# ICAO Carbon Emissions Calculator (ICEC): a reference tool for estimating carbon emissions

**By ICAO Secretariat**

As part of the ICAO's leadership role on all matters in addressing aviation emissions, ICAO developed and udaptes the ICAO Carbon Emissions Calculator (ICEC), which provides a standardized, transparent method for estimating carbon emissions from air travel, and it is the only internationally-approved tool of its kind.

To undertake this effort, ICAO developed a publicly available methodology[1], through the ICAO Committee on Aviation Environmental Protection (CAEP), to calculate carbon dioxide ($CO_2$) emissions from air travel. This methodology provides the basis for the ICEC[2], which allows the estimation of $CO_2$ emissions attributed to passengers and cargo transported by air on a specific route.

The ICEC is available in different interfaces such as:

- An online version publicly accessible from the ICAO website[3].
- An API[4] that allows automatic integration with software, webpages, or mobile applications released by third-party organizations
- Tailored standalone tools and databases developed on ad-hoc basis for third parties.

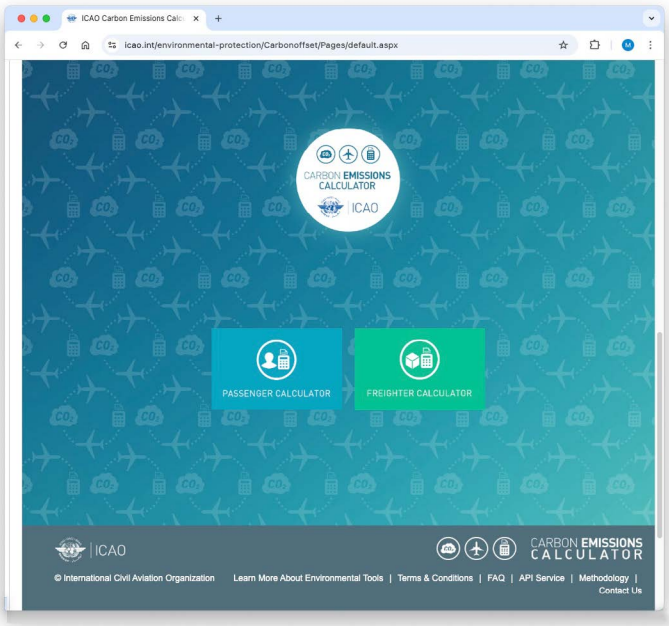


**FIGURE 1:** ICAO Carbon Emissions Calculator online version.

The methodology used by the ICAO calculator[1] incorporates the best publicly available industry data to account for key factors such as aircraft types, route specific data, passenger load factors and cargo carried. The ICAO fuel formula (IFF) is used to estimate aircraft fuel consumption based on the distance flown.

1 https://www.icao.int/environmental-protection/CarbonOffset/Documents/Methodology ICAO Carbon Calculator_v11-2018.pdf
2 https://applications.icao.int/icec
3 http://www.icao.int/environmental-protection/CarbonOffset/Pages/default.aspx
4 https://www.icao.int/environmental-protection/CarbonOffset/Pages/ICEC-API-Pricing-Table.aspx

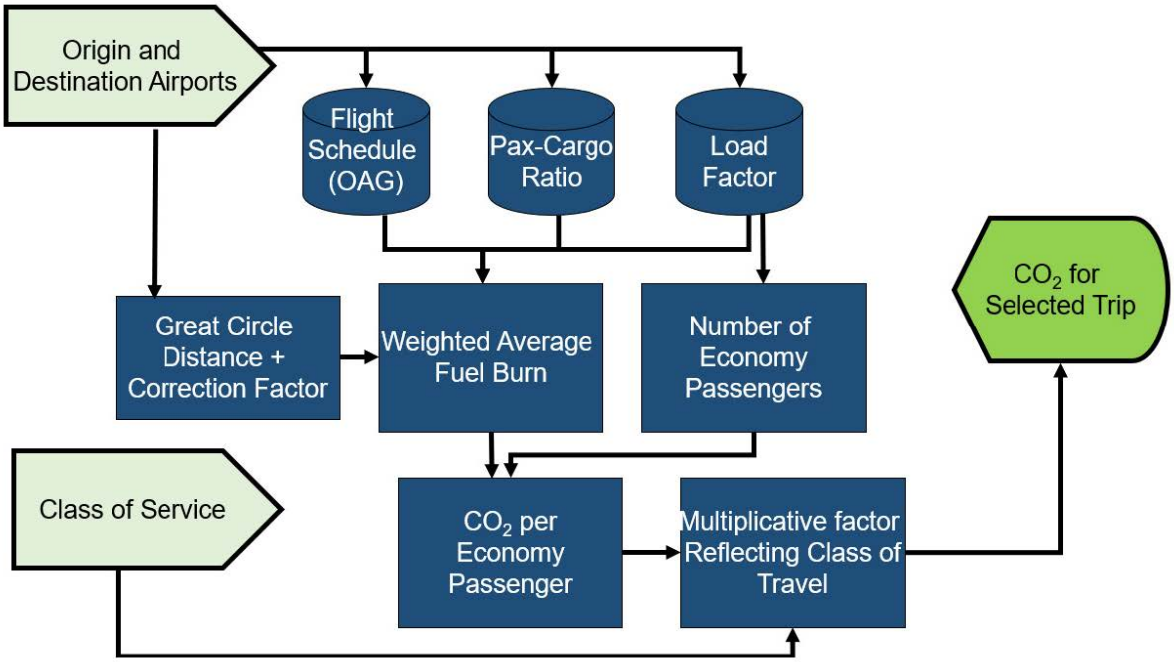


FIGURE 2: ICAO Carbon Emissions Calculator methodology and databases.

Although the only user inputs required for the ICEC tool are origin/ destination airports and the class of service, the ICAO calculator uses a series of databases - including the global airline schedules data, Cargo/ Passengers Ratio, Load Factors, and aircraft seat configuration - to generate accurate emissions estimates (see Figure 2).

The ICAO methodology is continuously refined by a dedicated group of technical experts from CAEP, and the databases used by ICEC are regularly updated to ensure accuracy and reliability.

## Recent enhancements to the ICAO Carbon Emissions Calculator (ICEC)

Following growing interest from the UN, the general public, and freight forwarders in receiving $CO_2$ information on air cargo shipments, ICAO has extended the capabilities of its Carbon Calculator to estimate carbon emissions associated with these activities. This new cargo function is accessible from the updated online interface of the ICEC (see also Figure 1).

The ICEC methodology and online tool were recently revised to increase the number of cabin classes modeled from two (economy class and premium classes) to four (economy class, premium class, business class, and first class). This enhancement improves the accuracy of ICEC, as the previous model may have overestimated the number of economy seats on a given airline, potentially underestimating the carbon footprint per seat across cabin classes.

Using publicly available data—such as U.S. BTS data, which was previously used to develop ICAO's Fuel Formulae—new aircraft types have been added to the IFF database, resulting in 4,190 new city pairs operated exclusively by these newly introduced aircraft types.

Finally, ICAO is advancing work to provide ICEC users with information on the availability of SAF at certain airports, based on data collected through the ICAO Airports SAF tracker[5].

5 https://www.icao.int/environmental-protection/SAF/Pages/Airports.aspx

## UN-system-wide use of the ICAO Carbon Emissions Calculator (ICEC)

In April 2009, the UN Environmental Management Group (EMG)[6] adopted the ICAO Carbon Emissions Calculator as the official tool for all UN entities to quantify their air travel $CO_2$ footprint, in support of the UN Climate Neutral initiative. Since then, interfaces to the calculator have been made available to UN environmental sustainability focal points, travel offices, and enterprise resource planning (ERP) systems, as well as through a special agreement with CRS companies such as Amadeus. Some UN travel offices have integrated the ICAO Calculator directly into their travel reservation and approval systems, providing real-time information to assist travel planning decisions.

Almost all organizations that report their greenhouse gas (GHG) inventories to the UN EMG Greening the Blue[7] initiative are using the ICAO Calculator. The adoption of the ICAO Calculator, as a common UN methodology and interface across the UN system, facilitates the aggregation of air travel emissions data, ensuring integrity and consistency in reported inventories.

The ICAO Calculator is also used to estimate the carbon emissions generated by major UN meetings, including the UNFCCC COPs, the UN Climate Summit, and the UN Environmental Assembly.

ICAO continues to actively support all UN agencies in quantifying and managing their air travel emissions by regularly updating the ICAO Carbon Emissions Calculator and providing ongoing technical assistance.

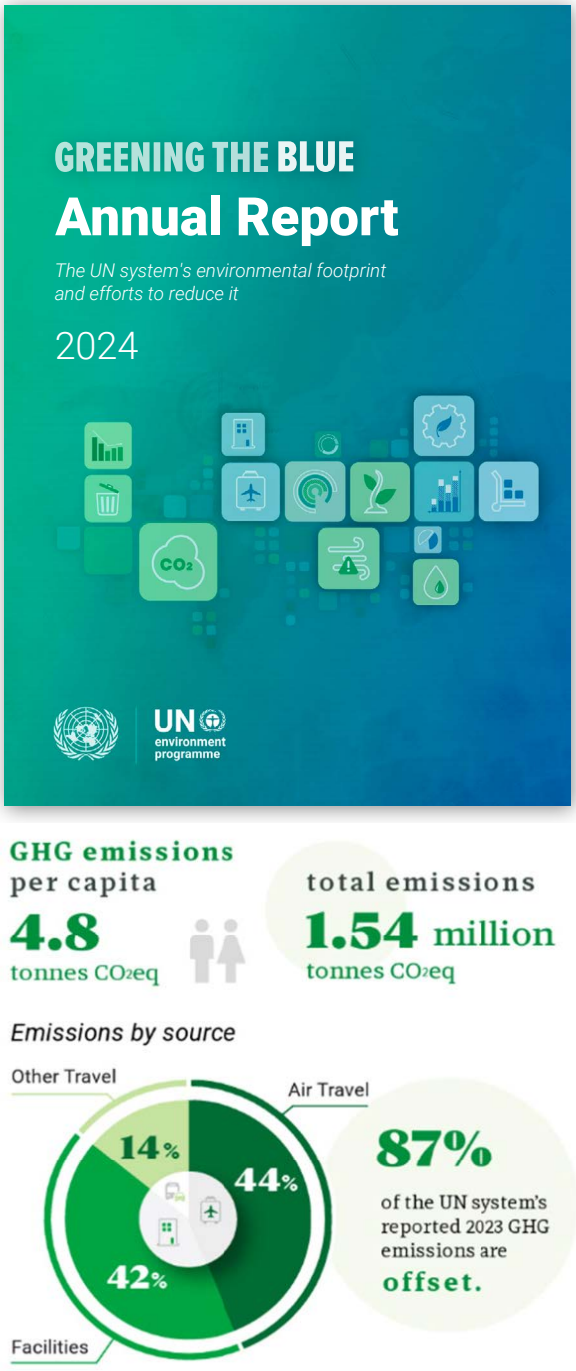


FIGURE 3: UN Greening the Blue Report and GHG Emissions inventory.

6 https://unemg.org/
7 https://greeningtheblue.org/interactive-report/2024.html#greenhouse