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Dubai Airshow demonstration flight: Methodology for calculation of greenhouse gas emissions and substantiation of environmental claims

This document explains the methodology for calculating (and estimating when needed) greenhouse gas (GHG) emissions as a basis for substantiating environmental claims associated with the flight of an Airbus A350-1000 from Toulouse (TLS) to Dubai World Central (DWC) scheduled in the context of the Dubai Airshow (17–21 November 2025).

The primary objective of this demonstration flight is to maximise GHG emissions mitigation measures currently available to aircraft operations to explore their potential in practice and their possible contribution to the decarbonisation ambition of the aviation industry.

The approach of this methodology is based upon the principles of the climate mitigation hierarchy, this means:

1. **Avoid emissions** by maximising operational and technological efficiency, with a particular focus on the use of the latest generation commercial aircraft.
2. **Reduce and substitute energy sources** through the use of physical sustainable aviation fuel (SAF) during the flight and by purchasing SAF Book & Claim Units.
3. **Manage the residual emissions of the flight after the implementation of the measures above** by purchasing carbon dioxide removal credits**.**

Key terminology and definitions of this document include:

- **Lifecycle Assessment (LCA):** According to the International Civil Aviation Organization (ICAO), the fuel used by an aircraft must account for all GHG emissions, from the production of the fuel to its end-use in the aircraft. The process includes emissions from **direct fuel consumption** and **upstream emissions** from the cultivation, harvesting, processing, and transportation of the fuel feedstock[1]. In this document, LCA is referred as "Well-to-wake" which entails the following:
  - **Well-to-Wake (WTWa):** The lifecycle boundary encompassing emissions from feedstock sourcing, refining, transport (Well-to-Tank), and the final flight operations (Tank-to-Wake, consistent with ICAO CORSIA and the

[1] For more information, please refer to the ICAO eligible fuels website, available here.

Greenhouse Gas Protocol ("GHG Protocol") standard for GHG emissions accounting.

- **Sustainable Aviation Fuel (SAF):** SAF is a fuel which in order to be considered sustainable must be made from renewable sources or feedstocks, such as used cooking oils, fats, plant oils, municipal, agricultural and forestry waste. It must also meet a set of greenhouse gas savings and sustainability criteria included in regulations such as ICAO CORSIA eligible fuels criteria and the EU Renewable Energy Directive (RED) or voluntary standards. These requirements include food security, water management and human rights considerations. Those criteria must be certified and verified by independent bodies throughout the value chain. In particular, **the definition used throughout this document is the one of ICAO CORSIA**, which defines SAF as renewable or waste-derived aviation fuels that meets sustainability criteria.[2]

- **Book & Claim (B&C):** A chain-of-custody model that decouples the physical delivery of SAF from the trading of its associated environmental attributes. The unit of traceability associated with the environmental attributes of SAF (B&C Units) are traced, tracked, purchased, registered and retired by a user remote from the physical delivery location.[3]

- **Carbon Dioxide Removals (CDRs):** Refers to technologies, practices, and approaches that remove and durably store CO2 from the atmosphere[4]. These include nature-based solutions such as afforestation and reforestation, or technological methods like Direct Air Capture and Storage.

Boundaries and scope of the calculation

The scope of the calculation is defined by the full fuel lifecycle emissions (WTWa) attributable to the TLS-DWC outbound flight.

Baseline definition: flight from TLS to DWC using conventional aviation fuel

Following the principles and recommendations of the GHG Protocol, particularly on project-intervention accounting, this methodology starts by defining a baseline of the business-as-usual which excludes mitigation interventions. This means that the

[2] Additional information on ICAO CORSIA eligible fuels is available here. Please note, however, that the ReFuelEU Aviation defines aviation fuel as "[...] aviation fuels that are either: (a) synthetic aviation fuels; (b) aviation biofuels; or (c) recycled carbon aviation fuels" and these need to meet the criteria of the RED. Additional information on EU RED is available here.
[3] Additional information on the RSB Book & Claim System and Methodology is available here
[4] For more information, please refer to the Intergovernmental Panel on Climate Change (IPCC) Assessment Sixth report or to the following IPCC factsheet

baseline is a TLS-DWC flight using an Airbus A350-1000, conventional aviation fuel (CAF) and no measures to mitigate residual emissions.

To calculate the emissions from the burning of CAF, the method used is the one established by ICAO CORSIA monitoring, reporting and verification standard as well as the eligible fuels methodologies. These mandate the use of energy-based lifecycle emission factors, expressed in grams of CO_2 equivalent per megajoule (gCO_2e/MJ), to quantify both the baseline and the resulting reductions.

Please find below the specific conditions:

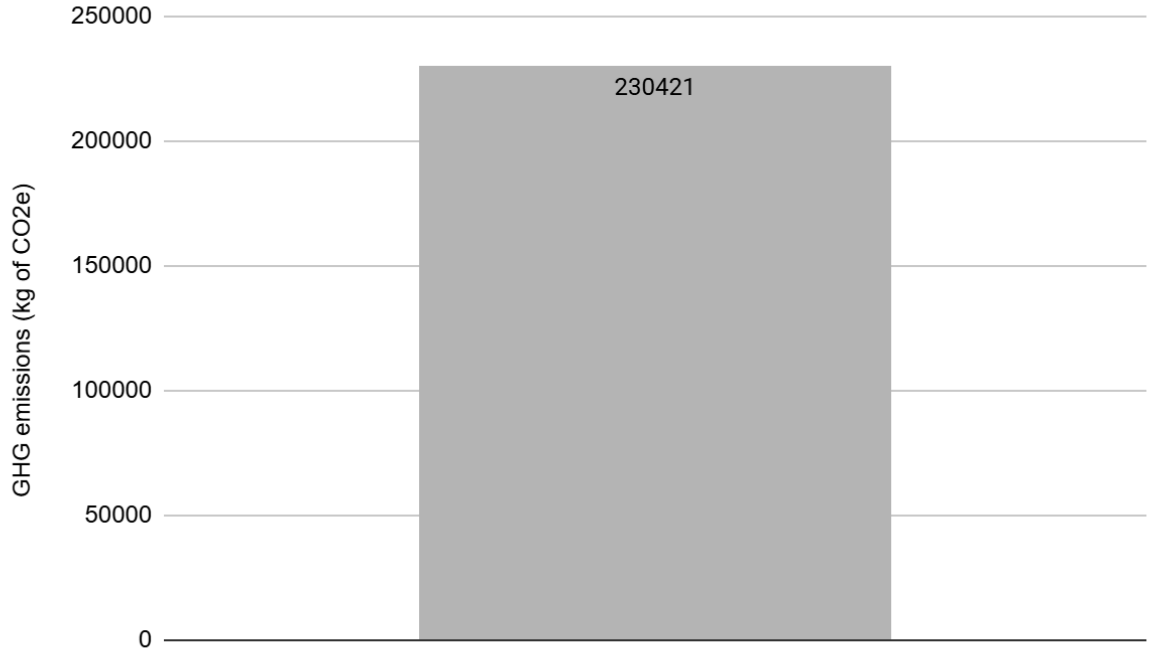
- **Aircraft Type:** Airbus A350-1000
- **Total Jet A1 Tonnage Required:** As per flight plan, the total CAF tonnage required is 60.00 tonnes. This mass represents the total fuel uplifted, incorporating mission fuel (36.60 tonnes) and reserves.[5]
- **WTWa Emission Factor for Jet A1:** The baseline lifecycle emissions value for standard jet fuel is set at 89 gCO_2e/MJ.[6]
- **Standard Energy Density:** The calculation relies on the standard approximation for Jet A1 energy density of 43.15 MJ/kg to convert fuel mass to energy content.[7]
- **Boundary conditions:** This flight is not carrying a commercial payload (typically 30t to 40t for passengers and baggage), reducing the fuel consumption compared with a standard commercial operation.

Accordingly, **the baseline is established as follows: 230.42 tonnes of CO_2e.**

[5] Please note that certain factors cannot be determined or anticipated due to uncertainties inherent to operations including, but not limited to, variability in air distance caused by winds and air traffic control requirements. Additionally, the aircraft performance can vary due to, but not limited to, atmospheric temperatures and availability of optimum flight altitudes.

[6] Corresponds to ICAO's CORSIA energetic WTW emissions factor in ICAO SARPS - Annex 16 Volume IV. At the time of writing, the value is 89 gCO2e/MJ for Jet-A fuel, Jet-A1 fuel, Jet-B fuel, TS-1 fuel, or No. 3 Jet fuel

[7] As per Table K.3 North American GHG emission factors for liquid fuels and electricity (page 90), ISO 14083:2023 Greenhouse gases – Quantification and reporting of greenhouse gas emissions arising from transport chain operations.



Based on the methods in the GHG Protocol and ICAO CORSIA and general operations knowledge, the formula used for the calculation is the following:

$$\text{Baseline Emissions } (tCO_2e) = \frac{\text{Jet A1 Mass } \times \text{Energy Content } \times \text{EF}_{\text{CAF}}}{1,000,000}$$

Where:

- **Jet A1 Mass** stands for the total mass of Jet A1 fuel required for the mission (in kg).
- **Energy Content** stands for the default energy density of Jet A1 fuel (43.15 MJ/kg).
- **EF_{CAF}** stands for the lifecycle emission factor of CAF Jet A1 fuel (89 **g**CO_2e/MJ)
- The divisor 1 000 000 converts the result from grams to tonnes

Boundary exclusions

The assessment explicitly excludes non-CO_2 effects (such as contrails, water vapour, and NOx) from the quantitative claim. This exclusion is mandated by the current lack of a universally agreed-upon, robust methodology for quantifying and attributing these complex effects within a lifecycle assessment context, ensuring the calculation remains consistent with established GHG Protocol and CORSIA accounting methodologies.

Intervention measures: Maximising the use of available mitigation measures to reduce GHGs emissions of a flight

Measure 1: Technology and Operations measures

The A350-1000 aircraft contributes to emissions reduction through its advanced design which offers a 25% reduction in fuel burn per seat compared to previous generation aircraft. This efficiency stems from the latest generation engine technology (Trent XWB, with a 9.6:1 bypass ratio), advanced aerodynamics (wing profile morphing), and the extensive use of lightweight materials (54% Carbon Fibre Reinforced Polymer, or CFRP).

Operational measures are also optimised, including the primary use of a Ground Power Unit (GPU) to minimise Auxiliary Power Unit (APU) consumption, optimised routing for the TLS-DWC sector, and general weight reduction (by not carrying a typical payload of passengers and cargo).

Limitations: The aircraft type used in both the baseline scenario and the intervention case is the same, therefore no emissions reduction can be quantified for the use of this technological solution. Furthermore, on operations, only after the flight takes place it will be possible to assess whether measures to reduce emissions where implemented, hence no quantification or estimation of GHG emissions reductions can be provided at this stage.

Accordingly, the specific parameters used for calculating GHG emissions savings are the following:

Please find below the specific conditions:

- **Aircraft Type:** Airbus A350-1000

- **Total Jet A1 Tonnage Required:** As per flight plan, the total CAF tonnage required is 60.00 tonnes. This mass represents the total fuel uplifted, incorporating mission fuel (36.60 tonnes) and reserves.[8]
- **WTWa Emission Factor for Jet A1:** The baseline lifecycle emissions value for standard jet fuel is set at 89 gCO_2e/MJ.[9]
- **Standard Energy Density:** The calculation relies on the standard approximation for Jet A1 energy density of 43.15 MJ/kg to convert fuel mass to energy content[10].
- **Boundary conditions:** This flight is not carrying a commercial payload (typically 30t to 40t for passengers and baggage), reducing the fuel consumption compared with a standard commercial operation.

Quantification of GHG emissions savings: 0 tonnes of CO_2e.

Measure 2: Use of Physical SAF

When using SAF, it is important to consider the certification limitations for its use which prevents an aircraft operator using 100% SAF and require a blend between SAF and CAF. Most SAF pathways are only approved for blending up to a specific ratio (often 50%) with conventional Jet A1.

The type of SAF to be used on this flight was produced using HEFA-SPK as production pathway and is a certified drop-in fuel (including ASTM D7566) ready for operation.

Although the maximum ratio for blending SAF HEFA-SPK is 50%, due to supply logistics constraints and availability, 21 tonnes of SAF will be used, representing 35% of the total fuel uplifted (blend) which is how Airbus receives the batches of SAF provided by our supplier TotalEnergies in Toulouse.

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[8] Please note that certain factors cannot be determined or anticipated due to uncertainties inherent to operations including, but not limited to, variability in air distance caused by winds and air traffic control requirements. Additionally, the aircraft performance can vary due to, but not limited to, atmospheric temperatures and availability of optimum flight altitudes.
[9] Corresponds to ICAO's CORSIA energetic WTW emissions factor in ICAO SARPS - Annex 16 Volume IV. At the time of writing, the value is 89 gCO2e/MJ for Jet-A fuel, Jet-A1 fuel, Jet-B fuel, TS-1 fuel, or No. 3 Jet fuel
[10] As per Table K.3 North American GHG emission factors for liquid fuels and electricity (page 90), ISO 14083:2023 Greenhouse gases – Quantification and reporting of greenhouse gas emissions arising from transport chain operations.

The mentioned situation shows a first obstacle in reducing the GHG emissions of a flight. SAF is still scarce and logistics to make it available at airports are still under development. This is the main reason why, in this case, it is not possible to use the maximum blend ratio of 50% mentioned above.

Thus, the aircraft is refuelled with 60 tonnes, 35% SAF blend, resulting in a total uplifted fuel mass equivalent to 21 tonnes of SAF and leaving 39 tonnes of CAF (65%). The fuel is associated with the following sustainability information:

- **Fuel type and pathway:** The pure SAF is Hydroprocessed Esters and Fatty Acids (HEFA-SPK), certified under ASTM D7566 Annex 2. The fuel blend is certified under ASTM D1655 & D7566 and Def Stan 91-091.
- **Feedstock and sourcing:** The HEFA was produced from Used Cooking Oil (UCO), a waste/residue feedstock, sourced from the Netherlands. The biofuel was produced by TotalEnergies and supplied via Airbus's existing supply agreement for the Toulouse premises.
- **Certification:** The supplier sustainability certification is ISCC EU. The Proof of Compliance (POC) will be delivered after the SAF is used.
- **GHG emissions savings:** For calculation purposes, the assumption taken before obtaining the corresponding POC is of **90% GHG emissions savings** on a life cycle basis compared to CAF. This corresponds to a SAF lifecycle emission factor of 8.9 gCO_2e/MJ (compared to 89 gCO_2e/MJ for CAF). Please note that the average GHG emissions savings at the Airbus Toulouse premises is 92.6%.

The GHG emissions reduction is calculated based on the difference between the CAF and SAF emission factors, multiplied by the energy content of the physical SAF used. The methodology aligns with CORSIA standards, using a default energy content value (43.15 MJ/kg) since the definitive sustainability documentation and actual measured values will be received post-flight.

The formula used for the calculation is:

$$\text{Reduction } (tCO_2e) = \frac{\text{Mass}_{\text{SAF}} \times \text{Energy Content } \times (\text{EF}_{\text{CAF}} - \text{EF}_{\text{SAF}})}{1,000,000}$$

Where:

- **Mass SAF** stands for the mass of fuel being replaced (in kg).

- **Energy Content** stands for the default energy density of Jet A1 fuel (43.15 MJ/kg)[11].
- **EF_{CAF}** stands for the lifecycle emission factor of CAF Jet A1 fuel (89 gCO_2e/MJ)
- **EF_{SAF}** stands for the residual lifecycle emission factor of the specific SAF used (ie. 8.9gCO_2e/MJ)
- The divisor 1 000 000 converts the result from grams to tonnes

Based on the above information and assumptions, the GHG emissions savings from using SAF are:

- **SAF absolute emission reduction: 72.58 tonnes of CO_2e**.
- **Estimated remaining emissions after physical SAF use: 8.07 tonnes CO_2e**. This residual amount represents the 10% of lifecycle emissions that remain unmitigated by the fuel substitution itself, relative to the WTWa boundary.

Measure 3: Using SAF Book & Claim units

The remaining 39 tonnes of CAF is mitigated with the retirement of 39.86 tonnes of SAF Book and Claim units. For the purposes of this document and clarity, Airbus only considers the use of 39 tonnes and there is no claim (regardless of being retired) of the remaining 0.8 tonnes.

SAF Book and Claim units are a solution to support the SAF market development. This one exists today but is not recognised for compliance or GHG accounting purposes under either mandatory or voluntary frameworks (neither the GHG Protocol nor the Science Based Targets initiative (SBTi)). The situation prevents aircraft operators from formally claiming associated GHG emission savings for the purchase and use of such certificates. This lack of recognition inhibits market investment and growth through this instrument.

[11] According to IATA.: “As SAF LCA values are normally given in the form of energetic density/content (i.e., CO2e/MJ), airlines should use the appropriate energy density/content of fuels (i.e., MJ/kg fuel), depending on the type of the feedstock, to convert the LCA values to emissions factors. The LCA values are normally found in the sustainability documentation or provided by the SAF producers/fuel suppliers. If the energetic content values cannot be obtained from the fuel supplier or the sustainability documentation, an alternative reference for energy content conversion values for each type of fuel (biomass-based) can be found in the ISO 14083:2023 document.”

In this exercise, the B&C Units are accounted for as an emissions reduction lever considering a market-based accounting method, similarly to renewable electricity certificates.

The system selected for purchasing and retiring B&C units is the RSB Book & Claim system. By strictly adhering to its manual and methodology[12], the following B&C Units will be retired:

- **Total Mass Equivalent:** The retirement will consist in three batches equivalent to 39.00 tonnes of neat SAF.
- **Mechanism Used:** The units were purchased by Airbus and will be retired in bulk through the RSB B&C registry.
- **Feedstock and Process:** The fuel represented by the B&C Units used Tallow feedstock and the HEFA conversion process.
- **Certification and Savings:** The B&C Units are certified under RSB CORSIA. They achieve a GHG emission reduction percentage of 82.618%, corresponding to an LCA value of 15.47 gCO_2e/MJ.

The reduction is calculated similarly to physical SAF, using the difference between the baseline factor and the B&C Unit's factor, multiplied by the energy equivalent.

Please note that there is a discrepancy between the RSB B&C units and the ICAO's methodology for calculating the savings of SAF. This one is explained by the use of different energy density values for such a fuel. The B&C Unit calculation is based on the actual SAF energy density value (44.34 MJ/kg), whereas the methodology presented in the report uses the default SAF value (43.15 MJ/kg).

The results obtained using the information of the purchased B&C units -ready to be retired after the flight is performed- are:

- **BCUs absolute emission reduction:** 123.74 tonnes of CO_2e
- **Remaining emissions of the BC portion:** 26.03 tonnes CO_2e

The combined application of physical SAF and B&C units achieve a total absolute emission reduction of **196.32** tonnes of CO_2e on a lifecycle approach.

[12] RSB Book & Claim System documents can be consulted here

Measure 4: Neutralising residual emissions with carbon dioxide removals (CDRs)

The CDRs selected are intended to neutralise the final residual emissions associated with this flight. Doing this aims at showcasing the option of managing all GHG emissions produced in flight.

- **Remaining emissions from physical SAF** (where the physical SAF achieves 90% emissions reductions relative to CAF): 8.07 tonnes CO_2e
- **Remaining emissions from B&C Units** (where the B&C SAF achieves 82.618% emissions reductions relative to CAF): 26.03 tonnes CO_2e
- **Total Residual Emissions**: 34.10 tonnes CO_2e

The target amount of residual emissions requiring neutralisation is therefore 34.10 tonnes CO_2e. An equivalent volume of CDRs will be retired to fully compensate for this residual amount after the flight is performed and all environmental information is received.

In light of the mentioned calculation, the CDRs units selected are the following for the flight's quantified scope:

- **Project Name:** Carillo IFM Reforestation project
- **Type:** Nature-based reforestation project
- **Location:** Mexico
- **Certification:** Certified by the Climate Action Reserve (CAR)
- **Vintage:** 2023
- **Internal Quality Rate:** The project was evaluated at a quality rate of 71% through the internal quality due diligence selection process (see below explanation of this process).
- **Project Details:** Developer is Ala-bool Trust SA de CV.
- **Registry:** CAR (Climate Action Reserve)

Airbus maintains a due diligence process for selecting CDRs, only choosing certified projects with an internal quality rating above 60%. This process involves:

1. Sourcing via a contracted broker (Schneider/Ecoact)
2. In-depth analysis by a third-party adviser (Ecocert)

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3. Vetting against criteria including technology, maturity, ESG risks (FPIC and HCV processes), and verified impact
4. Initiating direct participation in on-site audits, with an objective to conduct two audits per year on recurring projects, enhancing transparency and assurance

The choice of nature-based CDRs, particularly IFM reforestation projects, acknowledges the current market maturity, providing the necessary volume of reliable and cost-effective removals required for immediate neutralisation of residual aviation emissions of the flight once other levers including SAF were maximised.

Conclusion

The analysis confirms that the implemented mitigation strategy — combining inherent technological efficiency, substantial fuel substitution (physical SAF and B&C Units), and the neutralisation of residuals using CDRs — achieves the maximum possible reduction relative to the CAF baseline across the flight's defined WTWa lifecycle scope.

All the implemented measures contribute to mitigating and therefore reducing the GHG emissions impact of the flight relative to the baseline.