Sustainable Aviation Fuels in the EU

N. Scarlat

Marseille, 23rd June 2024

The views expressed here are purely those of the authors and may not, under any circumstances, be regarded as an official position of the European Commission.

European Commission

Joint Research Centre

Our purpose

The Joint Research Centre provides independent, evidence-based knowledge and science, supporting EU policies to positively impact society.

European Commission

Policy context

- The **European Green Deal** set the path in 2019 to a green transition, towards climate neutrality by 2050.

- **Fit for 55** package, updating the EU target for GHG emissions reduction at 55% by 2030, set the pathway toward 2050
- Revised **Renewable Energy Directive 2023/2413** (**RED III**) set a target of 42.5% RES by 2030:
  - for transport **14.5% GHG intensity reduction** (compared to the FFC baseline) **or binding 29% RES**;
  - sub-target of 5.5% for **advanced biofuels** & **renewable fuels of non-biological origin** (minimum requirement of 1% **RFNBO)**;
  - Revised sustainability requirements for bioenergy and biogas, strengthened requirements for biomass supply.
- **ReFuelEU Aviation** Regulation 2023/2405 setting the ambitions for aviation

European Commission

Sustainable Aviation Fuels: ReFuelEU Aviation

- **Ensure decarbonisation of the aviation sector and foster the uptake of SAF supply**
- **Aviation fuel made available to aircraft operators at each Union airport contains the minimum shares of SAF, including the minimum shares of synthetic aviation fuel**

	2025	2030	2035	2040	2045	2050
Share of SAF [%]	2	6	20	34	42	70
of which minimum share of synthetic aviation fuels [%]	-	>1.2	5	10	15	35

- **No incentives provided to reduce the price gap between SAF and conventional jet fuel, but does create a "level playing field" for all airlines**
- **'Effective, proportionate and dissuasive penalties' in case of non-compliance**
- **Reporting obligations on the Commission on possible amendment to support the production and uplifting of SAF as well as mechanisms allowing a bridging of the price differences between SAF and conventional fuels**
- **Defined Eligible Fuels considered as Sustainable Aviation Fuels**

European Commission

Scope of REFuelEU Aviation

Aviation fuel suppliers

- All aviation fuel suppliers supplying to Union airports

➢ to provide aviation fuels with minimum share of SAF, including the minimum shares of synthetic aviation fuels

➢ to complement any shortfall in the subsequent reporting period

Union Airports

- >800,000 passengers in the reporting period
- >100,000 tonnes freight traffic
- not situated in an outermost region

➢ to facilitate the access of aircraft operators to aviation fuels containing minimum shares of SAF

➢ to facilitate the access of aircraft operators to hydrogen or electricity to refuel or recharge aircraft

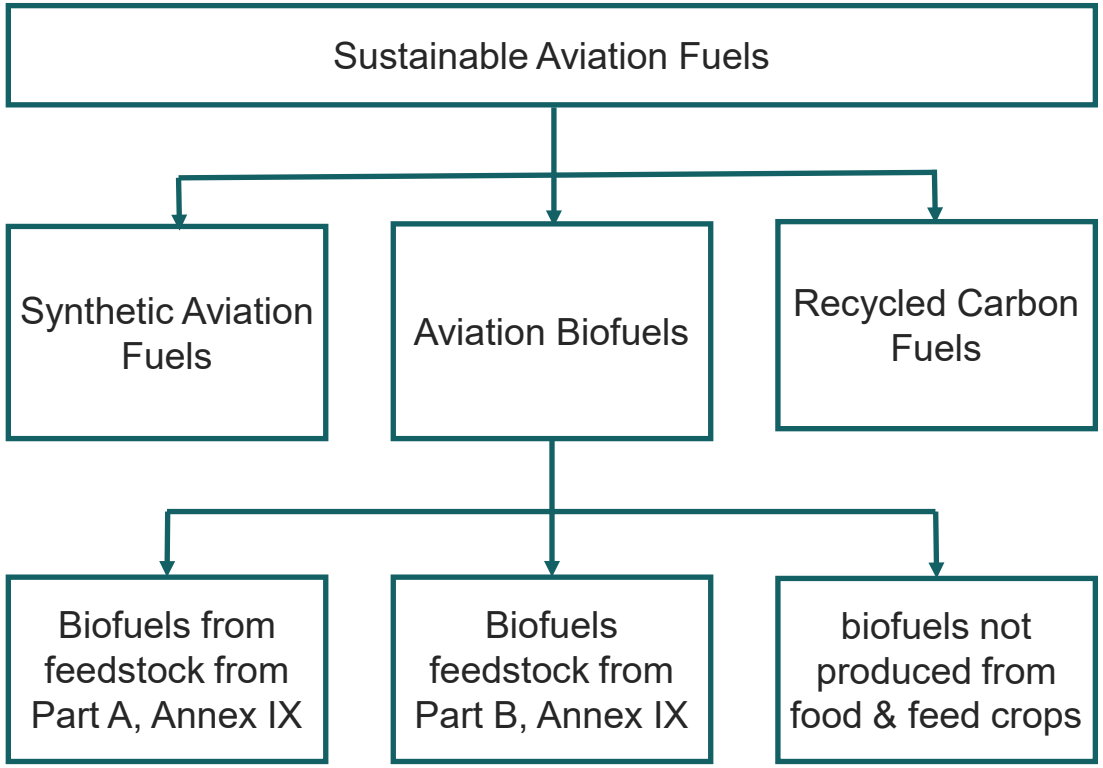
Aircraft Operators

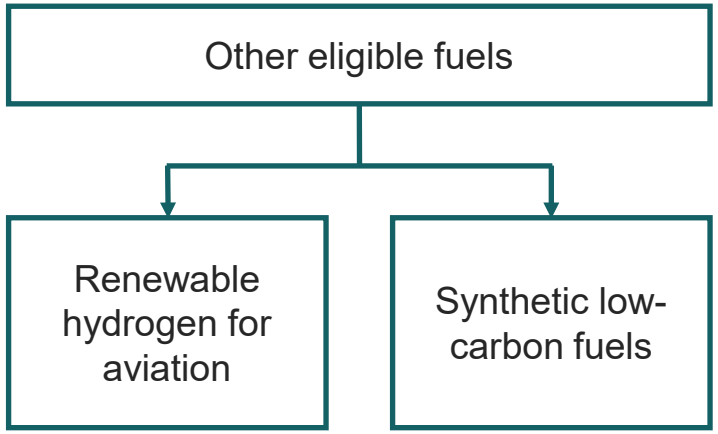
- >500 commercial passenger flights operated
- >52 commercial all-cargo air transport flights departing from Union airports

➢ to uplift at least 90% of the yearly aviation fuel required at a given Union airport to avoid tankering practices

European Commission

Eligible Aviation Fuels





Eligibility Sustainable Aviation Fuels

- sustainability criteria and GHG thresholds established in Directive (EU) 2018/2001 (50-65% for biofuels, depending on date of facility construction, 70% for RFNBOs & RCFs.
- **biofuels produced from food and feed crops are not eligible**

Multipliers and limits

- the share of advanced biofuels produced from the feedstock listed in **Part A of Annex IX** supplied in the aviation and maritime shall be considered to be 1,2 times their energy content
- the share of **renewable fuels of non-biological origin** supplied in the aviation and maritime shall be considered to be 1,5 times their energy content;
- the share of biofuels produced from the feedstock listed in **Part B of Annex IX** in the energy content of fuels and electricity supplied to the transport sector shall be limited to 1,7 %;

Definitions

Advanced Biofuels are biofuels that are produced from the feedstock listed in Part A of Annex IX

'synthetic aviation fuels' means aviation fuels that are **'renewable fuels of non-biological origin'**, which meet lifecycle emissions savings threshold of 70 % and the methodologies for assessing such lifecycle emissions savings and are certified

'synthetic low-carbon aviation fuels' - aviation fuels that are of **non-biological origin**, the energy content of which is **derived from non-fossil low-carbon hydrogen**, which meet lifecycle emissions savings threshold of 70 % and the methodologies for assessing lifecycle emissions savings

Renewable fuels of non-biological origin (RFNBOs) are '*liquid or gaseous fuels which are used in the transport sector other than biofuels or biogas, the energy content of which is derived from renewable sources other than biomass*' (Art. 2(36)).

RCFs are defined (Art. 2(35)) as '**liquid and gaseous fuels** that are produced from: i) **liquid or solid waste streams of non-renewable origin** which are not suitable for material recovery … or ii) from **waste processing gas and exhaust gas of non-renewable origin** which are produced as an unavoidable and unintentional consequence of the production process in industrial installations.'

EU GHG emission calculation methodology for biofuels

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr}$$

- Simplified (WtW), attributional methodology
- RED accounts for climate change impact of 3 main GHGs (CO2, CH4, N2O), using GWP at a time horizon 100 years

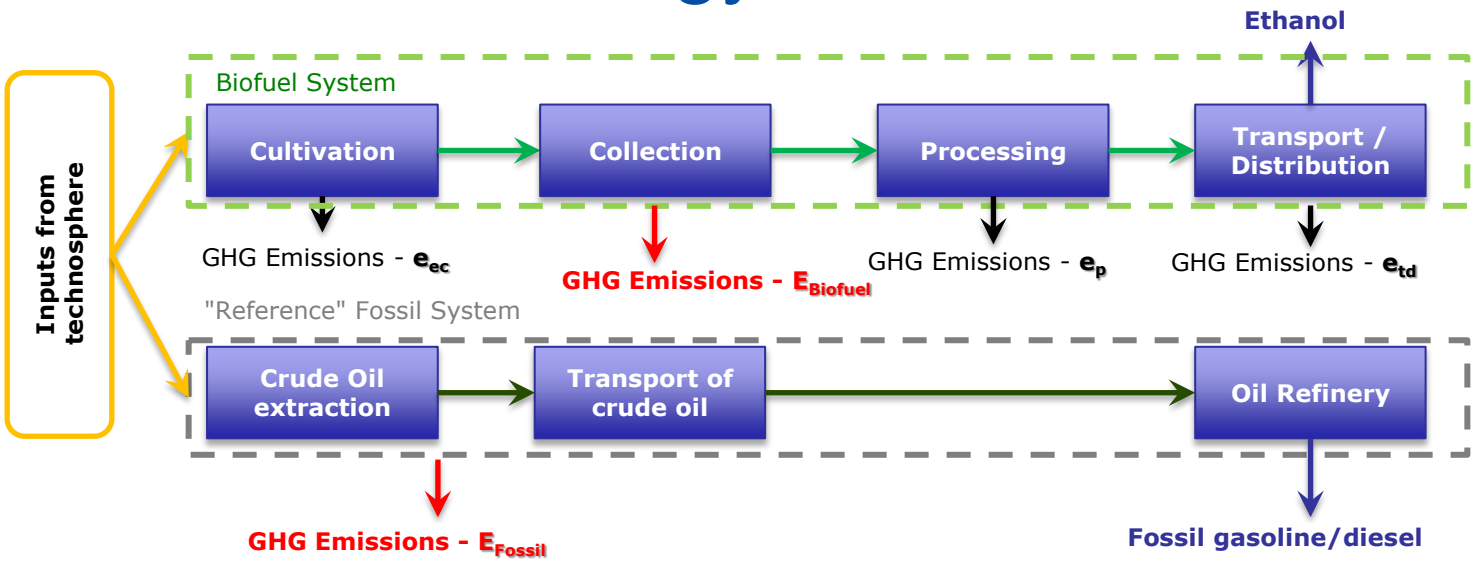
where

E	=	total emissions from the use of the fuel;
e_{ec}	=	emissions from the extraction or cultivation of raw materials;
e_l	=	annualised emissions from carbon stock changes caused by land-use change;
e_p	=	emissions from processing;
e_{td}	=	emissions from transport and distribution;
e_u	=	emissions from the fuel in use;
e_{sca}	=	emission savings from soil carbon accumulation via improved agricultural management;
e_{ccs}	=	emission savings from CO_2 capture and geological storage; and
e_{ccr}	=	emission savings from CO_2 capture and replacement.

Emissions from the manufacture of machinery and equipment shall not be taken into account.

JRC' calculations are available at:

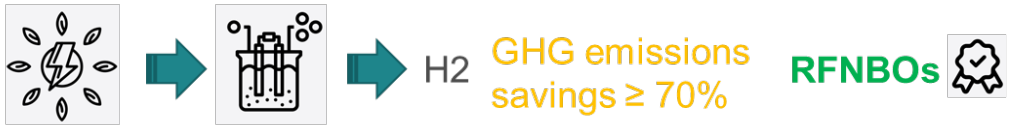
- ANNEX V - http://data.europa.eu/89h/e51f4304-7023-4fca-8900-7d206f89b914
- ANNEX VI - https://data.jrc.ec.europa.eu/dataset/jrc-alf-bio-bioenergy_jrc_annexvi_com2016-767_v1_july17



- Wastes and residues are assigned zero GHG emissions up to the point of collection
- Emissions from carbon stock changes caused by Land-Use Changes are annualized over a period of 20 years
- Allocation based on energy content between multiple co-products
- Infrastructure and end-of-life processes are not included
- Typical and default **GHG emission** values are available in the **Annex V & VI in RED** developed by JRC
- Operators can use **default values** to simplify calculation... or their **actual values**

Methodology for GHG emissions of RFNBO

1) New installation and Direct connection (➔additionality)



2) Electricity from the grid

a. Renewable electricity share ≥ 90%

b. CI electricity ≤ 18 $gCO_2eq./MJ$ AND temporal and geographical correlation

c. Grid electricity during imbalance settlement period

d. Grid electricity if additionality, temporal, and geographical correlation

$$E = e_i + e_p + e_{td} + e_u - e_{ccs}$$

E = total emissions from the use of the fuel (gCO2eq/ MJ fuel)

$e_i = e_{i\ elastic} + e_{i\ rigid} - e_{ex\text{-}use}$: emissions from supply of inputs (gCO_{2eq}/ MJ fuel)

- $e_{i\ elastic}$ = emissions from elastic inputs (gCO_{2eq} / MJ fuel)
- $e_{i\ rigid}$ = emissions from rigid inputs (gCO_{2eq} / MJ fuel)
- $e_{ex\text{-}use}$ = emissions from inputs' existing use or fate (gCO_{2eq} / MJ fuel)

e_p = emissions from processing (gCO_{2eq}/ MJ fuel)

e_{td} = emissions from transport and distribution (gCO_{2eq}/ MJ fuel)

e u = emissions from combusting the fuel in its end-use (gCO_{2eq}/ MJ fuel)

e_{ccs} = emissions savings from CCS (gCO_{2eq} / MJ fuel)

Three underlying principles

Additionality

Hydrogen production should add to the deployment of renewable energy

Temporal correlation

Renewable hydrogen should be produced when renewable electricity is available

Geographical location

Renewable hydrogen should be produced where renewable electricity is available.

Certified Aviation biofuels

Route	Feedstocks	Source	Certification	TRL
Hydroprocessed Esters and Fatty Acids (HEFA)	Vegetable and animal lipids	Annex IX, Part B	HEFA-SPK, up to 50% blend	TRL 8-9
Co-processing oils/fats	Vegetable and animal lipids	Annex IX, Part B	D1655, 5 to 10% co-feed	TRL 8-9
Direct Sugars to Hydrocarbons (DSHC)	Conventional sugars, lignocellulosic sugars	Annex IX, part A	HFS-SIP, up to 10% blend	TRL 7-8 - conventional sugars TRL 5 - lignocellulosic sugars
Alcohols to Jet (AtJ)	Sugar, starch crops, lignocellulosic biomass	Annex IX, part A	ATJ-SPK, up to 50% blend	TRL 6-7
Biomass Gasification + Fischer-Tropsch (Gas+FT)	Lignocellulosic biomass, solid waste	Annex IX, part A	FT-SPK, up to 50%	TRL 7-8
Biomass Gasification + FT with Aromatics	Lignocellulosic biomass, solid waste	Annex IX, part A	FT-SPK/A, up to 50% blend	TRL 6-7
Catalytic Hydrothermolysis (CHJ)	Vegetable and animal lipids	Annex IX, part A	CHJ, up to 50%	TRL 6
HEFA from algae	Microalgae oils	Annex IX, part A	HC-HEFA-SPK, up to 10% blend	TRL 5

Keep in touch

EU Science Hub: ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub – Joint Research Centre

EU Science, Research and Innovation

Eu Science Hub

European Commission

Thank you

N. Scarlat

EC-JRC - Unit C.2
Ispra (IT)

The views expressed here are purely those of the authors and may not, under any circumstances, be regarded as an official position of the European Commission.

European Commission

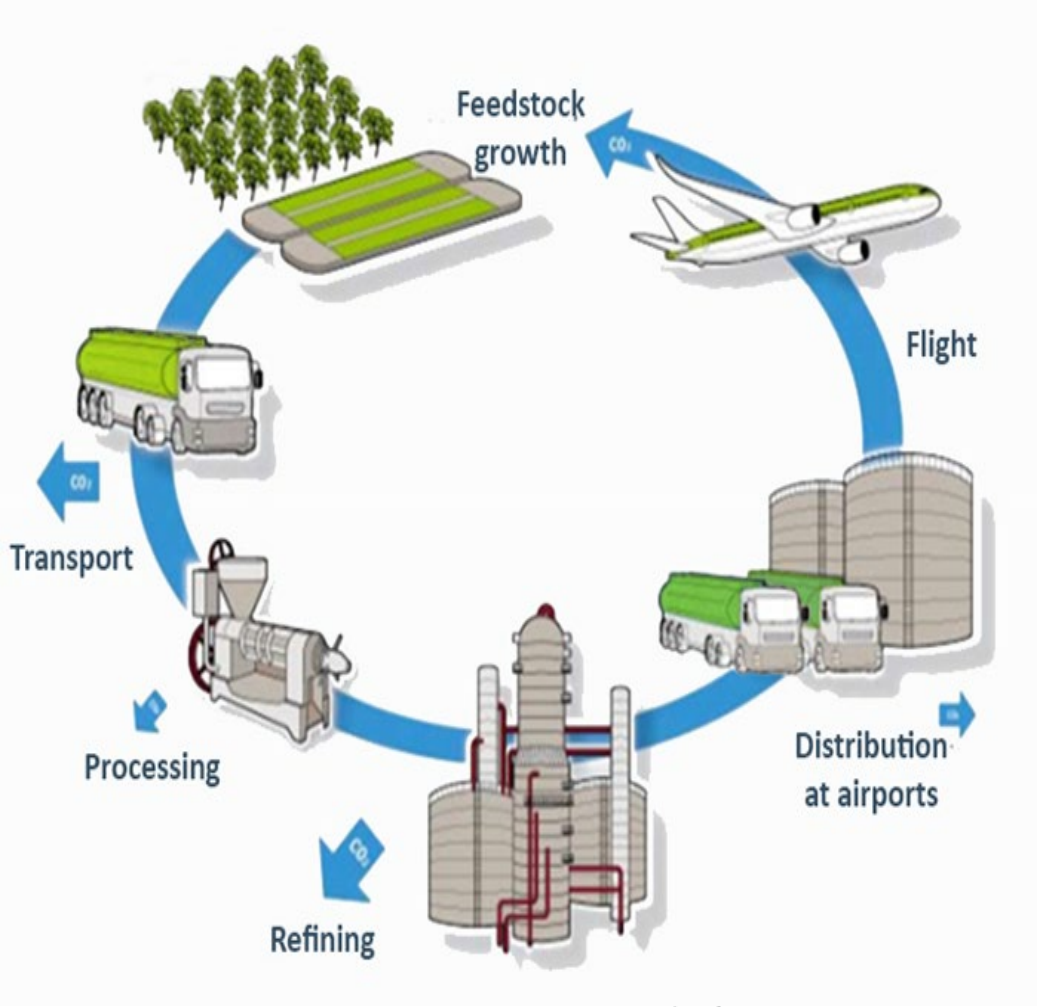
Backup

JRC in CORSIA

Fuels and especially Sustainable Aviation Fuels (SAF) have the greatest potential to reduce CO_2 emissions from international aviation.

FTG addresses technical issues related to aviation fuels, including the methodologies for considering CORSIA Sustainable Aviation Fuels and CORSIA Lower Carbon Aviation Fuels.

- JRC provides environmental performance assessments for alternative fuels for aviation
- methodology on **GHG default values for alternative jet fuel** pathways
- **sustainability criteria for alternative fuels** under the CORSIA scheme
- **guidance on potential policies and approaches** for the deployment of sustainable alternative fuels for aviation
- JRC works in a collaborative environment with ANL, MIT, PoliTo, UHasselt University, TUM University, etc.



European Commission