

The expected role of SAF in decarbonising international civil aviation

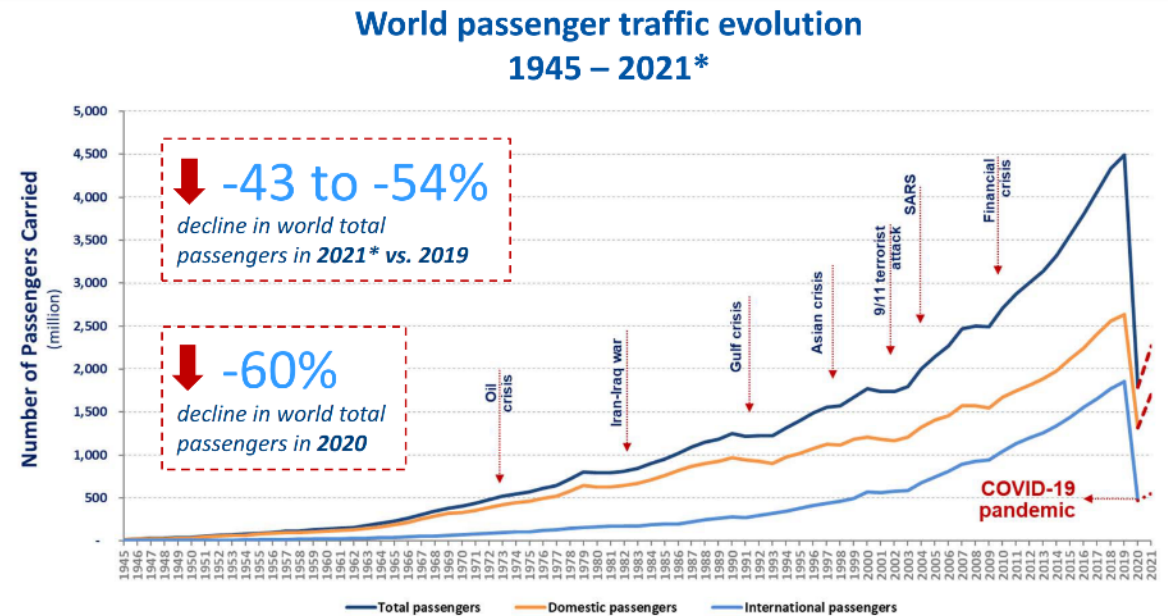
M. Prussi



Politecnico
di Torino

Why we need liquid fuels?

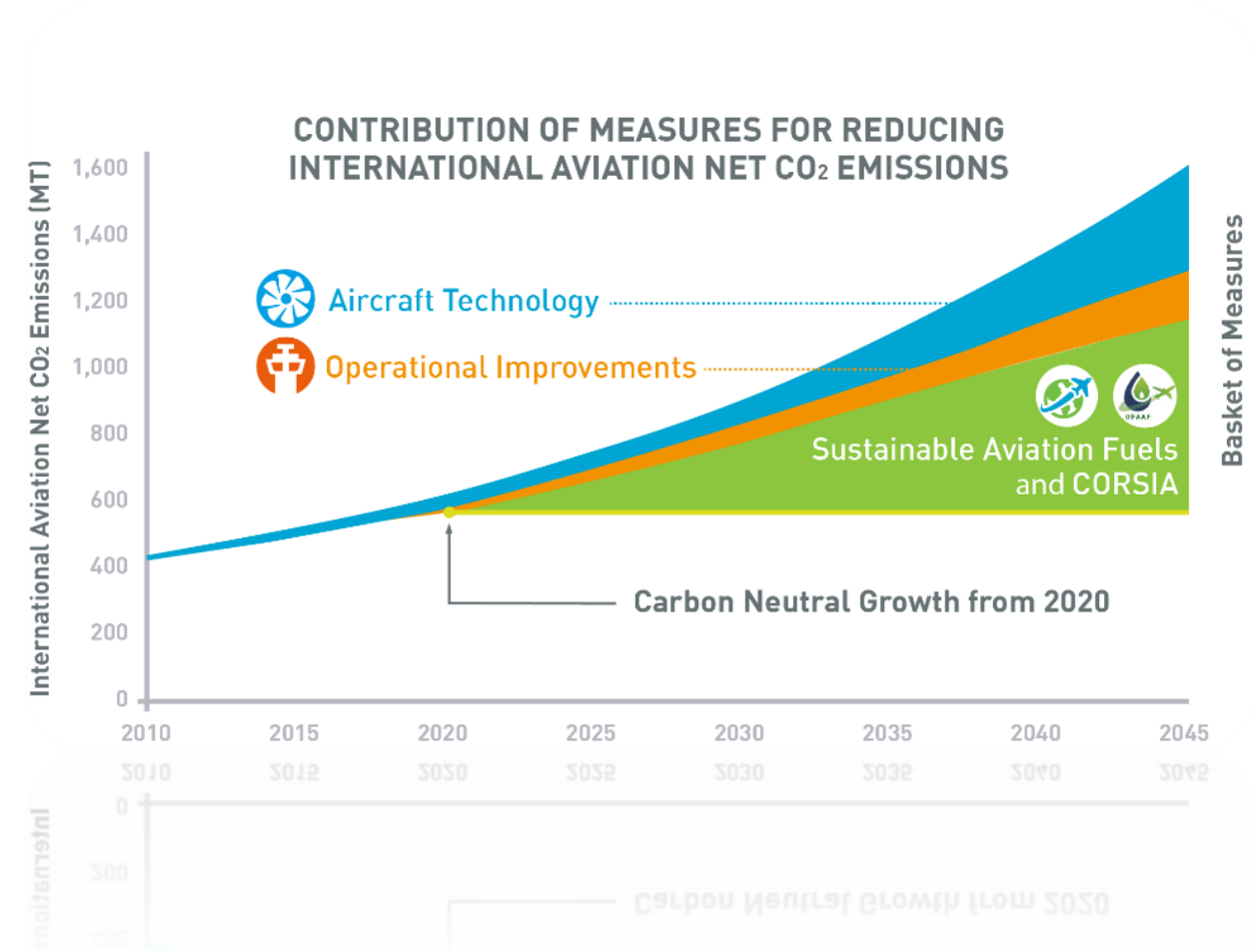
- Before COVID pandemic, international civil aviation was **consuming about 160 megatons (Mt) of fuel**, corresponding to approximately **2.6% of GHG emissions** from fossil fuel combustion.
- The sector was growing at a **significant pace**: before the COVID-19 crisis, ICAO forecasted that by 2050 international aviation **emissions could triple** compared with 2015.



https://www.icao.int/sustainability/Documents/Covid-19/ICAO_coronavirus_Econ_Impact.pdf

Why we need liquid fuels?

- Before COVID pandemic, international civil aviation was **consuming about 160 megatons (Mt) of fuel**, corresponding to approximately **2.6% of GHG emissions** from fossil fuel combustion.
- The sector **was growing at a significant pace**: before the COVID-19 crisis, ICAO forecasted that by 2050 international aviation **emissions could triple** compared with 2015.



Why we need liquid fuels?

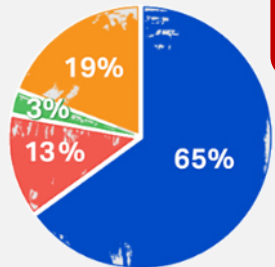
- Due to some peculiar characteristics of the aviation sector, **the penetration of disruptive technologies** (e.g. electrification) is expected to **occur at a different pace than in other sectors** (e.g. road).
- **Alternative** to fossil kerosene should ideally **be able to supply existing infrastructures and engines (drop-in fuels)**.
- This is the reason why **liquid alternative fuels could be an effective short-medium term mean** for decarbonising international aviation.



Which is the expected role of SAF?

Our strategy towards net zero

Achieving net zero by 2050 will require a combination of maximum elimination of emissions at the source, offsetting and carbon capture technologies.



65% Sustainable Aviation Fuel (SAF)

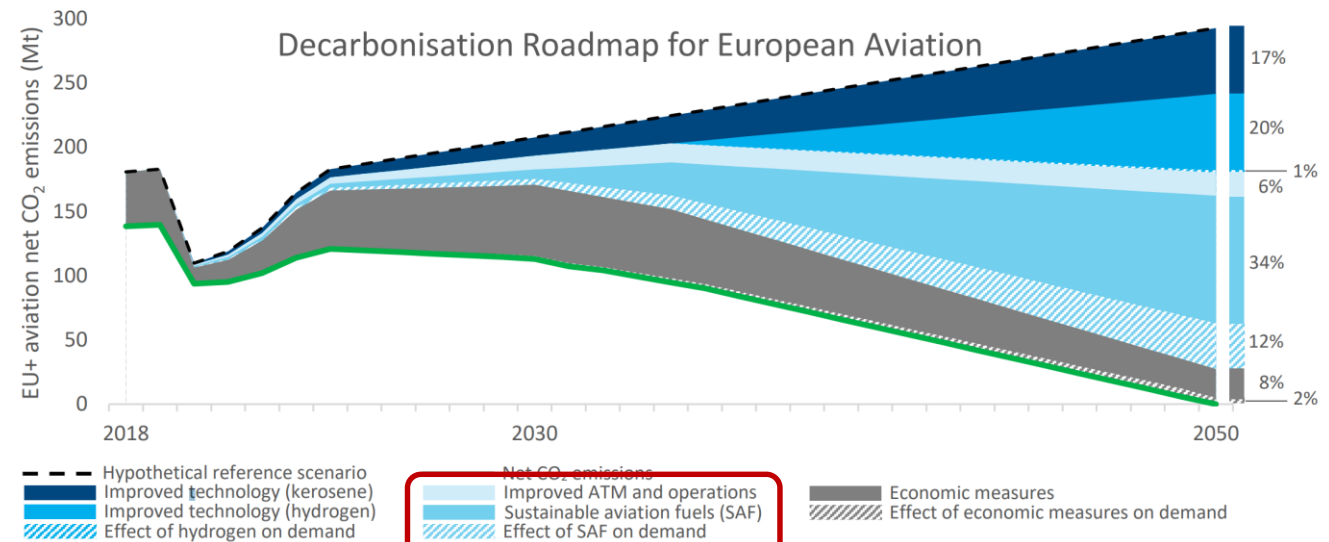
13% New technology, electric and hydrogen

3% Infrastructure and operational efficiencies

19% Offsets and carbon capture

IATA.

<https://www.iata.org/en/programs/environment/flynetzero/>



Results are presented for all flights within and departing from the EU region². Improving aircraft and engine technology, ATM and aircraft operations, SAF and economic measures all hold decarbonisation potential. Modelled for 2030 and 2050, the impacts are linearly interpolated. The base year for this study is 2018.

Destination2050.

https://www.destination2050.eu/wp-content/uploads/2021/02/Destination2050_ExecutiveSummary.pdf

The ICAO LTAG feasibility study

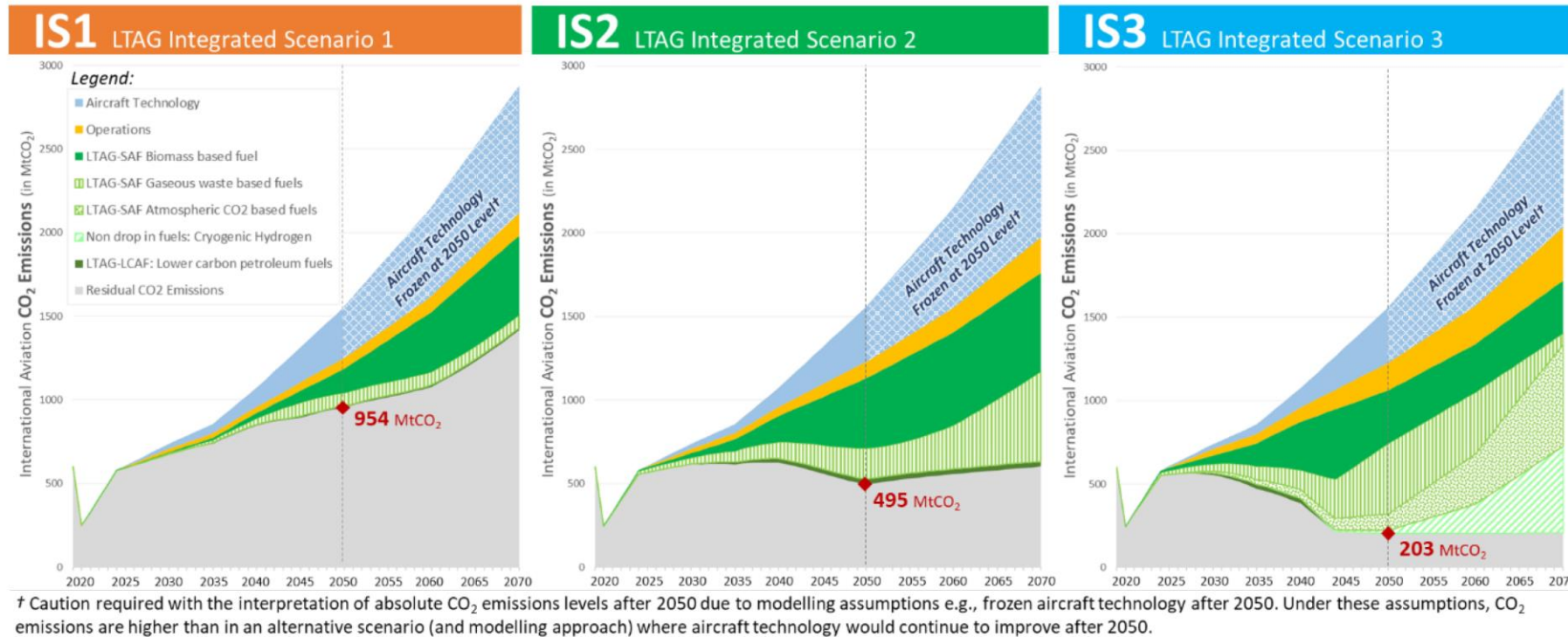
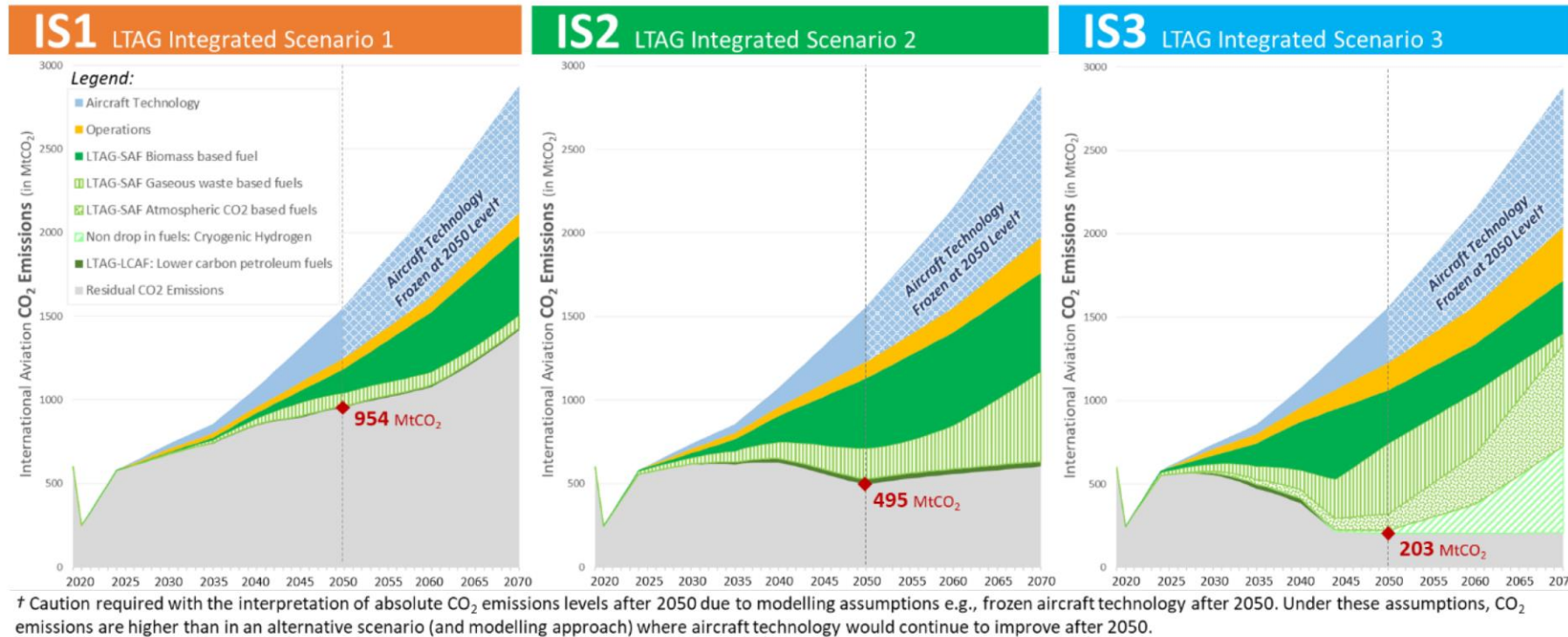


Figure 1. CO₂ emissions from international aviation associated with LTAG Integrated Scenarios

<https://www.icao.int/environmental-protection/Pages/LTAG.aspx>

- The 41st **ICAO Assembly** adopted a long-term global aspirational goal (**LTAG**) for international aviation of **net-zero carbon emissions by 2050**.
- **3 main integrated scenario** with **increasing aspiration** and **decreasing readiness** and **attainability**

The ICAO LTAG feasibility study



From LTAG it is clear
the **crucial role of SAF**

Figure 1. CO₂ emissions from international aviation associated with LTAG Integrated Scenarios

<https://www.icao.int/environmental-protection/Pages/LTAG.aspx>

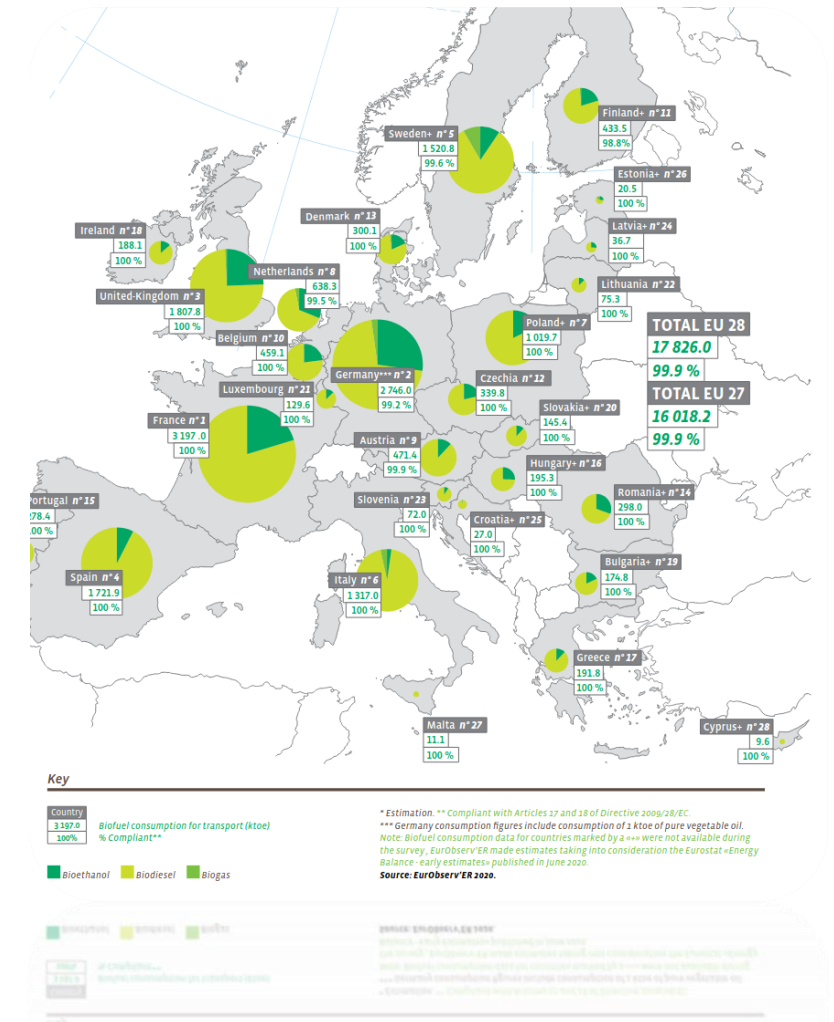
Cost per tonne of CO2 saved

For creating the fuel scenarios, the cost per tonne of abated CO2 has been established, in LTAG.

			Fuel Order per Scenario with Selection Criteria					
Category	Fuel Name	Abbreviation	F1*	MSP [\$/L]	F2^	Marginal Abatement Cost [\$/kg CO _{2e} _{red}]	F3	Lifecycle [gCO _{2e} /MJ]
LTAG-SAF	Biomass	LTAG-SAF-FTG	LTAG-LCAF	0.52	LTAG-SAF-FTG	<1	LTAG-SAF-DAC	8-13
	Solid/liquid				LTAG-LCAF		LTAG-SAF-CO ₂	
	Gaseous waste CO ₂	LTAG-SAF-CO ₂			LTAG-SAF-FTG		LTAG-SAF-FTG	
	Atmospheric CO ₂	LTAG-SAF-DAC	LTAG-SAF-CO ₂	~2.5	LTAG-SAF-CO ₂	4.3	LTAG-SAF-FTG	21-24
LTAG-LCAF	Lower carbon petroleum fuels	LTAG-LCAF	LTAG-SAF-DAC	N/A	LTAG-SAF-DAC	N/A	LTAG-LCAF	80.1

Expected volumes and production capacity

- At European level we are discussing mandates for SAF.
- Under the proposal of a target del 5%, the volume of SAF would be around 3.0 Mtoe/y.
- To put such figure into context, this would represent the **17.5% of the current EU27 biofuel consumption in the whole transport sector.**



Sustainability criteria for SAF

Other principles are considered during the certification process:



<https://rsb.org/rsb-corsia-certification/>

FIGURE 1: ISCC Sustainability Principles



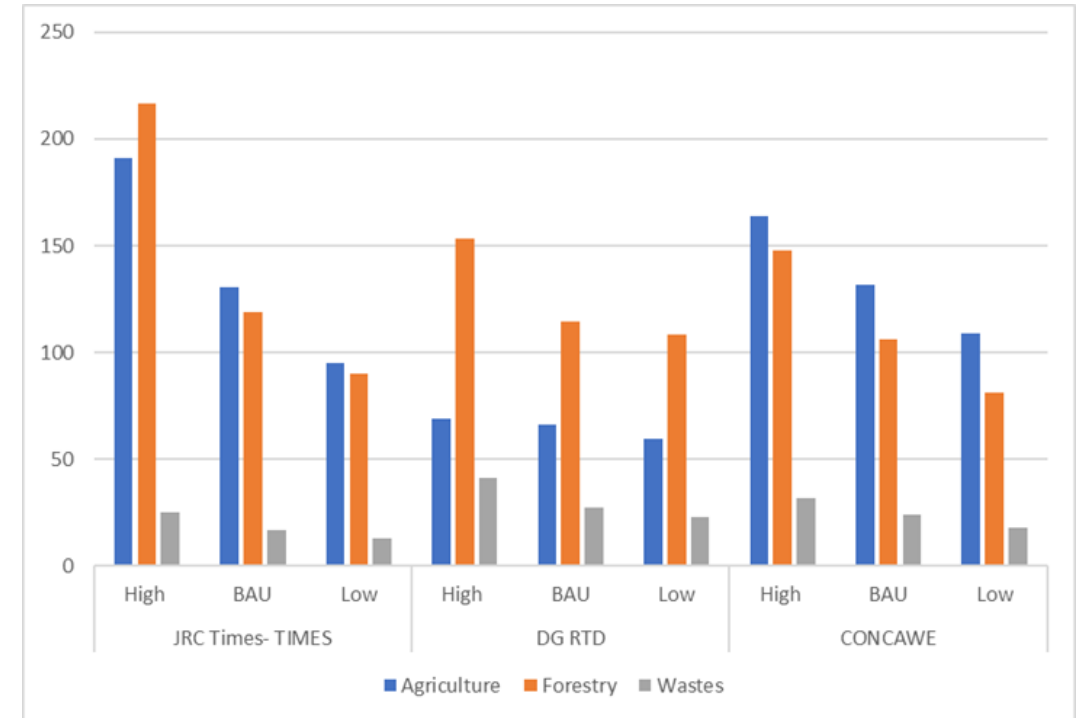
The feedstock availability issue

- Given the **expected contribution** of **SAF** to sector decarbonisation, it is clear the need of **ensuring sustainable feedstock availability**.
- **Increasing the potential feedstock pool** is a strategy to **limit** risks of feedstock **shortage** and/or **potential competition** with **other sectors** (e.g. maritime)

The feedstock availability issue

- The **analysis confirmed**, even under very conservative assumptions, that **feedstock availability may not be the major barrier in the short term**.
- Other **issues** such as the feedstock **costs**, the **price volatilities**, the existing logistical infrastructures, etc. are **relevant aspects**, contributing to the puzzle.
- Whilst feedstock is present across European regions **a critical element** which requires detailed analysis at the implementation, value chain level is the **effectiveness of its sustainable mobilisation alongside the synergies and trade offs that may arise**.

Feedstock potentials from the three selected studies for 2030.



Prussi, M., Panoutsou, C., & Chiaramonti, D. (2022). Assessment of the Feedstock Availability for Covering EU Alternative Fuels Demand. *Applied Sciences*, 12(2), 740.

Conclusions

- **Aviation is expected to recover from COVID-19 pandemic**, continuing increasing its growth, **with a significant associated environmental impact.**
- **Aviation is expected to rely on liquid fuels in the short-medium term**, especially for the long-haul flights.
- **Sustainable Aviation Fuels** are considered an **effective tool** for the sector decarbonisation strategy.
- Sustainable aviation fuels (**SAFs**) as defined in CORSIA **can reduce life-cycle GHG emissions by over 90%.**
- **A potential issue related to feedstock availability exist, even if analyses confirm that this may not be the major barrier in the short term.**
- **Feedstock costs, the price volatilities, competition with other sectors, etc. are other relevant aspects.**
- **Increasing the uptake of SAF will also require significant investments, in terms of production capacity, expecially for new technologies entering the market.**



The expected **role** **of SAF** in **decarbonising** international civil **aviation**

M. Prussi



Politecnico
di Torino