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Role for SAF in CORSIA:

SAF Requirements to Reduce CORSIA Offsetting Requirements

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Three Objectives for this Presentation

- → Describe how the SARP addresses SAF
- → How aeroplane operators report SAF usage in Emissions Reports
- → Very brief overview of the SAF value chain

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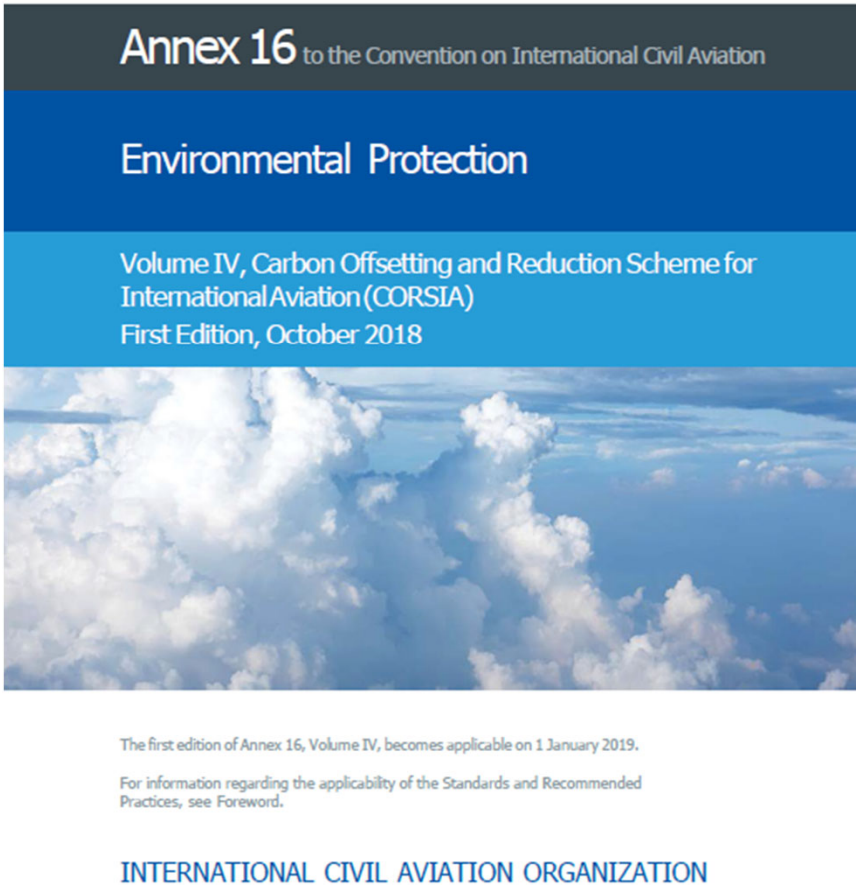
CORSIA Eligible Fuels In the SARP and ETM

Understanding the Requirements and Reporting Mechanism

CEF in the ICAO SARP

- Part II, Chapter 3, 3.3 Emission reductions
- Part II, Chapter 3, 3.4 Final offsetting requirements after CEF
- App. 5, Reporting, Table A.5.1
- App. 5, Reporting, Table A.5.2
- App. 5, Reporting, 3.3 Use of CEF in a State
- App. 6, Verification, 3.2 Objectives
- App. 6, Verification, 3.3 Scope


ICAO

International Standards and Recommended Practices

Annex 16 to the Convention on International Civil Aviation

Environmental Protection

Volume IV, Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
First Edition, October 2018

The first edition of Annex 16, Volume IV, becomes applicable on 1 January 2019.

For information regarding the applicability of the Standards and Recommended Practices, see Foreword.

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CORSIA Eligible Fuel: A Quick Introduction

- ICAO's definitions (from the SARP)
  - CEF—*A CORSIA sustainable aviation fuel or a CORSIA lower carbon aviation fuel, which an operator may use to reduce their offsetting requirements*
  - SAF—*A renewable or waste-derived aviation fuel that meets the CORSIA Sustainability Criteria under this volume*
  - LCAF—*A fossil-based aviation fuel that meets the CORSIA Sustainability Criteria under this Volume*

CEF: SAF and LCAF

- SAF can be produced from a variety of feedstocks, including:
  - Used cooking oil, beef tallow, and other fats and greases
  - Municipal solid waste
  - Sustainably produced ethanol
  - Agricultural and forest residues
- LCAF may use carbon capture and storage to reduce its carbon intensity; it must reduce emissions by at least 10% to be eligible
- SAF = Nearly all investment is flowing to SAF, which typically reduces CO_2 emissions by 50% or more from the fossil fuel baseline

Sustainability Criteria

→ ICAO's CEF must meet two ***sustainability criteria*** outlined in the ICAO document https://www.icao.int/environmental-protection/CORSIA/Documents/ICAO%20document%2005%20-%20Sustainability%20Criteria%20-%20November%202021.pdf , which, for the pilot phase, are limited to GHG emissions and carbon stock

CORSIA SUSTAINABILITY CRITERIA FOR CORSIA ELIGIBLE FUELS

Chapter 1: CORSIA SUSTAINABILITY CRITERIA APPLICABLE FOR BATCHES OF CORSIA ELIGIBLE FUEL PRODUCED BY A CERTIFIED FUEL PRODUCER BEFORE 1 JANUARY 2024

Theme	Principle	Criteria
1. Greenhouse Gases (GHG)	Principle: CORSIA eligible fuel should generate lower carbon emissions on a life cycle basis.	Criterion 1.1: CORSIA eligible fuel will 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.	Criterion 2.1: CORSIA eligible fuel will 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.
		Criterion 2.2: In the event of land use conversion after 1 January 2008, as defined based on the Intergovernmental Panel on Climate Change (IPCC) land categories, direct land use change (DLUC) emissions will be calculated. If DLUC greenhouse gas emissions exceed the default induced land use change (ILUC) value, the DLUC value will replace the default ILUC value.

Changes Coming in Sustainability Criteria

- Expanded sustainability criteria were announced at the Glasgow COP26 meeting in November 2021
- They take effect on 2024-01-01 when the first compliance period begins and address an additional ten criteria
  - The new criteria are similar to the 12 principles developed by the Roundtable on Sustainable Biomaterials

Additional (*) SAF Sustainability Criteria

- Greenhouse gases
- Carbon stock
- *Water
- *Soil
- *Air
- *Conservation
- *Waste and chemicals
- *Human and labour rights
- *Land use rights and land use
- *Water use rights
- *Local and social development
- *Food security

These requirements are effective for batches of SAF produced after 2024-01-01; LCAF requirements remain under development

CEF Reduces Offsetting Requirements

- Part II, Chapter 3, 3.3, Emission reductions from the use of CORSIA eligible fuels, provides the equation for claiming reductions from reported international flight emissions due to the use of CEF
  - NOTE: CEF used in both international and domestic flights can reduce an aeroplane operator's offsetting requirements

SARP: CEF Reduces Offsetting Requirements

- Offsetting requirements (Pilot Phase): $0R_y = 0E * SGF_y$
  - Extent of offsetting during the pilot phase depends on the extent of the post-pandemic recovery in commercial aviation use
- How an Aeroplane Operator would calculate its CEF reduction
  - Assume an offsetting requirement of 100 000 tCO2
  - Assume the AO purchased 10 tonnes (10 000 kg) of neat SAF (12 500 liters)

M9

Formula for Claiming CEF Reductions in a Year

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

ER=	28866 tCO2e
FCF	3.16
$MS_{t,y}$	
LSf *	7.7 gCO2e/MJ
LC	89 gCO2e/MJ
LSf/LC	0.086517
1-LSf/LC	0.913483

Initial offsetting requirement, before SAF:
100 000 tCO2
28 866 CEF reduction
71 134 CEF-adjusted offsetting obligation

* Global value for "Agricultural residues," assuming sugarcane bagasse

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Slide 12

M9 you can add 3.4. SARPs as well

Monica, 5/11/2022

Marginal $ Benefit of CEF Emission Reductions

- Assume cost of offset credit = $7.50 tCO2e
- Value of 28 866 t reduction = $216 495
  - Assumes AO has an offsetting requirement = or > 28 866 t
- Other reasons for aeroplane operators to support CEF:
  - The cost of carbon credits may increase over time
  - The CEF cost premium relative to fossil JetA may decrease
  - Increased demand for air travel will make achieving industry emission reductions harder without expanded use of CEF

Final Offsetting Requirements per SARP

- Part II, Chapter 3, 3.4.1 Final offsetting requirements when an AO uses CEF emission reductions:

$$FOR_c = (OR_{1,c} + OR_{2,c} + OR_{3,c}) - (ER_{1,c} + ER_{2,c} + ER_{3,c})$$

- This formula sums the offsetting requirements from each year in the compliance period and subtracts the emission reductions from the use of CEF in each year of the compliance period

ICAO Default Life Cycle Emissions Factors

→ When default life cycle emissions factors are used, they must come from the "CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels", available on the ICAO CORSIA website https://www.icao.int/environmental-protection/CORSIA/Documents/ICAO%20document%2006%20-%20Default%20Life%20Cycle%20Emissions%20-%20March%202021.pdf

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ICAO document

CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels

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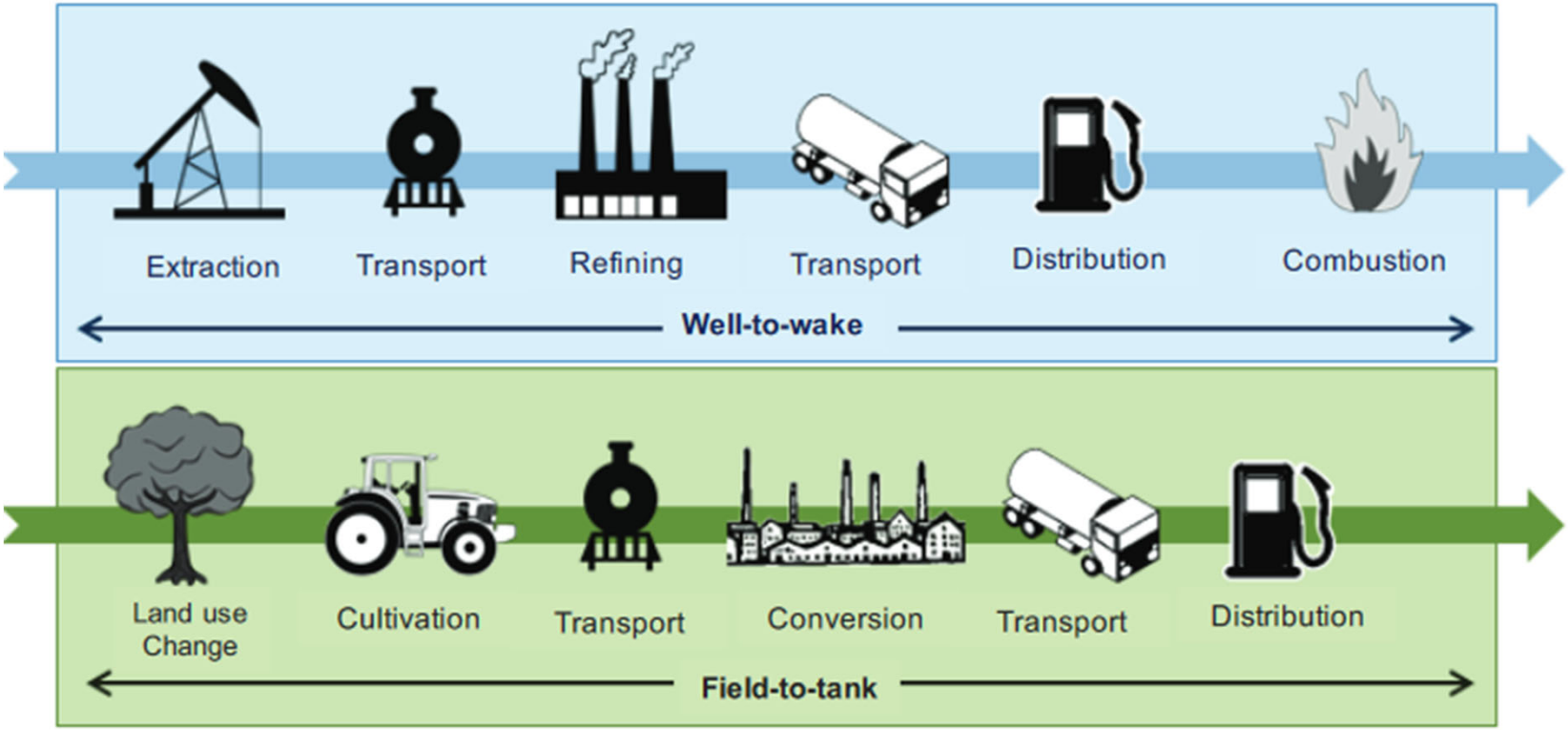
Life Cycle Assessment Concepts



Global Framework for Alternative Aviation Fuels
https://www.icao.int/environmental-protection/GFAAF/Pages/default.aspx

SARP, Appendix 5, Details What to Report

- Appendix 5 defines the data that aeroplane operators must report to their State authorities in each year in their “Emissions Report”
  - Some tables also define data to be reported by States to ICAO
- Data input requirements are defined by “field” numbers
  - States may expand the number of fields attributed AOs must complete

ETM Template for CEF Reporting

→ ICAO requires the collection of extensive information about CEF purchased and used by Aeroplane Operators

CORSIA ELIGIBLE FUEL CLAIM FORM

Note: for each claim of emissions reductions from the use of CORSIA eligible fuels, please replicate this form and fill separately.

Fuel Claim #:

a) Purchase date

Please enter the date when the neat CORSIA eligible fuel was purchased. Use the format yyyy-mm-dd.

b) Identification of the producer of the CORSIA eligible fuel

b1) Name of producer of the neat CORSIA eligible fuel

Please enter the name of the fuel producer.

SARP App. 5, Reporting, Table A5.1

- Field 12a: *Fuel type*, (i.e. type of fuel, feedstock and conversion process)
- Field 12b: *Total mass* of the neat CORSIA eligible fuel claimed (in tonnes) per fuel type
- Field 12c: Approved *life cycle emissions values*
- Field 12d: *Emissions reductions* claimed from a CORSIA eligible fuel (as calculated in accordance with equations described in Part II, Chapter 3, 3.3 and reported in tonnes)
- Field 12e: *Total emission reductions claimed* from the use of all CORSIA eligible fuels (in tonnes)

SARP App. 5, Reporting, Table A5.2, Add'l Info

- Field 1: *Purchase date* of the neat CORSIA eligible fuel
- Field 2: Identification of the *producer* of the neat CORSIA eligible fuel
- Field 3: *Fuel production*
  - Date
  - Location
  - Batch number
  - Mass of each batch

SARP App. 5, Reporting, Table A5.2, Add'l Info

- Field 4: *Fuel type*
  - Fuel type (e.g. JetA, JetA1, JetB, Avgas)
  - Feedstock used to create the neat CORSIA eligible fuel
  - Conversion process used to create the neat CORSIA eligible fuel
- Field 5: *Fuel purchased*
  - Proportion of neat CORSIA eligible fuel batch purchased (rounded to the nearest %)
  - Total mass of each batch of neat CORSIA eligible fuel purchased (in tonnes)
  - Mass of neat CORSIA eligible fuel purchased (in tonnes)

SARP App. 5, Reporting, Table A5.2, Add'l Info

- Evidence that fuel satisfies the CORSIA Sustainability Criteria
  - *Evidenced through certification*
- *Life cycle emissions values* of the CORSIA eligible fuel
  - Default or actual life cycle emissions values (LS), calculated as the sum of the LCA value and the value for indirect land-use change
  - Immediate purchaser (name and contact information)
  - Shipper (name and contact information)
  - Fuel blender (name and contact information)
  - Location of fuel blender, date received, and blend ratio (%)
  - Evidence of blending and mass of neat CORSIA eligible fuel claimed

SARP App. 5, Reporting, 3.3 CEF Use in a State

- State reports of CEF use to ICAO
- Field 1, Production
  - *Production year* of CORSIA eligible fuel claimed
  - *Producer* of CORSIA eligible fuel
- Field 2, Batch of CORSIA eligible fuel
  - *Batch number(s)* of each CORSIA eligible fuel claimed
  - *Total mass of each batch* of CORSIA eligible fuel claimed (in tonnes)

SARP App. 5, Reporting, 3.3 CEF Use in a State

- Field 3, CORSIA eligible fuel claimed
  - *Fuel types* (i.e. types of fuel, feedstock, and conversion process)
  - *Total mass* of the neat CORSIA eligible fuel (in tonnes) per fuel type being claimed by all the aeroplane operators attributed to the State
- Field 4, Emissions information (per fuel type)
  - *Total emissions reductions claimed* from the use of a CORSIA eligible fuel (in tonnes)
- Field 5, Emissions reductions, total
  - *Total emissions reductions claimed by all aeroplane operators* attributed to the State from the use of all CORSIA eligible fuel use (in tonnes)

SARP App. 6, Verification, 3.2 Objectives

→ 3.2.1 Objectives

- → d) The stated amount of *emissions reductions from the use of CORSIA eligible fuels is materially fair and an accurate representation* of emissions reductions over the reporting period, and is supported by sufficient and appropriate internal and external evidence
- → e) The claimed batches of CORSIA eligible fuels *have not also been claimed by the aeroplane operator under any other voluntary or mandatory schemes* it has participated in (where the emission reductions from CORSIA eligible fuels may be claimed) during the current compliance period, as well as in the compliance period immediately preceding it, and

SARP App. 6, Verification, 3.2 Objectives

→ f) The aeroplane operator has *monitored, calculated and reported its emissions reductions* associated from the use of CORSIA eligible fuels over the period of the reporting period in accordance with this Volume

SARP App. 6, Verification, 3.3 Scope

- 3.3.2 The scope of the verification of CORSIA eligible fuel claim(s) in the Emissions Report shall include the following:
  - a) *Any internal aeroplane operator procedures for CORSIA eligible fuels,* including aeroplane operator controls, to ensure the claimed CORSIA eligible fuels satisfies the CORSIA Sustainability Criteria
  - b) *Checks for double claiming are limited to the specific aeroplane operator*. Any findings outside of this scope are not relevant for the verification statement, however they should still be included in the Verification Report for further consideration by the State

SARP App. 6, Verification, 3.3 Scope

- c) *Assessment of verification risk* with appropriate changes to the verification plan
- d) Assessment of whether there is *sufficient access to relevant internal and external information to obtain sufficient confidence in each CORSIA eligible fuel claim*. Where evidence of the sustainability or the size of the CORSIA eligible fuels claim is considered either inappropriate or insufficient, *further information should be sought directly from the fuel producer with direct access facilitated through the aeroplane operator.*

CORSIA Eligible Fuel Verification Challenges

- The SARP specifies three objectives associated with verification of CORSIA eligible fuel quantities included in Emissions Reports
  - Emission reductions are *fairly stated*
  - There has been no double claiming of emission reductions *at the fuel batch level*
  - AOs have monitored, calculated and reported CEF over the reporting period
- Verification scope requirements parallel the objectives, and are generally limited to the AO, *but leave the door open for review of information from the fuel supplier in cases of doubt*

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Actors in the SAF Value Chain

Bringing SAF to Market
Is a Collaborative Effort

Actors in the SAF Supply Chain

- → Feedstock providers
- → Production facilities
- → Manufacturers
- → Blender
- → Fuel quality and sustainability certifiers
- → Transportation providers
- → Airport fuelers (tank farms, fuel dispensers)
- → Lawyers, financiers, and EPCs
- → Aeroplance Operators

Also key: Government policy support with regulations and subsidies!

Feedstock From Farms, Forests, Homes . . .

- Corn-based ethanol
- Fats, oils and greases
  - Tallow
  - Used cooking oil
  - Plant-based oils
- Municipal solid waste
- Agricultural residues
- Forestry residues

Fuel Production: Intermediate and Final

- Intermediate feedstock processing makes uniform inputs from:
  - Forest residues
  - Municipal solid waste
  - Oil seed grains
- Conversion to neat blendstock
  - HEFA: Hydroprocessed esters and fatty acids
  - Fischer-Tropsch: chemical reactions that converts a mixture of carbon monoxide and hydrogen or water gas into liquid hydrocarbons

Aircraft Manufacturers

- → Test fuel samples from different SAF pathways in their engines as part of the fuel pathway certification process
- → Participate in the ASTM certification process
- → Support research on new fuels for future aviation propulsion systems
- → Support ICAO's policy making processes

Blender

- Neat (100% strength) alternative fuel must be blended with fossil-based kerosene to meet standards set by ASTM, the body that defines chemical and other properties of jet fuel
- Maximum blend ratios vary from 10% SAF to 50% SAF, depending on the fuel pathway
- Blending takes place away from the fuel tank farm, often in a terminal

Sustainability Certifier

- ICAO defined an eligibility framework and requirements for Sustainability Certification Schemes
- Two schemes have been approved under this standard
  - International Sustainability and Carbon Certification
  - Roundtable on Sustainable Biomaterials
- Individual certification bodies are accredited by an ISO/IEC 17011 NAB to ISO 17065 to certify economic operators in the SAF value chain

Transportation Providers

- Transportation links along the SAF value chain include:
  - Feedstock producer to aggregator (e.g. grain elevator)
  - Aggregator to processor
  - Processor to blender
  - Blender to fuel farm
- Transportation CO_2e emissions are calculated for each defined "fuel pathway" that begins with the feedstock provider and ends with transportation to the fuel farm

Aerodrome Fuel Tank Farms

- At larger airports, a single fuel tank farm serves all aeroplane operators
  - The book and claim method of accounting allows a single AO to purchase—and take credit for—delivered SAF, even though the molecules of fuel will be distributed equally to all customers of the fuel tank farm
- Small commercial and general aviation aerodromes may be supplied by one or more aviation fuel distributors that fuel larger aircraft from mobile tank trucks and smaller aircraft through fuel dispensers

Lawyers, Financiers, and EPCs

- → Lawyers draft off-take agreements to be concluded between the SAF producer and aeroplane operators
- → Financiers invest capital to finance construction companies
- → Engineering, Procurement and Construction (EPC) contractors build the physical plant and turn it over to the SAF producer after commissioning

Aeroplane Operators

- → Aeroplane operators commit to purchase SAF from producers in multi-year *off-take agreements*
- → Some aeroplane operators also make direct financial investments
- → Aeroplane operators hail their use of SAF as part of their overall sustainability strategy and contribution to combatting climate change

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