AIRLINES FOR EUROPE

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NON-CO_2 EMISSIONS FROM THE AVIATION SECTOR
A4E PERSPECTIVES

Abstract

This paper sets out A4E's understanding of the issue and recommendations to address non-CO_2 emissions from the aviation sector.

European airlines are fully committed to decarbonising air transport and are accelerating their efforts to make Europe the world's first carbon neutral continent by 2050, through the reduction of CO_2 emissions in absolute terms and through CO_2 mitigation. Acknowledging its responsibilities, the EU aviation sector published in 2021 the "**Destination 2050 - A route to net zero European aviation**" roadmap, which sets out a pathway to reaching net zero CO_2 emissions by 2050[1].

The focus of governments in Europe and worldwide has been to reduce CO_2 emissions with an ambitious target of climate neutrality by 2050. In parallel, the sector is looking at other impacts on climate and well-being such as air quality, noise, and the climate impact of non-CO_2 emissions.

Introduction

According to most recent scientific reports on the matter, the largest impact for aviation in terms of non-CO_2 emissions is caused by **condensation trails** – so-called contrails - contrail cirrus-clouds, and **oxides of nitrogen** (NOx). There is consensus among the scientific community that contrail cirrus and NOx produce warming effects.

The latest Intergovernmental Panel on Climate Change (IPCC) report from April 2022 confirms these conclusions[2]. These emissions result in changes in the chemical

[1] Destination 2050 - A route to net zero European aviation, A4E, ACI Europe, ASD, ERA, CANSO, February 2021. www.destination2050.eu/

[2] Climate Change 2022 – Mitigation of Climate Change, April 2022, IPCC Link

composition of the global atmosphere and cloudiness, disrupting the earth-atmosphere radiation budget[3].

However, their precise impact under specific conditions needs to be further studied. Non-CO_2 effects can cause **both warming and cooling effects** and, unlike CO_2, do not follow a linear pattern but contribute to both positive and negative Effective Radiative Forcing (ERF). Estimating aviation's non-CO_2 effects is a complex challenge for today's atmospheric modelling systems. It is difficult to calculate the contributions caused by a range of physical processes in the atmosphere, including air movement patterns, chemical transformations, microphysics, or radiation.

A4E's call to action

Some of the technological solutions being developed and explored under the Destination 2050 roadmap may play an important role in mitigating the impact of non-CO_2 emissions, including:

1. Aircraft and engine technology

A4E is fully committed to supporting research on aircraft and engine technology. In this sense, the involvement of manufacturers is crucial to understanding how changes in the limits of aromatics and sulphur impact safety. Before calling for a reduction of aromatics in fossil fuels, there is a need to better understand the impact this may have on engine safety and the aromatics' precise contribution to the creation of soot. It is for this reason that the current threshold of 8% of aromatics in fossil fuels is seen by manufacturers and experts as a minimum rather than a maximum threshold. As the impact on engines, aircraft safety, and operations is not fully understood, establishing thresholds or mandating reduced aromatics on fossil jet fuels may be premature.

Recommendations

- A roadmap to investigate the situation regarding naphthalene content in fuel, with a report and recommendations to be published by 2025

2. Jet fuel improvements and SAFs

[3] When water vapour is ejected from the exhaust nozzle of an aircraft engine into sufficiently cold air, it condenses and freezes around soot and other particles, creating small ice crystals. In certain atmospheric conditions, these ice crystals create layers of cirrus clouds, causing a 'blanket' effect which keeps warmer air trapped in the lower atmosphere.

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Advances in fuel technology leading to a reduction of aromatics contents in aviation fuels will help. Aromatic and sulphur contents have an impact on local air quality and particulate emissions. Yet, science has not been able to quantify and properly understand this matter. SAFs, which typically have a lower sulphur and aromatics content, will contribute to reducing contrail formation. This can only be achieved if the aromatics content of the blend is lower than the current fossil fuel reference point. As such, further research into the aromatic and sulphur contents of SAF and how it influences contrail formation is indispensable.

SAFs are central in addressing non-CO_2 effects. A widespread uptake of SAFs will lead not only to a reduction in CO_2 emissions, but also, consequently, to a reduction in non-CO_2 emissions. International standards organisations, such as the American Society for Testing and Materials (ASTM International, can help harmonise fuel specifications worldwide. Taking into account safety concerns, a revised threshold could be considered for a new formulation of 100% SAF fuels. This is an area where further research is ongoing.

Recommendations

- Rapidly implementing the ReFuel EU legislation and deploy SAFs, providing a real incentive to European airlines and manufacturers regarding the uptake of SAFs

3. Operations

Enhancing the much-delayed implementation of the Single European Sky (SES) by the Network Manager, Air Navigation Service Providers (ANSPs), airports and other service providers would enable and incentivise airspace users to fly 'green' flight trajectories. Research has aimed at avoiding Ice Super Saturated Regions (ISSRs) and supporting climate-optimised flight trajectories which represent a cost-effective way of reducing non-CO_2 impacts. By avoiding ice-supersaturated regions (ISSRs) in the atmosphere, operators can reduce the likelihood of forming persistent contrail.

Optimised air traffic management could support environmentally optimised flight profiles whilst limiting trade-offs with fuel consumption. The EASA, Eurocontrol, European Environmental Agency (EEA) European Aviation Environmental Report 2022[4] for instance recommends a limit on time or flight kilometres, so that the avoidance of

[4] European Aviation Environmental Report 2022, September 2022 https://www.easa.europa.eu/eco/eaer

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ISSRs can never lead to a net warming effect on the climate. The avoidance of ISSRs and the associated non-CO_2 mitigation can be achieved without significantly affecting CO_2 emissions. Policymakers should investigate how to ensure this solution is cost-free for airlines.

Recommendations

- Improving data of flights plans and promoting 'green' flight trajectories
- Supporting the contrail prevention trials at MUAC with Germany's DLR research institute

Addressing non-CO2 Emissions

In line with the European Green Deal's ambitions and the EU roadmap to carbon neutrality by 2050, A4E's top priority remains the reduction of absolute CO_2 emissions in aviation. In this regard, most recent reports acknowledge the trade-off between additional fuel consumption from flight detours and the non-CO_2 emissions impacts from contrail cirrus.

A4E members have put in place measures to tackle non-CO_2 emissions, for example by renewing older aircraft with newer models that meet the highest criteria regarding Green House Gas (GHG) emissions and are investing in research through various national and European studies. A4E fully supports further research to better understand and predict ISSR, and several A4E members are actively engaged in activities that contribute to this better understanding; for example, through contrail observations in collaboration with the Maastricht Upper Area Control Centre (MUAC). A4E also encourages its pilots to respond favourably to aviation bodies' requests to mitigate non-CO_2 emissions by adapting their trajectories.

For the time being it is currently not appropriate to address CO_2 emissions and non-CO_2 emissions under the same legislation – the EU ETS Directive - partly because the impact of CO_2 emissions is better understood than the impact of non-CO_2 emissions, but particularly since non-CO_2 effects behave differently to CO_2. This can be explained because, in contrast to carbon, they are non-cumulative, and most non-CO_2 effects occur on a small number of flights. Conversely, carbon emissions currently come from all flights.

The revision of the ETS Directive should remain focused on CO_2 emissions, with non-CO_2 emissions addressed separately. Given the very specific behaviour of non-CO_2 effects, bespoke measures are more appropriate. Pricing them across all flights covered by the EU

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ETS would not actually result in non-CO_2 mitigation, whilst jeopardizing the integrity of the carbon pricing mechanism itself.

Taking a different approach could hamper our CO_2 reduction objectives. A more appropriate solution may be to incentivise airlines to avoid ISSRs through a bespoke system, which could be linked to other policies. In parallel, the uptake of Sustainable Aviation Fuels (SAFs), leading to a reduction of CO_2 emissions, should de facto also reduce non-CO_2 emissions.

A4E calls on legislators and aviation stakeholders to

- Address non-CO_2 emissions separately from CO_2 emissions, given their different behaviour and the distinct challenges they represent for the sector.
- Prioritise actions that lower both non-CO_2 and CO_2 emissions (e.g. operational decisions in-flight).
- Minimise the current level of scientific uncertainty over the magnitude of the effect of non-CO_2 emissions and fill the gap in scientific understanding through additional studies and investigations, before implementing any Monitoring, Reporting and Verification (MRV) obligations in the EU ETS Directive.
- Avoid inappropriate simple multipliers for CO_2 to account for non-CO_2 emissions that do not reflect the complexity of the non-CO_2 phenomena.
- Invest in research to better understand the trade-offs between warming and cooling effects of contrail cirrus clouds and changing NOx budgets, with the aim of providing the best available information for climate-optimised flight operations and avoiding unwanted warming effects.
- Recognise that the prevalence of non-CO_2 impacts varies greatly from region to region and from day to day, as it is a highly heterogeneous phenomenon that requires a more bespoke approach, while the effects of CO_2 emissions are homogeneous regardless of geographic location.
- Improve humidity forecast data, which is crucial to achieving higher quality ISSR forecast data in collaboration with weather services.
- Develop ideas on how to incentivise contrail cirrus avoidance and especially how to incentivise contrail cirrus cooling effects.

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