

ICAO CORSIA and Alternative Jet Fuels

To: Commercial Aviation Alternative Fuels Initiative
(CAAFI) Webinar

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Federal Aviation
Administration



Outline

- **ICAO Background**
- **CORSIA Overview and Technical Details**
- **Sustainable Aviation Fuels (SAF) in CORSIA**



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U.N. International Civil Aviation Organization (ICAO)

- ICAO sets standards and recommended practices for civil aircraft to enable our global aviation system
- General Assembly of 193 ICAO Member States
 - Meets every three years (this cycle sets the pace of ICAO work)
 - Assembly approves/endorsees work conducted in the previous three years and sets forth commitments and future work by ICAO
 - Resolution – method by which the Assembly makes policy and commitments
- ICAO Council
 - 36 member states with permanent representatives
 - ICAO Council conducts day-to-day oversight of ICAO work program; meets for two week voting sessions four times per year
- ICAO five Strategic Objectives:
 1. Safety
 2. Air Navigation Capacity and Efficiency
 3. Security & Facilitation
 4. Economic Development of Air Transport
 5. Environmental Protection
- ICAO Committee on Aviation Environmental Protection (CAEP)
 - Standing Committee of the Council to conduct environmental technical work



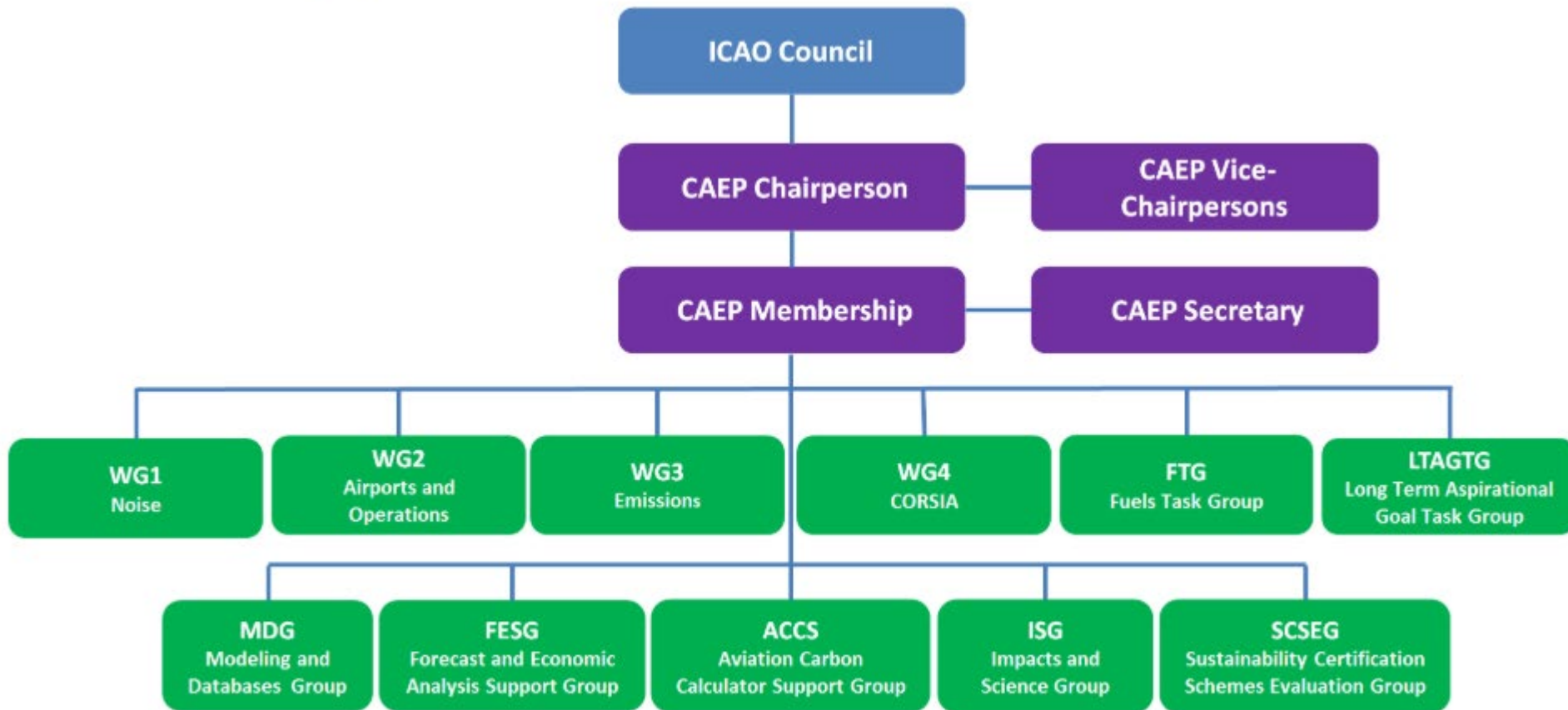
Federal Aviation
Administration

CAEP - Committee on Aviation Environmental Protection

- Standing Committee of the Council to conduct environmental technical work
- Develops Standards and Recommended Practices (SARPs) relating to environment
- Annex 16 on environment contains four volumes of SARPs: 1. noise, 2. engine emissions, 3. aeroplane CO2 emissions, and 4. CORSIA
- Composed of 29 Members from all regions of the world and 20 Observers
- Terms of Reference: Assessments and proposals take into account - technical feasibility, economic reasonableness and environmental benefit, interdependencies of measures, developments in other fields, and international and national programs
- Work on three year cycle - currently in CAEP/12 cycle (began Feb. 2019 and will culminate in CAEP/12 meeting in Feb 2022)
- Work of CAEP is done by a number of technical groups



CAEP Structure (Leading up to CAEP/12)



Technical Groups within ICAO CAEP working on CORSIA and Fuels

Fuels Task Group (FTG)

The Fuels Task Group addresses technical issues related to aviation fuels, including the methodologies for considering CORSIA Sustainable Aviation Fuels and CORSIA Lower Carbon Aviation Fuels under Annex 16, Vol. IV.

Working Group 4 (WG4)

WG4 deals with CORSIA, including the maintenance of Annex 16, Vol. IV.

Sustainability Certification Schemes Evaluation Group (SCSEG)

The SCSEG will undertake the evaluation of Sustainability Certification Schemes (SCS) in the context of their recognition under CORSIA.

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Historical Overview

2006: EU proposed Emissions Trading Scheme (ETS) to begin in 2012

2007: ICAO 36th Assembly agreed to explore other options

2010: 37th Assembly agreed on Carbon Neutral Growth 2020 goal

2012: Thune-McCaskill Bill – Directs FAA to

“...conduct international negotiations to pursue a worldwide approach to address aircraft emissions, including the environmental impact of aircraft emissions...”

2013: 38th Assembly agreed to the development of a Global Market-Based Measure (GMBM)

2016: 39th Assembly agreed to CORSIA framework

2018: CORSIA SARPs Agreed by ICAO Council

2019: CORSIA voluntary phase begins



ICAO Efforts to Address Climate Change

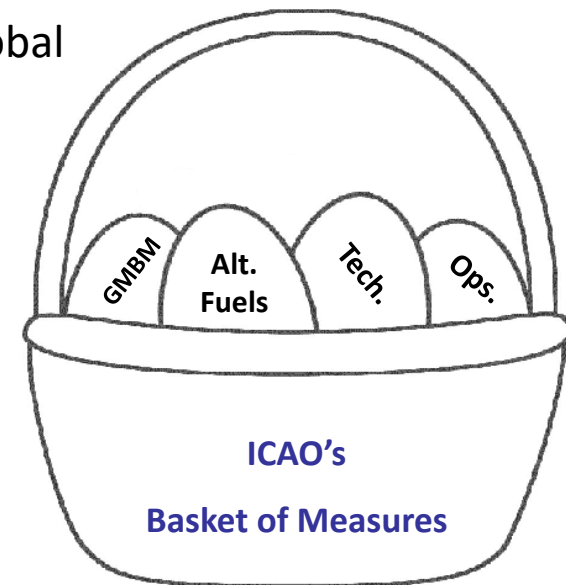
Direction from the 40th ICAO General Assembly

Assembly Resolution A40-18

- 2% annual fuel efficiency improvement until 2020, and aspirational 2% from 2021-2050. (para 4)
- CNG 2020 medium-term goal – “a collective medium-term global aspirational goal of keeping the global net carbon emissions from international aviation from 2020 at the same level...” (para 6)
- Long-term goal – “explore the feasibility of a long term global aspiration goal...the progress of the work to be presented to 41st Assembly.” (para 9)

Assembly Resolution A40-19

- “*Determines* that the CORSIA is the only global market-based measure applying to CO2 emissions from international aviation...” (para 18)



ICAO “Carbon Offsetting & Reduction Scheme for International Aviation” (CORSIA)



- CORSIA is a Global Carbon Offsetting Scheme
 - Offsetting to help international aviation meet Carbon Neutral Growth goal (relative to 2020 baseline)
 - Not a carbon tax or emissions trading scheme
 - Applies to Aircraft Operators, International Operations Only
 - Offsets required from 2021-2035
 - Have an initial pilot phase from 2021-2023
 - Council will conduct a review of CORSIA in 2022, ahead of 41st Assembly
- CORSIA Eligible Fuels (CEF) can be used by an airline to reduce their offsetting requirements



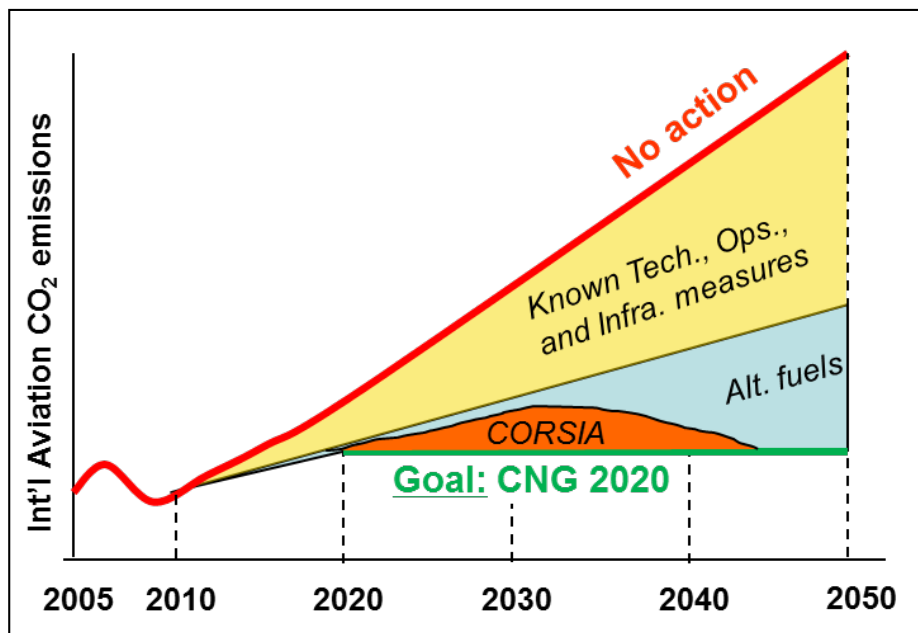
CORSIA (what it looks like)

Global Carbon Offsetting Scheme

- “Carbon Offsetting and Reduction Scheme for International Aviation” (CORSIA)

Applies to Aircraft Operators, International Only

- Exemptions for aircraft $\leq 5,700$ kg, operators with $\leq 10,000$ metric tons CO₂, and humanitarian, medical, firefighting flights



Offsetting to Help Meet the Carbon Neutral Growth from 2020 Goal

- Offset the increase in CO₂ emissions of international flights between participating countries after 2020, from a 2019 baseline



CORSIA (what it looks like)

Timeframe for Offset Requirement: 2021-2035

But, Emissions Monitoring, Reporting & Verification (MRV) Began in 2019 and Is Annual

- Emissions monitoring applies to all countries, even those not covered by the offsetting requirement

Demonstration of Compliance with Offset Requirement Every 3 Years

Country-by-Country Implementation, with Certain Reporting to and Determinations by ICAO

Emissions Savings from an Operator's Purchase of CORSIA Eligible Fuels Reduces Individual Operator Offset Obligations

CORSIA Is Intended to be in Lieu of Other Measures Imposed by States on International Aviation



Offsetting, Fuels, and CORSIA

Two means for an aeroplane operator to comply with CORSIA

1. Offsetting with Emissions Units
2. Claiming Emissions Reductions from CORSIA Eligible Fuels

Two types of CORSIA Eligible Fuels (CEF)

“CORSIA Sustainable Aviation Fuel”: renewable or waste-derived fuel

“CORSIA Lower Carbon Aviation Fuel”: fossil-based fuel

$$\text{Emissions Reduction} = 3.16 * \left[\sum \text{Net Fuel Mass} * \left(1 - \frac{\text{Life Cycle Emissions}}{89 \text{ g CO}_2/\text{MJ}} \right) \right]$$

To be eligible for CORSIA, a fuel needs to meet the CORSIA Sustainability Criteria as certified by ICAO Council Approved Sustainability Certification Scheme (SCS)



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CORSIA Eligible Fuels – Key Documents



There are a number of ICAO documents that contain information related to CORSIA Implementation

Annex 16 Volume IV

See: <https://www.icao.int/environmental-protection/CORSIA/Pages/SARPs-Annex-16-Volume-IV.aspx>

CORSIA Implementation Elements

See: <https://www.icao.int/environmental-protection/CORSIA/Pages/implementation-elements.aspx>

Five ICAO documents relate to CORSIA Eligible Fuels

See: <https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx>



Relationship among the CORSIA Eligible Fuel Documents and Annex 16 Volume IV

Annex 16 Vol. IV References

2.2.4.1 The **aeroplane operator** that intends to claim for emissions reductions from the use of CORSIA eligible fuels shall use a CORSIA eligible fuel that meets the CORSIA Sustainability Criteria as defined within **the ICAO document entitled “CORSIA Sustainability Criteria for CORSIA Eligible Fuels”** that is available on the ICAO CORSIA website.

2.2.4.2 The **aeroplane operator** that intends to claim for emissions reductions from the use of CORSIA eligible fuels shall only use CORSIA eligible fuels from fuel producers that are certified by an **approved Sustainability Certification Scheme** included in **the ICAO document entitled “CORSIA Approved Sustainability Certification Schemes”**, that is available on the ICAO CORSIA website. Such certification schemes meet the requirements included in **the ICAO document entitled “CORSIA Eligibility Framework and Requirements for Sustainability Certification Schemes”**, that is available on the ICAO CORSIA website.

3.3.1 The **aeroplane operator** that intends to claim for emissions reductions from the use of CORSIA eligible fuels in a given year shall compute emissions reductions as follows:

$$ER_y = FCF * \left[\sum_f MS_{f,y} * \left(1 - \frac{LS_f}{LC} \right) \right]$$

3.3.2 If a Default Life Cycle Emissions value is used, then the **aeroplane operator** shall use **the ICAO document entitled “CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels”** that is available on the ICAO CORSIA website for the calculation in 3.3.1.

3.3.3 If an Actual Life Cycle Emissions value is used, then an **approved Sustainability Certification Scheme** shall ensure that the methodology, as defined in **the ICAO document entitled “CORSIA Methodology for Calculating Actual Life Cycle Emissions Values”** that is available on the ICAO CORSIA website, has been applied correctly.

“ICAO Documents” Referenced in Annex 16 Vol. IV, and associated “Supporting Documents”

ICAO document
CORSIA Sustainability Criteria for CORSIA Eligible Fuels

ICAO document
CORSIA Eligibility Framework and Requirements for Sustainability Certification Schemes

ICAO document
CORSIA Approved Sustainability Certification Schemes

ICAO document
CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels


CORSIA Supporting Document
LCA Methodology

ICAO document
CORSIA Methodology for Calculating Actual Life Cycle Emissions Values

Sustainability Certification Schemes

- CORSIA Eligible Fuel need to come from a fuel producer that is certified by an ICAO Council approved Sustainability Certification Scheme (SCS)
- SCSs need to meet requirements of ICAO document entitled "CORSIA Eligibility Framework and Requirements for Sustainability Certification Schemes"
- Applications by SCSs being reviewed on an ongoing basis by the SCS Evaluation Group (SCSEG).
- SCSs interested in being considered should complete the application form (link below) and send it by email to officeenv@icao.int.
- Approved SCSs will be listed in ICAO document entitled "CORSIA Approved Sustainability Certification Schemes"

SCS Application Form – Version 1 (20 February 2020)



INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)
APPLICATION FORM FOR SUSTAINABILITY CERTIFICATION SCHEMES

INSTRUCTIONS

SCSs should complete the information on this application form and send it by email to officeenv@icao.int.

The form is divided in two parts, as follows:

Part I - Basic information from the Sustainability Certification Scheme (Name, Address, point of contact, among others).

Part II - Compliance evidence on the requirements of the ICAO document "CORSIA Eligibility Framework and Requirements for Sustainability Certification Schemes"

This ICAO document is available on the ICAO CORSIA website (<https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx>).

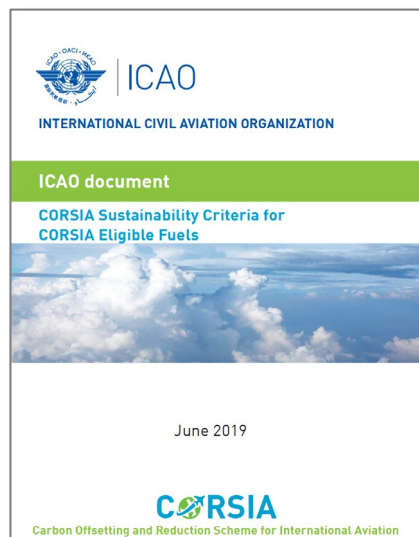
SCSs should provide evidence of compliance with the requirements laid out in the form (substantiated with e.g. available documents, website links, description of systems and procedures in place by the SCS).

Applications and other information submitted by SCSs will be publicly available on the ICAO CORSIA website, except for materials, which the applicants designate as business confidential.

Additional information may be requested during the evaluation process.

Sustainability Criteria for CORSIA Pilot Phase (until Dec-31-2023) – applies to SAF and LCAF

Compiled within the ICAO Document “CORSIA Sustainability Criteria for CORSIA Eligible Fuels”



Theme	Principle	Criteria
1. Greenhouse Gases (GHG)	Principle: CORSIA eligible fuel should generate lower carbon emissions on a life cycle basis.	Criterion 1: CORSIA eligible fuel shall achieve net greenhouse gas emissions reductions of at least 10% compared to the baseline life cycle emissions values for aviation fuel on a life cycle basis.
2. Carbon stock	Principle: CORSIA eligible fuel should not be made from biomass obtained from land with high carbon stock.	<p>Criterion 1: CORSIA eligible fuel shall not be made from biomass obtained from land converted after 1 January 2008 that was primary forest, wetlands, or peat lands and/or contributes to degradation of the carbon stock in primary forests, wetlands, or peat lands as these lands all have high carbon stocks.</p> <p>Criterion 2: In the event of land use conversion after 1 January 2008, as defined based on IPCC land categories, direct land use change (DLUC) emissions shall be calculated. If DLUC greenhouse gas emissions exceed the default induced land use change (ILUC) value, the DLUC value shall replace the default ILUC value.</p>

Potential Additional CORSIA Sustainability Criteria (post Pilot Phase) – Ongoing work within ICAO

Sustainable = environmental + greenhouse gas (1) +
social + carbon in the land (2) +
economic water quality (?) +
soil quality (?) +
air quality (?) +
conservation (?) +
wastes and chemicals (?) +
human and labor rights (?) +
land use rights (?) +
water use rights (?) +
local and social development (?) +
food security (?)

Life Cycle Emissions for CORSIA Eligible Fuels

Induced Land Use Change (ILUC):
included for fuels not derived from wastes, residues, or by-products

Core LCA

Stage #1: Production at source
(feedstock cultivation)

Stage #2: Conditioning at source
(harvest, collection, recovery)

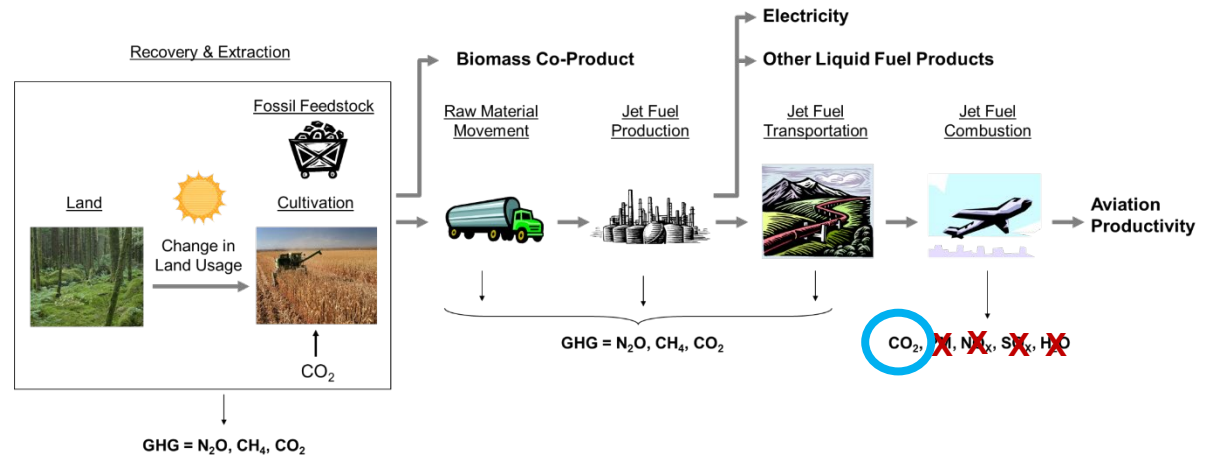
Stage #3: Feedstock processing
and extraction

Stage #4: Feedstock transportation
to processing and fuel production
facilities

Stage #5: Feedstock-to-fuel
conversion process

Stage #6: Fuel transportation and
distribution to the blend point

Stage #7: Fuel combustion in
aircraft engine



Life cycle values calculated by international team of experts:

Default Core LCA Values:

- DOE Argonne National Laboratory
- Massachusetts Institute of Technology
- E.U. Joint Research Centre
- University of Hasselt
- University of Toronto
- Brazilian Bioethanol Science and Technology Laboratory (CTBE)
- Universidade Estadual de Campinas

Default ILUC Values:

- Purdue University (GTAP-Bio)
- International Institute for Applied Systems Analysis (GLOBIOM)

Two Methods for Determining Life Cycle Emissions for CORSIA Eligible Fuels

Two methods to determine life cycle emissions value for CORSIA Eligible Fuels

1. CORSIA default life cycle emissions values
2. CORSIA methodology for calculating actual life cycle emissions values

Default LCA values

- Values developed by international team, approved by ICAO Council, and provided in ICAO Document, “CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels”

Actual LCA values using CORSIA Methodology

- Details within ICAO Document, “CORSIA Methodology for Calculating Actual Life Cycle Emissions Values”
- Airline operator / fuel producer can work with an eligible Sustainability Certification Scheme (SCS) to seek a core LCA value representative of their specific fuel production pathway
- SCS will need to prepare a technical report justifying actual LCA value
- Methodology uses attributional process with energy allocation of emissions among co-products to determine core LCA value
- Methodology provides a means to get an ILUC value of zero or negative ILUC values
- Methodology provides credits for MSW Landfill and Recycling Emissions
- Developing rules wherein additional credits could be considered in the future

CORSIA Default Life Cycle Emissions Values

Compiled within the ICAO Document "CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels"

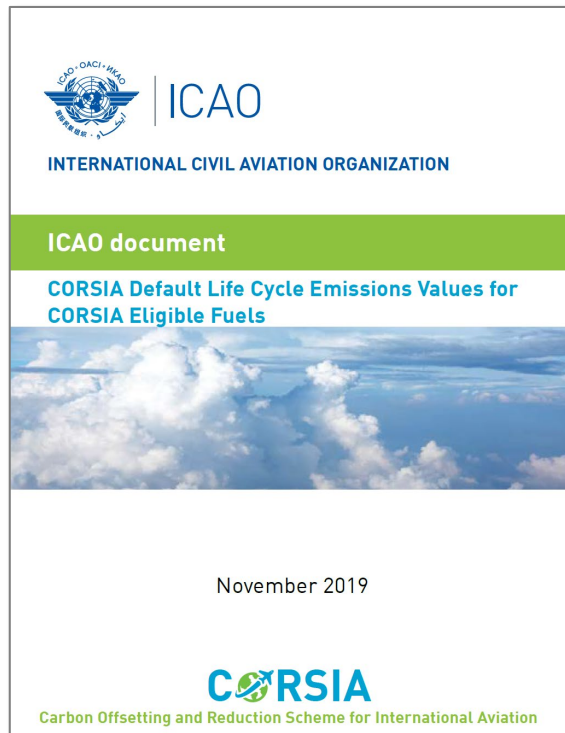


Table 1. CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels

Fuel Conversion Process	Region	Fuel Feedstock	Core LCA Value	ILUC LCA Value	LS _f (gCO ₂ e/MJ)
Fischer-Tropsch (FT)	Global	Agricultural residues	7.7	0.0	7.7
	Global	Forestry residues	8.3		8.3
	Global	Municipal solid waste (MSW), 0% non-biogenic carbon (NBC)	5.2		5.2
	Global	Municipal solid waste (MSW) (NBC given as a percentage of the non-biogenic carbon content)	NBC*170.5 + 5.2		NBC*170.5 + 5.2
	USA	Poplar (short-rotation woody crops)	12.2	-5.2	7.0
	USA	Miscanthus (herbaceous energy crops)	10.4	-32.9	-22.5
	EU	Miscanthus (herbaceous energy crops)	10.4	-22.0	-11.6
	USA	Switchgrass (herbaceous energy crops)	10.4	-3.8	6.6
Hydroprocessed esters and fatty acids (HEFA)	Global	Tallow	22.5	0.0	22.5
	Global	Used cooking oil	13.9		13.9
	Global	Palm fatty acid distillate	20.7		20.7
	Global	Corn oil (from dry mill ethanol plant)	17.2		17.2
	USA	Soybean oil	40.4	24.5	64.9
	Brazil	Soybean oil	40.4	27.0	67.4
	EU	Rapeseed oil	47.4	24.1	71.5
	Malaysia & Indonesia	Palm oil – closed pond	37.4	39.1	76.5
	Malaysia & Indonesia	Palm oil – open pond	60.0	39.1	99.1
Alcohol (isobutanol) to jet (ATJ)	Global	Agricultural residues	29.3	0.0	29.3
	Global	Forestry residues	23.8		23.8
	Brazil	Sugarcane	24.0	7.3	31.3
	USA	Corn grain	55.8	22.1	77.9
	USA	Miscanthus (herbaceous energy crops)	43.4	-54.1	-10.7
	EU	Miscanthus (herbaceous energy crops)	43.4	-31.0	12.4
	USA	Switchgrass (herbaceous energy crops)	43.4	-14.5	28.9
Alcohol (ethanol) to jet (ATJ)	Brazil	Sugarcane	24.1	8.7	32.8
	USA	Corn grain	65.7	25.1	90.8
Synthesized iso-paraffins (SIP)	Brazil	Sugarcane	32.8	11.3	44.1
	EU	Sugar beet	32.4	20.2	52.6

To download the Default Life Cycle Emissions Values document, please visit:
<https://www.icao.int/environmental-protection/CORSIA/Documents/ICAO%20document%2006%20-%20Default%20Life%20Cycle%20Emissions.pdf>



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Consideration of Induced Land Use Change

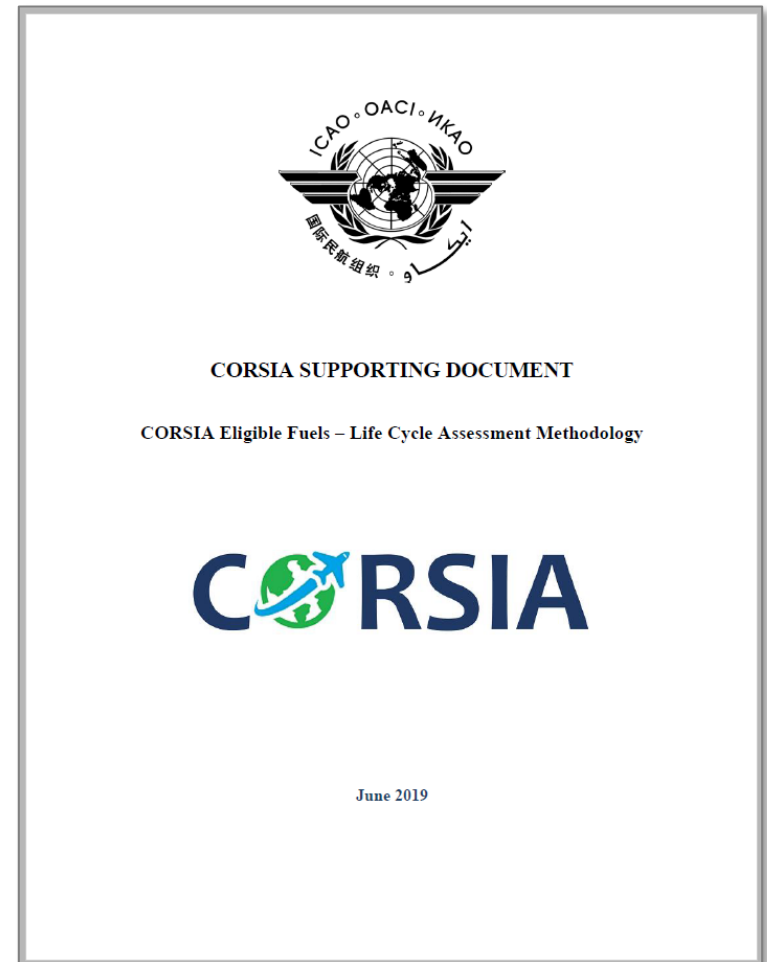
ILUC can be set to zero in certain circumstances:

- Feedstocks that are defined as wastes, residues, and byproducts
- Feedstocks that have yields per surface unit significantly higher than terrestrial crops (~ one order of magnitude higher) such as some algal feedstocks
- Feedstocks grown using land use change-risk mitigation practices that result in increased yields or that utilize unused land

Negative ILUC values are also allowed on a provisional basis during the pilot phase of CORSIA

CORSIA Supporting Document “CORSIA Eligible Fuels - LCA Methodology”

- Provides technical information and describes ICAO processes to manage and maintain the ICAO document “CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels”



Adding New Default Life Cycle Values

CORSIA SARP Package contains default life cycle emissions values for a number of fuel pathways.

Adding default life cycle values for a new fuel pathway (Part I of CEF LCA Doc)

- Following criteria need to be met for a pathway to be evaluated as a CORSIA Eligible Fuel:
 - The pathway uses an ASTM certified conversion process or, a conversion process for which the Phase 2 ASTM Research Report has been reviewed and approved by the OEMs.
 - The conversion process has been validated at sufficient scale to establish a basis for facility design and operating parameters at commercial scale
 - There are sufficient data on the conversion process of interest to perform LCA modelling.
 - There are sufficient data on the feedstock of interest to perform LCA modelling.
 - There are sufficient data on the region of interest to perform ILUC modelling, where applicable to the pathway.
- CAEP designees will determine if criteria have been met for adding a new pathway, carry out the calculation of default LCA values for the pathway, and communicate the results in this document.
- Requests for CAEP to consider a conversion process, feedstock, and/or region can be made by ICAO Member States, Observer Organizations, or an approved SCS to the CAEP Secretary in ICAO.

Ongoing Work of the CAEP FTG

- The FTG work program for CAEP/12 cycle (2019-2022)
- Maintenance of the fuels-related sections of Annex 16 Vol IV (CORSIA), including:
 - Calculation of default life cycle emission values for Sustainable Aviation Fuels (including both core LCA values and ILUC values).
 - Classification of feedstocks as wastes, co-products and main products
 - Development of approaches to minimize the risk of double counting
 - Development of proposals on strengthened sustainability criteria for SAF and LCAF
- Development of guidance on potential policies for the deployment of SAF
- Evaluation of SAF and LCAF availability through 2035
- Assessment of new technologies for SAF and LCAF production



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