IAEG
INTERNATIONAL AEROSPACE ENVIRONMENTAL GROUP

GREENHOUSE GAS (GHG)

GUIDANCE FOR CALCULATING CIVIL AND MILITARY AVIATION SCOPE 3 EMISSIONS FOR CATEGORY 11—USE OF SOLD PRODUCTS >

SCOPE 3 CATEGORY 11

USE OF SOLD PRODUCTS

The International Aerospace Environmental Group (IAEG) identified that Scope 3, “Corporate Value Chain,” Category 11, “Use of Sold Products,” as defined by the Greenhouse Gas (GHG) Corporate Protocol, is one of the most relevant Scope 3 emissions categories for most aerospace companies.

IAEG developed an industry-specific methodology and guidance materials, for voluntary consideration and use, to promote consistency of reporting approaches within the industry.

IAEG has produced guidance on both civil and military aviation applications. This guidance is intended to complement the GHG Corporate Protocol Scope 3 emissions accounting and reporting standard and the associated technical guidance for calculating Scope 3, Category 11 emissions.

EMISSION TYPES

DIRECT USE PHASE EMISSIONS

Emissions from products that directly consume energy (fuels or electricity) during use.

Examples: Emissions associated with fuel or electricity consumed by aircraft & engines, and emissions associated with energy (via engine offtakes) directly consumed by systems on board of the aircraft.

INDIRECT USE PHASE EMISSIONS

Emissions from products that indirectly consume energy (fuels or electricity) during use.

Examples: Emissions associated with the use of aircraft interiors, landing gear and other systems. Their weight contributes to the overall fuel burn of the aircraft, and therefore results in indirect emissions for those systems (aircraft interiors, landing gears, etc).

OVERALL PROCESS

Determine organizational boundaries

For products or integrated systems at least partially attributable to activities within the organizational boundaries

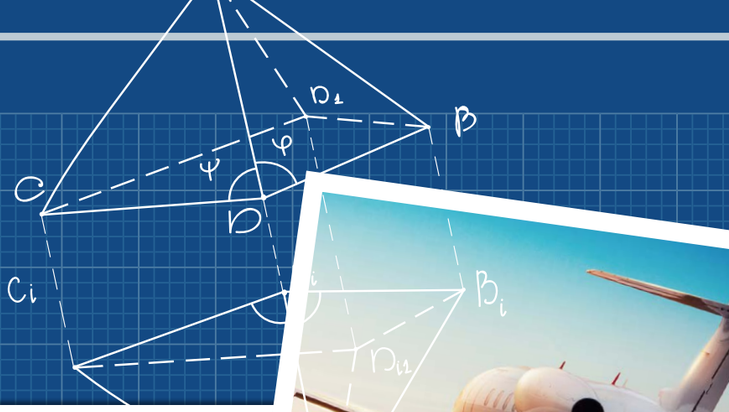
Calculate whole aircraft lifetime emissions

Allocate whole aircraft lifetime emissions to relevant products in question based on product lifetime and an allocation method

Report the portion of emissions defined by organizational boundaries

In the case of commercial aircraft, the guidance also provides equations to calculate an intensity metric expressed in gCO2e per Revenue Passenger Kilometer (RPK) or Revenue Tonne Kilometer (RTK) in order to show improvements in product performance over time.

CALCULATING CIVIL AIRCRAFT DIRECT USE PHASE EMISSIONS



Calculating by year then summed over the product lifetime:

$$\sum_{\text{AIRCRAFT TYPE}} \left\{ \text{NUMBER OF DELIVERED AIRCRAFT} \times \sum_{\text{YEAR = 1}}^{\text{EXPECTED AIRCRAFT LIFE}} \left[\text{ANNUAL EMISSIONS PER AIRCRAFT} \right] \right\}$$

$$\text{ANNUAL EMISSIONS PER AIRCRAFT} = \text{ANNUAL FUEL BURN PER AIRCRAFT} \times \text{JET FUEL EMISSION FACTOR} \times \left(1 - \text{PERCENT ALTERNATIVE FUELS} \times \text{EMISSION REDUCTION FACTOR}\right)$$

3.85 kg CO_2e per kg of fuel, for ICAO baseline Jet-A /Jet-A1.

If a scale-up projection of Sustainable Aviation Fuel (SAF) over time is assumed by the reporting company over the product lifetime, IAEG recommends to explicitly provide the SAF projection data and the data source cited (e.g., Waypoint 2050, IEA).

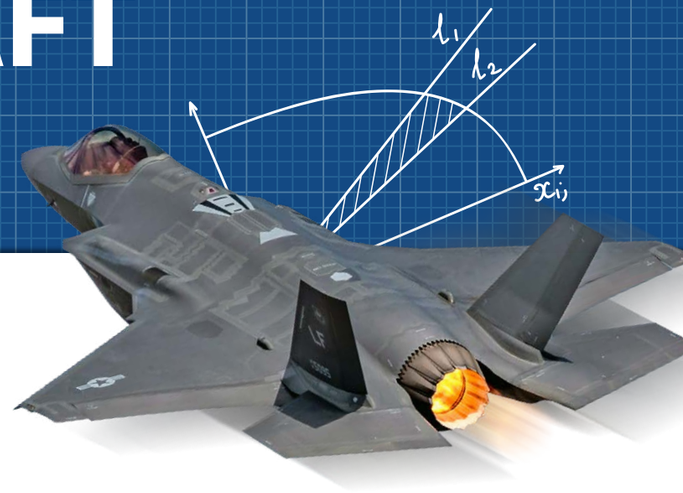
Depends on the SAF pathway and feedstock. Default lifecycle emission factors are provided by **ICAO for CORSIA Eligible Fuels.**

$$\text{ANNUAL FUEL BURN PER AIRCRAFT} = f\left(\text{UTILISATION, MISSION PROFILE, LOAD FACTOR, AIRCRAFT PERFORMANCE}\right)$$

Emission Reduction Factor $(ERF) = 1 - LSf/LC$ with LSf being the lifecycle emission of the selected SAF in gCO_2e/MJ, and LC representing the baseline life cycle emission (e.g., 89 gCO_2e/MJ for Jet-A /Jet-A1).

*Formulae are available for alternative sources of energy (electricity, hydrogen)

CALCULATING MILITARY AIRCRAFT DIRECT USE PHASE EMISSIONS



Calculating by expected flight hours over the product lifetime:

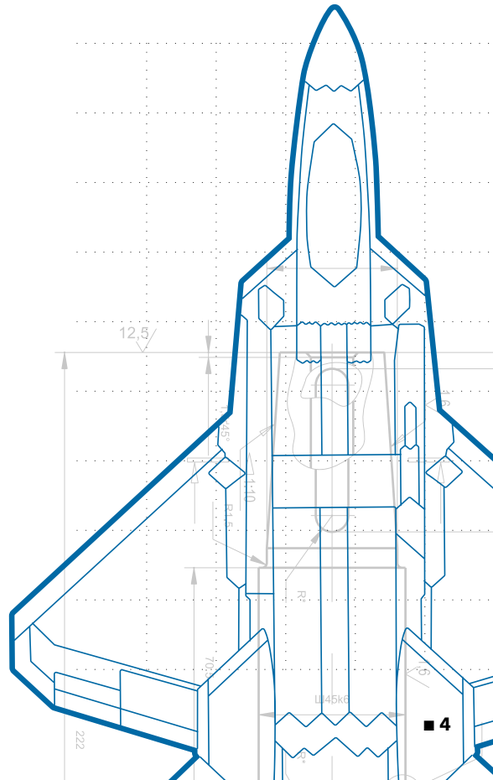
Given the nature and mission of military products, the annual flight hours are unpredictable and largely unknown. The calculation for military products is modified to utilize lifetime flight hours as a direct factor in the calculation. At this time, due to lack of information, use of alternative fuels is not considered in the calculation for military aircraft.

$$\sum_{\text{AIRCRAFT TYPE}} \left\{ \text{NUMBER OF DELIVERED AIRCRAFT} \times \text{LIFETIME FLIGHT HOURS OF THE AIRCRAFT (EXPECTED)} \times \text{EMISSION FACTOR PER FLIGHT HOUR} \right\}$$

$$\text{EMISSION FACTOR PER FLIGHT HOUR} = \text{FUEL BURN PER FLIGHT HOUR (EXPECTED AVERAGE)} \times \text{JET FUEL EMISSION FACTOR}$$

$$\text{FUEL BURN PER FLIGHT HOUR (EXPECTED AVERAGE)} = f\left(\text{AIRCRAFT, TYPE, LOAD FACTOR, ETC.}\right)$$

Function of all factors contributing to individual fuel burn rates by product or category of product.



INTENSITY METRIC FOR COMMERCIAL AIRCRAFT

To address the concern that products with longer lifetimes can appear to have higher use-phase emissions than products with shorter lifetimes, emissions intensity metrics can be used to demonstrate improvements in product performance over time. Commonly used commercial aviation metrics are therefore suggested.

PASSENGER AIRCRAFT

$$\frac{\textit{Sold Products Lifetime Emissions}}{\textit{Sold Products Associated Lifetime RPK Emissions}} \leftarrow \sum_{\text{AIRCRAFT TYPE}} \left\{ \text{NUMBER OF DELIVERED AIRCRAFT} \times \sum_{\text{YEAR = 1}}^{\text{EXPECTED AIRCRAFT LIFE}} \left[\text{AVAILABLE SEATS} \times \text{LOAD FACTOR} \times \text{TYPICAL STAGE LENGTH} \times \text{ANNUAL FLIGHT CYCLES} \right] \right\}$$

FREIGHTER AIRCRAFT

(OR AIRCRAFT CARRYING BOTH PASSENGERS AND BELLY FREIGHT)

$$\frac{\textit{Sold Products Lifetime Emissions}}{\textit{Sold Products Associated Lifetime RTK Emissions}} \leftarrow \sum_{\text{AIRCRAFT TYPE}} \left\{ \text{NUMBER OF DELIVERED AIRCRAFT} \times \sum_{\text{YEAR = 1}}^{\text{EXPECTED AIRCRAFT LIFE}} \left[\text{PAYLOAD} \times \text{TYPICAL STAGE LENGTH} \times \text{ANNUAL FLIGHT CYCLES} \right] \right\}$$

$$\text{PAYLOAD} = \text{AVAILABLE SEATS} \times \text{LOAD FACTOR} \times \text{WEIGHT OF PASSENGER AND LUGGAGE} + \text{BELLY FREIGHT} + \text{MAIN DECK FREIGHT}$$

↓

100 kg per passenger (including their checked baggage).

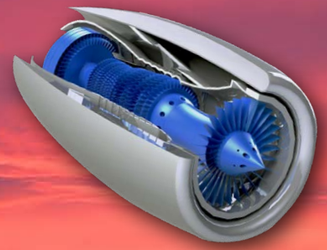
SOLD INTERMEDIATE PRODUCTS VS FINAL PRODUCT

SOLD INTERMEDIATE PRODUCTS

Products that require further processing, transformation, or inclusion in another product before use (e.g., engines, cabin interiors, hydraulic and electrical systems, landing gears, bolts, etc.).

VS

FINAL END-USE PRODUCT



CALCULATING DIRECT & INDIRECT USE-PHASE EMISSIONS *(FOR SOLD INTERMEDIATE PRODUCTS)*

Consistent with GHG Technical Guidance for Calculating Scope 3 Emissions, companies that sell intermediate products that directly consume energy—fuels or electricity—during use are required to include these direct use-phase emissions in their Category 11 calculations. However, the inclusion of indirect use-phase emissions is optional. The calculation starts with determining the emissions of the final product (i.e., aircraft) over the expected lifetime of the sold intermediate product. Then, a second calculation is performed to define the percentage of the emissions that should be allocated to the sold intermediate product. The allocation methodology is similar for both direct and indirect use-phase emissions. Two allocations methods are suggested:

Allocation method based on mass ratio for engines and equipment that do not consume energy:

$$\sum_{\text{INTERMEDIATE PRODUCT TYPES}} \left\{ \text{NUMBER OF DELIVERED PRODUCTS} \times \sum_{\text{YEAR = 1}}^{\text{EXPECTED LIFE OF INTERMEDIATE PRODUCT}} \left[\text{ANNUAL EMISSIONS PER AIRCRAFT} \times \frac{\text{MASS OF INTERMEDIATE PRODUCT}}{\text{MASS OF AIRCRAFT}} \right] \right\}$$

Hybrid allocation method for equipment that have both direct and indirect use-phase emissions (e.g., Environmental Control System, pneumatic systems, electrical systems, galleys):

$$\sum_{\text{INTERMEDIATE PRODUCT TYPES}} \left\{ \text{NUMBER OF DELIVERED PRODUCTS} \times \sum_{\text{YEAR = 1}}^{\text{EXPECTED LIFE OF INTERMEDIATE PRODUCT}} \left[\text{ANNUAL DIRECT EMISSIONS OF PRODUCT} \times \text{ANNUAL INDIRECT EMISSIONS OF PRODUCT} \right] \right\}$$

WHERE

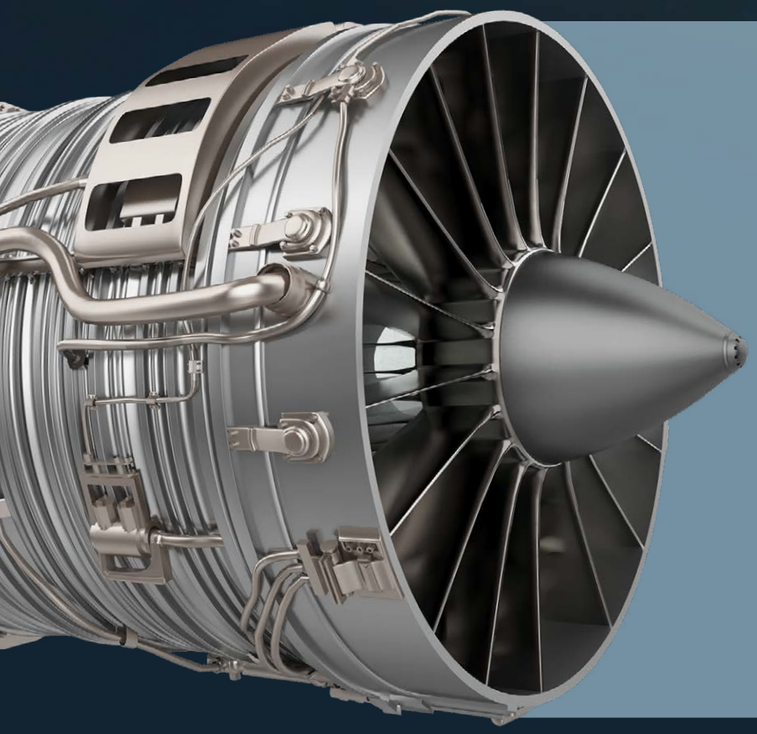
$$\text{ANNUAL DIRECT EMISSIONS OF PRODUCT} = \text{ANNUAL EMISSIONS PER AIRCRAFT} \times \left[\frac{\text{EQUIVALENT FUEL OFFTAKE PER INTERMEDIATE PRODUCT}}{\text{TOTAL FUEL BURN}} \right]$$

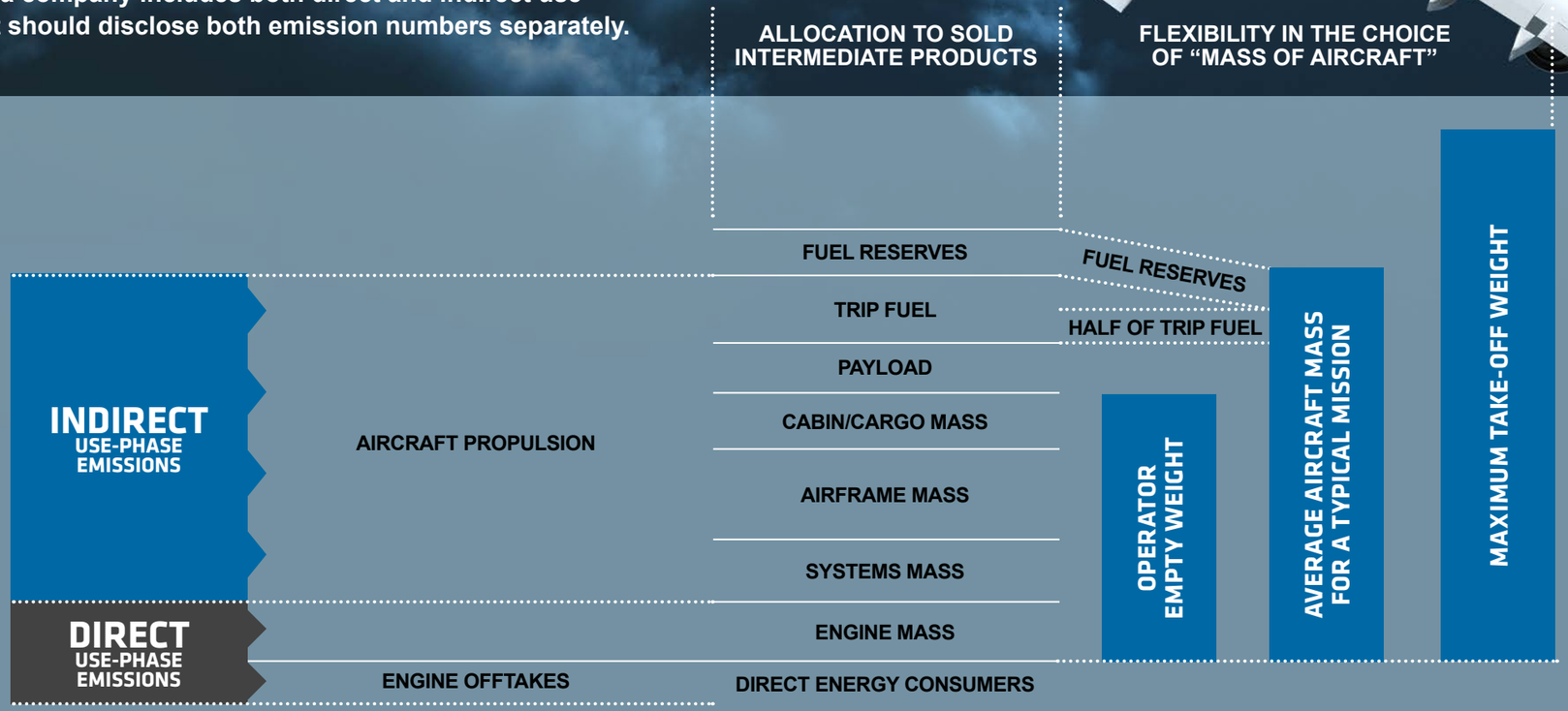
AND

$$\text{ANNUAL INDIRECT EMISSIONS OF PRODUCT} = \text{ANNUAL EMISSIONS PER AIRCRAFT} \times \left[\frac{\text{FUEL FOR PROPULSION}}{\text{TOTAL FUEL BURN}} \right] \times \left[\frac{\text{MASS OF INTERMEDIATE PRODUCT}}{\text{MASS OF AIRCRAFT}} \right]$$

ALLOCATION METHOD FOR SOLD INTERMEDIATE PRODUCTS

The choice of the “Mass of aircraft” shall be clearly stated in the reporting (e.g., Operating Empty Weight, average aircraft mass during the flight). If a company includes both direct and indirect use-phase emissions in its Category 11 calculations, it should disclose both emission numbers separately.





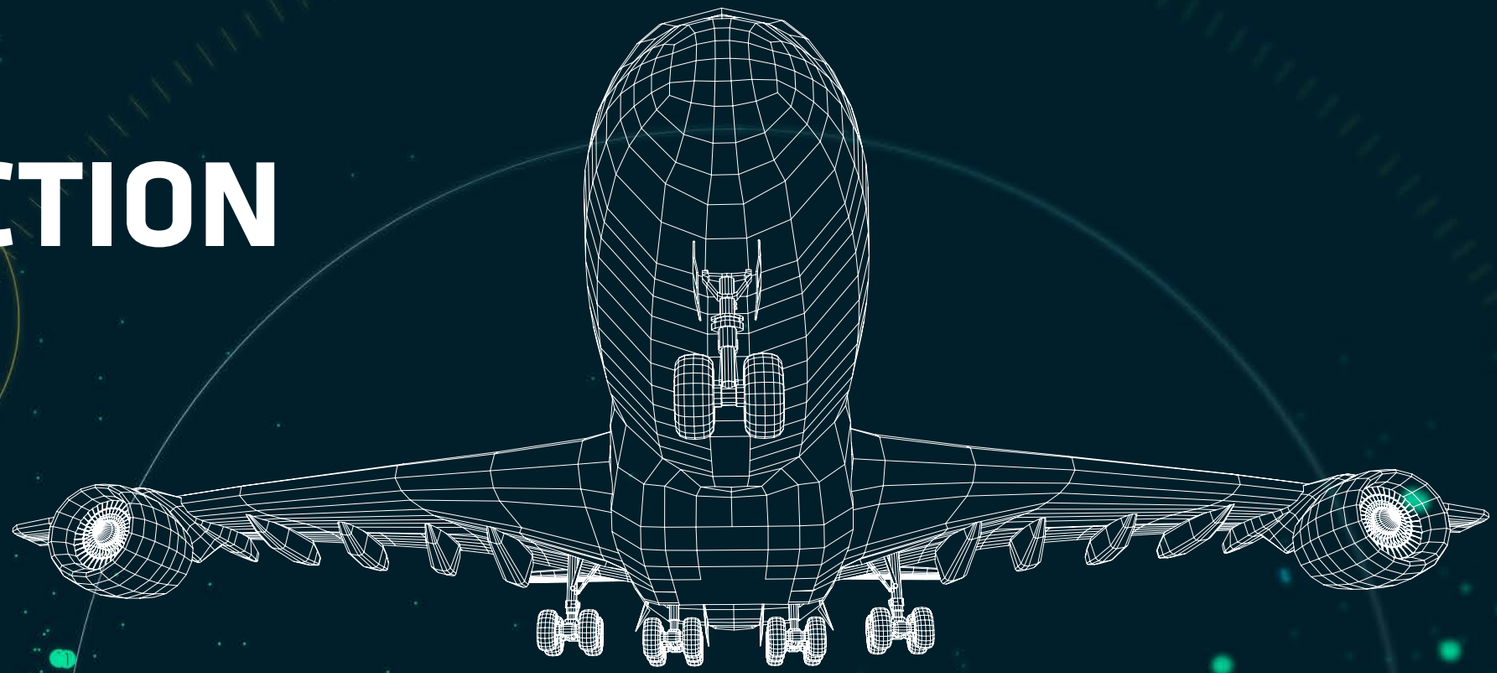
ALLOCATION METHOD ADAPTATION & EXCLUSION CASES

Companies may adapt the allocation method presented on the previous page based on their specific situation. For example, for products that contribute to the aircraft drag and / or lift compared to their contribution to the aircraft mass, the allocation may quantify this drag and / or lift contribution.

EXCLUSION CASES:

In certain cases, the eventual end use of sold intermediate products may be unknown or the sold intermediate product may be further manufactured within the value chain (leading to potential mass decrease of the intermediate product once fitted on the final product). This is typically the case for suppliers that are several tiers away in the supply chain of the aircraft and it may be very difficult for them to obtain information on product use, to a point were calculation is not possible or at least extremely difficult. A similar situation may exist for intermediate products that have several end-use applications. In such instances, and consistent with the GHG Corporate Protocol Scope 3, Category 11 guidance, companies may disclose and justify the exclusion of all downstream emissions related to these sold intermediate products. **For more information, see section 6.4 of the Scope 3 Standard** ***(accounting for downstream emissions).***

DATA COLLECTION



Companies can use internal aircraft utilization data (such as yearly number of flight hours, average mission range, payload).

If such internal data are not available, generic industry data are provided in the guidance (aircraft lifetime, Aircraft utilization per category of aircraft [flight cycle duration, annual flight hours], links to aircraft performance calculators).

Where possible, equipment manufacturers may contact their customers to obtain emissions value per aircraft family for mass and offtakes allocation.

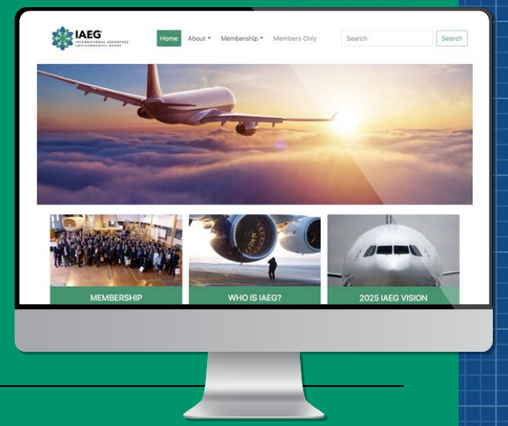
SUMMARY

GUIDELINE INCLUDES

- Formula for the computation of GHG emissions and intensity metric
- Fossil jet-A/A1, Jet-B, fossil Aviation Gasoline (AvGas) emission factors
- Incorporation of Sustainable Aviation Fuel (SAF) or alternative energy (hydrogen, ammonia, electricity)
- Allocation methodology for sold intermediate products
- Generic aircraft utilisation data per aircraft category (excluding business jets)
- Practical examples to illustrate the application of the guidance
- FAQ section
- Guidance for military products, including fixed-wing, rotary aircraft and non-commercial applications

This guidance is the result of the work of representatives from various manufacturers in the aviation supply chain—including manufacturers of parts, components, engines, and aircraft. It was recently enhanced to include guidance and references for military products.

AVAILABLE AT IAEG.COM



If you have any feedback or questions on this guidance please email:

> Questions@IAEG.com