Ente Nazionale per l'Aviazione Civile
Italian Civil Aviation Authority

BUILDING THE ROADMAP FOR THE SUSTAINABLE AVIATION FUELS IN ITALY

Summary of the path undertaken by Enac for the definition of the SAF policy

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THE EMISSIONS PRODUCED BY AIR TRANSPORTATION AND THE ROLE OF SUSTAINABLE AVIATION FUELS

In Europe, air traffic is responsible for just under 4% of total greenhouse gas emissions.

If compared to the entire transportation sector, its impact is about 13%.

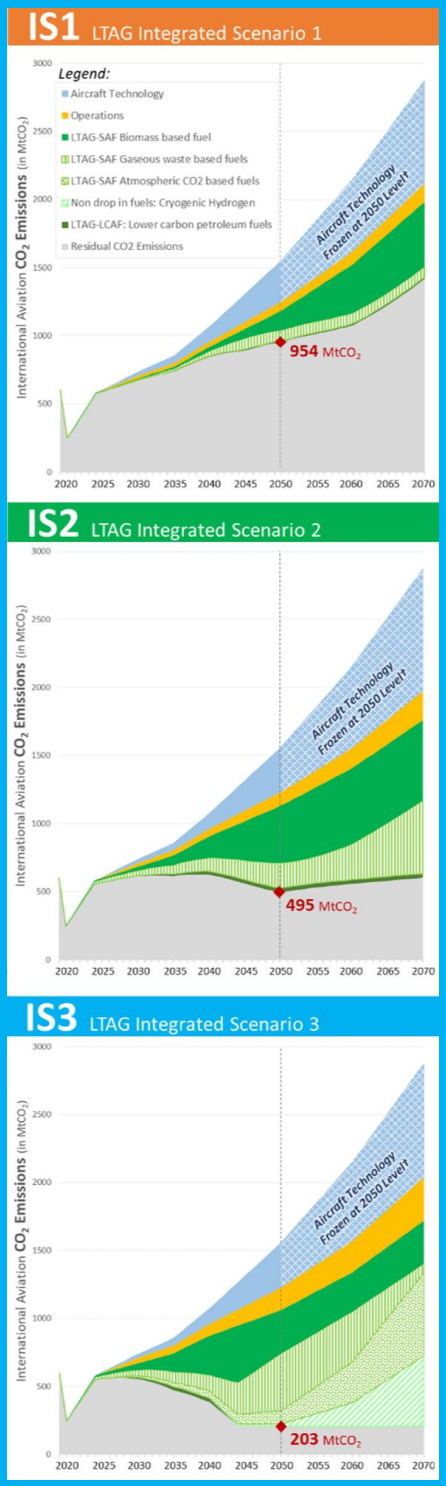
According to data available for Europe issued by the European Environmental Agency, atmospheric emissions (CO_2 and non-CO_2) from Aviation have increased from 1.2% to 3.7%[1] in the last three decades. With the outbreak of the COVID-19 pandemic, this figure was reduced sharply, and then grew as traffic volumes resumed. The latest estimates released by Eurocontrol, also considering the effects of the war in Ukraine, predict that the return to pre-pandemic levels will take place during 2024[2].

To better appreciate the "environmental weight" of Air Transport, it is appropriate to dwell on two additional aspects:

- ✓ expressing the emissions of air traffic not as compared to those of all sectors but only to the transportation sector, its associated share becomes more significant, reaching, in the pre-pandemic period, about 13%;
- ✓ in these last three decades that represented a period of strong growth in which the aircraft has become an accessible means to a wider public, other sectors such as energy production, manufacturing, agriculture or waste disposal, have recorded a variation of opposite sign, with levels of reduction of the emissions

[1] "Greenhouse gas emissions by aggregated sector", European Environmental Agency, 2019 (https://www.eea.europa.eu/data-and-maps/daviz/ghg-emissions-by-aggregated-sector-5)

[2] "EUROCONTROL Three-Year Forecast 2022-2024", EUROCONTROL (2022)



Picture 1. LTAG integrated scenario (source: ICAO LTAG Report 2022)

between 20% and 40%. Only the maritime transportation, one of the other sectors whose emissions are defined hard-to-abate, has seen an increment - even if in smaller manner - as for the aviation sector.

This context provides the rationale behind all the commitments undertaken, at International and National level by institutions and industry, to achieve the so-called "net neutrality", the condition under which emissions produced throughout the life cycle of the product (life-cycle emissions) - thus taking into account not only the operational phase but also the production phase and, where applicable, the disposal phase - are zero.

This concept applied to aviation fuels has led to the definition of Sustainable Aviation Fuels (SAF), namely hydrocarbons - therefore hydrogen and carbon compounds - of non-fossil origin, which compensate a large part of the emissions from their combustion with those absorbed during production.

The report of the International Civil Aviation Organization (ICAO) on the possibility of achieving a Long-Term Global Aspirational Goal (LTAG) for the reduction of CO_2 emissions[3], draws future scenarios in which, while taking into account a continuous growth of air traffic, emissions can be reduced through the integration of various factors such as the reduction of aircraft fuel consumption, the adoption of more efficient flight procedures

[3] "Report on the feasibility of a Long-Term Global Aspirational Goal (LTAG) for international aviation CO_2 emission reductions". ICAO CAEP, March 2022

and, above all, the introduction of sustainable fuels.

As shown in Picture 1, these integrated scenarios, called IS1, IS2 and IS3 and sorted by increasing levels of ambition and investment, show how much SAF as a whole can do to achieve the goal of reducing CO_2 emissions.

As can be seen, the green areas in Picture 1 refer to different types of SAF. In accordance with the classification adopted in Europe in the forthcoming regulation "RefuelEU Aviation", SAF can be distinguished in:

- ✓ **synthetic fuels**, also called e-fuel or RFNBO (Renewable Fuels of Non-Biological Origin), derived from processes that exploit hydrogen produced from non-fossil sources and carbon already present in the atmosphere, for example in the form of CO_2;
- ✓ **biofuels**, mainly derived from biomass, animal or vegetable fats or organic waste;
- ✓ **fuels derived from recycled carbon**, that is from waste substances with a high carbon content - produced unintentionally and not otherwise disposable - from industrial processes (for example, waste gases produced in blast furnaces).

These products, although very different from each other, have the common characteristics of not requiring an extraction process of hydrocarbons from underground and of being able to recycle organic compounds already present in the atmosphere or in substances that have previously absorbed them from the atmosphere, as in the case of biomass.

SAF represent the most effective solution for CO_2 reduction in the short to medium term.

Today they still need to be blended with traditional jet-fuel. In the near future they will be used in their neat state.

The ability of SAF to reduce emissions compared to the use of traditional kerosene varies greatly depending on the type of feedstock and the transformation process: typical values are around 70% for biofuels derived from fats through the HEFA process (Hydroprocessed esters and fatty acids), the most widely industrially used today, and can reach 100% in the case of synthetic fuels produced with renewable energy.

At the current stage, for safety reasons linked to older generation jet engines still in use, SAF cannot be used 100% but they must be blended with conventional kerosene. To date the maximum fraction of SAF allowed by the regulations is equal to 50%, even though

newly designed engines that can be powered with neat SAF, without affecting flight safety, are already in use.

The European regulation "RefuelEU Aviation" will introduce the obligation of a minimum share of SAF available at all airports of the European Union

THE EUROPEAN REGULATORY FRAMEWORK

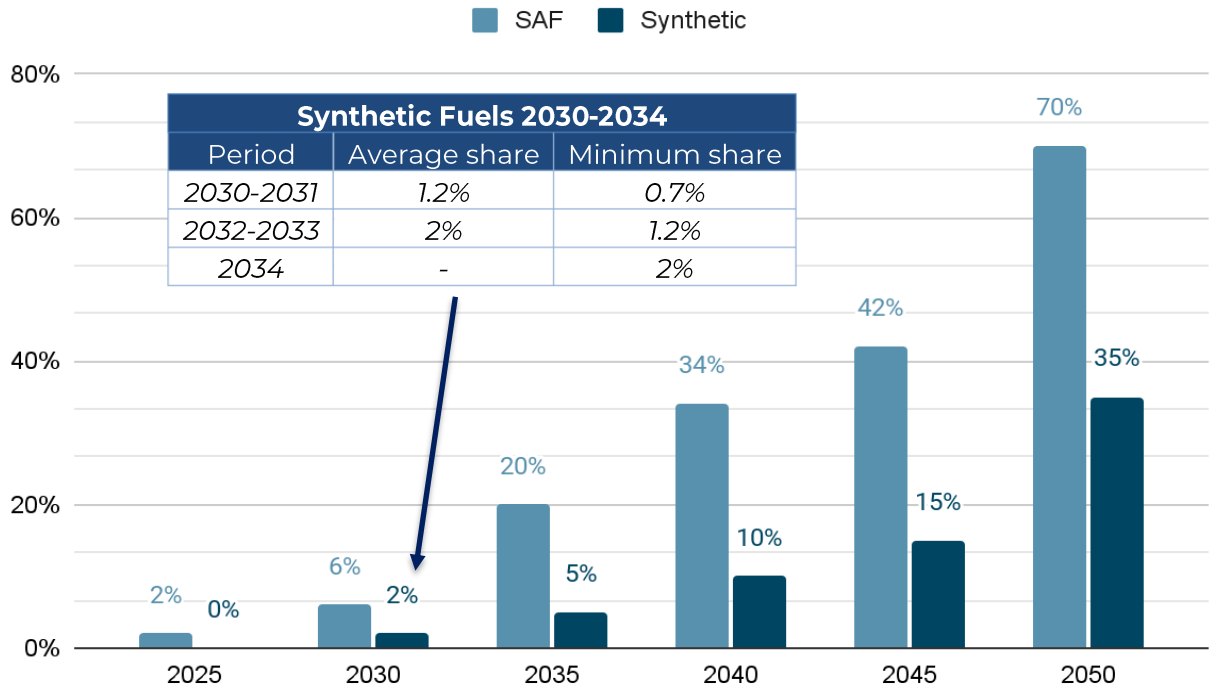
Since the cost of SAF is now very high compared to that of conventional fuel, mainly because of its low availability on the market, several countries in the world have already introduced policies to accelerate its production and spread, mainly through national mandates, that is by imposing minimum supply shares for SAF to fuel producers.

In 2021, a process was launched in Europe to create a level playing field within the Union through the proposed "RefuelEU Aviation" regulation, which is expected to come into force by the end of 2023.

The main regulatory elements introduced by the "RefuelEU Aviation" are the minimum shares of SAF, which fuel producers will have to provide to European airports, and the obligation for aircraft operators - European and extra-European - departing from any airport within EU to refuel at that airport for at least 90% of the fuel need related to the route to be covered.

This second measure, in addition to ensuring that each aircraft operator takes on the share of SAF available at each airport, also serves to counter the practice of tankering, which can give the operator economic advantages but also involves an increase in consumption and therefore in emissions.

The minimum shares of SAF introduced by the "RefuelEU Aviation" are represented in Picture 2 and, as observable, apply both to all SAF and to the subcategory of synthetic fuels. These constraints, which will come into force from 2025, will impose by law the use of SAF and will result in an important boost to the fuel market, also affecting sectors other than Air Transportation.



Picture 2. Minimum shares of SAF and synthetic fuels introduced by the "RefuelEU Aviation"

In addition to the dominant role of SAF in the above-mentioned regulation, the ETS (Emission Trading System) European Directive as amended by the Directive 2023/958 of May 2023 is worth to be mentioned as it introduces an incentive for aircraft operators using SAF. Through this measure, in fact, 20 million emission allowances will be reserved for airlines using SAF to cover part of the cost differential between these fuels and traditional jet fuel.

THE ITALIAN CONTEXT AND THE NATIONAL OBSERVATORY ON SAF

Starting from 2019, Enac has established a "National Observatory on SAF" with the aim of creating a technical board attended by institutions, such as the Ministry of Infrastructure and Transport (MIT) and the Ministry of Environment and Energy Security (MASE) and Italian stakeholders who have expressed interest in SAF.

As summarised in Picture 3, this group consists of Italian and foreign aircraft operators, airport management bodies, operators in the fuel supply chain (producers, distributors, and handlers), aircraft manufacturers, research bodies and trade associations.

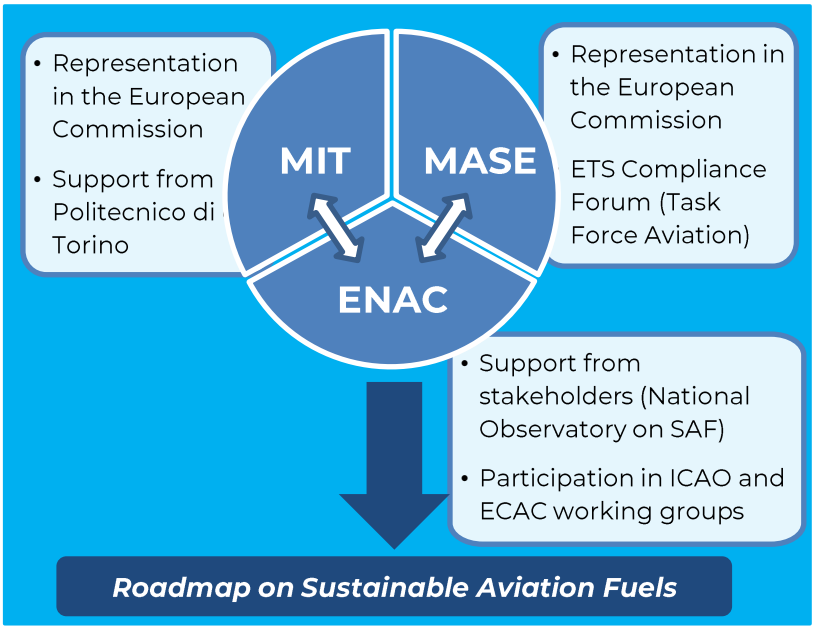
Picture 3. Map of stakeholders participating in the Enac National Observatory on SAF

Since its creation, the National Observatory on SAF has organised several technical meetings to define the needs of Italian stakeholders and identify the most shared strategies at national level, especially in view of the introduction of the Regulation "RefuelEU Aviation".

Through this initiative, Enac main objective is to provide institutional partners with a comprehensive framework that allows to elaborate the best policies to encourage the introduction of SAF in Italy, minimising the risk that increased costs could depress the demand for air transportation, resulting in a damage to the whole sector.

THE PROCESS FOR THE DEFINITION OF A SAF POLICY

Starting from 2022, Enac, in synergy with MIT, MASE and the stakeholders participating in the National Observatory on SAF, has set the goal of defining a "Roadmap on SAF in Italy", focusing on the study of possible incentive policies, with a consistent approach to the context defined by "RefuelEU Aviation".



All this happened in collaboration with the Ministry of Infrastructures and Transport which took advantage of the contribution of the Politecnico di Torino, in order to elaborate an agreed strategy to be then analysed by the policymaker.

The process of definition of the aforementioned roadmap was conceived by placing at the centre an open and constant confrontation with stakeholders, using as starting points the collection and the analysis of their point of view. To this end, starting from February 2023, Enac has launched a stakeholder engagement phase through the distribution of a questionnaire designed in a way consistent with the guidelines produced by international reference bodies such as ECAC (European Civil Aviation Conference).

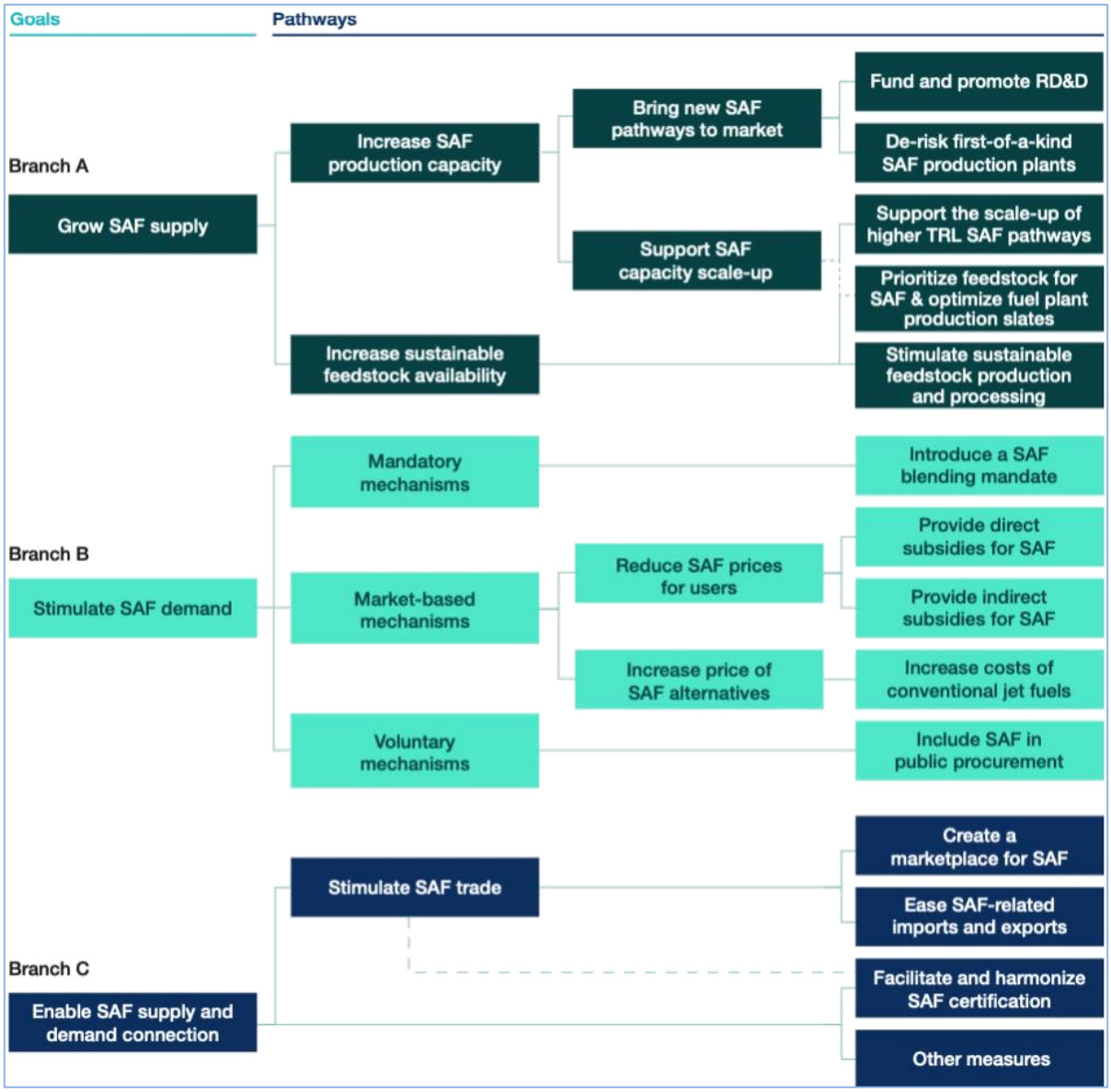
At the beginning of 2023, ECAC has indeed published, thanks to the contribution of Enac and the other Civil Aviation Authorities of each Member State, a guideline[4] for the definition of a SAF policy at national level, using examples of international validity such as those developed by ICAO or the World Economic Forum[5].

The classification of the policies introduced by the latter and then adopted by ECAC (Picture 4) has been taken up in the Italian context and inserted in a process of adaptation and simplification, in order to present to stakeholders an adequate number

[4] ECAC Guidance on Sustainable Aviation Fuels (SAF) – 1st Edition, 24 February 2023

[5] Clean Skies for Tomorrow Sustainable Aviation Fuel Policy Toolkit (World Economic Forum, 2021)

of options, accompanying them with impact indicators to be used as metrics for the evaluation of each policy.



Picture 4. SAF policy classification according to the World Economic Forum

Policies were then divided into 3 macro-groups:

1. policies suitable for the Italian context, including those already implemented or planned;

2. policies not suitable for the Italian context, because outdated or in conflict with other existing measures;

3. policies not belonging to previous groups.

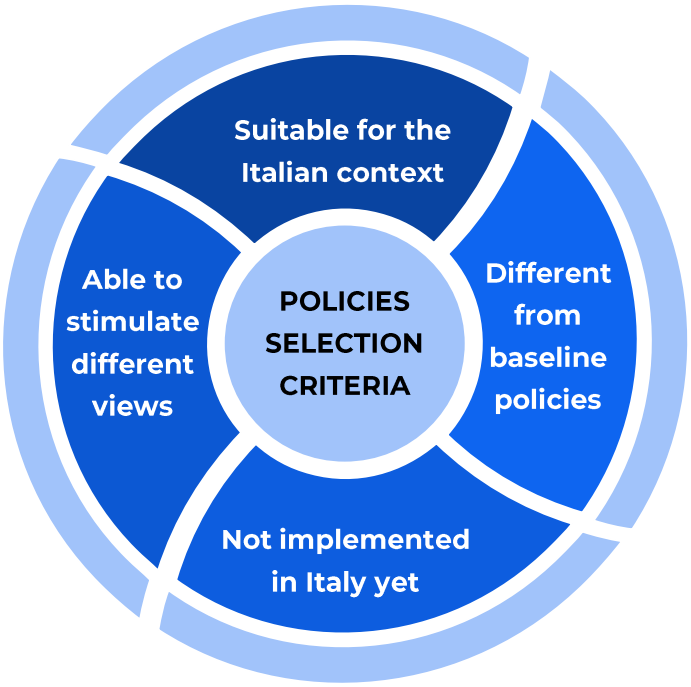
Group 1 policies were considered useful to build a baseline package and it was not considered a priority to require an evaluation by stakeholders. These are shown in Table 1.

A/PO1	Establish dedicated innovation funds or financing options to support early-stage SAF production pathways at lower technology readiness levels
A/PO4	Eligibility of SAF for tax advantages and blending or production incentives
A/PO5	Bonds/Green bonds
A/PO9	Recognize SAF benefits under carbon taxation or cap-and-trade systems
B/PO12	Update existing policies to incorporate SAF
B/PO14	Levy a dedicated SAF fee on flights to finance SAF acquisition, with possible variation accounting for flight distance and SAF blending target levels
B/PO15	Introduce a domestic carbon price or cap-and-trade mechanism, potentially aviation-specific, to price-in the cost of GHG emissions for fossil fuel
C/PO20	Adopt clear and globally or regionally recognized sustainability standards for feedstock supply
C/PO21	Support SAF stakeholder initiatives
C/PO22	Support the roll-out of existing SAF production technologies and international capacity building to developing countries to promote the adoption of SAF production globally

Table 1. Policy baseline from the ECAC guidance on SAF policy

Group 2 policies, not listed here for the sake of brevity, were excluded from the questionnaire, while Group 3 policies were included as being in line with the following criteria:

- ✓ sufficiently different from baseline policies;
- ✓ adaptable to the Italian context;
- ✓ able to stimulate different views among stakeholders;
- ✓ not implemented in Italy yet.



The proposed SAF policies concern:

- ✓ *investments in productivity*
- ✓ *tax relief for producers and/or operators*
- ✓ *distribution of SAF on the territory*
- ✓ *import of feedstocks*

SCALE OF IMPACT ASSESSMENT

5) strongly positive
4) slightly positive
3) negligible
2) slightly negative
1) strongly negative

The policies of the latter group were subjected to a process of adaptation and simplification that led to reduce the number to 10.

As Table 2 shows in detail, the policies cover various areas through the proposal of interventions aimed at attracting investment on SAF, creating new production plants, or expanding existing ones, introducing tax reductions for those who produce or use SAF, and facilitate the entry of feedstocks and the distribution of SAF on the territory.

A similar process has been adopted to define the impact indicators that can represent the expectations regarding SAF's production capacity, the economic impact on passengers, competitiveness among operators, energy independence, boost of research and public acceptance.

As summarised in Table 3, these indicators have been included in the questionnaire in the form of questions, expressing, for each of the 10 policies, a value from 1 to 5 on a quality scale of increasing impact.

P#	Policy description
P1	Attract **investments** on the production of SAF in Italy, guaranteeing to the investors that the **Italian government will pay the difference of market price** between SAF and conventional fuels (e.g.: using financial instruments like the contracts for difference) and recognising greater subsidies for SAF with lower carbon intensity
P2	Attract **investments** aimed at starting or increasing the production of SAF in Italy, by **providing investors with capital grants and loans** at reduced rates, with guarantee from the Italian State
P3	**Increase** the share of feedstocks and intermediate products destined for the production of SAF with **indirect measures**, based on incentives that push competing sectors towards decarbonisation solutions of different types (e.g.: electricity from renewable sources for road transport)
P4	Provide specific **tax incentives** for **SAF producers** with production facilities located in Italy (including blenders), establishing a proportionality to the cost differential between SAF and conventional jet-fuel (Note: a higher cost may be related to a lower carbon intensity)
P5	Provide specific **tax incentives** for **producers of feedstocks or intermediate products** for the production of SAF with facilities located in Italy, establishing a proportionality to the cost differential between SAF and conventional jet-fuel (Note: a higher cost may be related to a lower carbon intensity)
P6	Provide specific **tax incentives** for **users of SAF produced in Italy**, establishing a proportionality to the cost differential between SAF and conventional jet-fuel (Note: a higher cost may be related to a lower carbon intensity)
P7	For both producers and users of SAF produced in Italy, assign **additional tax incentives** that reward the **lower carbon intensity** of SAF, taking the benefits related to both lower CO_2 and non-CO_2 emissions (e.g.: air quality, contrails, NOx, etc.) into account
P8	Guarantee the **commitment of the Italian government** towards the use of SAF through political declarations indicating **ambitious objectives** (e.g.: minimum SAF shares higher than the European targets)
P9	Establish **a transfer system of purchase certificates** of SAF produced in Italy (e.g.: national level book and claim), favouring the growth of the market of the SAF in the Italian airports
P10	**Reduce import barriers** for feedstocks and intermediate products intended for SAF production in Italy (e.g.: reduce the current restrictions on imports of agricultural, plant, chemical and waste products if they are intended for the production of SAF)

Table 2. SAF policy included in the questionnaire for the stakeholders

Q#	"At the Italian level, what kind of impact may have the evaluated policy on…
Q1	…the increase in the **share of feedstocks or intermediate products** destined for the production of SAF?"
Q2	…the increase of the total **production capacity** of SAF?"
Q3	…**the expansion of existing SAF production facilities** and the creation of new ones?"
Q4	…the choice of feedstocks and production pathways with **lower carbon intensities**?"
Q5	…the mitigation of the increase of **SAF cost** compared to conventional fuels?"
Q6	…the mitigation of the increase of the **ticket cost** for the passenger?"
Q7	…the initiation or expansion of SAF **research and development** activities?"
Q8	…reducing the **dependence of the Country** on energy imports?"
Q9	…the guarantee of a **level playing field** among competitors (producers, distributors, users, etc.)?"
Q10	…**citizens' awareness** of the efforts undertaken by the aviation sector towards environmental sustainability objectives?"

Table 3. Questionnaire regarding impact indicators for policies assessment

The questionnaire was sent to the participants of the above-mentioned technical board and requests for expressions of interest were published via Enac website and social channels, in order to extend the invitation to all organisations potentially interested.

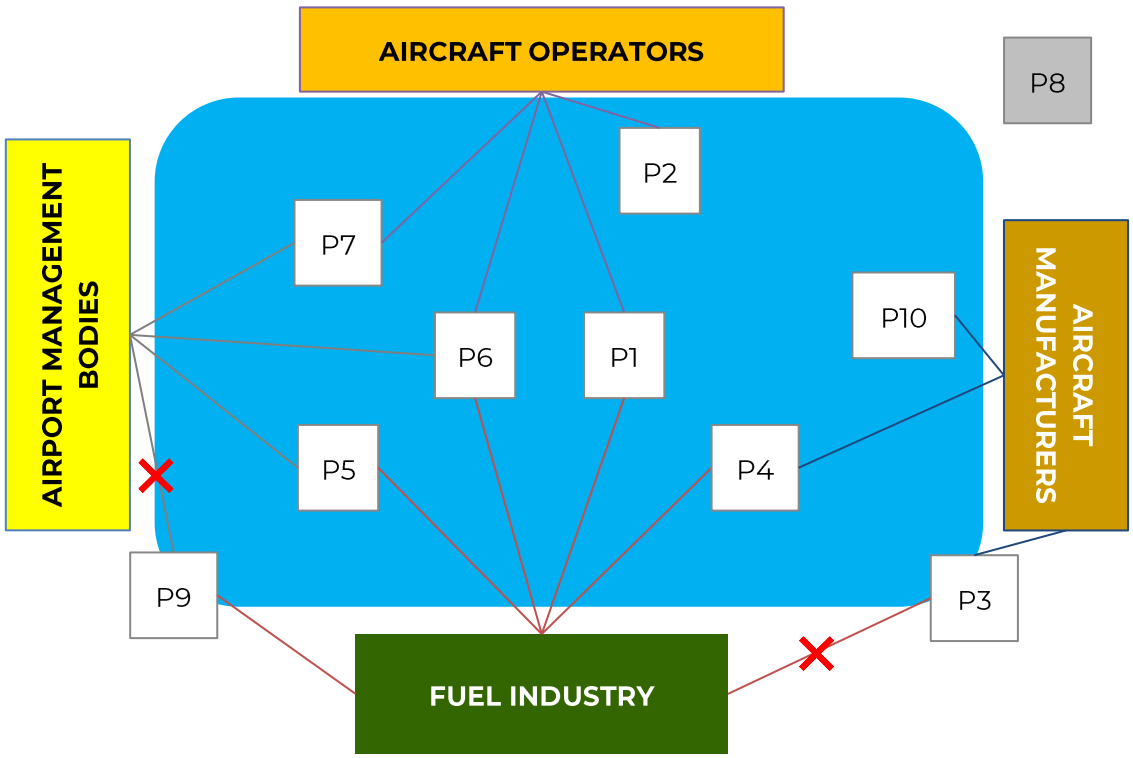
During the data collection period, out of 60 organisations contacted, 48 replied to the questionnaire, including 7 airport managing bodies, representing an overall view of about 70% of national air traffic in terms of number of passengers, 19 air carries operating in Italy, the main companies of the fuel production-distribution-handling industry, the major aircraft manufacturers operating in Italy, as well as research institutions and universities.

The data collected have highlighted many common aspects among the views expressed by the different stakeholder groups, summarised as follows:

- ✓ the approval of the policies has been driven mainly by the following expectations:
  - increase in the share of feedstocks or intermediate products destined for the production of SAF;
  - increase in the total production capacity of SAF;
  - expansion of existing SAF production facilities or creation of new ones;
- ✓ among the policies, the most appreciated is the one concerning the introduction of tax incentives for the use of SAF produced in Italy by aircraft operators (policy 6);

- ✓ many stakeholders would like to see additional incentive measures such as additional tax relief for producers of SAF (policy 4) and feedstocks (policy 5), tax-related rewards for those who choose to produce or use SAF less polluting than others (policy 7) and incentives to attract investments in the production chain (policy 1, in particular);
- ✓ a further fact that unites the vision of the subjects interviewed is the scepticism towards any more ambitious national policies than those set at European level by the "RefuelEU Aviation" (policy 8).

The "policies scenario" illustrated in Picture 5 provides a simplified graphic representation of the above.



Picture 5. "Policies scenario": at the centre of the table those deemed most suitable by stakeholders

In addition to what has already been said, Picture 5 shows that policy 3, relating to measures to push other transportation sectors towards means of decarbonisation not competing with SAF (electricity, for example) and policy 9, on a certificate transfer system (see book & claim, for instance), were considered partially appropriate by the actors in the fuel industry and by airport management bodies, respectively.

On policy 3, the reason for the scepticism lies on the fact that the production of fuels in refineries cannot take place with a siloed approach with respect to the different transportation sectors.

For policy 9, there is a dread whether a system similar to book & claim, that removes the constraint for aircraft operators to refuel at all airports, would slow down the distribution of SAF on the national territory. In this regard, it should be noted that a system of transfer of certificates will be subject to evaluation by the European Commission in order to be included in the flexibility mechanism provided by the "RefuelEU Aviation". The outcome of this assessment is expected by July 2024.

Final Remarks

The results of the questionnaire have been discussed with stakeholders within the 6th technical meeting of the National Observatory on SAF, held in July 2023, confirming that the priorities lie in the need to stimulate the production, encouraging the activation of economies of scale that lead to a reduction of the current cost differential between such fuels and the traditional ones.

As the introduction of SAF today faces major obstacles from the low availability of finished products on the market and from the difficulty of sourcing feedstocks, Enac has included among its priorities the initiation of an even more direct dialogue with the industry, which includes a further in-depth analysis aimed at defining a common strategy for the country.

While maintaining the general principles of fuel sustainability represented by the Sustainability Criteria defined by ICAO, Enac highlights how it is urgent and necessary to address the lack of availability of SAF on the market through a holistic approach that does not place disproportionate limitations on possible feedstocks and transformation processes.

More specifically, Enac believes that the most appropriate strategy to be implemented in the short term to bridge the production gap of SAF compared to the needs of the air

transportation sector, must envisage not to restrict feedstocks to production waste only, and must therefore be directed towards the use of biofuels obtained from biomass produced through dedicated crops, such as intermediate crops or those derived from degraded land or otherwise unsuitable for agriculture, in compliance with the criteria of non-competition with food and feed crops as defined by RED[6]. In this sense, Enac has initiated a useful dialogue with the national production industry that not only has the know-how for the technologies referred to but has also proved ready to operate toward this goal.

This strategy would create immediate benefits for the sector in terms of the availability of sustainable fuels and, at the same time, would fully include the emerging countries that, contributing to the development of the production chain in the international air transportation system, would become leaders of the change towards green aviation. Such productions could take place, in fact, in those countries that today are at the centre of capacity building programmes, strongly wanted by ICAO as in the case of the ACT-SAF, and financed not only by Member States but also by the European Commission. The implementation of these activities would thus lead to the inclusion in a virtuous circle of countries that today can be feedstock suppliers but do not have the necessary technologies to enter the production chain.

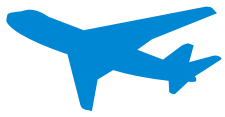
In conclusion, from this preliminary investigation emerges that it is useful and necessary to act at national policy level in order to encourage the introduction and the increase of SAF according to guidelines that meet the needs of stakeholders.

At the same time, and as a priority, this study highlights the need and opportunity to implement as soon as possible a virtuous strategy of national production of SAF from biomass, which can easily be integrated into the international context in a consistent manner with the approaches identified by both the European Union and the United Nations Organization.

ACKNOWLEDGEMENTS

Enac thanks the authorities and people who have contributed to this study by their participation in the activities of the National Observatory on SAF and in the questionnaire on SAF policy.

[6] Renewable Energy Directive 2018/2001/EC, Art. 2, § 2, point 40



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