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Reducing Greenhouse Gas Emissions in the Aviation Industry

Estimating the Cost for Passengers

by

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Introduction

Aviation is simultaneously a vital part of the transportation of passengers and goods in a modern society and a contributor to greenhouse gas emissions.

According to estimates from the International Energy Agency, the aviation industry needs to reduce its carbon dioxide ('CO_2') emissions by 2.4% per annum to achieve the Paris Climate Agreement goal of Net Zero in 2050, which has been reaffirmed by the International Air Transport Association ('IATA').

Beyond improvements in aircraft technology and operational efficiency, aviation is probably one of the more difficult sectors to decarbonise. There are currently at least three potential routes for the aviation industry to decarbonise: (i) alternative propulsion technology; (ii) sustainable aviation fuel; and (iii) permanent CO_2 removal.

European Union: Greenhouse Gas Emissions Targets

The European Commission has adopted a series of legislative proposals designed to achieve climate neutrality in the EU by 2050 and an intermediate target of at least a 55% net reduction in greenhouse gas emissions by 2030.

European Union Emissions Trading Scheme

A founding principle of the European Union ('EU') market is that the polluter pays. This principle is designed to cap the greenhouse gas emissions allowable from industry.

The EU Emissions Trading Scheme ('ETS') is a cornerstone of the EU policy to combat climate change. The ETS is mandated by legislation and constrains the total amount of emissions of the sectors covered by the system by setting a limit on the number of emissions allowances issued. To achieve an absolute reduction in the level of CO_2 emissions, the total number of emissions allowances decreases over time. Airlines must pay the ETS price of a tonne of CO_2 for each tonne they emit in excess of their free emission allowances.

At the time of writing, April 2022, the ETS remains the biggest carbon market in the world.

Carbon prices are experiencing some market volatility by increasing sharply in 2021 to values not expected until the end of the decade. The cost of one tonne of CO_2 was close to €100 in February 2022, dropped by 35% since the war in Ukraine but recovered partially in the light of news that Russia suspended natural gas supply to some European countries (Poland & Bulgaria).

Aviation – Cap on Allowances for Each Tonne of CO_2 Emitted

The annual cap on aviation allowances[1] for each tonne of CO_2 emitted as a result of their activities for phase 3 of the ETS for the period from 2013-2020 was originally set at 210,349,264 allowances per year. To account for Croatia's integration, the allowances were increased by 116,524. The allowances were distributed as follows:

82% granted for free to aircraft operators
15% are auctioned
3% in a special reserve for distribution to fast-growing aircraft operators and new entrants.

To apply for free allowances, aircraft operators had to provide independently verified tonne-kilometre[2] data for 2010 and a report on their transport volume. Around five hundred aircraft operators applied for free allowances.

There are a number of exemptions from the general emissions trading obligation. For example, official flights of reigning monarchs, heads of state, heads of government and government ministers of non-member states of the European Economic Area ('EEA') Agreement, military flights in military aircraft, law enforcement flights, search and rescue missions, firefighting flights, humanitarian missions and medical emergency flights, training flights, and flights for scientific research or for checking, testing, or certifying aircraft or equipment.

The European Commission and the EEA Joint Committee drew up a benchmark value by dividing the total annual number of free allowances by the sum of the verified tonne-kilometre data provided by aircraft operators.

In the period 2012 to 2020, an airline received 0.6422 allowances per 1,000 tonne-kilometres flown. In this way, fuel efficiency was encouraged. The allocation of free allowances to an aircraft operator is administered by the Member States to which the aircraft operator is assigned.

Global Voluntary Scheme to Offset the Growth in Emissions

The scheme known as the Carbon Offsetting and Reduction Scheme for International Aviation ('CORSIA') was introduced in October 2016 by the International Civil Aviation Organisation

[1] Each allowance represents one tonne of greenhouse gas emissions.

[2] One tonne-km is one metric tonne of revenue load carried one kilometre.

('ICAO'). The scheme aims to hold CO_2 emissions at 2020 levels by requiring participating airlines to monitor their emissions on international flights and offset any growth in their CO_2 emissions above their 2020 levels. The scheme is voluntary until the end of 2026, after which membership is compulsory. The offsetting is implemented by purchasing 'eligible emission units' generated by projects that reduce emissions, such as renewable energy.

Fundamental Differences: EU ETS *versus* CORSIA

For aircraft operators, the ETS covers flights landing and taking off in the EEA. The incrementally falling supply of allowances forces operators who need additional allowances to purchase them on the market from other traders in the system. The need for additional allowances is determined by two factors:

(i) an operator's free allocation of allowances; and

(ii) the actual emissions of that operator.

The price of an allowance under the ETS is determined by supply and demand. As the price of an allowance rises, the incentive to reduce emissions rises.

By contrast with the ETS, CORSIA is an offsetting scheme which covers international flights between member states. CORSIA membership is voluntary until the end of 2026. Emissions reductions that cannot be achieved in the aviation sector can be compensated through emission reductions in other sectors. The emission units satisfying the Emission Unit Criteria adopted by ICAO are eligible under CORSIA for purchase by aircraft operators.

Estimating the Costs for Passengers - FPG Amentum Estimate

In December 2021, FPG Amentum published a note (the 'FPGA Note') in which it investigated the cost of reducing CO_2 emissions by 10% for an A320NEO aircraft [FPG Amentum, 2021].

In the FPGA Note, the cost of emitting a tonne of CO_2 was priced at three levels: €60, €100, and €250, or equivalently, $70, $115, and $290 at a EUR/USD exchange rate of 1.15.

The FPGA Note then took as an example an A320NEO to estimate the cost per passenger per flight of offsetting 10% of the emission of CO_2 by the aircraft. The FPGA Note made the following assumptions:

A. An average annual utilisation rate at 9 flight hours per day or equivalently an average of 4.5 flight cycles per day, each cycle consisting of a two-hour flight.
B. The aircraft is assumed to have full economy seating capacity and 80% load factors.

We use the figures in the FPGA Note to illustrate the total cost per passenger per flight of offsetting the emission of CO_2 for an A320NEO aircraft based on the conditions at A and B listed above.

Table 1 below summarises the costs for different levels of CO_2 prices on the EU Emissions Trading System market.

Table 1

Based on the Conditions at A and B Above

Price of a Tonne of CO_2 on the ETS	**Annual Cost Per Aircraft in USD Millions**	**Cost Per Passenger Per Flight in USD**
$70	1.8	7.4
$115	3.0	12.1
$290	7.6	30.6

The figures in Table 1 show that at $290 per tonne of CO_2, the cost of a ticket for a one-way flight would need to increase by $30.60 to pay for the CO_2 emissions associated with the flight.

Alternative Propulsion Technology - Liquid Hydrogen Fuel for Aircraft

The use of liquid hydrogen to fuel aircraft greatly reduces the production of greenhouse gasses as the by-products of hydrogen combustion are water vapour and a small amount of nitrogen oxide.

Airbus and the engine manufacturer, CFM International, are testing hydrogen combustion technology on an A380 platform with the aim of producing a hydrogen-combustion propulsion system. This is part of their efforts to build aircraft that produce no CO_2 emissions by 2035.

The energy per unit volume of liquid hydrogen[3] is about one quarter of that of jet fuel which means that the aircraft design will need much larger and better-insulated fuel storage tanks. Offsetting this design requirement, the weight of liquid hydrogen is about one-third that of jet fuel for the same energy output.

Airports will also need to develop their infrastructure to handle hydrogen fuel. Airbus is reported to have entered into a partnership with a number of stakeholders, for example, Singapore's Changi Airport, to evaluate the infrastructure requirements for a hydrogen airport hub.

Sustainable Aviation Fuel ('SAF")

CO_2 extracted from the atmosphere can be combined with clean hydrogen to create a synthetic crude that can then be refined into fuel compatible with aviation jet fuel. This type of SAF burns more cleanly than conventional jet fuel. SAF can be almost carbon neutral over the life cycle. Production facilities can be set up anywhere there is access to clean energy and hydrogen.

3 In order to maintain hydrogen in the liquid state, it must be stored at a temperature below -252.9°C.

Currently, SAF is between two and five times more expensive than jet fuel. Over the next two years, a number of factors are likely to push the price of SAF down; the most important of these are supportive government policies. Other factors include lower production costs, increased market competition, and the likely rise in the cost of carbon emissions.

Jet fuel must meet certain specification standards before use as an aviation fuel. Likewise, SAF must meet certain specification standards for use in aviation as a synthesised hydrocarbon fuel. The percentage of SAF that can be blended with jet fuel depends on the particular approved SAF production pathway. When SAF is blended with jet fuel, tested, and meets certain standards, it may be used in aircraft and is fully fungible with jet fuel. Therefore, it can travel via the same pipelines as jet fuel from an airport fuel infrastructure perspective. Currently, SAF is available to buy from at least six airports, Oslo and Bergen airports in Norway, Los Angeles World Airports, San Francisco International Airport, Ontario International Airport, and Telluride Regional Airport.

The European Commission's proposal for a Corporate Sustainability Reporting Directive ('CSRD') will both revise and extend the scope of the Non-Financial Reporting Directive. The CSRD will require consistent reporting and audit requirements in relation to sustainability risks and impacts by all large companies. This will link the cost of capital to the progress companies are making in relation to sustainability and the level of climate risk they present.

In the US, in a recent speech in Menlo, Iowa, President Joe Biden stated that SAF is essential to getting net-zero by 2050. In recent flight tests, it was shown that 100% SAF can be used in both engines of an airliner. By accelerating the civil aviation approval process for the use of higher percentages of SAF in aircraft, airlines could switch to SAF earlier, potentially allowing them to achieve the net-zero target sooner than 2050.

References

FPG Amentum, 2021 – Aviation Insights – Cost differentiation between SAF and Carbon Offsetting: https://www.fpg-amentum.aero/wp-content/uploads/2022/01/2021_December_Aviation-Insights_FPG-Amentum_SAF_vs_Carbon_Cost.pdf

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The Banking & Aviation Finance Committee is grateful to Jan for co-authoring this briefing note.