2022 airlines' emission analysis

Methodological note

April 2023

1. Introduction

Every April, the European Commission releases compiled EU and Swiss emissions trading system (ETS) emissions data[1]. T&E analyses this data to understand the performance of airlines. This year, we extended the scope of the analysis to all emissions from flights departing from EU27, Norway, Iceland, Switzerland and the UK - hereon called EU31, to put the ETS pricing mechanisms in perspective. This was done by calculating the aircraft fuel consumption of scheduled flights data, from OAG[2], using Eurocontrol's fuel consumption methodology[3]. Our analysis focuses on 2022 emissions, as well as 2019 emissions, as the historical peak year of aviation emissions, prior to the covid crisis.

This methodological note details how the emissions from the different scopes were estimated in order to build the top polluting airline ranking, and how we deduced the effective carbon pricing.

2. Geographical scopes and corresponding emissions sources

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

Since the agreement between Switzerland and the EU on linking their ETSs in 2020, airlines report emissions and allocations from flights within Switzerland, and departing from Switzerland to the EEA[4] in a separate section in the ETS log (called "CH emissions'' and "CH allocations").

In 2021 the scope of the EU ETS was reduced. Aircraft operators now report emissions from flights from the UK to the EEA under the UK ETS[5]. Since UK ETS verified emissions were not made available yet, we estimated them from OAG data (Table 1).

Table 1 gives an overview of the ETS coverage of emissions depending on the countries of departure and arrival of a flight, as well as the source used in our analysis to estimate the corresponding emissions for airlines, both in 2022 and 2019.

[1] https://ec.europa.eu/clima/policies/ets/registry_en#tab-0-1

[2] https://www.oag.com/

[3] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-a-aviation-1/view

[4] The EEA includes the EU member states, Norway and Iceland.

[5] Emissions from flights from the EEA to the UK remain under the EU ETS scope (source).

Geographical scope of emissions	ETS coverage in 2019	ETS coverage in 2022	Source for 2019 emissions	Source for 2022 emissions
Emissions from flights within the EEA[6]	EU ETS	EU ETS	EU transaction log (Section 3)	EU transaction log (Section 3)
Emissions from flights from the EEA to the UK	EU ETS	EU ETS	EU transaction log (Section 3)	EU transaction log (Section 3)
Emissions from flights from the UK to the EEA	EU ETS	UK ETS**	EU transaction log (Section 3)	OAG, Eurocontrol* (Section 4)
Emissions from Switzerland to the EEA	Not covered	Swiss ETS	OAG, Eurocontrol* (Section 4)	EU transaction log (Section 3)
Emissions from the EEA to Switzerland	Not covered	EU ETS	OAG, Eurocontrol* (Section 4)	EU transaction log (Section 3)
Other emissions, from flights departing from EU31 that are not included in the above categories	Not covered	Not covered	OAG, Eurocontrol* (Section 4)	OAG, Eurocontrol* (Section 4)

Table 1: Geographical scopes, ETS coverage and emission sources. * Estimated emissions. **Official UK ETS emissions are to be released later this year.

3. EU transaction log

3.1 Emissions filling

We fill emissions if an account has not yet reported their emissions (i.e., they have -1 reported),it is listed as open and they are not excluded from reporting. Typically, there are a certain number of accounts that do not report their emissions on time. For the aviation sector, the operators that have not reported their 2022 emissions in time accounted for 19% of aviation emissions in 2021. For the other sectors, they accounted for 5% of 2021 stationary emissions. For operators that have not reported their emissions, we calculate the overall growth in emissions of the corresponding sector, defined by its activity code (e.g. 21 for the sector of refining of mineral oil, 10 for aviation operators). We then apply this growth factor to their 2021 verified emissions to obtain the 2022 estimation. For accounts that closed during the year 2022, the emissions are scaled down depending on the number of months the account was open in 2022.

Although the same process is applied on the majority of airlines that have not reported their emissions, a more detailed analysis was undertaken for several specific airlines. For accounts that are combined with other ones (see Section 3.2 Airline Grouping) and that have their verified emissions missing for 2022, we apply the same growth as the accounts of the same group to their 2021 emissions. At the time of the publication, on the 7th of April 2023, Air France had not yet filled its emissions in the EU transaction log and we estimated its emissions using OAG data and

[6] The EEA includes the EU27, Norway and Iceland.

Eurocontrol's fuel consumption (2.11 Mt). On the 11th of April, we updated Air France EU ETS emissions with its reported EU and Swiss ETS emissions (1.99 Mt).

3.2 Airline Grouping

Some airlines have different accounts in different member states of the EU. For all intents and purposes, these different accounts are attributable to an airline based on whether or not a passenger believes they are flying with a certain company or not. EasyJet, for example, has four accounts, however they do not have four separate airlines, or websites to book those flights, or are operated by different entities. This differs from subsidiaries, for example Lufthansa owns Brussels Airlines, but Brussels Airlines is a different brand than its parent company.. The airlines that we grouped together are shown in the table below, under an airline alias that is the commonly used name.

Airline ALIAS	Identifier in ETS log	Note
TUI	30011.TUI AIRLINES BELGIUM	
	Handelskonto TUIfly GmbH	
	TUI Airlines Nederland BV	
	TUIfly Nordic AB	
	Thomson Airways Limited	
Ryanair	Ryanair Sun S.A.	Has not reported its emissions
	Ryanair UK Limited	
	Ryanair DAC	
ASL	27011.ASL Airlines Belgium	
	ASL AIRLINES FRANCE SA	
	Farnair Switzerland	Account closed
	ASL Airlines (Hungary) Kft.	Account closed
	ASL Airlines (Ireland) Limited	Has not reported its emissions
FedEx	11102.FedEx Express Corporate Aviation	
	FEDERAL EXPRESS CORPORATION	
EasyJet	easyJet Switzerland SA	Account closed
	EACL ETS Account	
	EASYJET UK LIMITED	Has not reported its emissions

	easyJet Europe Airline GMBH	
Norwegian	Norwegian Air Shuttle AOC	
	Norwegian Air Sweden AOC AB	
	Norwegian Air International Limited AOHA	Excluded
	Norwegian Air UK	Has not reported its emissions
DHL	European Air Transport Leipzig GmbH	
	DHL Air Limited	
Iberia	IBERIA LAE SA OPERADORA SU	
	Iberia Express, S.A.	
Eurowings	Handelskonto der Germanwings GmbH	
	Eurowings GmbH	
Transavia	TRANSAVIA FRANCE	Has not reported its emissions
	Transavia Airlines	
Wizz air	WIZZ AIR UK LIMITED	
	WIZZ AIR HUNGARY LTD	
British Airways	British Airways PLC	
	BA CITYFLYER LIMITED	

Table 2: Account combined in the ETS

4. Estimates of emissions from the remaining geographical scopes

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

4.1 Comparison of OAG estimates with other data sources

We calculate that the emission from flights departing from EU27 using OAG data are 5% below the emissions from UNFCCC in 2019[7] and that emissions from the 2019 ETS scope are 2% below the verified emissions from the EU transaction log. The same comparison for 2022 shows that OAG emissions are 5% higher than ETS emissions calculated from the EU transaction log. Table 2 shows, by airline, the comparison between the emissions calculated from OAG, and the emissions reported under the EU ETS for the years 2019 and 2022. Although the OAG estimates of ETS emissions are not used in our analysis - we use OAG estimates only for the emissions not covered by the EU ETS, this comparison aims at checking the accuracy of the estimates from OAG at the airline level.

Scope	**2019 EU ETS scope (incl. flights to and from the UK)**			**2022 EU ETS scope (incl. flights from and to Switzerland, but excl. flights from the UK)**		
Airline	**OAG estimated emissions 2019 (Mt)**	**Reported ETS emissions in 2019 (Mt)**	**Difference OAG - ETS (Mt)**	**OAG estimated emissions 2022 (Mt)**	**Reported ETS emissions in 2022 (Mt)**	**Difference OAG - ETS (Mt)**
Ryanair	11.1	10.5	0.59	10.4	9.5	0.88
Deutsche Lufthansa AG	4.5	4.4	0.10	3.4	3.2	0.20
Air France	2.5	2.5	-0.02	2.1	2.0*	0.12
British Airways	2.8	2.9	-0.08	1.0	0.9	0.02
Easyjet	6.5	6.6	-0.04	3.9	3.3	0.59
KLM-Royal Dutch Airlines	2.1	1.9	0.18	1.8	1.5	0.33
Emirates	0.1	0.0	0.01	0.0	0.0	0.01
Wizz Air	2.7	2.6	0.09	2.6	2.4	0.20
TUI	1.7	1.8	-0.09	1.1	1.0	0.05
Qatar Airways	0.1	0.0	0.03	0.0	0.0	0.00

Table 3: comparison of OAG data with ETS data from the EU transaction. Note that the scope of the ETS in 2022 is different from the one in 2019, and that emissions are not directly comparable from one year to the other.

* At the time of the analysis, Air France had not reported its ETS data yet, and emissions were approximated using OAG. On 11/04/2023, emissions under EU and Swiss ETS were updated with reported emissions.

[7] UNFCCC's scope includes emissions from private jets. Therefore, the comparison is made after adding T&E own private jets' emission estimates to the emissions calculated from OAG.

4.2 Ryanair and Wizz Air recovery

Table 3 shows that estimates for Ryanair and Wizz Air, which we identified as having already surpassed their 2019 level of emissions, are very close to EU ETS data, respectively 5.6% and 3.6% higher for the year 2019, and 9.2% and 8.4% higher for the year 2022.

For those two airlines, more details on the calculations of total emissions are given below.

In 2019, Ryanair emitted 10.5 Mt of CO_2 under the EU ETS, which at the time, included all flights within countries in the EEA and the UK. In 2022, we find that Rynair emitted 9.5 Mt of CO2 under the EU ETS. In order to compare the two years, we need to add 2022 Ryanair emissions from flights from the UK to the EEA that are now covered by the ETS. Using OAG data, we estimate those emissions to be around 2 Mt. We therefore can say with confidence that Ryanair's emissions from the EU ETS scope as it was in 2019 are higher in 2022 than they were in 2019. Regarding the remaining emissions, we find that they were 1.6 Mt in 2019, and 1.8 Mt in 2022. As a result, we find that Ryanair's total emissions in 2022 (13.3Mt) are higher than the total emissions in 2019 (12.1Mt).

Wizz Air's EU ETS emissions were 2.6 Mt in 2019. In 2022, Wizz Air emitted 2.4 Mt under the EU ETS. We estimate its emissions from the UK to EEA to be 0.5 Mt. We estimate remaining emissions to be 0.6 Mt in 2019 and 0.8 Mt in 2022, which results in total emissions of 3.2 Mt in 2019 and 3.7 Mt in 2022.

Reported ETS emissions from 2013 to 2019 show that both Ryanair and Wizz Air have increased their emissions year after year until 2019. Given that most of those airlines' emissions are covered by the EU ETS (87% and 82% respectively in 2019), we deduce that 2019 was the year of their overall peak emissions before the covid crisis, and subsequently, that they reached their peak emissions in 2022.

4.3 Top 10 polluting airlines

Airlines are ranked by their total departing emissions from flights departing from EU31. It should be noted that our emissions estimates for Iberia (3.1 Mt) and United Airlines (3.0 Mt) were close to the emissions estimates of Qatar Airways emissions (3.1 Mt), which is the last airline in the top 10 ranking.

5.Effective price of carbon emissions

For each airline, we calculate the effective prices of a tonne of CO_2 emitted. To do so, we divide the amount of money they pay for their emissions priced under the ETSs by their total emissions from flights departing from EU31. Under the EU ETS scheme, around 500 aircraft operators[8] are allocated free allowances. From 2021 onwards, a 2.2% linear reduction factor started applying on these allocations. Emissions priced under an ETS are emissions covered by this ETS, minus the number of free allowances. We use an average carbon price of €81.04/tonne of CO_2 [9] for the EU and the Swiss ETS (that are linked), and €91.89/tonne of CO_2 [10] for the UK price.

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[8] https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/free-allocation/allocation-aviation_en

[9] Ember

[10] Ember. Using the 2022 average conversion rate of 0.8528 (Source).

Further information

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