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COMMISSION STAFF WORKING DOCUMENT

Full-length report

Accompanying the document

Expert Report

Updated analysis of the non-CO₂ climate impacts of aviation and potential policy measures pursuant to EU Emissions Trading System Directive Article 30(4)

UPDATED ANALYSIS OF THE NON-CO₂ CLIMATE IMPACTS OF AVIATION AND POTENTIAL POLICY MEASURES PURSUANT TO EU EMISSIONS TRADING SYSTEM DIRECTIVE ARTICLE 30(4)

Introduction

As part of the 2017-revision of the EU Emissions Trading System (ETS) regarding aviation, the co-legislators tasked the European Commission with presenting “an updated analysis of the non-CO₂ effects of aviation, accompanied, where appropriate, by a proposal on how best to address those effects”, as per Article 30(4) of Directive 2003/87/EC.

Previous analyses date back to the 2006 Impact Assessment for the inclusion of aviation in the EU ETS that examined the possibility of regulating oxides of nitrogen (NO_x),¹ and the 2008 study ‘Lower NO_x at Higher Altitudes: Policies to Reduce the Climate Impact of Aviation NO_x Emission’.² At the time of those analyses, the scientific understanding was not considered sufficiently mature to propose policies to address these impacts. Instead, since 2012, the EU ETS as the cornerstone of the EU’s climate policy regulates solely carbon dioxide (CO₂) emissions from covered flights, which, in contrast to non-CO₂ impacts, directly correlate with the amount of fuel burned.

To fulfil the requirement of Article 30(4) of the EU ETS Directive, the European Commission commissioned the study presented in this Staff Working Document to the European Aviation Safety Agency (EASA). The study captures the much-evolved scientific understanding, presenting an updated analysis of the main climate impacts associated with air traffic, besides CO₂ emissions. EASA conducted the work through a project team comprising renowned experts in this field from the EU and UK, covering the whole spectrum of different schools of thought in the climate science domain. This allowed for open debates and the consideration of diverging opinions in the analysis of the specified tasks. Combined with the validation of this work through two peer reviews, this ensured the scientific rigour of the provided analyses.

The following guiding questions structured the work of the experts:

- What is the most recent knowledge on the climate change effects of non-CO₂ emissions from aviation activities?
- What factors/variables have had an impact on these effects (e.g. technology/design, operations, fuel, market-based measures)? What is the level of that impact? Do these factors/variables exhibit trade-offs or interdependencies between different impacts?
- What research has been undertaken on potential policy action to reduce non-CO₂ climate impacts? What are the pros and cons of policy options in terms of implementation? What knowledge gaps still exist?

The non-CO₂ impacts assessed by the experts arise namely from emissions by aircraft of oxides of nitrogen (NO_x), soot particles, oxidised sulphur species, and water vapour. Their net impact is a warming effect on the climate, although there are a number of individual

¹ https://ec.europa.eu/clima/sites/clima/files/transport/aviation/docs/sec_2006_1684_en.pdf

² https://ec.europa.eu/transport/sites/transport/files/modes/air/studies/doc/environment/oct_2008_nox_final_report.pdf

warming and cooling effects from the respective aviation non-CO₂ emissions, with trade-offs and uncertainties of different degrees.

The authors note that the scientific understanding on the climate change effects of non-CO₂ emissions from aviation activities has advanced over the last 10 years. With regard to these impacts and how to assess them in terms of CO₂-equivalent emissions metrics, some uncertainties remain and new ones have emerged. The report identifies and evaluates a range of policy options as well as research areas to be tackled to address these uncertainties.

Summary of the report's findings on policies

The policy options to address non-CO₂ climate impacts from aviation assessed in the report are divided into three categories: financial/market-related, fuel, and air traffic management (ATM), with two options under each of these. In principle, the options could co-exist with one another.

The two financial measures analysed consist in a **monetary charge levied on aircraft NOx emissions** on one side and/or the **inclusion of such emissions under the EU ETS** on the other side. These would incentivise manufacturers and airlines to reduce these emissions, while taking account of associated trade-offs. Outstanding research issues towards making the policies implementable include better understanding the potential net cooling effect from aircraft NOx emissions under certain future scenarios of declining emissions of tropospheric ozone precursors from surface (non-aircraft) sources; the need for an accurate, internationally recognised methodology for estimating cruise NOx emissions; an appropriate CO₂-equivalent emissions metric and time horizon for NOx emissions, taking into account the trade-off between the two; as well as an appropriate level of the charge. Given these outstanding research issues, the report concludes that these financial measures could be implemented in the mid-term, i.e. 5 to 8 years.

The fuel-related measures comprise the **reduction of aromatics** within fuel (leading to cleaner fuel burn and reduced non-volatile Particulate Matter [nvPM] emissions) and the **mandatory use of Sustainable Aviation Fuels (SAF)**. Both measures target emissions of soot particulates and contrail cirrus clouds. Reducing aromatics content would require fuel producers to adapt their production processes and a system to monitor the aromatics content of fuels. Given a set of research issues that would need to be addressed according to the experts, the measure could potentially be implemented in the mid- (i.e. 5 to 8 years) to long-term (i.e. 8+ years). The mandatory use of SAFs could be implemented through an EU blending mandate specifying that a certain percentage of the total jet fuel sold over a set time period would have to be SAF. If well designed, this should lead to simultaneous reductions in CO₂, nvPM and sulphur emissions (though not NOx emissions). The experts consider that if related outstanding research issues linked to this measure are resolved, the measure could potentially be implemented in the short- (i.e. 2 to 5 years) to mid-term (i.e. 5 to 8 years).

The measures in the ATM category are **avoidance of ice-supersaturated areas** and a **climate charge**. While optimizing the flight trajectory to avoid climate-sensitive regions would reduce the formation of contrail-cirrus clouds, the climate charge would address all non-CO₂ effects (NOx, water vapour, soot, sulphates, contrails). As a series of research issues that would first need to be addressed, the avoidance of ice-supersaturated areas measure could potentially be implemented in the midterm, i.e. 5-8 years, according to the experts.

Regarding the climate charge, the experts deem that given the broader nature of the measure and the associated "significant" research needed, it could potentially be implemented in the long-term, i.e. 8+ years.

Towards policies targeting aviation's full climate impacts

The magnitude and significance of non-CO₂ climate impacts from aviation activities, previously estimated to be at least as important in total as those of CO₂ alone, and possibly up to four times the impacts of CO₂ emissions, are confirmed by the report. This results in the need to consider how to best to address them to contribute to the EU's climate objectives and the Paris Agreement, complementary to climate action already being taken on CO₂ emissions. This would allow moving towards policies targeting aviation's full climate impacts.

However, the complexity of non-CO₂ climate impacts relative to CO₂ ones and the trade-offs between various impacts, makes targeted policy making more challenging in this area. This study is an important step towards better knowledge, both on the science and on related policies.

The report enables the Commission to examine the policies analysed by the experts, each with its associated advantages and drawbacks. The specific issues identified in the report need to be addressed in order to take these potential instruments forward at EU level. Without necessarily being exhaustive, three main dimensions for further work could be envisaged:

First, the scientific consensus indicates that – from measurements at ground and altitude – the use of sustainable aviation fuels – both advanced biofuels and power-to-liquid – reduce soot particulate emissions. The announced ReFuelEU Aviation policy initiative aims to provide climate benefits through both lower life-cycle CO₂ emission and lower particulate emissions. In addition, Commission services could further lead the possibility to lower the current global standard for maximum aromatics content in aviation fuels.

Second, there is a clear need for additional research, to increase certainty on the various non-CO₂ impacts and trade-offs between them. This requires measuring emissions at the different stages of flights and related to different types of fuels. Horizon Europe provides a suitable platform at EU level.

Third, increasing the efficiency of operational measures, in particular Air Traffic Management is key, but needs European coordination. For instance, a potential first step towards full optimisation of flight profiles for lower climate impacts could focus on ways to avoid ice-supersaturated areas (avoiding contrails), to complete the work carried out since 2013 in this area.³

In conclusion, the European Commission welcomes the findings of the report consolidating the state of the art of the climate science on the subject, as well as providing an analysis of measures to address these. The report clearly summarizes the work needed towards feasible policies with an assessment of required time horizons.

³ See, for instance, the project ATM4E at: <https://www.atm4e.eu>