EXPONENTIAL ROADMAP INITIATIVE

NORDIC CLIMATE ADVISORY GROUP

Harmonised guide on quantifying GHG emissions from flights

Introduction

This guide is designed to help companies report aviation-related greenhouse gas (GHG) emissions in a harmonised, transparent manner. It covers both business travel and air freight, with a particular focus on non-CO_2 effects and the use of the Radiative Forcing Index (RFI) or other multipliers. The usual context will be quantification of organisations' GHG inventories in accordance with the Greenhouse Gas Protocol standards and ISO 14064:1 (2018). Accounting of GHG impacts in relation to SAF purchases, which rely on the use of environmental attribute certificates, is not covered by this guide.

The guide has been compiled by the Nordic Climate Advisory Group, formed under the Exponential Roadmap. The group's common goal is to align on best practices and ensure reporting that is consistent, science-based, and relevant for policy and target setting.

It presents our point of view and recommendations on best practice for calculating and reporting GHG emissions from flights and air freight.

Background

Flight greenhouse gas emissions have contributed about 4% of global warming to date, and emissions are expected to continue rising in the years to come (Klöwer et al, 2021). At the same time, flights are typically one of the largest sources of emissions for companies, after those from their production and services, putting companies in a unique position to help reduce global emissions in a critical sector. As such, it has become an important measure for companies which is widely provided to them. Unfortunately, members of this group have witnessed how important elements are sometimes missed, resulting in possible misrepresentations or underestimations of these emissions.

Aviation contributes to climate change not only through CO_2 emissions but also via a range of non-CO_2 effects. These arise from emissions of nitrogen oxides (NO_x), water vapour (H_2O), soot, sulphate aerosols, and from the formation of contrails and contrail-induced cirrus (CiC).

These effects are frequently of comparable magnitude to, and in many assessments exceed, the warming attributable to aviation's CO_2 emissions alone. Current estimates suggest that non-CO_2 impacts could account for roughly two-thirds of aviation's cumulative climate effect. To capture these impacts in reporting and policy discussions, the Radiative Forcing Index (RFI) is often applied as a simplifying factor. The inclusion of aviation's non-CO_2 effects in climate assessments and mitigation strategies is critical to provide a complete picture of the sector's climate impact.

The global warming effect of aviation, expressed through RFI factors, varies with several parameters such as: flight altitude, distance, routing, atmospheric conditions, time of day, aircraft engine technologies and fuel characteristics.

Different scientific and governmental bodies have reached varying conclusions on which measurement approaches should be applied, and the RFI factors recommended by authorities have evolved. The lack of a unified standard has led to inconsistencies in reporting, with different data sources and methods applied across consultancies and companies. This is also evident in the Nordic context, where varying approaches are already used in GHG reporting. An additional challenge is that airlines rarely provide detailed flight-specific operational data, which limits reporting accuracy. Together, these issues highlight the need for clearer guidance and more harmonised approaches – a gap this guide aims to address.

As part of the guide's second core purpose, it is important to recognise that CO_2 emissions per passenger-kilometre (business travel) or per ton-kilometre (air freight) vary significantly depending on factors such as distance, flight class, load factors, aircraft technology and use of sustainable fuels.

Methodological choices in how emissions are calculated can further influence the results. For this reason, the recommended best practices include suggestions that aim to harmonise reporting of the full climate effects from flights — covering both CO_2 and non-CO_2.

Guiding principles

The recommendations are based on the following principles:

A. Compliance with the GHG Protocol
B. Harmonized reporting
C. Scientific robustness
D. Effective decision support
E. Transparency to stakeholders
F. Practical feasibility for GHG reporting
G. "Future readiness" for science-aligned target setting

Target audience

These recommendations are intended for all companies that engage in air travel, which wish to quantify their flight-related emissions, report and reduce them. Best practice implementation is particularly relevant for:

- Organisations with large absolute flight emissions
- Organisations where flight emissions constitute a significant portion of Scope 3.

1. Harmonised Guidance

The following recommendations should always be followed:

1.1 Include upstream emissions

Even though this is not currently a requirement under the GHG Protocol, upstream emissions are a material part of the carbon footprint of transportation, which typically adds around 20% to flight CO_2 emissions (around 10% when including RFI 1.7). Including them prepares for the adoption of frameworks such as the target-setting standards from the Science Based Targets initiative and brings some harmonisation to the estimated impact of flight travel across companies.

1.2 Use an RFI factor of 1.7 or higher (GWP 100) within the calculations

- The group recommends using **RFI 1.7 or higher (GWP100)** as the default value for all flight types and distances, as noted in Lee et al. (2021).
- The applied RFI factor shall always be disclosed in reporting. It should be explicitly stated in the **methodology section**, under operational boundaries.

This metric (GWP100) with a factor of 1.7 is included in the UK Government emission factors, published by DESNZ/DBT (formerly BEIS). Since this source is widely used in corporate carbon reporting and is also the most common reference among participants in this group, selecting it is motivated by a **harmonisation perspective**. In addition, GWP100 is the standardised default metric for GHG reporting today.

At the same time, the group acknowledges that there is no full consensus on which metric should be used as the default. Different external bodies, including governmental agencies, have adopted different approaches. The authors of the selected source (Lee et al., 2021) even recommend the use of GWP*100 rather than GWP100. Therefore, the recommendation of 1.7 (GWP100) should not be interpreted as representing the most scientifically robust factor (criteria C). The group emphasises that it is not a research body and does not aim to make such claims.

1.3 Differentiate calculations and apply conservative assumptions

If the data needed to differentiate calculations are not available (e.g., flight distance or flight class), apply relevant assumptions and ensure conservative estimates are used, in line with GHG Protocol recommendations.

Sources that provide only average flight-class emission factors underestimate emissions from business- and first-class travel. Therefore, they are not recommended, as they do not provide representative results for such flights.

1.4 Ensure transparent reporting

Carbon footprint providers shall include in their report to clients the following points, while also encouraging them to disclose them in their company sustainability reports:

- Present GHG results both including and excluding non-CO_2 effects, alongside the main results table. This can be done per category (e.g., business travel) and/or at the total results level.
- Explicitly state the RFI-factor used in the methodology section
- Include a table outlining the operational boundaries for each emissions category and specify the multipliers applied (e.g., business travel and freight). The factor should also be noted in the results table for enhanced transparency.

Table 1: Example reporting of scope 3.6 Business travel emissions.

3.6 Business travel emissions			
Flight emissions	Excl. non CO_2 effects	Incl. non-CO_2 effects	RFI factor
	386 tCO_2e	609 tCO_2e	1.7

The company's total emissions include those with non-CO_2 effects.

1.5 Use supplier data with caution

Best practice is to calculate emissions from supplier activity data (e.g., distance, class) rather than relying on supplier-reported emission data. This ensures harmonisation and control over which sources are applied.

Exceptions may be made when supplier data is transparent and high-quality. If supplier-reported data is used, it should be supplemented with RFI factors (see 1.3) and upstream emissions (see 1.2) where missing.

> *Emission data shared from travel agencies are often reported without an RFI factor, without upstream emissions added, and with a variation of sources used for calculating CO_2 emissions. Emission data shared by freight companies are also typically reported without an RFI factor and with varying sources used to calculate CO_2 emissions. Upstream emissions are typically included.*

2. Additional recommendations

In addition to the general recommendations above, organisations can do the following:

2.1 Add GWP* reporting alongside GWP100

In addition to GWP100, we recommend reporting emissions separately using RFI 3.0 (GWP*100). While the established corporate reporting standards typically default to GWP100 to ensure consistency with national inventories and global targets, this group recommends GWP* as an emerging best practice for corporate reporting. This approach, supported by recent academic findings (e.g., Allen et al., 2018; Lee et al., 2021), better accounts for the distinct warming behaviour of short-lived pollutants. Adopting this dual-reporting approach signals a commitment to scientific robustness and transparency regarding the full climate impact of aviation. This helps account for uncertainty in this field, provides more nuanced reporting, and sends a strong signal to policymakers on the importance of limiting these effects.

GWP* (pronounced "GWP-star") is a climate metric designed to more accurately capture the warming impact of short-lived climate pollutants (SLCPs), compared to the traditional Global Warming Potential (GWP) metric. Unlike GWP100, which assesses impact over a 100-year horizon, GWP* better represents how SLCPs such as methane and aviation's short-lived non-CO_2 effects (e.g., contrail cirrus or ozone formation from NOx_x) influence global temperature.

The metric and values used here are derived from Lee et al. (2021). It is important to note that Lee et al. (2021) serves as the primary scientific basis for the aviation assessment in the IPCC Sixth Assessment Report (AR6), specifically informing the Effective Radiative Forcing (ERF) estimates in Working Group I (The Physical Science Basis) and Working Group III (Mitigation of Climate Change). Consequently, the shift from the older 1.9 factor to the current 1.7 (GWP100) in UK Government (DESNZ) factors reflects the updated science established in this foundational paper.

2.2 For SMEs, use DESNZ/DBT as the default calculation source

DESNZ/DBT (formerly BEIS, in the UK) **is recommended as the default source** for CO_2 emission factors from flights and air freight. It allows differentiation by distance and flight class, is transparent and license-free, and is widely adopted both in Sweden and internationally.

Alternative sources were considered, but are **not recommended** as the default. For example, SMED (Svenska MiljöEmissionsData) is not widely recognised outside Sweden, lacks clarity on RFI application, and applies different RFI factors depending on flight type.

2.3 Use granular data sources when supporting strategy

More detailed data sources, such as IATA, Google Travel Impact Tool, RDC, ICAO, and NTM Advanced, can be valuable if granular data is available (e.g. aircraft type). If these tools are used for decision-making and emission reduction strategies, this purpose is prioritised over the need for complete harmonisation.

For example, Google's Travel Impact Tool shows that consumers can reduce per-trip CO_2 emissions by 22-63% by selecting lower-emission flights. Most of these sources do not include RFI multipliers or upstream emissions, which must be added separately. Upstream fuel emissions may also need to be supplemented, as they are inconsistently included.

3. Future outlook

Several projects are underway to develop more accurate methodologies for estimating non-CO_2 effects from aviation, such as E-CONTRAIL. An overview of some of these projects can be found here. The aim is to estimate these emissions in the near future to facilitate emission-reduction strategies for the aviation industry. In the EU, aircraft operators under the purview of the EU ETS have the added obligation as of January 1st, 2025, of monitoring and reporting their non-CO_2 effects, including soot particles, water vapour, nitrous oxides (NO_x) and oxidised sulphur species, as an effort to collect flight-specific data for non-CO_2 effects.

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