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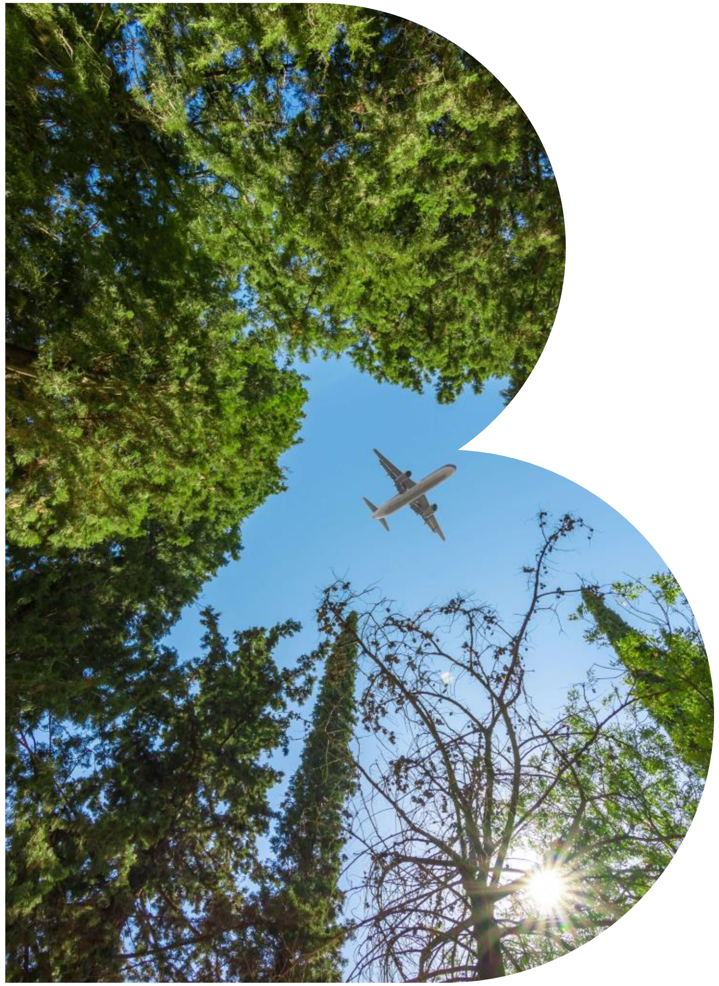

Achieving 2030 ReFuelEU targets

II° congresso nazionale del
"Patto per la decarbonizzazione del trasporto aereo"

PATTO PER LA DECARBONIZZAZIONE DEL TRASPORTO AEREO

Aeroporti di Roma

eni

Rome, 26th October 2023

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Agenda

Role of Sustainable Aviation Fuels

Announced supply for Sustainable Aviation Fuels

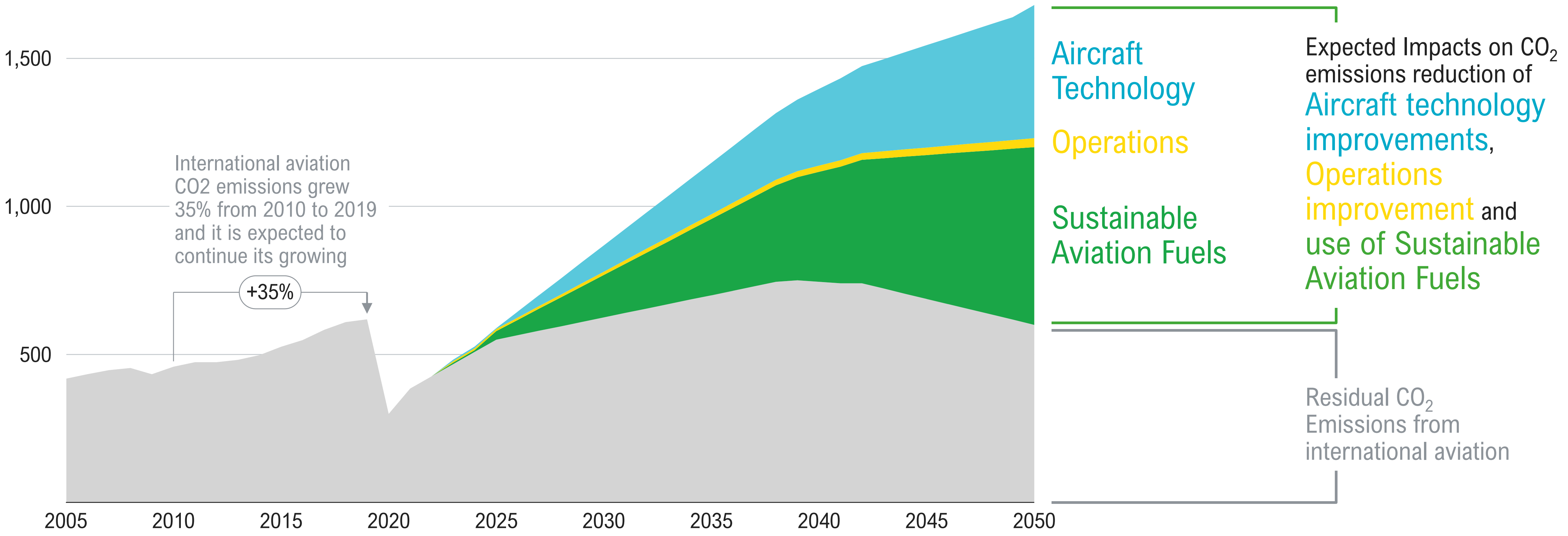
Expected Sustainable Aviation Fuels demand in Italy

Impacts of on aviation value chain in Italy

Source: Roland Berger

CO_2 emissions grew significantly pre-Covid with increasing impact in the following years: SAF adoption expected to have a relevant role in decarbonizing aviation sector

International aviation CO_2 Emissions globally [$MtCO_2$; 2005-2050]



Source: ICAO Long-Term Aspirational Goal (LTAG), Roland Berger

EU agreed to enhance ReFuelEU and define more stringent rules to cut aviation emissions by promoting an increasing quantity of Sustainable Aviation Fuels

New rules of ReFuelEU agreed on April 2023

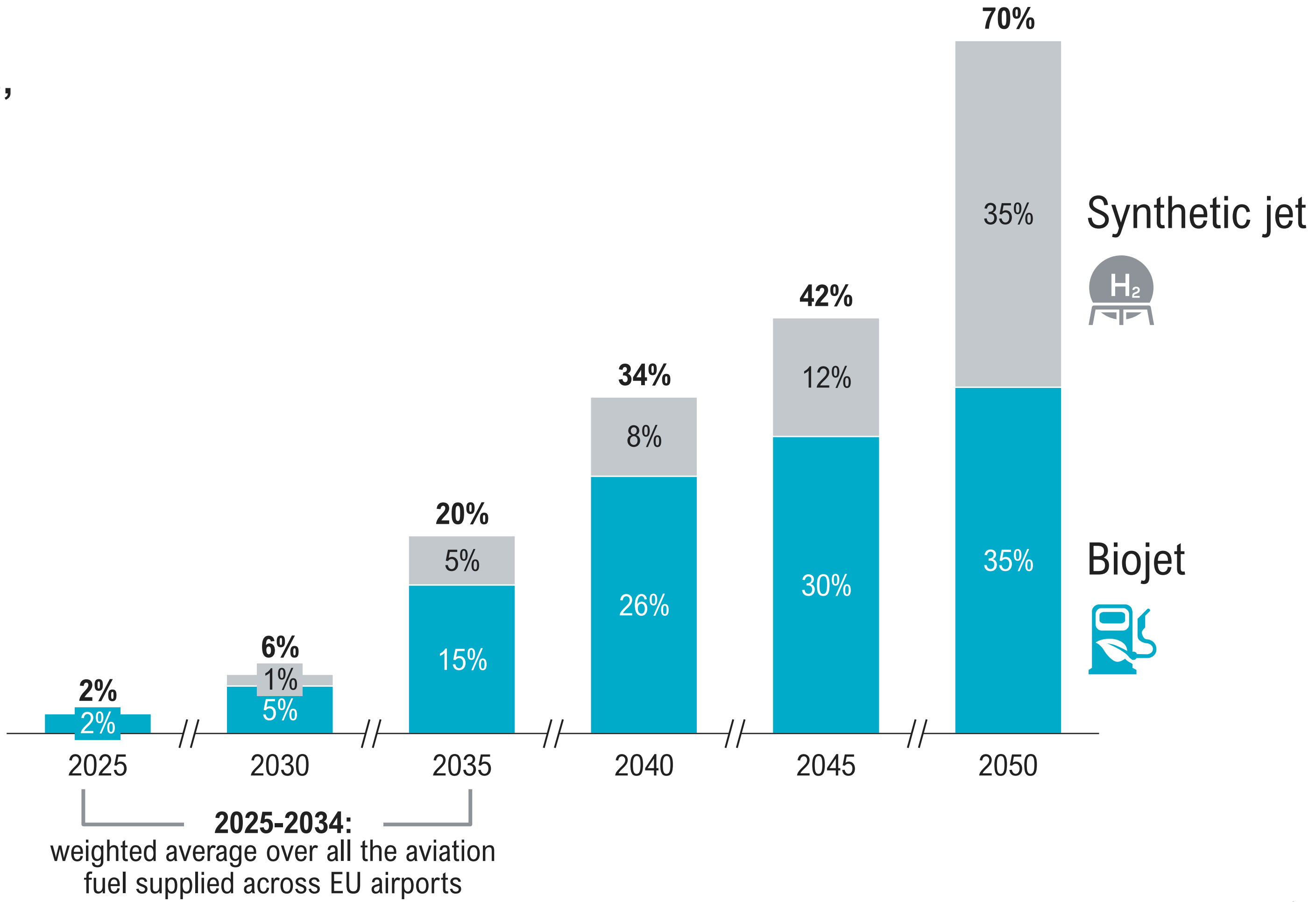
What is sustainable aviation fuels?

The term "sustainable aviation fuels" include **"drop-in" fuels,** fully fungible with conventional aviation fuels, belonging to:

Biofuels from:
- used cooking oil,
- animal fats (tallow)

and **advanced biofuels** produced from:
- agricultural or forestry residues
- bio-waste

Synthetic aviation jet fuel from
- hydrogen and
- CO_2



Source: European Commission; Roland Berger

There are several synthesis routes for producing SAF today: biojet from oils, sugars/ cereals and biomass, synthetic jet from CO_2 and water through electrolysis

Biojet synthesis pathway and feedstock overview

SAF type	Biojet			Synthetic jet	
Technology	HEFA	Alcohol to Jet	Gasification – FT	Fischer-Tropsch (FT)	Methanol to Jet
Pathway description	**Hydroprocessed Esters and Fatty Acids**, it involves the refining of vegetable oils, tallow, or waste greases into SAF	**AtJ converts alcohol feedstocks** (sugars, starches, hydrolyzed cellulose) into SAF	**Gasification – Fischer Tropsch converts syngas from feedstock gasification**, into hydrocarbons in a FT reactor to produce SAF	**FT – Power-to-Liquid converts syngas** produced from H_2 and CO_2 into SAF via a **FT reaction**	**MtJ – Power-to-Liquid converts syngas** produced from H_2 and CO_2 into SAF **via methanol synthesis**
Feedstock[1)]	**Non-edible oils** **UCO** – Used Cooking Oil **Animal fats** **Vegetable oils** **Rapeseed** oil **Sunflower** oil Not allowed by ReFuelEU	**Lignocellulosic Biomass/ waste** **Forest/ agri** residues **Food and Bio-**waste **Crops** **Sugar crops** **Corn** Not allowed by ReFuelEU	**Lignocellulosic Biomass** **Forest** residues **Agri** residues **Waste** **Food** waste **Bio-**waste	**Hydrogen**	**Carbon dioxide**

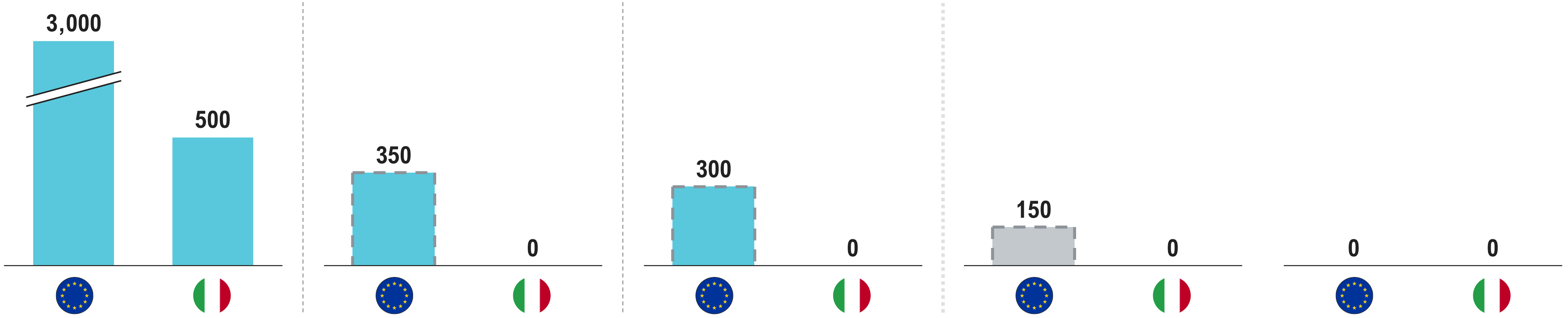
1) The feedstock perimeter for each biofuel category is currently being revised as part of the definition of the EU Renewable Energy Directive III (RED III)

Source: European Commission; Roland Berger

Today HEFA is the mature technology with large production scale volumes, feedstock availability to be consolidated; AtJ, G-FT and PtL less mature

SAF production market overview [k ton; 2030]

SAF type	Biojet			Synthetic jet	
Technology	HEFA	Alcohol to Jet	Gasification – FT	Fischer-Tropsch (FT)	Methanol to Jet
Technology Readiness Level (TRL)[1]	Consolidated maturity and market presence (9) Large-scale production volumes	Emerging maturity with reg. market presence (7) Small-scale production volumes	Emerging maturity with reg. market presence (7) Small-scale production volumes	Low maturity with scare asset/ market presence (6) Technology demonstr. in rel. environments	Low maturity with scare asset/ market presence (6) Technology demonstr. in rel. environments
Announced capacity	3,000 / 500	350 / 0	300 / 0	150 / 0	0 / 0



1) TRL 9: Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space), TRL 7: System prototype demonstration in operational environment, TRL 6: Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)

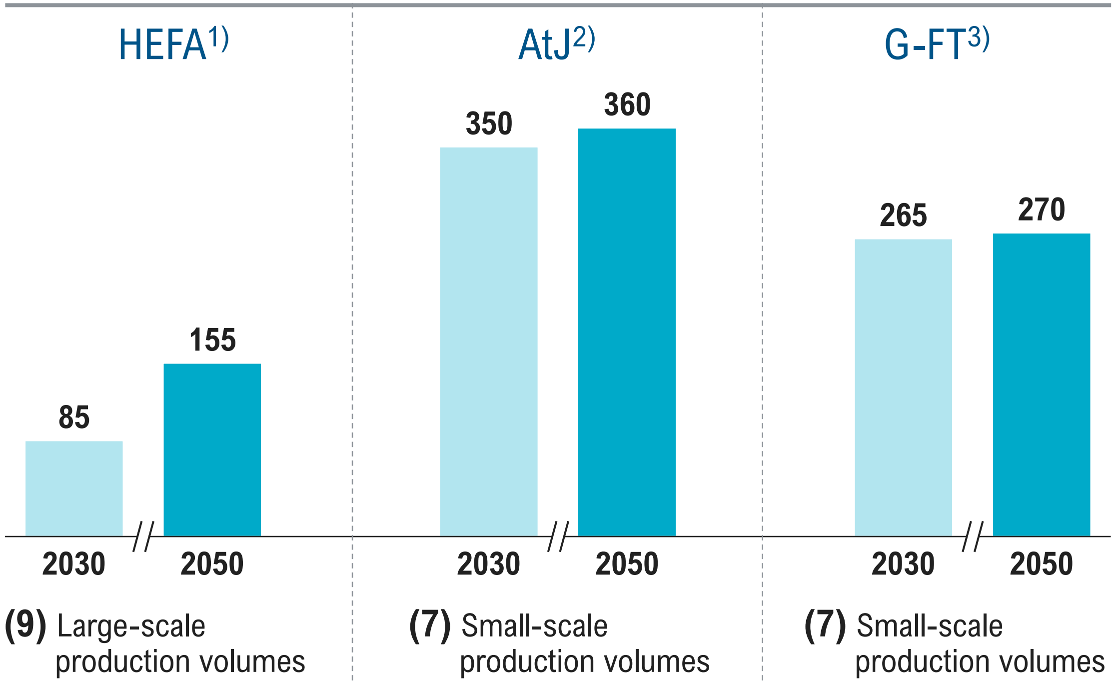
Source: Company information; Roland Berger

Not exhaustive / Subject to regulatory review

For biojet, global feedstock dynamics highlight the need for perimeter extensions to overcome competition vs food and develop production technologies for AtJ and FT

Biofuel capacity and perimeter evolution

Global theoretical biofuel potential [ton m]



Technology readiness level (X)

HEFA feedstock perimeter evolution

First generation:
- Relevant contribution to food vs fuel conflict
- High ILUC banned in EU from 2030
- Impact on food prices
- De-forestation risk/land use change

Second generation advanced and low ILUC:
- Intermediate crops after production of cereals or other food crops
- Land with low organic content, abandoned or contaminated
- Residues and wastes from agro-industry and agro-forestry

Wastes and residues[4] | **Cover crops** | **Non-food crops degraded land** | **Agricultural residues**[5]

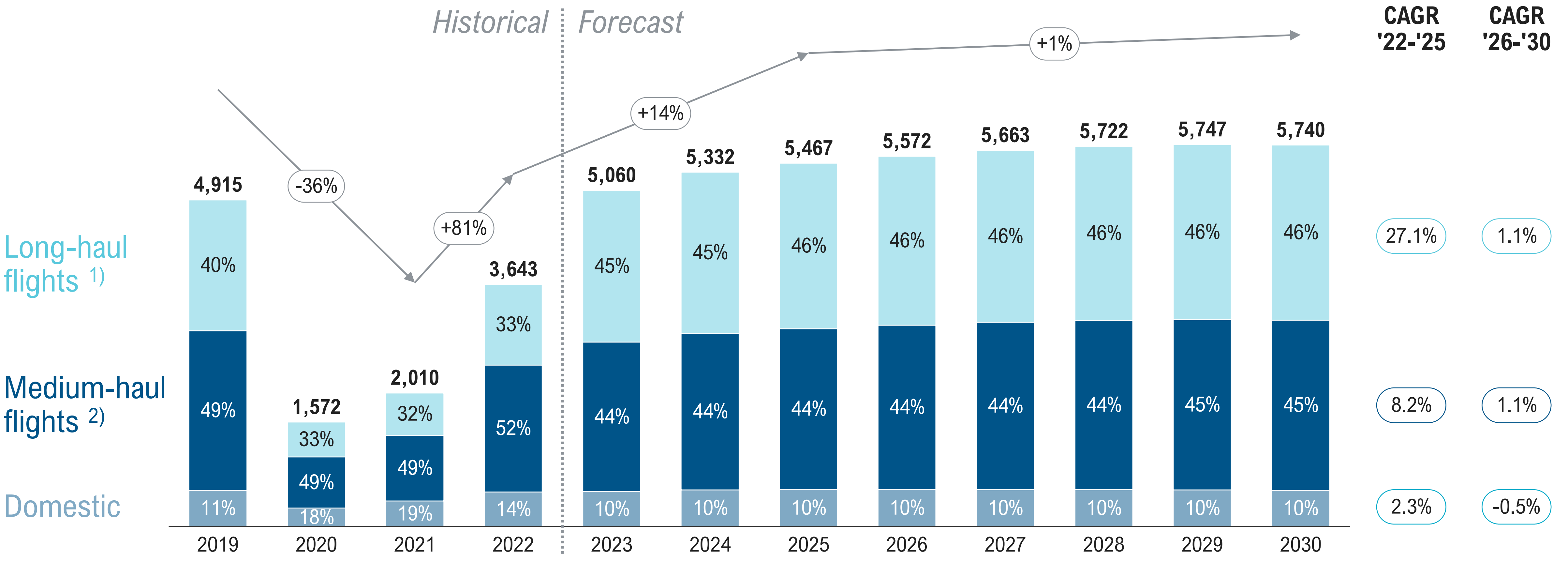
Novel vegetable oils

1) Includes UCO, Animal fats and vegetable oils; 2) Includes Sugar Crops, Corn, Wheat and Cereal strow; 3) Includes agriculture and forest residues and biowastes; 4) Composed of UCO and non-edible oils (animal fats); 5) Agricultural residues destined for HEFA production

Source: Roland Berger

Although with a moderate impact compared to other countries, jet fuel consumption in Italy is forecast to grow in the following years with a relevant impact on CO_2

Total quantity of jet fuel used in Italy [k ton; 2019-2030]



1) Long-haul flights include traffic to Asia, America, Oceania and Africa (excl. North Africa); 2) Medium-haul flights include intra-Europe traffic and flights to North Africa

Source: Assaeroporti; Eurostat; Eurocontrol; Roland Berger

SAF demand will be supported both by regulation and airline incorporation targets to match public airline pledges and support airline decarbonization plans

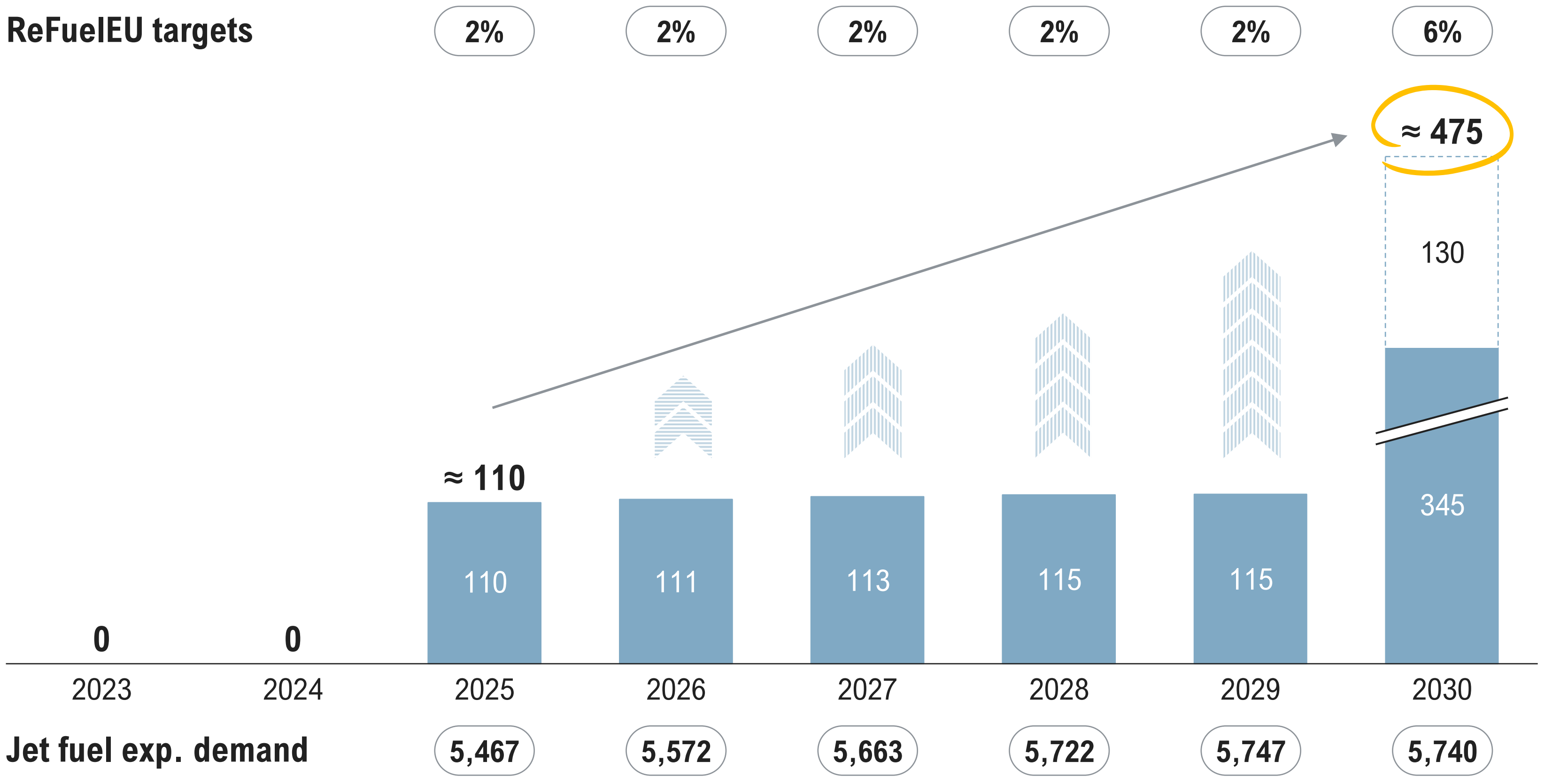
SAF demand in Italy [k ton; 2023-2030]

Total SAF demand

Additional potential SAF demand from airlines' targets

>=10% by 2030

SAF regulatory demand (biojet + synthetic jet)



1) 12.5% by 2030

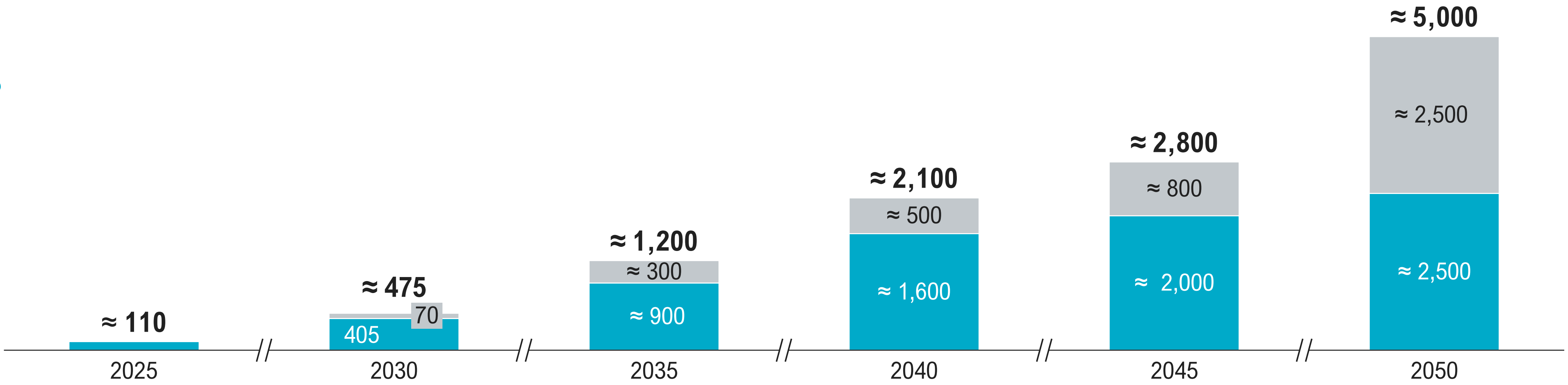
Source: Assaeroporti; Eurostat; Eurocontrol; ENAC – Dati di traffico (2022); ReFuelEU; Roland Berger

SAF demand projected to 2050 sharply increases due to more stringent targets post 2030, especially for synthetic – potential revision due to technological evolution

Biojet and synthetic jet demand in Italy [k ton; 2025-2050]

		2025	2030	2035	2040	2045	2050
Kerosene jet fuel expected demand		5,467	5,740	≈ 6,000	≈ 6,350	≈ 6,700	≈ 7,000
SAF targets	Biojet	2%	4.8%	15%	26%	30%	35%
	Synthetic jet	-	1.2%	5%	8%	12%	35%

SAF demand



xx % ReFuelEU targets; Biojet; Synthetic jet

Source: Assaeroporti; Eurostat; Eurocontrol; ENAC – Dati di traffico (2022); ReFuelEU; Roland Berger

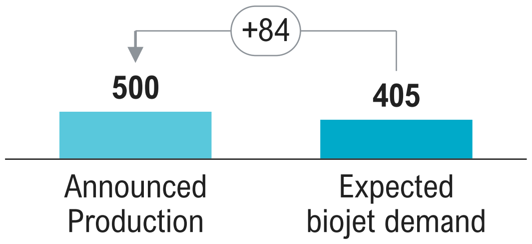
2030 biojet demand could be met by current production, regulatory scale-up requirements highlight the need for investment in R&D for 2050 projections

SAF announced production vs. expected demand [k ton; 2030, 2050]

2030

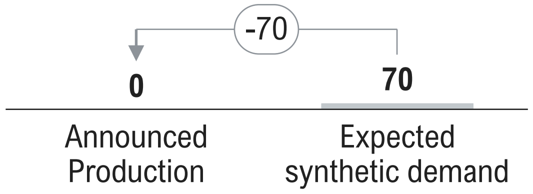
Biojet

- **SAF announced production** in Italy enough to **cover 2030 biojet demand**
- Possibility to **export overcapacity** to meet EU regulatory demand



Synthetic jet

- **Lack of production announcements**
- **Need of procurement-based solutions** to achieve the regulation driven target by 2030

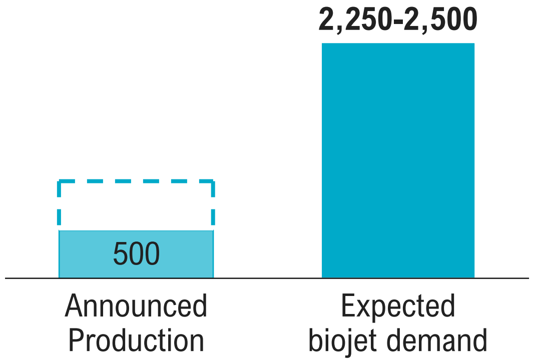


2050

Biojet

Requirements to meet ambitious scale-up requirement:

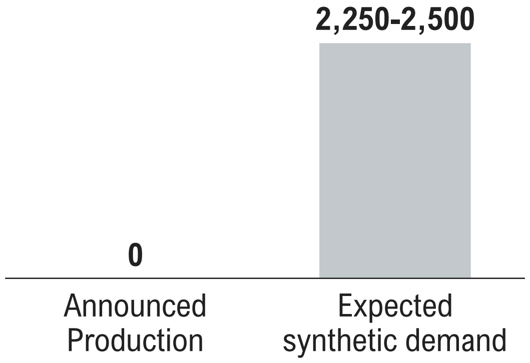
- **Feedstock security to enlarge base for HEFA**
- **Technological advancement via R&D to develop new plants**



Synthetic jet

Requirements to bridge the gap between the large demand scale-up and low existing TRLs:

- **Stringent development plan**
- **Feedstock procurement capabilities (Hydrogen and CO_2)**



Source: Roland Berger

Synthetic jet production by 2050 would require dedicated electrolyzers and renewable energy plants comparable to overall Italy 2030 development plan

Synthetic jet fuel production requirements [2030-2050]

		2030 Plan [1)]	2030 need - 1.2% target	2050 need - 35% target
Green H_2	**PV and Wind production**	200 TWh Terna and PNIEC 2023 target	5 TWh	180 TWh Assuming ≈ 2,100 MWh/ MW for utility scale PV and 3,000 MWh/ MW for wind power
	Utility scale PV and Wind capacity	90 GW Terna 2023 target	1.7-2.5 GW Assuming ≈ 2,100 MWh/ MW for utility scale PV and 3,000 MWh/ MW for wind power	60-90 GW
	Electrolyzers installed	5 GW Strategia Nazionale per l'H_2 target	0.8 GW	28 GW
CO_2	**Biogenic CO_2 production capacity p.a.**	8-9.5 Mt Calculated based on average biogenic emissions by sector	0.3 Mt	10 Mt

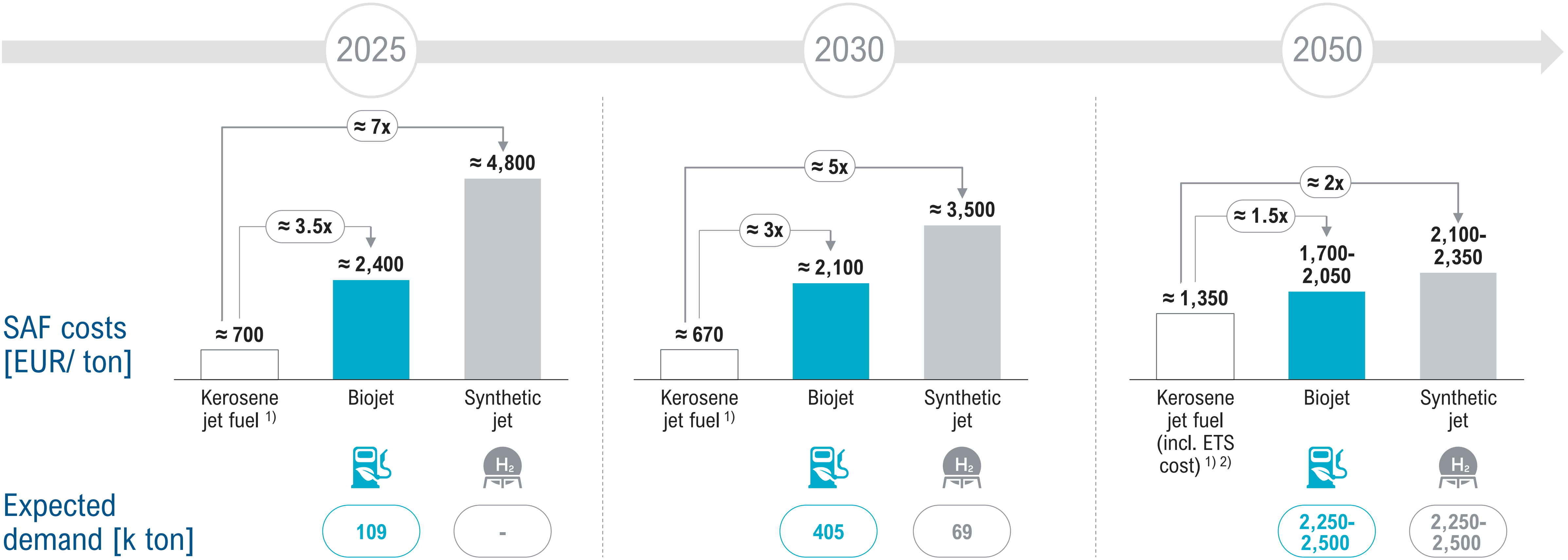
Values referred to 2030 **Values referred to 2050**

1) Terna development plan to reach Fit for 55 (EU goal to reduce net greenhouse gas emissions by at least 55 percent by 2030) target

Source: Renewable Energy Report – PoliMi (2022 and 2023); PNIEC; Piano di sviluppo-Terna (2023); Strategia Nazionale per l'Idrogeno; IRENA; Industrial emissions portal; European Biogas association; GSE; ISPRA; Roland Berger

Biojet production costs expected to be ≈ 3x vs kerosene jet fuel in 2030 while synthetic jet fuel could be more than 5x higher

Kerosene jet fuel vs. biojet vs. synthetic jet fuel costs [2025-2050]



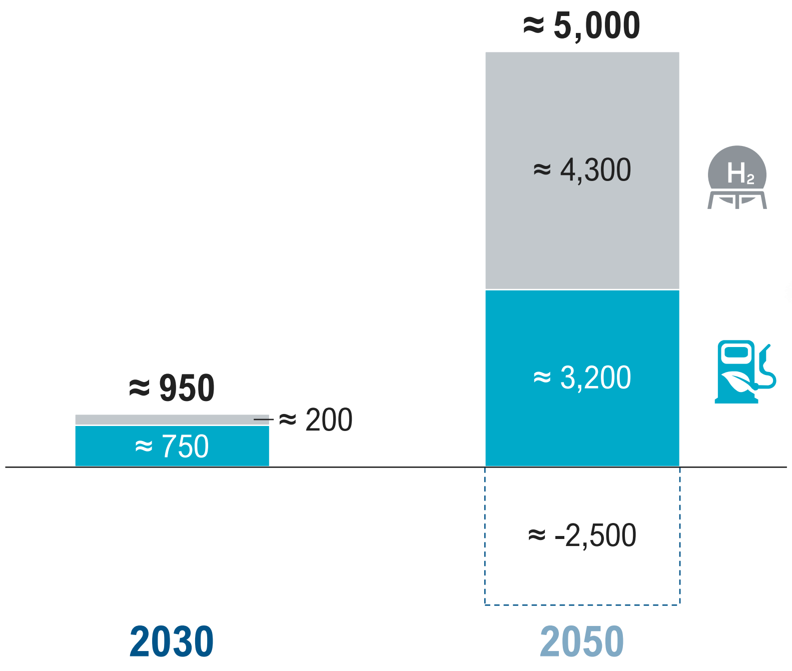
1) Kerosene jet fuel cost based on S&P commodity insight prices and EIA price evolution (YoY %); 2) CO_2 savings (tons) calculated using CEF (CORSIA) Emissions Reductions Formula starting from kerosene jet fuel emissions (3.16 kg CO2/ kg of fuel) and quantified using IEA (International Energy Agency) "Announced Pledges Scenario for Advanced economies" CO_2 price estimates

Source: S&P commodity insight; EIA; IEA (International Energy Agency); Argus; Company information; Roland Berger

Extra cost for SAF adoption is expected to be ≈ EUR 5 bn per year in 2050 with a potentially significant impact on airlines

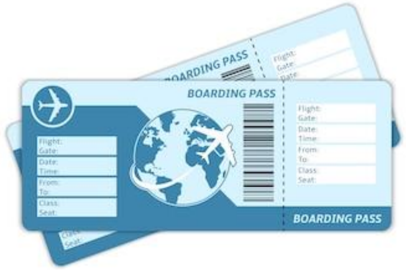
Extra costs per ticket sold[1)] [2030-2050]

Extra costs for airlines due to SAF adoption (≈ 8% in 2030 and 70% in 2050) [EUR m/ y][2)]



Biojet | Synthetic jet | ETS avoided costs

Expected ticket price increase [EUR/ ticket][3)]



10 - 30
(2030) (2050)

	2030	2050
Domestic flights E.g., Rome (FCO) - Milan (LIN)	6	20
Medium-haul flights E.g., Rome (FCO) - London (LHR)	8	25
Long-haul flights E.g., Rome (FCO) - New York (JFK)	13	50

1) Including the CO_2 saved quantified using IEA "Announced Pledges Scenario for Advanced economies" CO_2 price estimates – Using IEA "Net Zero Scenario for Advanced economies" the average EUR/ ticket would decrease by ≈ 10% to EUR 27; 2) Kerosene jet fuel expected to be ≈ 670 EUR/ ton in 2030 based on S&P commodity insight prices and EIA price evolution (YoY %); 3) Assumption: number of departing passengers for 2030 = 105 m and for 2050 = 150 m

Source: S&P commodity insight; EIA; IEA (International Energy Agency); Argus; Company information; Roland Berger

Combining its leadership positioning with timely technology and policy innovation, Italy can achieve a SAF market at scale and benefit the entire aviation industry

Need to act now to foster Italian leadership on SAF production, complying with the progressively stringent regulation and play a leading role in the market

- Leveraging domestic expertise and development plans, **Italy has achieved top market positioning in terms of current and short-term SAF production potential**
- SAF incorporation is expected to rapidly scale-up (6% in 2030 to 70% in 2050). To achieve a successful SAF market at scale, **Italy needs to act now to maintain its leadership position** across the entire regulatory timeline by supporting the development of new technologies (i.e., synthetic jet) and maximizing the scale of the current biojet technology
- Current SAF production costs are higher (3x) than fossil-based kerosene jet fuel with significant extra costs today which will grow throughout the relevant timeline across the entire aviation value chain, **potentially impacting end-user pricing dynamics (passenger ticket cost)**
- **Key area for investment and innovation will be logistics** (blending and distribution) which in the short-term can be mitigated via the use of a SAF certification system, however long-term solutions require the implementation of a capillary network to service all domestic airports
- **In the interest of ensuring that demand across the aviation industry is not impacted and air travel safeguarded**, further price increases must be mitigated - **accelerating technological development and securing feedstock networks** will bring benefits to the entire aviation ecosystem
- A set of policies can be adopted to support SAF supply and demand dynamics, among these **tax credits for producers and users along with funds to support both low maturity technologies and logistical evolutions could have significant positive impacts** and support the E2E market

Source: Roland Berger

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