

【欧州】 【Common】

Common - EU decarbonization policy: Monitoring, reporting, and verifying the non-CO₂ effects of aviation: The EU's new requirements for airlines to measure and report non-CO₂ emission effects from flights

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【概要 : Summary】

While in the EU, CO₂ emissions from aviation activities have been included in the EU ETS since 2012, non-CO₂ emissions affecting the climate have not been regulated so far. These non-CO₂ effects such as NO_x emissions, soot particles, oxidised sulphur species, emissions of water vapour causing contrail cirrus and other atmospheric processes were considered being too difficult to measure. The impact of non-CO₂ emissions and contrail cirrus highly depends on the location and time of their occurrence, and the monitoring, reporting, and verification involves technical feasibility problems, while they also impose an additional administrative burden for aircraft operators.

Nevertheless, with the constant increase of air traffic, the reduction of the climate impact of non-CO₂ emission effects is considered being necessary and unavoidable.

Therefore, on 23 September 2024, the European Commission adopted the Implementation Regulation (EU) 2024/2493 amending Implementing Regulation (EU) 2018/2066 on the monitoring and reporting procedures (MRV) to cover also the non-CO₂ effects of aviation.

To minimise the aviation sector's non-CO₂ effects, in a first step, as of 1 January 2025, aircraft operators will be required to monitor, report, and verify their non-CO₂ emission effects. By 31 December 2027, the Commission is expected to consider the submission of a legislative proposal to expand the scope of the EU ETS to non-CO₂ effects of aviation.

【記事 : Article】

1. Background of the introduction of a MRV for non-CO₂ emissions from aviation

Since the EU Emissions Trading System (EU ETS) for aviation was introduced in 2012, the carbon emissions of the aviation sector could be reduced by more than 17 million tonnes per year and the amount of fuel burned per passenger dropped by 24% between 2005 and 2017 (European Commission n.d.a). However, these improvements have been outpaced by a continued growth in air traffic (European Commission n.d.a). Currently, direct emissions from aviation account for 13.9% of the emissions from the EU's transport sector (European Commission n.d.a). To reach the 2030 and 2050 overall GHG emission reduction targets, Directive (EU) 2023/958 amends the emission

trading in the EU's aviation sector by introducing a full auctioning of GHG emission certificates from 2026 (Directive (EU) 2023/958, Council of the EU 2023). However, the overall climate impact of aviation is much higher than just its GHG emissions. The non-CO₂ effects, including persistent contrails, emissions of NO_x and soot particles and others climate relevant atmospheric processes account for 66% of the aviation climate impact, thereby outweighing the sector's GHG emissions (European Commission 2023a, 2024b, 2024c).

Therefore, in a first step, the EU will introduce a monitoring, reporting and verification (MRV) system for the coverage of non-CO₂ effects of aviation (Directive (EU) 2023/958, European Commission n.d.c). Accordingly, Directive (EU) 2023/958 amends Directive 2003/87/EC by adding an obligation of aircraft operators (AO) "…to report once a year on the non-CO₂ aviation effects occurring from 1 January 2025" (Directive (EU) 2023/958, European Commission 2023a). By 31 December 2027, the Commission considers the expansion of the EU ETS to the aviation sector's non-CO₂ emission effects (European Commission n.d.a).

2. Challenges to measure and calculate non-CO₂ effects

Including non-CO₂ effects in the EU ETS and under the MRV framework is recommended for climate reasons but measuring non-CO₂ effects adds administrative burden and complexity. A flight's non-CO₂ effects depend on various factors, including fuel type, engine use, emission location in terms of latitude and longitude, the time of emissions, the cruise altitude, and prevailing weather conditions with high- or low-pressure systems at the time of the flight, to name just a few factors (Directive (EU) 2023/958, Niklaß, Dahlmann, Grewe et.al. 2019). Therefore, early studies, like in Faber et al. (2008), found scientific understanding

insufficient for regulating non-CO₂ climate impacts from aviation activities. However, the European Parliament and the Council required the Commission to deal with the problem and present an updated analysis of the non-CO₂ effects of aviation, leading to a European Aviation Safety Agency (EASA) study. This EASA study highlighted that while individual effects vary and significant uncertainties remain, there are already several measures in place that could contribute to reducing the climate impacts of aviation's non-CO₂ emissions (EASA 2020a, SWD(2020) 277 final).

The largest quantifiable non-CO₂ effects are the "net NO_x effect" and contrail cirrus (EASA 2020b). NO_x is not a climate warming agent per se, but its emissions result in changes in the chemical balance of the atmosphere, which has radiative impacts, quantified as a "net-NO_x effect" (EASA 2020b). The emission of NO_x leads to increasing O₃ concentrations and decreasing methane (CH₄) concentrations. However, the lifetime of ozone perturbations is weeks, and the methane perturbation has a lifetime of about 12 years, whereas CO₂ emissions partly remain in the atmosphere for several thousand years (Niklaß, Dahlmann, Grewe et.al. 2019). The emission of water vapour and soot particles in wet and cold air leads to the formation of contrails and contrail cirrus, and such artificial cirrus-like clouds have lifetimes of minutes or hours (Niklaß, Dahlmann, Grewe et.al. 2019). Contrail cirrus formation depends on atmospheric conditions and there are significant uncertainties regarding its net effect, as shifting the temporary cruise altitude by one flight level (1000 ft) up or down, the climate impact from contrail formation can be avoided totally (Niklaß, Dahlmann, Grewe et.al. 2019). Eventually, a trade-off must be made between a simple operational feasibility and a flight routing to reduce the NO_x emission indices (Niklaß, Linke, Dahlmann et.al. 2022).

On 1 December 2023, the European Commission consulted stakeholders and the public on the introduction of a MRV system for non-CO₂ effects in aviation and based on the revised EU ETS, Art 14.5 on the MRV framework, by 31 August 2024, the European Commission had to present an Implementing act including non-CO₂ emissions effects (Nikov 2023, 2024, Directive (EU) 2023/958, European Commission 2023b).

3. Methodologies to calculate non-CO₂ effects and remaining uncertainties

Regarding the metric used for non-CO₂ effects under the MRV framework, they need to be scientifically correct, transparent and simple (Eichinger 2023). To compare aviation CO₂ emissions with non-CO₂ impacts on a common scale, it is required to set up “equivalent emissions metrics” (CO₂-e) (Eichinger 2023). The key criteria for choosing a CO₂e method must be that CO₂e factors should be easy to calculate, predictable and transparent. They should also provide incentives for actually reducing non-CO₂ effects (Niklaß, Linke, Dahlmann et.al. 2022). Regarding the selection of the calculation methodology for CO₂ equivalents (MRV scheme), Niklaß, Linke, Dahlmann et.al. (2022) underline that for integrating non-CO₂ effects into existing policy instruments like the EU ETS, aircraft operators and authorities must collect and monitor additional flight data for CO₂e calculation, which will probably increase their administrative efforts. The level of these additional efforts and related costs will strongly depend on the chosen CO₂e calculation method (Niklaß, Dahlmann, Grewe et.al. 2019). More accurate CO₂e approaches, taking into account the relevant atmospheric processes, will result in larger benefits for climate mitigation, but they will also require a higher amount of data for monitoring, reporting and verification (Niklaß, Dahlmann, Grewe et.al. 2019). A good compromise between high mitigation incentive of

non-CO₂ impacts and slightly reduced MRV effort could initially be a location-dependent CO₂e factor, as no Medium-Range Weather Forecast is required (Niklaß, Linke, Dahlmann et.al. 2022). A route-specific CO₂e estimate of all flights over the reference period (e.g., year, season) is considered being reasonably accurate, as extreme weather events of single days are compensated. It is suggested to use a pilot MRV phase, focusing only on monitoring and reporting of CO₂e to test and to improve MRV procedures (Niklaß, Linke, Dahlmann et.al. 2022).

4. The inclusion of non-CO₂ effects of aviation into the EU's MRV framework

On 23 September 2024, the Commission formally adopted the amended MRV rules in the Commission Implementing Regulation (EU) 2024/2493, which amends Implementing Regulation (EU) 2018/2066. The amendments cover the monitoring and reporting requirements for non-CO₂ aviation effects per flight, as well as the zero-rating of emissions from the combustion of renewable fuels of non-biological origin (RFNBOs), recycled carbon fuels (RCFs) and synthetic low carbon fuels (SLCFs) under the EU ETS, among others (European Commission 2024c, Commission Implementing Regulation (EU) 2024/2493).

The MRV system for non-CO₂ aviation effects will apply from 1 January 2025 for calculating CO₂ equivalent per flight (European Commission n.d.c). Accordingly, the A0 must monitor the non-CO₂ aviation effects occurring per flight, calculate the CO₂ equivalent (CO₂e) and report those non-CO₂ aviation effects once a year (C (2024) 6542 final). To facilitate the start of the MRV for non-CO₂ effects, in 2025 and 2026, such reporting will only cover routes between airports located in the European Economic Area (EEA), and on routes departing from the EEA to Switzerland or to the United Kingdom, while the non-CO₂ aviation effects taking place from other flights may be reported on a voluntary basis (C

(2024)6542 final). To minimise administrative burden, A0 should provide a single monitoring plan for CO₂ emissions and non-CO₂ effects.

To calculate CO₂e for non-CO₂ effects for each flight, each A0 shall monitor the flight trajectory, enhanced weather data, aircraft properties, aircraft performance information data per flight, and use the Global Warming Potential (GWP) metric in the time horizons GWP20, GWP50 and GWP100 (20-, 50-, and 100-years horizons) (C (2024)6542 final). Furthermore, each A0 shall calculate CO₂e per flight based on a weather-based approach (Method C) (Commission Implementing Regulation (EU) 2024/2493). Estimates for the formation, life cycle and contrail climate effects for single flights regarding the emitted H₂O and NO_x and their impact on the atmospheric composition shall be included. Small emitters may use a more simplified location-based approach (Method D) (Commission Implementing Regulation (EU) 2024/2493).

To automate the MRV of non-CO₂ aviation effects for some of the necessary data, AOs, accredited verifiers, and competent authorities may use the Commission's information tool, the "non-CO₂ aviation effects tracking system" (NEATS) (European Commission 2024b, Commission Implementing Regulation (EU) 2024/2493). Data automatically provided by NEATS include a. Flight information, b. Flight trajectory and c. Weather data (European Commission 2024b). Regarding a. Flight information, it includes i. Flight number, ii. Day and time of the flight, iii. Arrival and departure airport. Regarding b. Flight trajectory data, NEATS provides i. Timestamp, ii. Latitude, iii. Longitude, and iv. Altitude (European Commission 2024b). Regarding c. Weather data, it includes i. Air pressure, ii. Air temperature, iii. Humidity. In addition, "enhanced" data is required for the weather dependent-approach including specific humidity/relative humidity over ice eastward and northward wind, vertical velocity, outgoing

longwave radiation, among others. This data will be provided by EUROCONTROL to NEATS (European Commission 2024b). Data required directly from the A0 includes d. Aircraft properties, including i. Aircraft type, ii. Engine UID, iii. Aircraft mass (if not provided, take-off mass/load factor). Furthermore, it needs e. Fuel properties per flight and f. (optional) Aircraft performance (European Commission 2024b).

To map the background atmospheric conditions that influence the persistence of contrails, weather forecasts or hindcasts weather prediction, models will be based on data provided by national weather authorities, ensuring transparency, and avoiding administrative burden for airlines (European Commission n.d.c).

NEATS also streamlines the reporting at the end of each reporting year, as it will automatically generate an XML table, containing all data for each flight. It also provides verifiers and the competent authority with the ability to access and cross-check data (European Commission 2024b). The use of NEATS is optional for AOs as they can choose to use NEATS for the given flights or opt to use their own or third-party information technology tools provided that these tools comply with the provisions of the amended Implementing Regulation (EU) 2018/2066, and alternatives are approved by the Commission (C (2024) 6542 final). A list of accredited verifiers will be published by the end of 2025. The Commission is expected to make a legislative proposal to expand the EU ETS to non-CO₂ effects of aviation by the end of 2027, if appropriate (European Commission n.d.c, 2024b).

5. Conclusion and considerations

As of 1 January 2025, the monitoring and reporting of non-CO₂ aviation effects of aviation will cover all flights involving airports within in the EEA, which is also the general scope of the EU ETS Directive. For flights to non-EEA airports, the Implementing Act foresees a time

limited deferral of two years (2025 and 2026) for the introduction of a mandatory MRV, while voluntarily reporting will be possible during this time. From January 2027, the monitoring and reporting requirement will be mandatory for all inbound and outbound flights to and from the EEA. The reason for this phased approach is to facilitate the smooth launch of the new MRV system for all stakeholders.

The MRV framework for monitoring, reporting and verifying non-CO₂ effects of flights is a first important step to gain better knowledge on the non-CO₂ effects of aviation. AOs must begin preparing now to ensure compliance under the MRV system and they need to consider an integration of NEATS or other third-party solutions into their MRV to automate the reporting process for non-CO₂ aviation effects. The MRV system will use available data and the most advanced models to quantify the non-CO₂ aviation effects.

Regardless the remaining uncertainties in the calculation of the aviation sector's non-CO₂ effects, establishing a MRV for non-CO₂ effects of aviation will offer important data that could eventually lead to the inclusion of non-CO₂ effects under the EU ETS for aviation. The Commission is expected to present an impact assessment for a legislative proposal to expand the scope of the EU ETS to include non-CO₂ aviation effects by 31 December 2027. It can be expected to lead to an inclusion of non-CO₂ climate species into the EU ETS.

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