TAKS
TRANSPORT ANALYSIS AND KNOWLEDGE SYSTEMS

Assumptions and methodology adopted in the CORSIA related analysis ahead of the ICAO Assembly

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A. Overview of the data

- The CORSIA related analysis ahead of ICAO Assembly has resulted in the following data:
  Data for 14 carrier regions and 6 CORSIA policy options (see D) for 3 years (2025, 2030 and 2035):

  CO_2 emissions international aviation (Mt)

  CO_2 emissions domestic aviation (Mt)

  Total CO_2 emissions (Mt)

  CO_2 emissions subject to CORSIA (Mt)

  CORSIA offsets (Mt)

  Offsets as % of total CO_2 emissions

  Costs for purchasing offsets (million €)

  % of emissions on EEA departing flights

  Whereby a carrier region relates to all carriers with have their home base in a certain world region
- Data for 5 route groups and 6 CORSIA policy options (see D) for the same 3 years:

  CO_2 emissions international aviation (Mt)

  CO_2 emissions subject to CORSIA (Mt)

  CORSIA offsets (Mt)

  Offsets as % of CO_2 emissions on route group

  Costs for purchasing offsets (million €)

  Offset costs as a % of total operating costs

  Costs per passenger for purchasing offsets (€)
- Data for 5 route groups and EU ETS for all departing flights (see E) for the same 3 years:

  Costs for purchasing allowances if route group would be subject to EU ETS or UK ETS (million €)

  Allowances costs as a % of total operating costs

  Costs per passenger for purchasing allowances if route group would be subject to EU ETS or UK ETS (€)

  Whereby the following 5 route groups have been distinguished:

  EEA - United States

  EEA - Middle East

EEA - China

EEA - Brazil

United Kingdom - United States

B. Data sources and model used

- The data have been generated with the use of the AERO-MS. The IPR of the AERO-MS is with The European Union Aviation Safety Agency (EASA)[1].
- More information on the AERO-MS can be found on the EASA website[2].
- Computations of CO_2 emission by route group for 2019 and 2020 have been brought in line with CORSIA Central Registry data published by ICAO[3].

C. Baseline scenario including recovery from COVID-19

- Both ICAO and IATA have made estimations when aviation emissions will recover to the pre-COVID level of CO_2 emissions in 2019. The most recent expectation is that by 2025 international air travel and related aviation emissions are back to the level of 2019. For domestic air travel, an earlier recovery is expected with domestic air travel and related aviation emissions to be back to the level of 2019 by 2023[4].
- For the growth of aviation emissions after the recovery to 2019 levels, use is made of the a pre-COVID analysis of ICAO from 2018[5].
- The baseline scenario includes the Sustainable Aviation Fuels (SAFs) blending mandates of 2%, 5% and 32% for respectively 2025, 2030 and 2040 for all flights departing from an airport in an EEA Member States. In line with both EU ETS and CORSIA regulations, it is hereby assumed that SAFs have zero CO_2 emissions.

D. CORSIA policy options

- The 6 CORSIA policy options which are considered are:
  1. Baseline: average 2019/2020. 5 major countries in mandatory phase.
  2. Baseline: 2019. 5 major countries in mandatory phase.
  3. Baseline: 70% of 2019/. 5 major countries in mandatory phase.
  4. Baseline: average 2019/2020. 5 major countries not in mandatory phase.
  5. Baseline: 2019. 5 major countries not in mandatory phase.
  6. Baseline: 70% of 2019/. 5 major countries not in mandatory phase.

[1] The European Union Aviation Safety Agency (EASA) has made available the AEROMS model for this analysis on a complimentary basis. The results of this analysis do not reflect the official opinion of EASA or of the European Union. Responsibility for the information and views expressed lies entirely with the authors.
[2] https://www.easa.europa.eu/domains/environment/impact-assessment-tools
[3] https://www.icao.int/environmental-protection/CORSIA/Documents/CCR%20Info%20Data%20Transparency_PartII_Nov2021_web.pdf
[4] https://www.aerotime.aero/articles/30355-air-passenger-numbers-wil-recover-in-2024-iata
[5] https://www.icao.int/sustainability/Documents/LTF_Charts-Results_2018edition.pdf

- The year 2019 as the Baseline is the least stringent because 2019 emissions were not affected by the CORSIA baseline, and the higher the baseline, the lower the offset obligations.
- According to the CORSIA Central Registry data, CO_2 emission from international aviation in 2019 and 2020 were respectively 606.48 and 265.24 Mt (see: reference in footnote 3). This implies that the average emissions over 2019/2020 were 435.86 Mt. The average emissions over 2019/2020 are thereby 71.9% of 2019 emissions. Hence, in terms of environmental stringency, the 70% of 2019 baseline option is slightly higher (but also very comparable) in comparison with the average 2019/2020 baseline option. However the 70% of 2019 emissions does not consider the non-representative, COVID-affected traffic and emissions of 2020. This is especially relevant in relation to the individual share of aircraft operators which according to the CORSIA resolution comes into play after 2029.
- Offset obligations of individual aircraft operators are also affected by the so-called sectoral growth rate and individual growth rate. In the pilot, first phase and first years of the second CORIA phase (period 2021-2029) offset obligations will be based on a 100% sectoral growth rate (and hence 0% individual growth rate). In line with the CORSIA resolution[6], it is assumed that from 2030 through 2032 the individual growth rate will go up to 20% (i.e. 80% sectoral growth rate) and from 2033 through 2035 the individual growth rate will go up to 70% (i.e. 30% sectoral growth rate) The ratio between sectoral growth rate and individual growth rate does not affect total offset obligation for the aviation sector but only the distribution of the offset obligation across aircraft operators.
- For all 6 policy options it is assumed that CORSIA applies to flights between the 115 countries which have signed up to CORSIA for 2023[7].
- According to article 9e of the CORSIA resolution, the second (mandatory) phase applies from 2027 through 2035 to all States that have an individual share of international aviation activities in RTKs in year 2018 above 0.5% of total RTKs or whose cumulative share in the list of States from the highest to the lowest amount of RTKs reaches 90% of total RTKs, except Least Developed Countries (LDCs), Small Island Developing States (SIDS) and Landlocked Developing Countries (LLDCs) unless they volunteer to participate in this phase. ICAO RTK data for 2018 show 5 major aviation countries which have not signed up to CORSIA to join the mandatory CORSIA phase (2027-2035)[8]. These are: Brazil, China, India, Russia and Viet Nam. In 3 scenarios we have assumed these 5 countries will indeed join CORSIA from 2027 onwards, and in 3 scenarios it is assumed the 5 countries will waive the requirements from the CORSIA resolution.

E. EU ETS policy option

- Currently intra EEA flights are covered by the EU ETS, and extra EEA flights are temporary derogated from the EU ETS. In the absence of a new amendment to the EU ETS resolution, the EU ETS will revert back to its original full scope from 2024 onwards[9]. Full scope would mean that all extra EEA flights (i.e. all flights departing from and arriving in the EEA) will be subject to the EU ETS. In this analysis we have considered an EU ETS policy option whereby all flights departing

[6] https://www.icao.int/environmental-protection/documents/resolution_a39_3.pdf
[7] https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA_participating_States.aspx
[8] https://www.icao.int/sustainability/Documents/RTK%20ranking/International%20RTK%20rankings_2018_SIDS_LDC_LLDC.pdf
[9] https://ec.europa.eu/clima/eu-action/transport-emissions/reducing-emissions-aviation_en

from the EEA will be subject to the EU ETS (and hence flights arriving from non-EEA countries to the EEA are still derogated from the EU ETS).

- The cap for the EU ETS option for all departing flights is assumed to be relatively as strict as the cap for the EU ETS option covering only intra EEA flights. In 2019 the cap for aviation for intra EEA traffic only was 35.7 Mt. Verified emissions in 2019 were 68.2 Mt. Hence the cap reflected about 52% of verified emissions. For the EU ETS option for all departing flights it is assumed that as a starting point the cap also reflects 52% of the 2019 emissions on the flights covered by the scenarios. In line with the fit-for-55 package, a Linear Reduction Factor (LRF) of 4.2% is applied to the cap from 2024 onwards.
- Also it is assumed that a phase out of free allocation of aviation allowances (EUAAs) will take place: from 82% in 2024 with a linear decrease to zero in 2027. Hence from 2027 onwards 100% auctioning of EUAAs is assumed.
- For the UK ETS, relevant for the outputs for the route group United Kingdom - United States, assumptions have been made which are comparable to the ones for the EU ETS.

F. Offset and allowances prices

- The CORSIA related international credit prices are based on the ones adopted in the impact assessment study for the EC regarding potential interactions between the EU ETS and CORSIA[10]. In the EC impact assessment study two price scenarios for CORSIA carbon prices have been considered, whereby for this analysis the higher price scenario is adopted. The prices per ton of CO_2 in $€_{2021}$ as assumed in the analysis are presented in the table below.
- Since aviation was included in the EU ETS in 2013 up to early 2018 the EU ETS allowance price varied between 5€ and 10€ per tonne of CO_2. From 2018 onwards the allowance price has gone up, and in 2019 and early 2020 the price varied between 20€ and 30€. From 2020 onwards the price has further increased significantly and in 2021 the average EU ETS allowance price was around 54€. In 2022 the price further increased and so far generally varied between 80€ and 90€.
- Allowances prices are projected to further increase to 100 € per tonne of CO_2 in 2030 and 200 € per tonne of CO_2 in 2050[11]. Based on this, in this analysis it is assumed that for 2035 the allowances price will be 125€ per tonne of CO_2.

Assumed prices per ton CO_2 in $€_{2021}$		
	EU ETS allowances	CORSIA offsets
2025	90.1	5.3
2030	100.0	13.7
2035	125.0	23.1

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[10] Further support to the preparation of an impact assessment on revision of the EU Emission Trading System Directive 2003/87/EC concerning aviation - Publications Office of the EU (europa.eu)
[11] T&E aviation decarbonisation roadmap - DRAFT - clean copy_Proofread.docx (transportenvironment.org)