CORSIA has been recently reviewed at the 41st Assembly meeting of ICAO. A revised baseline to 2019 emission levels for the pilot phase and 85% of 2019 levels in the subsequent phases were welcomed by ICAO's member states, IATA, and airlines.

The changes brought by this update will impact airlines as the sector's emissions will grow and catch up with the baseline emissions. By 2024, airlines will likely have to pay to offset carbon emissions proportional to this growth.

CORSIA is still at a voluntary stage. Only international flights between participating member states are subject to offsetting requirements. Some major international markets are not part of the voluntary stage; approximately 40% of CO_2 emissions from international aviation are not subject to CORSIA offsetting.

CORSIA UPDATES

The International Civil Aviation Organization (ICAO) is an agency within the United Nations. ICAO has been assigned the task of reducing carbon emissions from international aviation. ICAO developed the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) as a global offsetting scheme.

CORSIA is a medium-term scheme (2021-2035) designed to complement other efforts such as technological innovations, operational improvements and sustainable aviation fuel [ICAO, 2022a]. CORSIA is delivered in three phases. The pilot phase and the 1st phase are voluntary.

- pilot phase (2021-2023)
- 1st phase (2024-2026)
- 2nd phase (2027-2035)

Applications for new members are accepted every year by the deadline of 30 June. In 2021, out of ICAO's 193 member states, 88 volunteered to participate in CORSIA's pilot phase; the number increased to 107 in 2022 and 115 from January 2023. In the spirit of the No Country Left Behind initiative, ICAO provides support and capacity building to all its member states.

Since 2019, airlines have been monitoring and reporting their annual CO_2 emissions and submitting them to national agencies on a voluntary basis. These reported emissions are verified through third-party processes. ICAO member states, in turn, report these emissions to ICAO via the CORSIA Central Registry (CCR).

According to CORSIA, airlines must offset any CO_2 emissions they emit above a pre-set baseline. The airlines compensate for any increase in emissions above the baseline by buying credits on the carbon market from environmental projects recognized by CORSIA and other international agencies. CORSIA only covers international flights between participating states. The total CORSIA CO_2 emissions were **608** million tonnes in 2019 and **265** million tonnes in 2020, i.e., a drop of 56% [ICAO, 2021]. In 2021, this value increased to **290** million tonnes – a 9.46% increase year-on-year, but still significantly below the pre-COVID levels.

Some international flights are not subject to the scope of applicability of CORSIA. Not only international flights between state pairs which include Least Developed Countries (LDC), Landlocked Developing Countries (LLDC) and Small Island Developing States (SIDS) are exempt from offsetting requirements, but also some states with significant international aviation market share are not yet part of the voluntary stage of CORSIA. This is why in 2021, only 167 million tonnes of CO_2 emissions from international travel were subject to offsetting requirements; this represents 57% of the emissions reported by the state pairs in 2021. CORSIA reports the total CO_2 emissions aggregated for all aircraft operators on each state pair. CORSIA seeks to disclose aggregated values without revealing individual data for specific states or operators. In cases in which emissions of an individual operator or state can be identified, or data may be regarded as confidential, ICAO will publish such values aggregated and without attribution to a specific operator or a specific state pair [CORSIA, 2022].

ICAO originally planned to use as a baseline the average traffic and emissions from 2019 and 2020. However, the discrepancy between the two values and the much lower emission levels in 2020 would have led to a low baseline and, consequently, more emissions to offset and more credits to buy by the airlines. In 2020, ICAO redefined the baseline in terms of 2019 alone. A further amendment was decided at the 41st ICAO Assembly meeting when the baseline was changed to

- 100% of 2019 CO_2 emissions during the pilot phase (2021 – 2023)
- 85% of 2019 CO_2 emissions after the pilot phase (2024 – 2035)

The 85% of 2019 value was proposed as a mid-point scenario between the average of 2019 and 2020 emissions (i.e., ~70% of 2019 emissions) and the 2019 levels [CAEP, 2022].

Offsetting requirements for each airline are calculated according to sectoral and individual growth. The formula for an airline's offset requirements in a particular year was updated to reflect primarily sectoral growth rather than individual growth. An airline's individual growth was initially envisaged as playing a role in calculating offsets from 2030; this was further pushed to 2033 under the update.

$$Airline\ Offsets = \%\ Sectoral * (airline's\ emissions\ covered\ by\ CORSIA * Sector's\ growth\ factor) +$$
$$+ \%\ Individual * (airline's\ emissions\ covered\ by\ CORSIA * Airline's\ growth\ factor)$$

where

- 100% Sectoral and 0% Individual during 2021- 2032
- 85% Sectoral and 15% Individual during 2033- 2035
- $Sector's\ growth\ factor_{year} = \begin{cases} \frac{Total\ emissions_{year} - Total\ emissions_{2019}}{Total\ emissions_{year}} & \text{for } year = 2021 - 2023 \\ \frac{Total\ emissions_{year} - 85\% * Total\ emissions_{2019}}{Total\ emissions_{year}} & \text{for } year = 2024 - 2035 \end{cases}$
- $Airline's\ growth\ factor_{year} = \frac{Airline\ emissions_{year} - 85\% * Airline's\ emissions_{2019}}{Airline\ emissions_{year}}$ for $year$ = 2033-2035

If the total emissions in a certain year are less than the total emissions in the baseline, the sectoral growth is negative, and airlines do not have any offsetting requirements in that particular year.

The formula also implies that it may be possible for an airline to pay more for offsetting CO_2 emissions in a subsequent year if there is sectoral growth, even if the airline maintains the same amount of CO_2 emissions, or – depending on how large the sectoral growth is - even if the airline reduces its emissions. ICAO does not assign targets to member states, and airlines operating in these countries have no obligation to reduce emissions. Hence, for an airline that tries to reduce emissions, it is fair that the other airlines collectively reduce emissions to keep sectoral growth small. The CORSIA incentive for individual airlines to reduce emissions is added from 2033 when the airline growth factor begins to play a role in calculating offsetting requirements. The airline's individual growth component is applied from 2033 - the later stage of the 2nd CORSIA phase - to allow equal treatment of airlines participating in the first and second phases of the CORSIA [CAEP, 2022].

Depending on the recovery rate of air traffic, the sector's growth may remain negative in 2023 compared to 2019, and airlines will not have any offsetting requirements in 2023. However, by 2024, the total emission will most likely match and exceed the baseline of 85% of 2019, even in the low recovery rate scenarios like 10% year-on-year emissions growth. If the recovery is fast, i.e., 50% year-on-year from 2023 onward, the industry could expect to exceed the baseline significantly (Figure 1). These assumptions should be limited to the post-COVID recovery period and not extended beyond 2024. Double-digit year-on-year growth in emissions is unlikely beyond the recovery period.

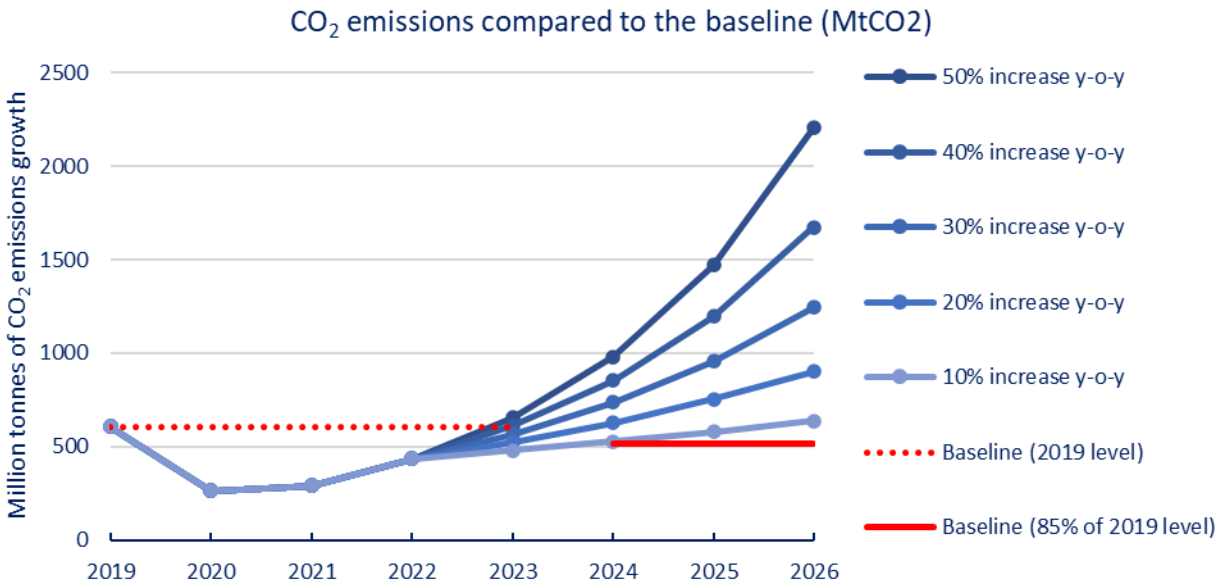

Figure 1: Offsetting requirements depend on the air traffic recovery. The 2019-2021 data points are total CO_2 emissions from international aviation published by ICAO. The 2022 data point is an estimate based on IATA's international RPKs growth in 2022 relative to 2021. Making assumptions from 2023 onwards of 10%, 20%, 30%, 40%, and 50% year-on-year emissions growth shows how emissions will likely catch up with the baseline, either in 2023 or 2024.

The Committee on Aviation Environmental Protection (CAEP) - a technical committee of the ICAO council – produces a periodic review of CORSIA. In their 2022 CORSIA assessment of the impact of the COVID pandemic recovery, CAEP recovery scenarios (including the 85% of 2019 baseline from 2024 onwards) indicate that emissions could remain below the baseline in the majority of scenarios and for many years [CAEP, 2022]. Their update - due mid-2023 - includes more complex analyses on the impact of the COVID-19 pandemic and CO_2 emissions growth scenarios beyond the pilot phase.

CORSIA EXEMPTIONS

There are exemptions from CORSIA offsetting requirements to protect aviation activities linked to humanitarian and medical activities. Also, airlines with less than 10,000 tonnes of CO_2 emission per year from international operations and aircraft with a Maximum Take-Off Mass under 5,700kg are excluded from CORSIA offsetting requirements and from the need to monitor, report and verify emissions.

Not all routes are covered by CORSIA. If one or both states connecting the route do not participate in the scheme, then that route is not subject to CORSIA offsetting, although it retains reporting requirements. Notably, among the leading states and largest aviation markets, China is not participating in the pilot phase of CORSIA. While initially, China indicated support for the CORSIA scheme and made important contributions to the development of CORSIA, China did not agree to take part in the voluntary stage. China continues to monitor, report, and verify emissions and matches CORSIA in the development of its own environmental regulations for civil aviation.

Among the amendments presented by China to drafting the Assembly Resolution (A41-22) is the request that "each participating state may adopt calculation methodologies in its nationally determined plan to implement CORSIA". A particular objection is the inclusion of an airline's individual growth component in the offsetting formula between 2033 and 2035. The amendments were noted but not supported by the Executive Committee of the Assembly [ICAO, 2022b].

In 2021, the highest levels of emissions not subject to offsetting requirements were on international flights to and from China (Figure 2a). Among state pairs, the international flights between the US and China (both directions) amounted to nearly 14 million tonnes of CO_2 in 2021 – all free of offsetting requirements and close to 60% higher than the highest emissions between state pairs subject to offsetting requirements (Figure 2b).

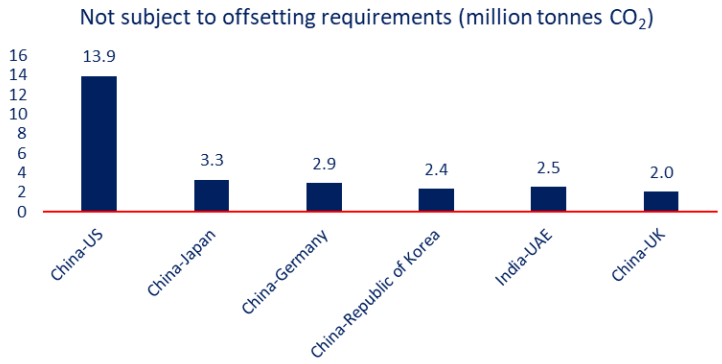

Figure 2a

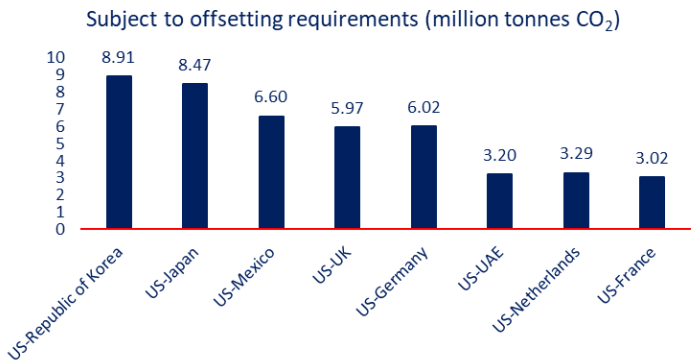

Figure 2b

Figure 2: Since 2021, the information reported by CORSIA includes the total CO_2 emissions from flights subject to offsetting requirements and the total CO_2 emissions from international flights that are not subject to offsetting requirements.

International flights to and from China produced 48.37 million tonnes of CO_2 emissions in 2021 (less than half of its 2019 value of 111.75 million tonnes). The 2021 value represents ~40% of all international emissions not subject to offsetting requirements and 16.6% of all reported international emissions (regardless of the scope of applicability of offsetting requirements). If the Chinese international air traffic returns to its 2019 values, the emissions related to China will represent an even higher percentage of the emissions not subject to offsetting requirements; pre-pandemic, international aviation to and from China represented 18% of the global international aviation. Other notable non-participants are India, Russia, and Brazil [ICAO, 2022c].

COST IMPLICATIONS FOR AIRLINES

Airlines with large international operations may emit more than 5,000,000 tonnes of CO_2 annually during international flights, e.g., Turkish Airlines, Korean Air, United Airlines, American Airlines and Delta Air Lines - in no particular order. A sectoral growth of 5% in 2023 compared to 2019 would lead to a cost of offsetting emissions of 1.25 million USD for such an airline, assuming emissions trade at 5 USD per tonne CO_2. Assuming the same constant emissions in 2024 as in 2023 (i.e., zero growth from 2023 to 2024), the same sectoral growth of 5% observed in 2023 relative to 2019 becomes 19.25% sectoral growth relative to the updated baseline of 85% of 2019 level in 2024. This implies that the same absolute growth relative to 2019 would translate into a 4x cost in 2024 simply due to the update in the baseline. It would cost the airline 4.8 million USD in 2024 to offset emissions to match this sectoral growth.

The price of CORSIA carbon offsetting is low, especially when compared to the EU ETS carbon price. Its cost is expected to grow just as the EU ETS carbon price grew over time; the cost of carbon registered in the EU ETS was priced for years below 10 EUR per tonne, but its price exceeded 100 EUR per tonne in February 2023. Some estimates claim that the cost of CORSIA carbon offsetting may reach 90 USD by 2050.

CONCLUSIONS

Carbon offsetting in international aviation will likely start impacting airlines as the sector's total emissions will exceed the baseline by 2024. Only airlines operating routes between CORSIA participating states will be subject to offsetting requirements. The scale of the impact on airlines may be negligible in 2023, but for some airlines, it may become significant already in 2024 with the drop in baseline.

Offsetting is not intended to replace CO_2 emissions reductions from new technology and operational and infrastructure advances [IATA, 2020]. SAF, e-fuels, aircraft technologies and operational and infrastructure improvements will be the main pathways to decarbonise aviation. The offsetting of international aviation is playing a bridging role until the other efforts can scale up.

REFERENCES

[IATA, 2020] Offsetting CO_2 Emissions with CORSIA
https://www.iata.org/en/programs/environment/corsia/
[ICAO, 2021] International Civil Aviation Organization (2021). "CORSIA 2020 Emissions".
https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA%202020%20Emissions_Nov2021_web.pdf
[ICAO, 2022a] CORSIA Newsletter. https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_Newsletter_November_2022_for_web.pdf
[ICAO, 2022b] Assembly – 41st session Draft on Agenda item 18.
https://www.icao.int/Meetings/a41/Documents/WP/wp_603_rev_en.pdf
[ICAO, 2022c] CORSIA participating states for 2023.
https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA_participating_States.aspx
[CAEP, 2022] Analyses in Support of the 2022 CORSIA Periodic Review: Assessment of Additional CORSIA Baseline Options. https://www.icao.int/environmental-protection/CORSIA/Documents/CAEP_CORSIA%20Periodic%20Review%20%28C226%29_Additional%20scenarios%20for%20CORSIA%20baseline.pdf
[CORSIA, 2022] Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) — Frequently Asked Questions (FAQs). https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_FAQs_Dec2022.pdf

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