85-€105).

The table and graph in Figure 77 illustrate the cumulative Phase 4 costs under a range of EUA price sensitivities for each of the movement growth scenarios. Under the no additional movements scenario, with free allocation being phased out in 2026, total Phase 4 costs range from €1.8 billion-€2.2 billion while for the 1.5% CAGR scenario, cumulative costs range from €1.9 billion-€2.3 billion.

Figure 77: Cumulative Phase 4 costs under a range of allowance costs given a 2026 phase out scenario



	€85 per auctioned EUA	€95 per auctioned EUA	€105 per auctioned EUA
No additional movements	€1.8b	€ 2.0b	€ 2.2b
1.5% CAGR	€ 1.9b	€ 2.1b	€ 2.3b

To reiterate the carbon forecasting analysis, from 2023 to the end of Phase 4 in 2030, the impact of the 1.5% movement CAGR scenario compared to the no additional movement scenario results in an additional 104,711 flights. In terms of EU ETS costs per movement, each additional flight within the 1.5% movement scenario contributes a further €1,050 to the National EU ETS obligation within the €105 scenario. Under the €95 and €85 scenarios, each additional movement in the 1.5% CAGR scenario contributes an additional €950 and €850, respectively.

Comparing the two movement scenarios (no additional movements and 1.5% CAGR) within the context of the European Council and Parliament's EU ETS amendments (2026 free allocation phase out and OMR inclusion) highlights how allowance obligations are impacted by domestic aviation policy creating varying allowance obligations and EU ETS requirements for Dutch carriers.

Key Messages
Chapter 6: Movement Scenario Comparative Analysis

Chapter 6 provided a comparative analysis to assess the EU ETS implications of a no additional movement scenario. Within this scenario, the number of EU ETS applicable routes Dutch carriers fly remains fixed at 2023 levels through 2030. The chapter served to quantify the EUA/EUAA obligation and cost impacts differing sectorial outlooks could have on the Dutch aviation sector for EU ETS. The analysis was conducted using the 2026 Phase Out scenario.

Key Takeaways

- For the No Additional Movement Scenario, flight numbers were capped at 2024 figures and totalled 2,411,846 where the 1.5% CAGR Scenario, flights totalled 2,516,598 across the duration of Phase 4. Between the two scenarios, there was a total movement delta of 104,753 flights with EU ETS obligations.
- From the No Additional Movement Scenario to the 1.5% CAGR scenario, there was a 361,847 tonnes of fuel burn on account of the additional flights. The overall increase in fuel burn led to a 24,066 tonne difference in SAF uplift as there was a need to offtake additional volumes to meet voluntary targets and meet the ReFuelEU mandate under the 1.5% CAGR scenario.
- Following additional fuel burn and SAF uplift, the 1.5% CAGR scenario the difference in EUA/EUAA obligations between the two movement scenarios stood at 1,048,368 over the duration of Phase 4. For the 1.5% CAGR Scenario, total allowance obligations totalled 27,079,833 while under the No Additional Movement Scenario allowance obligations totalled 26,031,465.
- Comparing the two movement scenarios, the cumulative Phase 4 auctioning cost exposure difference ranged from €87 million - €108 million. The price range is reflective of the EUA/EUAA pricing scenarios with €87 million representing €85 per allowance and €108 million, €105 per allowance. The cost delta is driven by the 1,027,218 auctioning EUA/EUAA difference between the two movement scenarios across the duration of Phase 4.

7. Conclusion

This report has served to provide The Ministry of Infrastructure and Water Management (IenW) an analysis of the implications of the EU ETS changes on the Dutch aviation sector. This work was structured around answering the following three tasks:

1. **Assessing the implications of increased annual carbon cap reductions:** Provided a technical analysis of fiscal and operational impacts of raising the annual carbon cap from 2.2%/yr. to 4.32%/yr for 2024-2027, up to 4.4% from 2028 to 2030. This task was focused on the particular implications for Dutch aviation stakeholders and how an increased cap reduction would interact with aviation free allowances.
2. **Comparative analysis of free allowance elimination timelines:** Provided an assessment of the varying implications of free allowance elimination timelines. With aviation's free allowance provisions removal being accelerated to 2026, the cost and allowance purchasing requirements for Dutch carriers was examined.
3. **Delivering SAF allowance and offtake insights:** Provided an assessment of the EU's SAF allowance and fiscal support scheme. This project task particularly focused on quantifying the extent of support which could be made available to Dutch carriers. would ease supply-side risks.

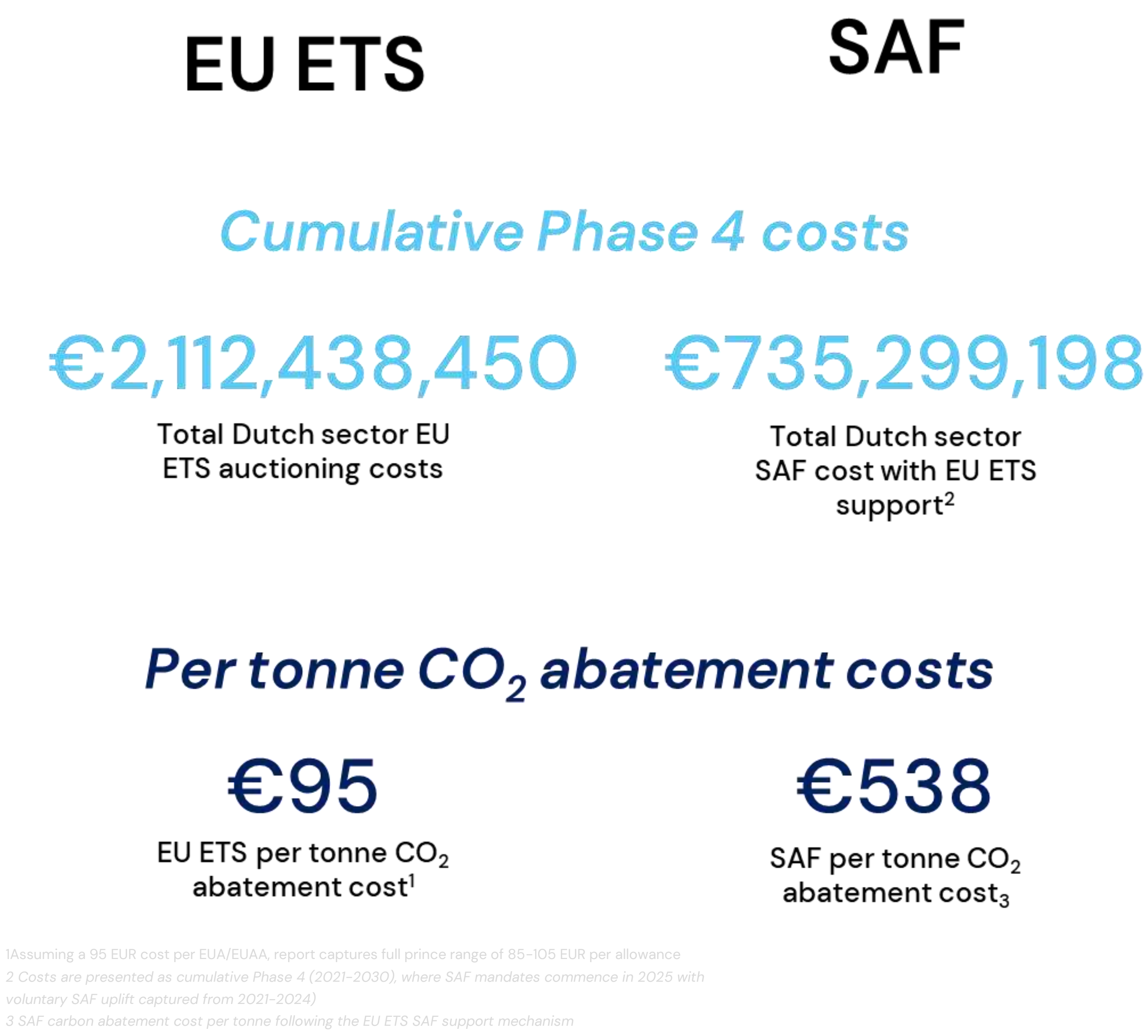
What is clear from the revised policy scenario analysis is that the changes to Phase of EU ETS serve reinforce the polluter pays principal. By increasing costs through the elimination of free allowances, the EU further incentivise more efficient flight operations, fleet renewal and increased SAF offtake to reduce allowance obligations. Given current fleet renewal plans and EUROCONTROL aligned growth, under Parliament's Phase 4 revisions, the cumulative cost of EU ETS could range from €1.89-2.33 billion for Dutch carriers.

From 2024, with the introduction of the increased linear reduction factor and the elimination of free allowances, the cost of EU ETS compliance will increase for Dutch and European carriers alike. In the central €95 EUAA/EUA pricing scenario, the additional costs of EU ETS auctioning obligations in 2030 will equate to approximately €2.63 per passenger for Dutch carriers. Despite the significant structural changes to EU ETS in the total elimination of free allowances by 2026 under Parliament's amendments, the cost burden was less than originally anticipated. This is due to Dutch carriers, and the European aviation sector as a whole, historically exceeding the sector specific cap, with Dutch carriers purchasing approximately 60% of its allowance obligations.

A key take-away from the analysis was presented Chapter 6, the Movement Comparative Analysis. The additional 104,753 movement from the no additional movement to the 1.5% CAGR scenario highlights how CO_2 emitted and allowances surrendered will mainly depend on the capacity of Schiphol Airport. Annual carbon emissions following fleet renewal under the two movement scenarios across Phase 4 was calculated to be approximately 1,140,000 tonnes of CO_2. In the central price scenario of €95, the cost delta of the EU ETS obligations of the two movement scenarios was €98 million. If the Schiphol cap were to be reintroduced or if movements were to be restricted between 2024 and 2030, the costs which would have had to be spent on EU ETS compliance could be redirected to additional SAF offtake or further fleet renewal.

While the SAF Support mechanism is a step in the right direction in incentivising SAF uplift, the value of EU ETS is not significant enough to drive additional SAF use. The SAF support available, if claimed in proportion to the Dutch aviation sector's share of EU movements would reduce the cost the average cost of SAF by €445 per tonne from €2,282 to €1,837. However, as outlined in Figure 78, purchasing enough SAF to abate one tonne of carbon would be approximately €443 more than surrendering an EUA/EUAA to cover that the same tonne of carbon. While the cumulative EU ETS costs of Phase 4 for Dutch carriers surpasses the cumulative cost of assessed SAF uplift on an almost 3 to 1 basis, the per tonne abatement cost of EU ETS remains significantly lower. As a result, a stricter EU ETS does not inherently drive additional SAF uplift beyond what is mandated or already voluntarily committed.

Figure 78: Cumulative Phase 4 costs under a range of allowance costs given a 2026 phase out scenario



EU ETS

SAF

Cumulative Phase 4 costs

€2,112,438,450

Total Dutch sector EU ETS auctioning costs

€735,299,198

Total Dutch sector SAF cost with EU ETS support[2]

Per tonne CO_2 abatement costs

€95

EU ETS per tonne CO_2 abatement cost[1]

€538

SAF per tonne CO_2 abatement cost[3]

1Assuming a 95 EUR cost per EUA/EUAA, report captures full prince range of 85-105 EUR per allowance

2 Costs are presented as cumulative Phase 4 (2021-2030), where SAF mandates commence in 2025 with voluntary SAF uplift captured from 2021-2024)

3 SAF carbon abatement cost per tonne following the EU ETS SAF support mechanism

There is still much uncertainty around the value of SAF support which will be made available to Dutch carriers through the 20 million free allowances. However, schemes such as the HBE and Schiphol's SAF are a step in the right direction to fostering a supporting aviation decarbonisation regulatory environment within The Netherlands. Additional Dutch SAF incentives could serve to replicate the U.S. SAF 'value stack' where Federal and States policies can be simultaneously claimed to significantly reduce the green premium cost of SAF compared to conventional aviation fuel. This could be achieved by replicating the success of Schiphol's SAF scheme at other Dutch airports to help ensure future traffic growth outside of The Netherlands central aviation hub is done so sustainability and in a non-carbon intensive manner. Additional national biofuel support aimed at producers would also serve to incentivise the further commissioning of SAF facilities. This would help support carriers such as KLM and Transavia to meet their voluntary SAF targets domestically while enabling foreign carriers to simultaneously uplift SAF within The Netherlands.

With the EU Parliament's changes to the EU ETS set to commence next year, it is crucial that national governments, national emission agencies, and carriers alike understand the implications and significance of said structural reforms. These amendments to aviation's EU ETS have been implemented to help achieve the Union's objectives of reducing net greenhouse gas emissions by at least 55 % by 2030 and becoming climate-neutral by 2050. Understanding the future landscape of ETS obligations will enable carriers and regulators alike to deploy carbon mitigating measures to support the Union's decarbonisation objectives while mitigating cost exposure and risks.

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Our team brings experience from successfully delivering sustainability projects both within aviation and out-of-sector. Our aviation experience ranges from policy analysis with the UK, US, and EU on the ETS, CORSIA, EVs, and biofuels, to detailed advisory on airline sustainable fuel offtake contracts and decarbonisation strategies. Most recently our team supported JetBlue to contract one of the largest SAF offtakes to date, and we've purchased SAF Certificates from IAG to address our own staff travel emissions. Our experts can draw on best-practice developed while successfully delivering sustainability projects for over 75 Global FT500 leading companies, and we supported the first US greenhouse gas inventory, the first mandatory greenhouse gas reporting program, the first federal agency climate adaptation program, and the development of China's emissions trading scheme. Learn more at icf.com/aviation.