# T&E aviation's pricing tool

## Methodology

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This methodology note accompanies the T&E aviation pricing tool. It describes the data and analysis, including calculation of $CO_2$ emissions, passenger volumes, EU emission trading system (ETS) and fuel tax revenues, and projection of passenger numbers.

### Geographical scope

The scope of the tool includes the EU27, the UK,  Norway, Switzerland and Iceland.

### Calculation of $CO_2$ emissions

Automatic Identification System (AIS) data from Plane Finder for 6 weeks – January, July, August, November of 2018, February of 2019 and November of 2017– were processed.  The data compiled individual plane movements between airports in Europe, enabling the assignment of aircraft movements to countries based on point of departure. The amount of $CO_2$ emitted by each country pair in the studied weeks was calculated by applying the kerosene $CO_2$ emission factor to the aircraft's total fuel burn, computed for each aircrafts' type and journey length using the ICAO $CO_2$ calculator methodology[1]. The weekly data were extrapolated to get annual $CO_2$ data for each country pair. $CO_2$ emissions from the nine Outermost Regions[2] were calculated separately from those of their parent countries. Flights identified as freight journeys are excluded from the analysis.

### Analysis of passenger volumes

Passenger volumes between the 27 EU members, the UK, Norway, Switzerland and Iceland in 2018 were extracted from Eurostat dataset *Air passenger transport between reporting countries (avia_paocc)*. Since those data include passengers flying from or to outermost regions - for example, the airport of La Gomera (Canary Islands) reports its passenger for Spain - the dataset *Detailed air passenger by reporting country and routes (avia_par)* was used to separate Outermost Regions from their parent countries. For example, passengers travelling between the Azores and France were subtracted from those travelling between France and Portugal in the first dataset *(avia_paocc)* so that the Azores could be treated as a separate entity.

[1] ICAO CO2 Calculator Methodology, available: https://www.icao.int/environmental-protection/CarbonOffset/Documents/Methodology%20ICAO%20Carbon%20Calculator_v10-2017.pdf

[2] Canary Islands (Spain), French Guiana (France), Guadeloupe (France), Martinique (France), Mayotte (France), Réunion (France), Saint-Martin (France), Azores (Portugal), Madeira (Portugal)

## Allocation of EU ETS revenues

The EU emission trading system[3] has $CO_2$ allowances specifically for the aviation sector, EU Aviation Allowances (EUAAs). Airlines must purchase EUAAs to cover their intra-EU emissions. As the number of EUAAs are capped for airlines, emissions above these caps must be covered through allowances bought from the pool of allowances that cover stationary installations, EU allowances (EUAs). Generally, airlines receive 85% of their EUAAs for free, however they need to pay for all other emissions.

EUAAs are attributed to member states (MSs) based on the auctioning data[4]. EUAs attributed to aviation are based on the EU wide aviation verified emissions[5] that are above the total EUAAs auctioned. The EUA revenue due to aviation is then split across MSs based on their share of stationary emissions. While EUAAs are a 'definite' means of calculating revenues for a member state, airlines are free to buy EUAs from anywhere in the market, thus the allocation of revenues is highly speculative. We deem this to be the best available proxy for their distribution.

The user can change Linear Reduction Factor (LRF)[6], ETS allowance price[7], and EUAA auction share to see projected revenues from EUAAs and aviation generated EUAs. The increase of revenues generated by the modification of the LRF, the ETS price and the auction share are uniformly transferred to ticket prices. Ticket prices are from kiwi.com.

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3 https://ec.europa.eu/clima/policies/ets_en

4 EU27
https://www.eex.com/en/market-data/environmental-markets/auction-market/european-aviation-allowances-auction/euaa-auction-download
UK https://www.theice.com/marketdata/reports/149
EFTA states' auctioning under EU ETS in phase 3 did not start before 2019 and the accumulated unsold volumes from 2013 to 2018 have been distributed between 2019 and 2020. EUAAs auctioned for Norway and Iceland were deduced from administered EUAAs and distributed proportionally according to auctionning data of 2019.
Swiss ETS is joining EU ETS from 2020 onwards. The EUAAs cap of the Swiss ETS was used to calculate revenues for Switzerland and is added to the EU ETS EUAAs cap.
https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/climate-policy/emissions-trading/informationen-fuer-luftfahrzeugbetreiber.html

5 https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1

6 The LRF reduces the total amount of EUAAs and as a consequence, the amount of allowances that are distributed for free. Without a reduction in emissions, airlines will have to purchase more EUAs.

7 In reality, as the ETS is a cap and trade system, the carbon price should increase with the scarcity of allowances. If reductions in emissions occur faster than the cap reduces, there can be a surplus of allowances, pushing the price down. This is to a large extent remedied by the market stability reserve, In the tool, the value of 25€/tonne is used as a proxy for the average value of allowances in 2019.

## Application of fuel tax

Users can choose to implement a tax on kerosene. In case of a multilateral agreement, the fuel used for flights between the countries that are part of the agreement is taxed. Users can change the value of the tax, and the year it comes into force. The ticket price increase generated by the fuel tax between two countries is calculated by the following:

On average, passengers travelling between country A and country B emit *X* kg $CO_2$ per passenger. A fuel tax of *T* €/litre of kerosene equates to a tax of $\frac{T}{kerosene\ emission\ factor}$ €/kg $CO_2$[8], which increases the ticket price by $\frac{X \times T}{kerosene\ emission\ factor}$ €. For example, a fuel tax of €0.33/litre is equivalent to €131/t$CO_2$. The average $CO_2$ emissions per passenger is 0.10 t$CO_2$/passenger. The average ticket price for a one way journey is €85 per passenger. Therefore, a fuel tax across EU27, the UK, Norway, Switzerland and Iceland of €0.33/litre would increase the average ticket price by 15%. Note that there is a large variation across MSs.

## Projection of passenger demand and $CO_2$ emissions

For each year *Y*, the total ticket price increase generated by the introduction of a tax on kerosene and/or a strengthened ETS measure is calculated. The total increase in price is calculated for the affected passenger flows, and this price increase is distributed across all passengers at a full pass-through. Price elasticities of demand[9] are applied to deduce the decrease in the number of passengers, and subsequent reduction in $CO_2$ emissions[10] . Revenues from the fuel tax of year *Y* are then calculated by multiplying the updated $CO_2$ emissions included in the fuel tax agreement by the corresponding price of a tonne of $CO_2$, using the kerosene $CO_2$ emission factor[11]. In case of the introduction of a kerosene tax in year *Y*, or/and a brutal change in ETS price or auction share that impact significantly the $CO_2$ emissions, the decrease in ETS revenues is calculated as a second order effect.

$CO_2$ emissions and passenger numbers for the baseline of year *Y*+1 - without having considered yet the effect of the measures implemented in year *Y*+1 - are calculated by applying uniformly a compound annual growth rate of 2.7%[12] across all states. Revenues, $CO_2$ emissions, and passenger volumes of year *Y*+1 are then deduced by applying the same process as for year Y.

[8] Kerosene CO2 emission factor of 2.519 kgCO2/litre of kerosene burnt.

[9] https://www.iata.org/whatwedo/Documents/economics/Intervistas_Elasticity_Study_2007.pdf
-0.92 and -0.84, respectively for domestic and intra EU flights.

[10] It is considered that a decrease in terms of passenger is directly translated into a decrease in CO2 emissions. In reality, a decrease of passengers could in the first place lead to smaller occupancy rates.

[11] Kerosene CO2 emission factor of 2.519 kgCO2/litre of kerosene burnt. (Density * Specific energy * Carbon intensity)
https://en.wikipedia.org/wiki/Energy_density#Energy_densities_of_common_energy_storage_materials

[12] ICAO 2018, https://www.icao.int/sustainability/Documents/LTF_Charts-Results_2018edition.pdf

## Business as usual

$CO_2$ savings are calculated by comparing the accumulated $CO_2$ that would be emitted if the legislation remains at it is, that is to say no fuel tax, a LRF of 2.2% from 2021 onwards and a constant allowance price of 25€/tonne of $CO_2$ used as a proxy.

## Summary of key results

The scope includes EU27 (with outermost regions), the UK, Norway, Switzerland and Iceland).

| | passengers (million) | | $CO_2$ emissions (Mt) | | average price CO2 (€/tonne) | | average ticket price (€) | |
|---|---|---|---|---|---|---|---|---|
| Scenario/year | 2021 | 2030 | 2021 | 2030 | 2021 | 2030 | 2021 | 2030 |
| BaU | 819.5 | 1037.4 | 83.7 | 105.9 | 12.5 | 16.2 | 84.8 | 85.2 |
| Fuel Tax 0.33€/l 2021 ETS (85% free, LRF 2.2%, 25€/tCO2 | 709.4 | 898.0 | 70.5 | 89.2 | 142.3 | 146.7 | 97.7 | 98.2 |
| Fuel Tax 0.33/l in 2021 Strengthened ETS (0% free allowances, 50€/tCO2) | 680.7 | 865.2 | 67.8 | 86.1 | 176.9 | 176.9 | 101.2 | 101.2 |

## Further information

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