Ente Nazionale per l'Aviazione Civile
Italian Civil Aviation Authority

A ROADMAP FOR SUSTAINABLE AVIATION FUELS IN ITALY

Enac path for the definition of SAF policy

A roadmap for Sustainable Aviation Fuels in Italy

Enac path for the definition of SAF policy

Enac – Italian Civil Aviation Authority

Department of Environment and Sustainable Mobility

Via Gaeta 3, 00185 Roma

ambiente@enac.gov.it

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FOREWORD

The fight against climate change requires immediate actions, as numerous events now testify to the planet's suffering, primarily caused by human activities.

Every energy-intensive sector must contribute to protecting the environment and air transportation has long been committed to sustainable mobility solutions, actively participating in international forums on this issue.

Although air transportation accounts for about 3% of global greenhouse gas emissions, hence its impact is relatively small, reducing emissions in aviation is challenging due to the sector's stringent performance and safety requirements.

The aeronautical industry addresses sustainability at both the ground infrastructure level, focusing on energy transition interventions at airports, and in the direct emissions caused by air traffic.

While infrastructure can leverage mature technologies from the construction and energy production sectors, air traffic must rely on developing solutions, which carry greater economic and financial uncertainty.

In this context, Enac, the Italian Civil Aviation Authority, has identified three main lines of action:

- Transitioning from traditional fossil fuels to Sustainable Aviation Fuels (SAF);
- Implementing energy transition in airport infrastructures;
- Developing intermodality and advanced air mobility models.

This document focuses on the first point, offering a work plan for policymakers to foster the development of a SAF market in Italy. These policies result from ongoing dialogue between Enac and stakeholders, including aircraft operators, airport managing bodies, fuel producers and distributors, aircrafts manufacturers, research organizations, universities, and trade associations.

According to the International Civil Aviation Organization (ICAO), SAF represents the most promising solution for achieving net-zero greenhouse gas emissions.

Other technologies, such as hydrogen or electric propulsion, are still under research and development and are not yet ready for safe and large-scale implementation. Consequently, many manufacturers have postponed including hydrogen engines in their business plans (see example reference in bibliography [1]).

In contrast, SAF are already certified for aeronautical use and are compatible with current aircraft technology.

It is therefore necessary and appropriate to prioritize SAF as a drop-in fuel that can be used in existing aircraft. Pending the concrete realization of engines that can be powered by other "cleaner energies" - which will be better developed in the future, but today cannot be exploited on a large scale for operators' needs - the approach based on SAF allows an immediate and effective response to the request to reduce CO2 emissions of air transportation.

Using Sustainable Aviation Fuels (SAF) allows for the combination of environmental and economic sustainability. In the pursuit of an essential energy transition, it is crucial that the air transportation sector is not burdened to the point of economic decline.

The adoption of SAF enables the energy transition in air transportation to be achieved today, without disproportionately impacting the market relative to the sector's actual global contribution to CO2 emissions.

However, SAF is still produced in limited quantities (about 0.2% of global needs), leading to high costs (3-7 times higher than conventional jet fuel). Therefore, the full involvement of fuel manufacturers is crucial in this transition, a point reiterated by Italy and Enac in national and international forums.

Italy, through Enac and in collaboration with the Ministry of Infrastructures and Transport, and the Ministry of the Environment, actively participates in international debates to identify strategies for increasing SAF production and usage, thereby reducing the cost differential with traditional jet fuel.

This approach aims to reconcile air transportation with environmental sustainability without causing a counterproductive reduction in the sector, which is vital for global economic and cultural exchanges.

In line with this energy transition goal, Enac presented a feasible short-term proposal at the ECAC meeting in Malta in September 2023, attended by the Directors General of the European Civil Aviation Authorities. This proposal aimed to bridge the SAF production gap and was based on using biomass.

The proposal sparked significant debate in Europe, with some comments being incorporated into the documentation Europe submitted to the CAAF/3, the 3rd ICAO Conference on Alternative Aviation Fuels held in Dubai in November 2023 (see footnote 2). At this conference, the Italian delegation, led by the President and Director General of Enac - mandated by the Minister of Infrastructures and Transport - reaffirmed the strategy of using SAF to reduce aviation environmental impact, in line with the actions identified at European level.

Italy's approach highlights the primary role of biological feedstock, not limited to waste but including all non-food-or-feed biomass, in producing SAF through sustainable and technologically mature processes for large-scale production.

This position is supported by ongoing dialogue with the national production industry, which is ready to contribute to promoting SAF from biomass. The strategy involves a productive synergy with SAF producers, particularly at the national level, and with African countries, which could benefit from entering this virtuous production cycle aimed at the energy transition of international air transportation.

Summary

This document outlines the path taken by Enac to develop a national roadmap for Sustainable Aviation Fuels (SAF), in anticipation of the upcoming European RefuelEU Aviation Regulation. Starting in January 2025, this regulation will mandate minimum shares of SAF supply at European Union airports.

Enac's roadmap is the result of an investigation based on open and continuous dialogue with stakeholders, initiated in 2019 within the National Observatory on SAF.

The investigation involved two questionnaires focusing on potential policies to facilitate SAF development in Italy and related implementation measures. Participants in these questionnaires included entities operating in Italy, such as aircraft operators, airport managing bodies, aviation fuel producers, distributors and handlers, aircraft and subsystem manufacturers, universities, and research bodies.

The investigation method was derived from the "ECAC Guidance on Sustainable Aviation Fuels," with solutions tailored to the Italian context. The general objective, aligned with stakeholder feedback, was to establish a balanced and stable framework for SAF market development in Italy.

With a response rate exceeding 80%, the survey results helped identify key action lines to achieve specific goals: increasing SAF supply and demand, improving supply-demand connections, ensuring feedstock availability, and complying with the RefuelEU Aviation Regulation. These action lines were then linked to prioritized implementation measures, resulting in a structured three-year roadmap and implementation plan.

The document also provides a comprehensive overview of the current national and international SAF context and future development strategies. It emphasizes the alignment of these strategies with national interests and the relations with foreigner institutions in the matter of environment and air transportation.

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.

1 Introduction

1.1 Air transportation emissions and the role of SAF

According to data from the European Environmental Agency for Europe, in the last three decades the share of atmospheric emissions (CO2 and non-CO2) attributed to air transportation in the total of those produced by all sectors has increased from 1.2% to 3.7% ([2]).

With the arrival of the COVID-19 pandemic, this figure was reduced sharply, and then grew as traffic volumes resumed. The latest estimates released by Eurocontrol, also taking the effects of the war in Ukraine into account, predict that the return to pre-pandemic levels will take place during 2024 ([3]).

To better understand the environmental impact caused by air transportation, it is important to consider two additional aspects:

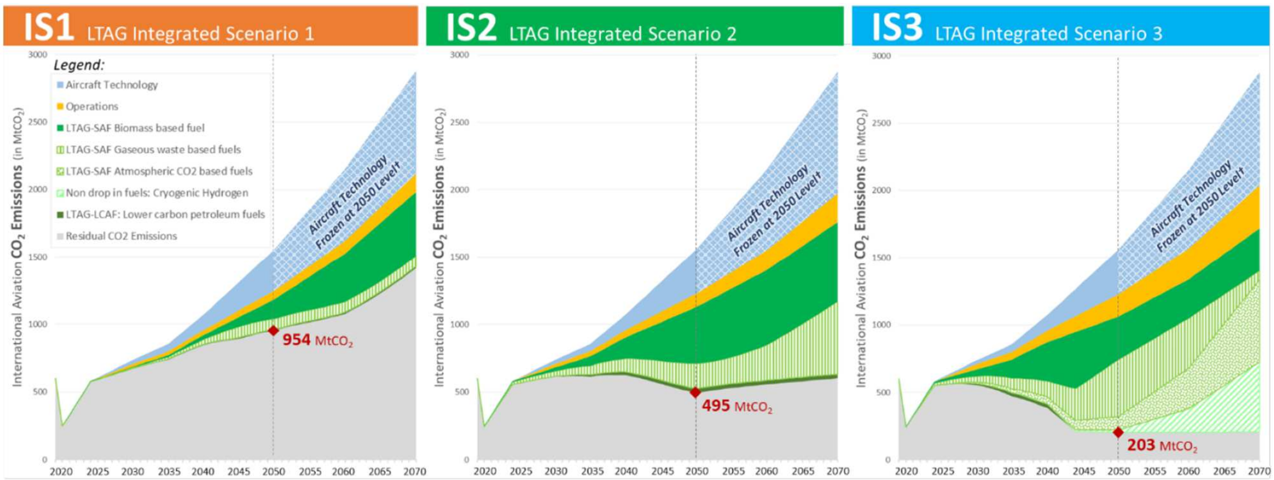
- when expressing the emissions of air traffic solely within the transport sector, the associated share becomes more significant, reaching approximately 13% in the pre-pandemic period;
- over the past three decades, a period of substantial growth during which air travel has become accessible to a broader public, other sectors such as energy production, manufacturing, agriculture, and waste disposal have experienced reductions in emissions ranging from 20% to 40%. In contrast, air transportation has seen an increase, together with marine transportation, another sector with hard-to-abate emissions, albeit to a lesser extent than the aviation sector.

This context provides the rationale behind the commitments made by institutions and industry at both international and national levels to achieve "net-zero emissions." This condition means that emissions produced throughout the entire lifecycle of a product - including the operational phase, production phase, and, where applicable, disposal - are zero.

Applying this concept to aviation fuels has led to the development of Sustainable Aviation Fuels (SAF), which are non-fossil hydrocarbons that offset a significant portion of the emissions produced during combustion with those absorbed during production.

The International Civil Aviation Organization (ICAO) report on achieving a Long-Term Global Aspirational Goal (LTAG) for CO2 emissions reduction ([4]), outlines future scenarios where, despite continued growth in air traffic, emissions can be reduced. This reduction is achieved through a combination of factors, such as reduced fuel consumption by airplanes, more efficient flight procedures, and, most importantly, the introduction of sustainable fuels.

As depicted in Figure 1, these integrated scenarios, labelled IS1, IS2, and IS3 and arranged by increasing levels of ambition and investment, illustrate the potential impact of SAF in achieving the goal of reducing CO2 emissions.



† Caution required with the interpretation of absolute CO_2 emissions levels after 2050 due to modelling assumptions e.g., frozen aircraft technology after 2050. Under these assumptions, CO_2 emissions are higher than in an alternative scenario (and modelling approach) where aircraft technology would continue to improve after 2050.

Figure 1 . "Integrated Scenarios" (IS) elaborated in the ICAO LTAG Report ([4])

As seen in Figure 1, green areas refer to different types of SAF. In accordance with the classification adopted in Europe, summarized in Figure 5 , SAF can be distinguished into:

- **synthetic fuels**, also called e-fuel or RFNBOs (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 CO2;
- **biofuels**, mainly derived from biomass, animal or vegetable fats or organic waste;
- **recycled carbon fuels**, waste substances with a high carbon content - produced unintentionally and not otherwise disposable - from industrial processes (for example, waste gases from blast furnaces).

These products, though diverse, share the common characteristic of not requiring the extraction of hydrocarbons from underground oilfields. Instead, they recycle organic compounds already present in the atmosphere or in substances that have previously absorbed them, such as biomass.

The emission reduction potential of SAF, compared to traditional kerosene, varies significantly based on the type of feedstock and the processing pathway. Typical reduction values are around 70% for biofuels derived from fats using the HEFA process

(Hydroprocessed Esters and Fatty Acids), which is currently the most widely used industrial method. Emission reductions can reach 100% for synthetic fuels produced with renewable energy.

At present, for safety reasons related to older generation jet engines still in use, SAF cannot be used at 100% concentration and must be blended with conventional kerosene. Currently, regulations permit a maximum SAF fraction of 50%. However, newly designed engines that can operate on neat SAF without compromising flight safety are already in use.

1.2 SAF IN THE INTERNATIONAL CONTEXT

It is impossible to discuss Sustainable Aviation Fuels (SAF) without placing the debate in an international context.

Aviation is a sector where considerations often extend beyond national borders, primarily due to flight safety regulations and the geographical reach of air transportation.

As described below, the debate occurs at various levels, from national to global, including regional scales such as European and other intermediate levels.

Before delving into the details of how these levels interact and their connections, it is essential to highlight Italy's activities first within ECAC[1] and then at CAAF/3, the 3rd Conference on Alternative Aviation Fuels, organized by ICAO in November 2023 in Dubai.

Italy, through Enac, has advocated for prioritizing technologically mature solutions, emphasizing the use of SAF over other cleaner energy sources like hydrogen or electric propulsion. Additionally, Italy has promoted the use of biomass as a primary feedstock for SAF production over other potential sources.

This approach, focused on the practical implementation of the energy transition in air transportation, was represented by Enac during the CAAF/3 debate and it was preceded by a preparatory phase characterized by discussions with other EU and ECAC countries. This collaborative effort led to the presentation of a paper, endorsed by all states in the European Region (EU and ECAC), incorporating the main elements of Italy's position within the broader European vision for aviation decarbonization[2].

[1] Founded in 1955 as an intergovernmental organisation, the European Civil Aviation Conference (ECAC) aims to harmonise civil aviation policies and practices between its Member States. ECAC's mission is to promote the continued development of a safe, efficient and sustainable European air transportation system.

[2] Document CAAF/3 -WP/19 - point 3.3 - presented by EU Presidency (Spain at that time) and ECAC. In the mentioned document, in line with the claims made by Enac, it is stated that: *"SAF can be used already today given its compatibility with existing in-service aircraft. SAF use will continue in long-term considering the*

It should be pointed out here that the international debate on SAF has taken place, and is taking place, mainly within the framework of the ICAO, the UN Agency headquartered in Montreal, whose main task is to define standards of international validity for civil aviation. To date, there are 193 ICAO member countries, supported by more than 100 organizations in the role of observers, and in its Council, there are 36 countries, including Italy.

The ICAO body responsible for environmental issues is the Committee on Aviation Environmental Protection (CAEP), whose structure is composed of a governing body with decision-making powers, to which today belong 31 representatives of Member States including Italy, and to which refer 11 technical working groups, composed of experts from both institutional bodies and industry. The work of the CAEP is organized in three-year cycles and today we are in the 13th cycle, covering the period 2022-2025.

Issues relating to the environmental impact of alternative fuels are being studied mainly within the Fuel Task Group (FTG), which over the years has drawn up important reference documents for the sector. Among these, the most important are the already mentioned LTAG report ([4]), which provides forecasts on the possible future scenarios and the potential impact of new aeronautical technologies, efficiency of operations and alternative fuels (see Figure 1) and documents relating to Volume IV of ICAO Annex 16 on the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) programme. Although the latter does not deal exclusively with alternative fuels, the documentation produced for its implementation provides the internationally recognised requirements to be able to demonstrate the sustainability of fuels and quantify the positive impacts on the environment ([5]).

This paragraph deliberately refers to alternative fuels instead of sustainable fuels, as the ICAO's vision must necessarily be as broad as possible and not limited to SAF but cover all possible "*aviation cleaner energies*". In addition to forms of power currently in the research and development phase such as electric and hydrogen-based, "*aviation cleaner energies*" include the so-called *Lower Carbon Aviation Fuels (LCAF),* fuels of fossil origin produced in a less impactful way than in the traditional methods of manufacturing (for example by capturing the CO2 emitted).

long operational life of aircraft and that hydrogen and electric propulsion for commercial aviation is still at the stage of research and development. It is therefore important that air transport has the access to the sustainable natural resources for SAF production and that the ongoing work towards certification of use of 100% SAF is pursued. Sustainable biofuels can provide an immediate response for deployment given their technology and commercial maturity and opportunity to use the existing refining capacities."

The simplified schemes in Figure 2, Figure 3 and Figure 4 show the origin of greenhouse gas emissions over the entire life cycle (life-cycle emissions) from conventional fuels, LCAF and SAF, expressed in CO2 equivalent (CO2eq) to take into account both CO2 and other substances such as methane and nitrogen oxides.

During 2023, ICAO, through intense work by the Climate and Environment Committee (CEC), the CAEP and the FTG, produced a path for the definition of a "*Global Framework for SAF, LCAF and other Aviation Cleaner Energies*". This path culminated in the CAAF/3, the third conference on alternative fuels for aviation organized by ICAO in Dubai in November 2023, which resulted in a common vision of 4 building blocks, whose main objectives are listed below and come from [6]:

1. *Policy and Planning*: in the context of the ICAO *Long-Term Global Aspirational Goal*, the aim is to reduce international aviation CO2 emissions by 5% by 2030 through the use of SAF, LCAF and other "Aviation Cleaner Energies" with respect to levels that would occur without the use of these;
2. *Regulatory Framework*: the aim is to recognize the set of rules and standards of CORSIA as a common basis for the eligibility of sustainable fuels;
3. *Implementation Support*: the aim is to ensure that all States can participate in the development and production of alternative fuels, promoting and facilitating the transfer of technology and knowledge;
4. *Financing*: the aim is to make operational the ICAO Finvest Hub, a matchmaking platform designed to connect alternative fuel projects with investment funds.

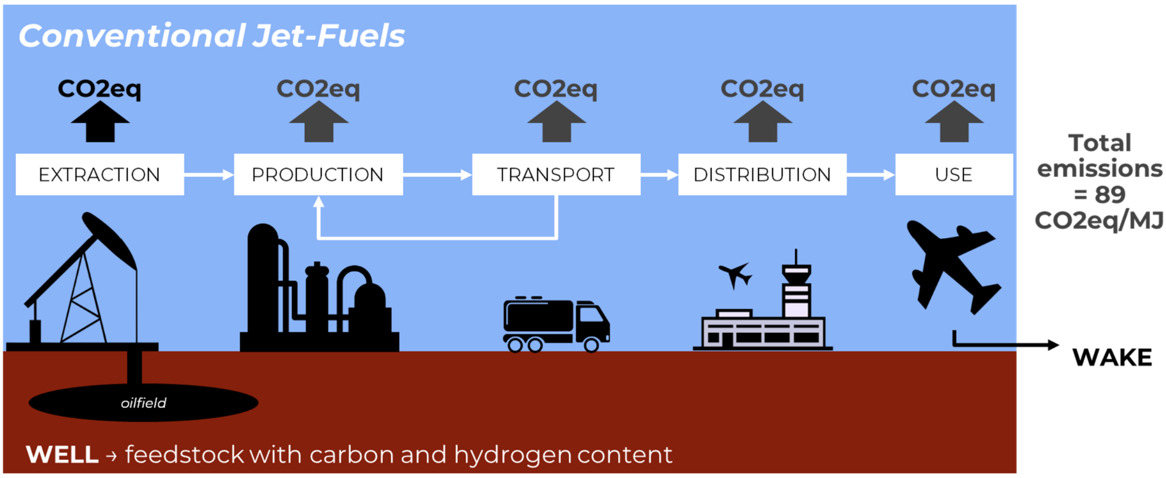


Figure 2 . Life cycle emissions scheme for conventional jet-fuels (CJF)

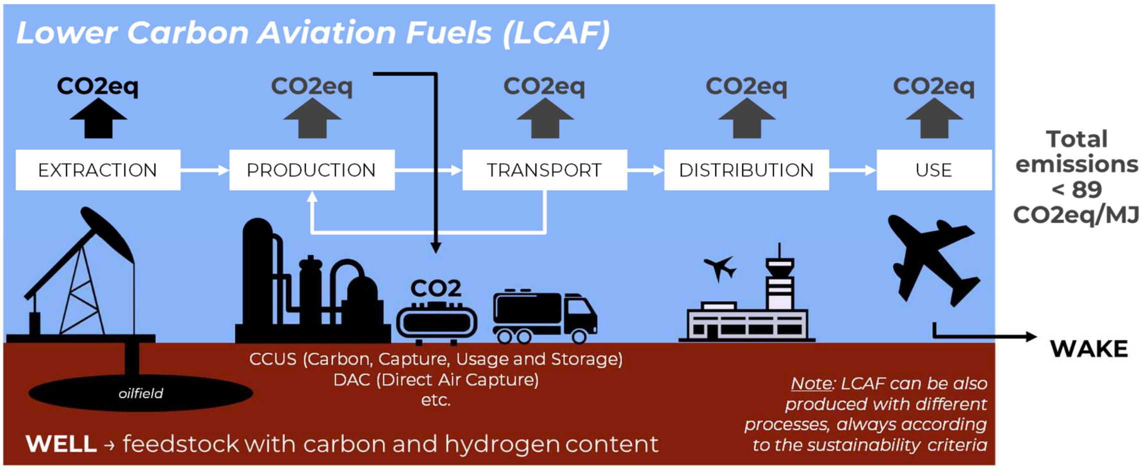


Figure 3 . Life cycle emissions scheme for lower carbon aviation fuels (LCAF)

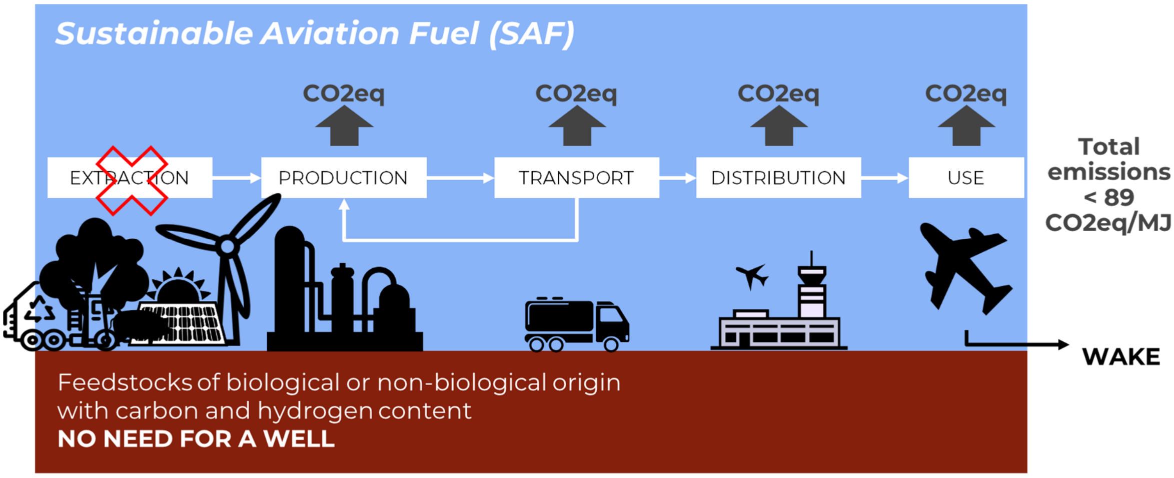


Figure 4 . Life cycle emissions scheme for Sustainable Aviation Fuels (SAF)

In this context, Europe, as well as Italy, has contributed to the discussion both by participating in the work of ICAO and in similar European bodies. As the CAEP is the ICAO body responsible for the environment, so the European Aviation and Environment Working Group (EAEG) focuses on environmental issues within the ECAC (European Civil Aviation Conference) which comprises 44 countries including EU Member States, United Kingdom, Switzerland, Turkey, Norway, Iceland, Ukraine and others.

The European policy on sustainable aviation fuels has placed its ambition at the highest levels, both in terms of the share of sustainable fuels to be introduced and in terms of their sustainability, that is the ability to reduce greenhouse gas emissions throughout the life cycle.

For example, whereas ICAO includes LCAF in the CORSIA and sets the minimum CO2eq emission reduction at 10% for fuel eligibility, European rules exclude any fossil fuel and introduce a minimum threshold of 70% in most cases and in no case less than 50% (see Figure 5).

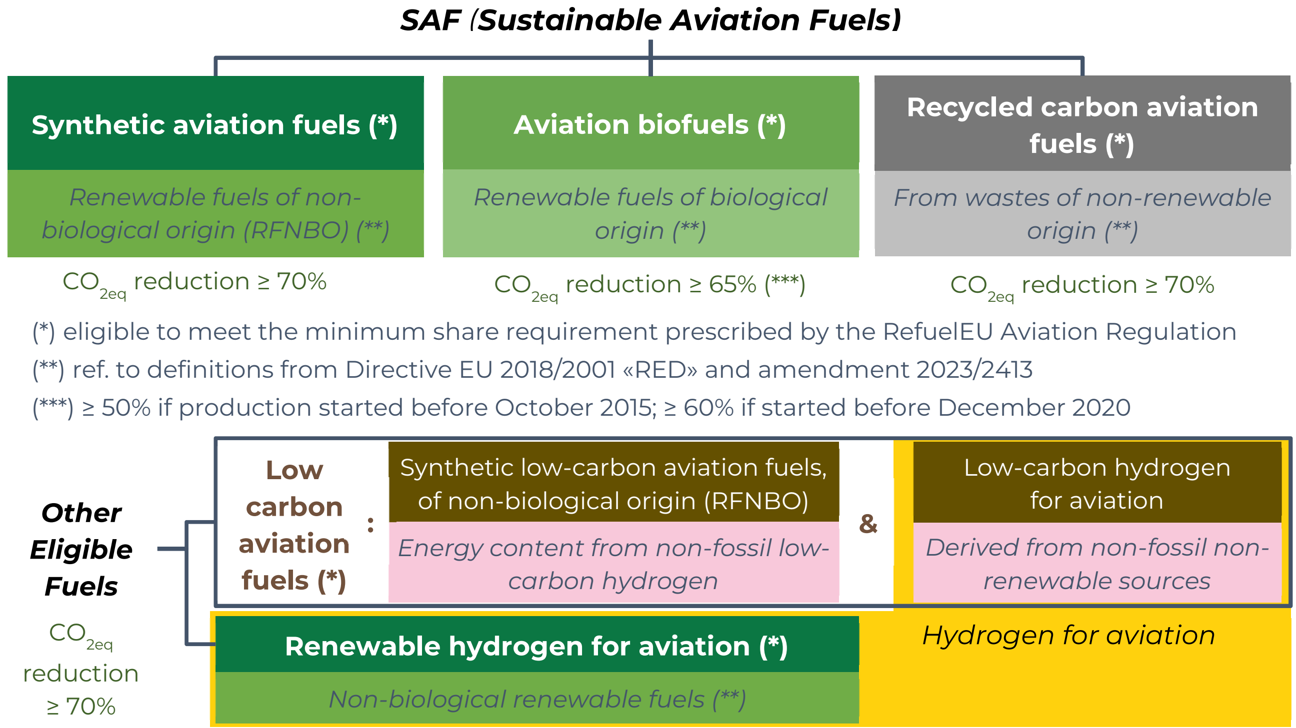


Figure 5. Classification of alternative fuels according to the RefuelEU Aviation Regulation[3]

In accordance with Regulation (EU) 2023/2405 "of the European Parliament and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transportation" ([7]), short RefuelEU Aviation, Figure 5 shows the classification adopted in Europe and the minimum thresholds of CO2eq reduction for each category.

As can be seen in Figure 5, the feedstocks that can be used do not include petroleum derivatives, while it is possible to use hydrogen, both if produced from renewable sources, commonly called "green" hydrogen, and from non-renewable sources provided that they are non-fossil, also known as "pink” hydrogen, as in the case of hydrogen produced using nuclear energy.

The RefuelEU Aviation Regulation is just one of the reforms included in the package "Fit-for-55", a group of 12 measures promoted by the EU to combat climate change with the objective of reducing greenhouse gas emissions in all sectors by at least 55% by 2030 compared to 1990 levels.

[3] Please note that the “Low carbon aviation fuels” indicated in the RefuelEU Aviation Regulation differ from the *Lower Carbon Aviation Fuels* (LCAF) defined by ICAO, which are obtained from fossil sources

The reform package "Fit-for-55" is represented in the images of Figure 6 , in which the column highlighted in light blue refers to the most relevant measures for the air transportation sector.

The first of these is the Renewable Energy Directive - RED (v. [8]), which defines the requirements for feedstocks used to produce SAF and the methodologies for the Life-Cycle Assessment of fuels, in other words, the assessment of their environmental sustainability. Therefore, RED is the main pillar of the RefuelEU Aviation Regulation.

The second is the Emissions Trading System (ETS) Directive, v. [9], which establishes a scheme for the trading of greenhouse gas emissions allowances in the sectors of air and maritime transportation, and stationary installations. The ETS introduces a cap-and-trade mechanism to link emissions produced or avoided to cost or revenue items, respectively. This Directive is of particular importance for SAF since, as required by Directive 2023/958, in the period 2024-2030, up to 20 million allowances will be allocated to aircraft operators using non-fossil fuels.

The most relevant regulatory aspects for SAF contained in the RefuelEU Aviation Regulation and in the RED and ETS Directives are reported in greater detail in paragraph 1.3.

Completing the European framework there are some important initiatives taken by the European Commission to support the introduction of the RefuelEU Aviation Regulation and more generally the Fit-for-55 package. Those of interest to the aviation sector are:

- the Renewable and Low-Carbon Fuels Value Chain Industrial Alliance - RLCF, whose main purpose is to build a pipeline of industrial projects aimed at encouraging the production of sustainable fuels for aviation and maritime transportation;
- the Alliance for Zero Emission Aviation, whose task is to lay the foundations for the future introduction of electric and hydrogen-powered aircraft;
- The "European Clearing House for Sustainable Aviation Fuels (SAF)", an initiative managed by EASA that aims to identify, by means of public tender ([10]) subjects able to support the certification of SAF deriving from feedstocks and production processes not yet included in the certified paths.

Figure 6 . "Fit-for-55" package reforms (source: European Commission)

At an intermediate level between ICAO and ECAC, the International Aviation Climate Ambition Coalition (IACAC), which includes most of the ECAC members, USA, Canada, Mexico, Dominican Republic, New Zealand, South Korea, Kenya, Ivory Coast, Morocco and other countries from all continents for a total of about 60. In accordance with its constituent act ([11]), the objective of the IACAC is to cooperate with ICAO and other organisations to achieve net-zero carbon emissions related to the air transportation sector by 2050.

1.3 THE REGULATORY FRAMEWORK

ICAO's projections for the IS1, IS2 and IS3 LTAG scenarios, previously introduced in Figure 1, contain detailed estimates of the alternative fuel allowances underlying them and the emission cuts related to them. These data from [12] are detailed in Figure 7.

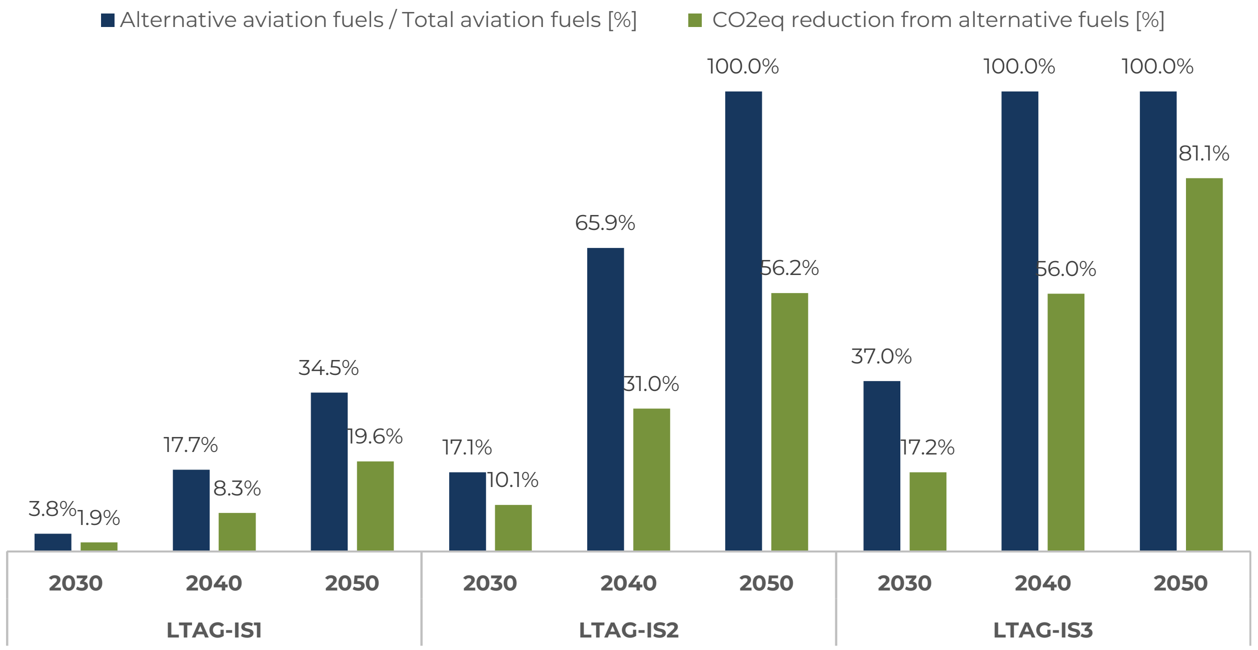


Figure 7 . Share projections of alternative fuels and emission reductions (data from [12])

Looking exclusively at 2030 in the IS1 scenario, based on the assumption that the spread of SAF is driven more by the market than by the push of energy transition, the share of alternative fuels is equal to about 3.8% of the world's jet-fuel needs. This fraction rises to 17.1% and 37% if we consider respectively the IS2 and IS3 scenarios, in which it is assumed that the push of energy transition has a gradually increasing weight.

To have a more concrete idea about the challenge behind the IS1 figure for 2030, it is sufficient to note that today the worldwide availability of SAF is less than 0.2% of the needs, a condition that leads to a particularly high cost of these fuels compared to traditional ones.

To overcome the deadlock caused by the limitation of the availability of SAF due to the high cost and vice versa, several countries in the world have already introduced policies for the production and spread of these fuels. Such policies include both economic incentives intended for SAF producers and users, and the so-called blending mandates, rules that impose a minimum share of supply and consumption of sustainable fuels.

There are many countries in the world that have built policies based on obligations of this type, considering them useful to ensure a minimum market demand, certain over time and therefore likely to encourage investment. In addition, some of these have already experienced them in the past, such as Norway (0.5% from 2020), France (1% from 2022, increase to 1.5% in 2024) and Sweden (1% from 2021).

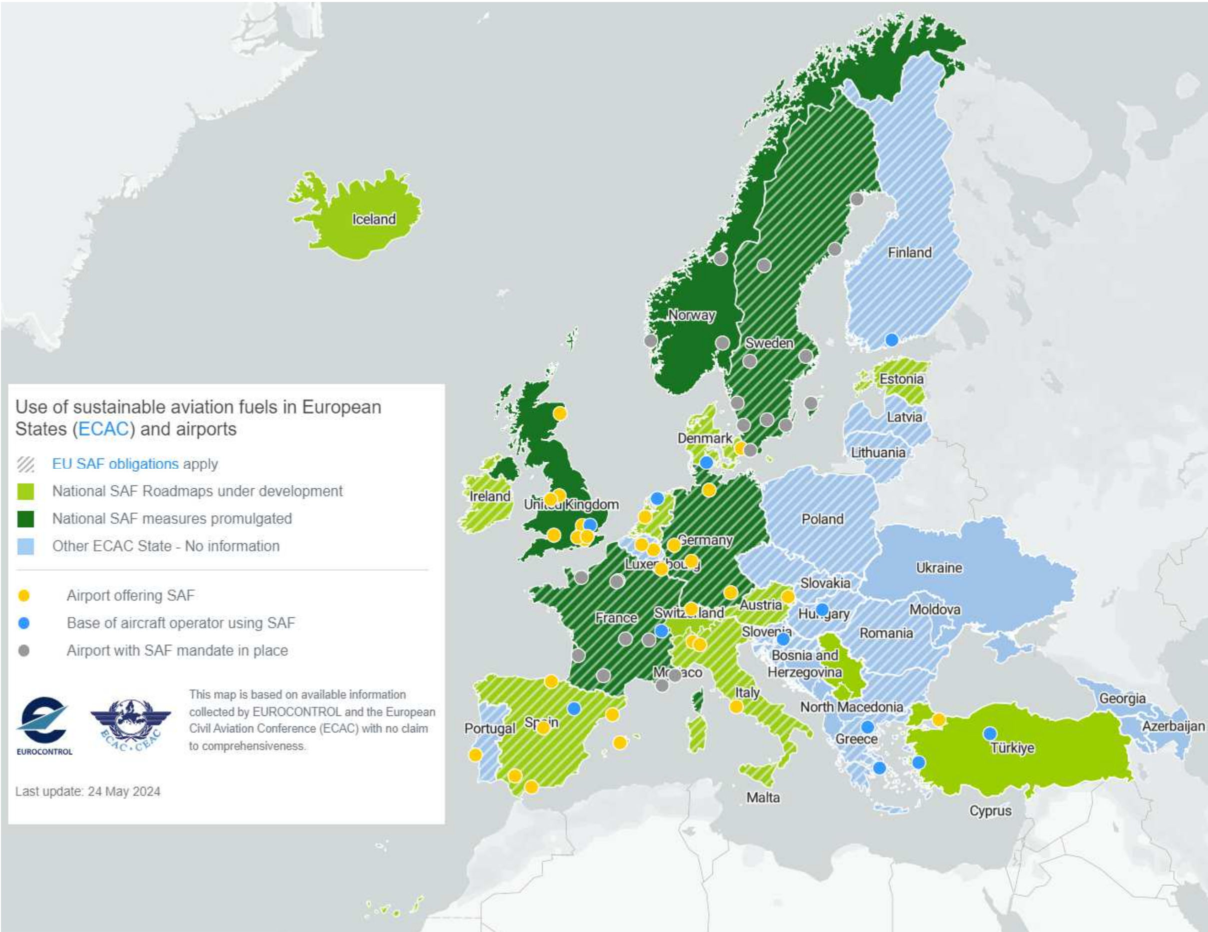


Figure 8 . National mandates on SAF in ECAC countries (elaborated from [13])

As for Europe, the map drawn up by Eurocontrol and ECAC in Figure 8 shows that most of the ECAC member countries have similar measures already in force or planned. Among these, in fact, indicated with the diagonal line pattern, include the countries in which the aforementioned RefuelEU Aviation Regulation, entered into force on 20/11/2023, will be applied.

The RefuelEU Aviation Regulation defines, in fact, the minimum shares of SAF that in the period 2025-2050 fuel suppliers must make available at main EU airports, defined as "Union Airports". As indicated in Figure 9, the mandate covers both the totality of sustainable aviation fuels and the subcategory of synthetic aviation fuels, with further details reported in Table 1.

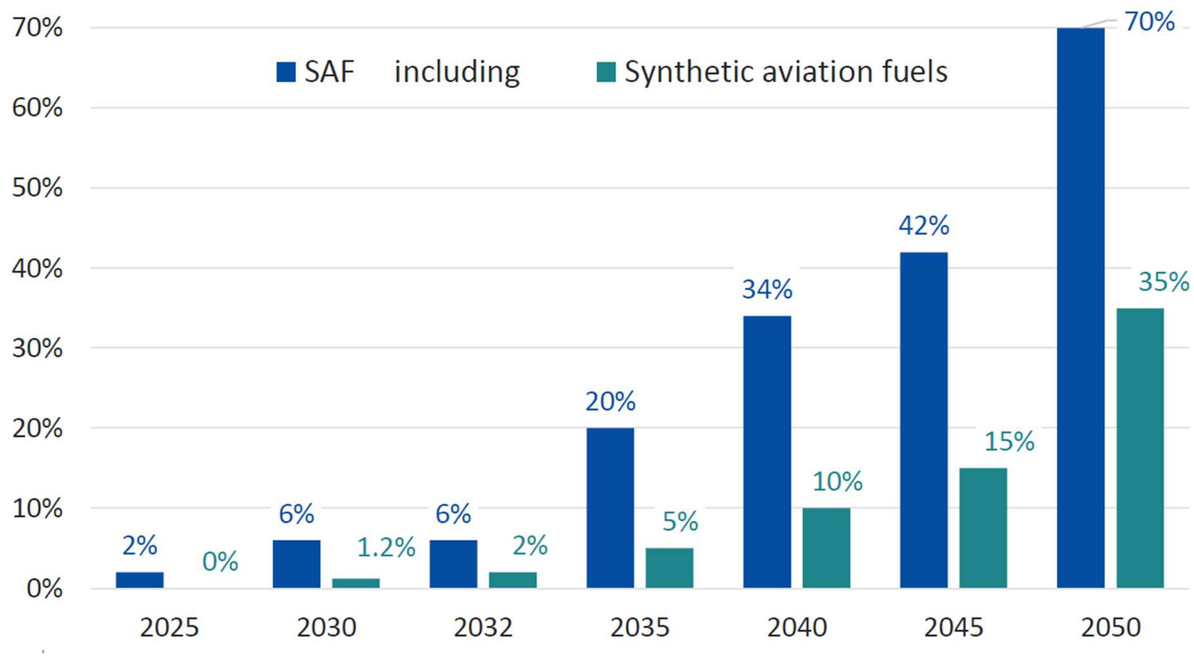


Figure 9. Minimum quotas of SAF and synthetic fuels introduced by the RefuelEU Aviation Regulation (source: European Commission, DG-MOVE, Aviation Policy Unit)

Period	Average share	Minimum share
2030-2031	1.2%	0.7%
2032-2033	2%	1.2%
2034		2%

Table 1 . Detailed mandate requirements for synthetic fuels in the period 2030-2034

Although the obligation applies to fuel suppliers, the Regulation indirectly leads aircraft operators to use SAF made available at airports. This mechanism is ensured by a further measure contained in the Regulation against tankering, which provides for the obligation for any aircraft operator - European or not - to source at a given “Union Airport” from which it operates, covering at least 90% of the fuel required for the all the routes originating from that airport.

This measure, aimed at counteracting the practice - called *tankering* - whereby an operator takes on more fuel than necessary in those airports where it costs less, leads to reduced consumption and emissions, and at the same time ensures that the share of SAF available at each Union airport is actually taken on board the aircrafts.

Figure 10 schematically illustrates the link that the RefuelEU Aviation Regulation establishes between the obligation to provide minimum shares of SAF and the measure against tankering, and it introduces the so-called "flexibility mechanism" that, in the period 2025-2034, will enable fuel suppliers to meet the minimum SAF quotas in terms of average value calculated between all supplied airports rather than for each of them.

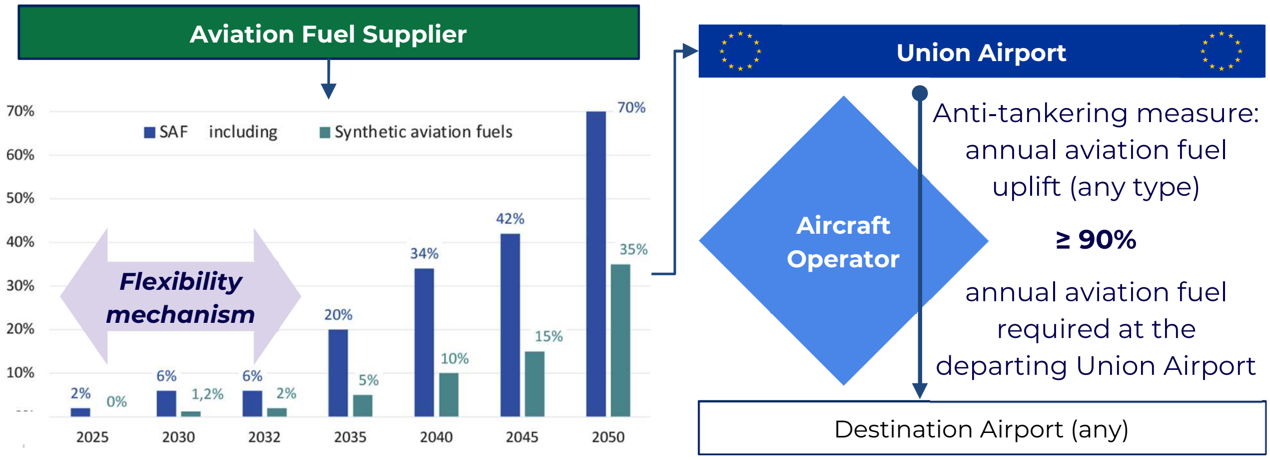


Figure 10. Minimum SAF shares and anti-tankering measure according to the RefuelEU Aviation Regulation

As already mentioned, the basis of the RefuelEU Aviation Regulation is the RED, in particular in terms of methodologies for assessing the environmental sustainability of the life cycle of fuels and specifications of feedstocks.

Referring for details to the documentation of the Directive ([8]), in relation to the first aspect, it should be noted that the methodology provided by RED is the one to be used to determine whether or not the minimum emission-cutting levels mentioned above have been met (see Figure 5).

As regards the second aspect, it is clear that RED, in its Annex IX, provides in detail the feedstocks eligible for the production of SAF belonging to the biofuel group. Table 2 summarizes the feedstocks included in Annex IX, highlighting the main differences that its proposed revision ([14]), currently pending adoption, would introduce.

In line with the provisions of the "Fit-for-55" package, it is also appropriate to mention the European ETS (Emission Trading System) Directive which, with the amended Directive 2023/958 of May 2023, introduced a reward mechanism for aircraft operators using SAF.

Through this measure, in fact, 20 million emission allowances will be reserved for aircraft operators that use SAF in order to cover part of the cost differential between these fuels and conventional jet-fuels, with a criterion that greater environmental sustainability of the fuel will be matched by a higher share of the price gap to aircraft operators. In particular, the reserved shares will cover:

- 70% of the price differential between the use of fossil kerosene and hydrogen from renewable eneergy sources and advanced biofuels;
- 95% of the price differential between the use of fossil kerosene and renewable fuels of non-biological origin;
- 100% of the price differential between the use of fossil kerosene and any eligible non-fossil aviation fuel for flights involving outermost regions;
- 50% of the price differential for other eligible fuels that are not derived from fossil fuels.

Finally, to help EU States in the implementation of the RefuelEU Aviation Regulation, EASA and the Directorate General for Mobility and Transport (DG-MOVE) of the European Commission have created the RefuelEU Member State Network. This is a working group created to promote the exchange of best practices between EU States in the implementation of the RefuelEU Aviation Regulation and will operate in parallel with the Expert Group appointed by DG-MOVE to follow the internal aviation market on sustainability issues [15].

Aviation biofuels	Annex IX (Directive EU 2018/2001)	Proposed amendment according to [14]
Advanced biofuels according to Annex IX/Part A	• Algae • Biomass from various types of waste (mixed municipal waste, industrial not suitable for feed or food use, forestry, private households, etc.) • Animal manure and sewage sludge • Others	Proposal to include: • Non-food crops grown on severely degraded land not suitable for food and feed crops • Residues and waste from alcoholic distilleries • Row methanol from wood pulp production

Aviation biofuels	Annex IX (Directive EU 2018/2001)	Proposed amendment according to [14]
Biofuels according to Annex IX/Part B	• Used cooking oil • Animal fat	Proposal to include: • Intermediate crops from areas where agricultural production is limited to only one annual harvest, avoiding further demand for soil and maintaining organic matter content in soil • Residues and waste not suitable for food and feed use from the production of bread, sweets, beverages, fruits and vegetables, beer, wine, oil, etc. • Crops damaged (unintentionally) not suitable for food or feed use • Municipal wastewater and derivatives other than sewage sludge • Others
Other biofuels not derived from food and feed crops that meet the sustainability and emission reduction criteria defined by RED and are certified in accordance with RED.		

Table 2. Feedstocks for the production of aviation biofuels according to RED

1.4 Role and objectives of Enac

The Italian institutions mainly involved in air transportation sustainability are the Ministry of Infrastructure and Transport (MIT), the Ministry of the Environment (MASE), and the Italian Civil Aviation Authority (Enac), that, as schematically summarized by the diagram in Figure 11, dialogues with both ministries in the areas described in the previous paragraphs.

As for SAF and for other topics of environmental interest, Enac collaborates with the aforementioned ministries both for the purpose of providing specialist support, and to pursue national policies in a synergistic way.

The collaboration between these institutions in on environmental sustainability of air transportation sees in the ETS a recent and particularly concrete example. In fact, the competent authority for the implementation of the ETS Directive in Italy is currently identified in an interministerial committee, called "ETS Committee", which has competence for both aviation and stationary installations. Established in 2013 and amended by Legislative Decree No. 47/2020 ([16]), the ETS Committee is a collegiate body consisting of 15 members for the aviation field. 5 of these have only advisory functions, whereas the others have voting rights (the President and 2 others are designated by the Ministry of the Environment, the Vice President and 2 others by the Ministry of Economic Development, 1 by the Ministry of Justice and 3 by the Ministry of Transport). Among these, 2 members are from Enac and intervene exclusively on topics related to air transportation. Further revisions may be implemented following the transposition of the ETS Directive amended 2023/958.

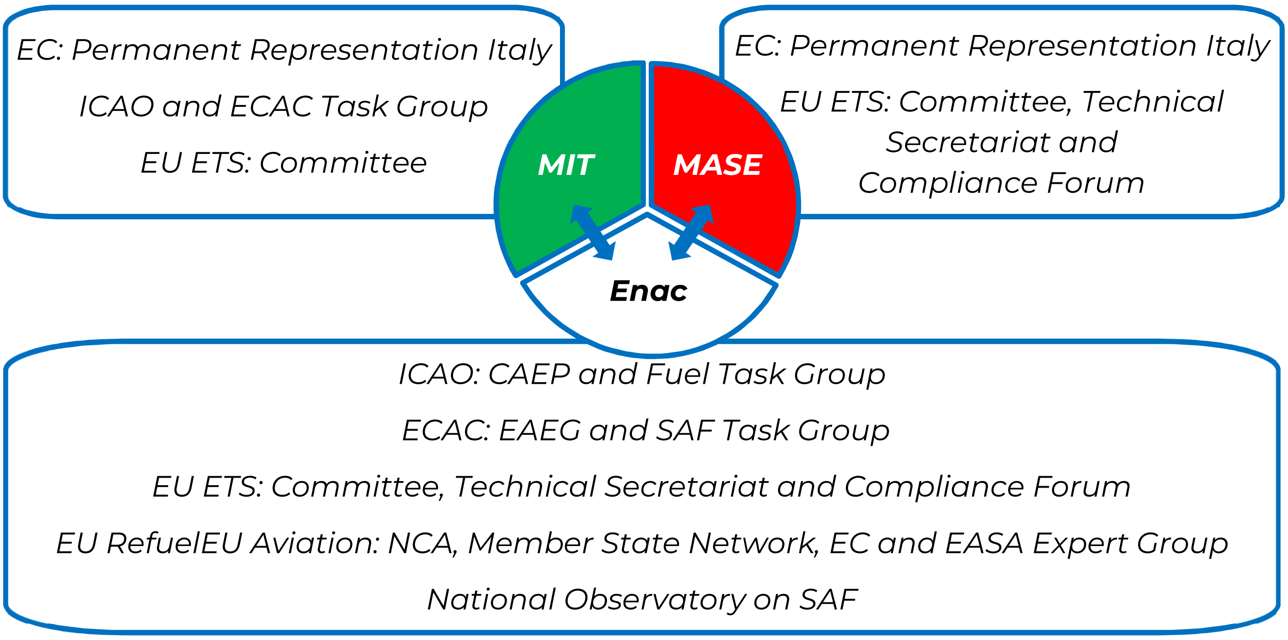


Figure 11. Institutional roles of Enac, MIT and MASE in air transport sustainability

As Figure 11 shows, Enac is the proposed National Competent Authority (NCA) for the implementation of the RefuelEU Aviation Regulation in Italy, a role that gives the authority functions of both support and control. The first concerns mainly the verification of reports on quantities and types of fuel that aircraft operators must send annually to EASA, the second aims instead to the enforcement of the obligations introduced by the Regulation through the establishment of an appropriate penalty system.

In addition to these tasks, Enac, since the first draft of the RefuelEU Aviation Regulation issued in 2021, has set the goal of defining, in synergy with the aforementioned Ministries, a "Roadmap for SAF in Italy" focusing on the study of possible policy incentives for the production and use of SAF, with a coherent approach to the context defined by European regulations.

This document, drawn up on the basis of a survey carried out among the main stakeholders in the sector operating in Italy, follows on from the summary published last

November ([17]) and represents a milestone of this process which, as described in Chapter 2, has been developed since the establishment by Enac of the National Observatory on SAF.

2 THE NATIONAL OBSERVATORY ON SAF

Regarding sustainable aviation fuels, in 2019 Enac has launched an initiative to establish a National Observatory on SAF, involving the Ministry of Transport, the Ministry of Environment and all the potential stakeholders.

The main objectives underlying the creation of the Observatory are related to sharing knowledge on SAF, encouraging opportunities for discussion and dialogue between different actors in the system, jointly analysing and evaluating constraints, critical issues and barriers, identifying possible initiatives and potential projects, collecting and sharing suggestions, as well as presenting a shared national policy.

This group is now made up of aircraft operators, airport managing bodies, operators in the fuel supply chain (manufacturers, distributors and handlers), aircraft manufacturers, trade associations, universities and research bodies (see Figure 12).

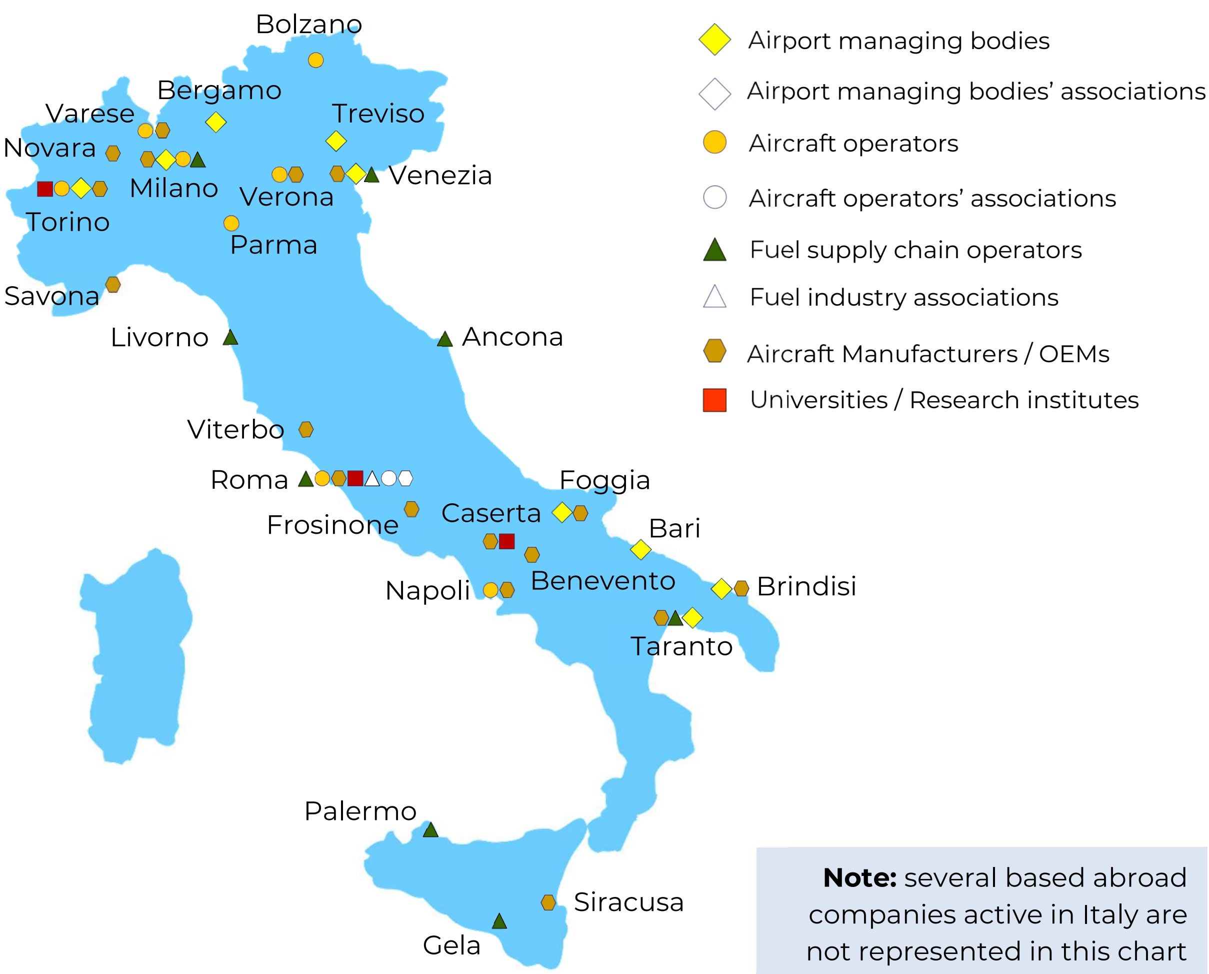


Figure 12. Map of stakeholders participating in the SAF policy survey

Figure 12 provides an overview of the geographical distribution and the categories through which the stakeholders who actively participated in the activities of the National Observatory on SAF have been classified, in particular by contributing to the SAF policy investigation summarised in this document.

In 2023, in view of the entry into force of the European Regulation, the activities of the Observatory were intensified to collect, through a survey based on appropriate questionnaires, the views of the different actors in relation to national SAF policies.

The main objective of Enac through this initiative is to provide institutional partners with a comprehensive framework to study and identify the best policies for encouraging the introduction of SAF in Italy. This framework aims to minimize the risk of increased costs depressing the demand for air transportation, thereby preventing potential harm to the entire sector.

As detailed in Chapter 3, the survey was divided into 2 phases, the first for the selection of policies and the second for the identification of measures aimed at implementing the selected policies.

Both phases were attended by about 80% of the subjects, companies and public bodies, members of the National Observatory on SAF. Among these, there are 7 airport managing bodies and 2 related associations, representing together almost all the national air traffic in terms of number of passengers, 18 aircraft operators (Italian and foreigner) and 2 trade associations, the main companies involved in the production, distribution or handling of aviation fuels, the major aircraft manufacturers operating in Italy and experts fromuniversities and research bodies.

In order to provide a fuller reading of the assessments provided by stakeholders during the survey, the following paragraphs provide a more detailed account of the participants, divided according to the macro-categories indicated in Figure 12, with a focus on publicly known SAF activities.

2.1 Aircraft operators

Figure 13 represents the geographical location of the aircraft operators and the trade associations that actively contributed to the survey presented in Chapter 3. The representation is limited to the locations actually or potentially involved in activities concerning SAF. More details are given in Table 3, where the known SAF activities for each aircraft operator are summarised.

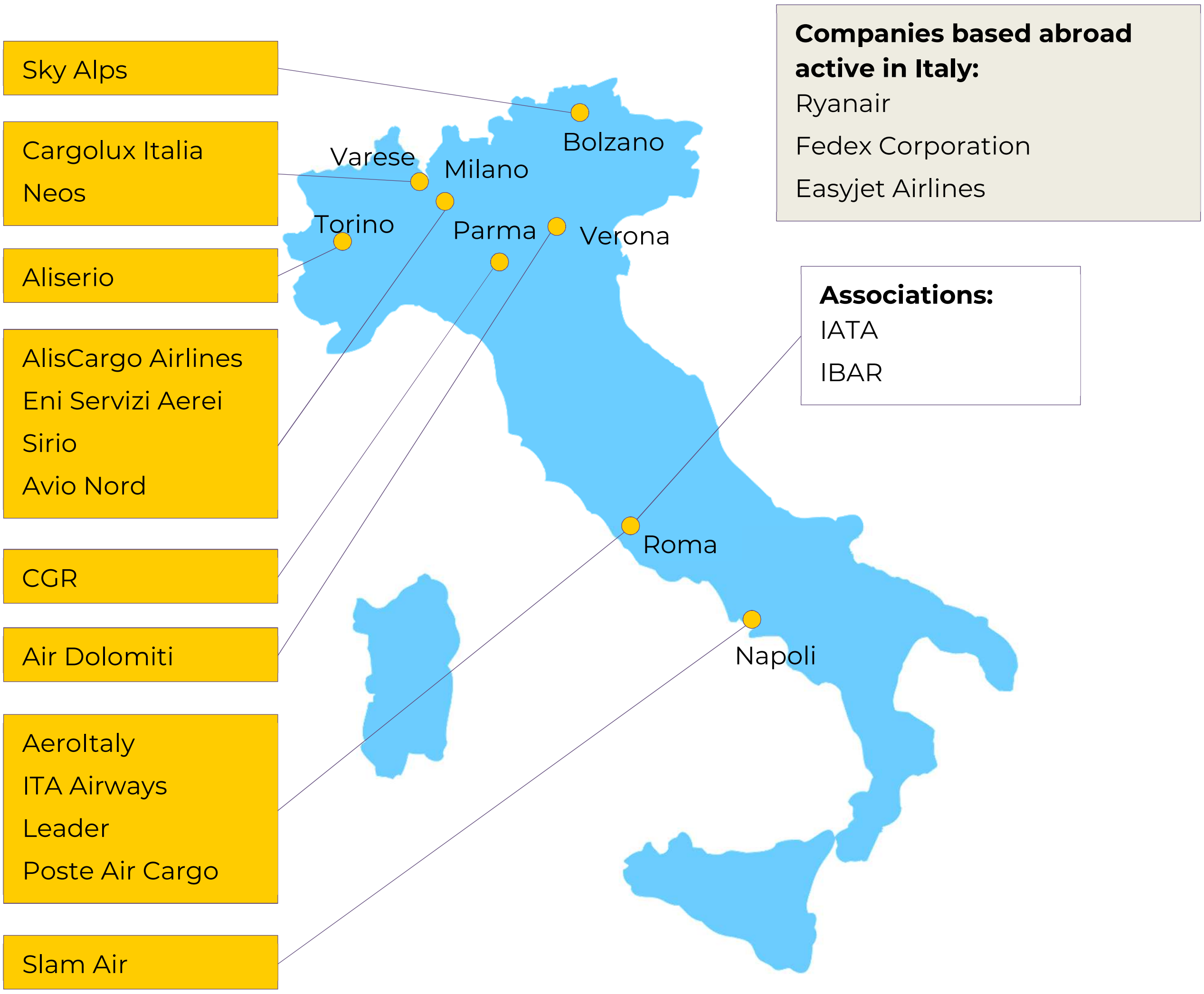


Figure 13 . Map of aircraft operators participating in SAF questionnaires

Name	Locations in Figure 13	Known activities related to SAF
AeroItalia S.r.l.	Roma	-
Air Dolomiti S.p.A.	Villafranca di Verona (VR)	Voluntary compensation of passengers on COMPENSAID platform through SAF or environmental protection projects
AlisCargo Airlines S.p.A.	Milano	-
Aliserio S.r.l.	Caselle Torinese (TO)	-
Avio Nord S.r.l.	Milano	-
Cargolux Italia S.p.A.	Vizzola Ticino (VA)	SAF regularly used abroad
CGR S.p.A.	Parma	Experimental activities within the European Association of Aerial Surveying Industries (EAASI)
Easyjet Airlines Ltd.	*Abroad*	Experimental activities and regular use of SAF on domestic flights in France
ENI Servizi Aerei S.p.A.	San Donato Milanese	SAF regularly used at Rome Ciampino and Milan Linate airports
Fedex Corporation	Abroad	Experimental activities since 2015 and partnership with Boeing in the research program "ecoDemonstrator"
IATA (International Air Transport Association)	*Abroad*	Guidelines on SAF policy, involvement in CORSIA and ETS, collaboration with ASTM for the certification of SAF; initiatives for the exchange of knowledge and between stakeholders (v. Sustainable Aviation Fuel Symposium)
IBAR (Italian Board Airline Representatives)	Roma	Collaboration with other global associations to fully understand the industry's views on the environmental and economic sustainability of air transportation
ITA Airways S.p.A.	Roma	SAF used occasionally from 2021. Launch in 2023 of the "Fly with SAF" program for cargo flights. CHOOSE platform for passenger compensation for the use of SAF
Leader S.r.l.	Roma	-
Neos S.p.A.	Somma Lombarda (VA)	-
Poste Air Cargo S.r.l.	Roma	Experimental activities on the Bari-Brescia route in 2022
Ryanair Ltd.	*Abroad*	SAF regularly used abroad. Partnership since 2022 with NESTE for supply at Schiphol. Supply agreements for about 680,000 tons by 2030
Sirio S.p.A.	Milano	Occasional use of SAF in Italy, first supply of SAF in Milano Linate (December 2021)
Sky Alps S.r.l.	Bolzano	First flight with SAF on the Bordeaux-Nice route (11/9/2023)
Slam Air S.r.l.	Napoli	-

Table 3 . SAF activities conducted by participating aircraft operators

2.2 Airport managing bodies

Figure 14 shows the airport managing bodies and the trade associations that have actively contributed to the investigation. More details are given in Table 4, where the known SAF activities for each participant are summarized.

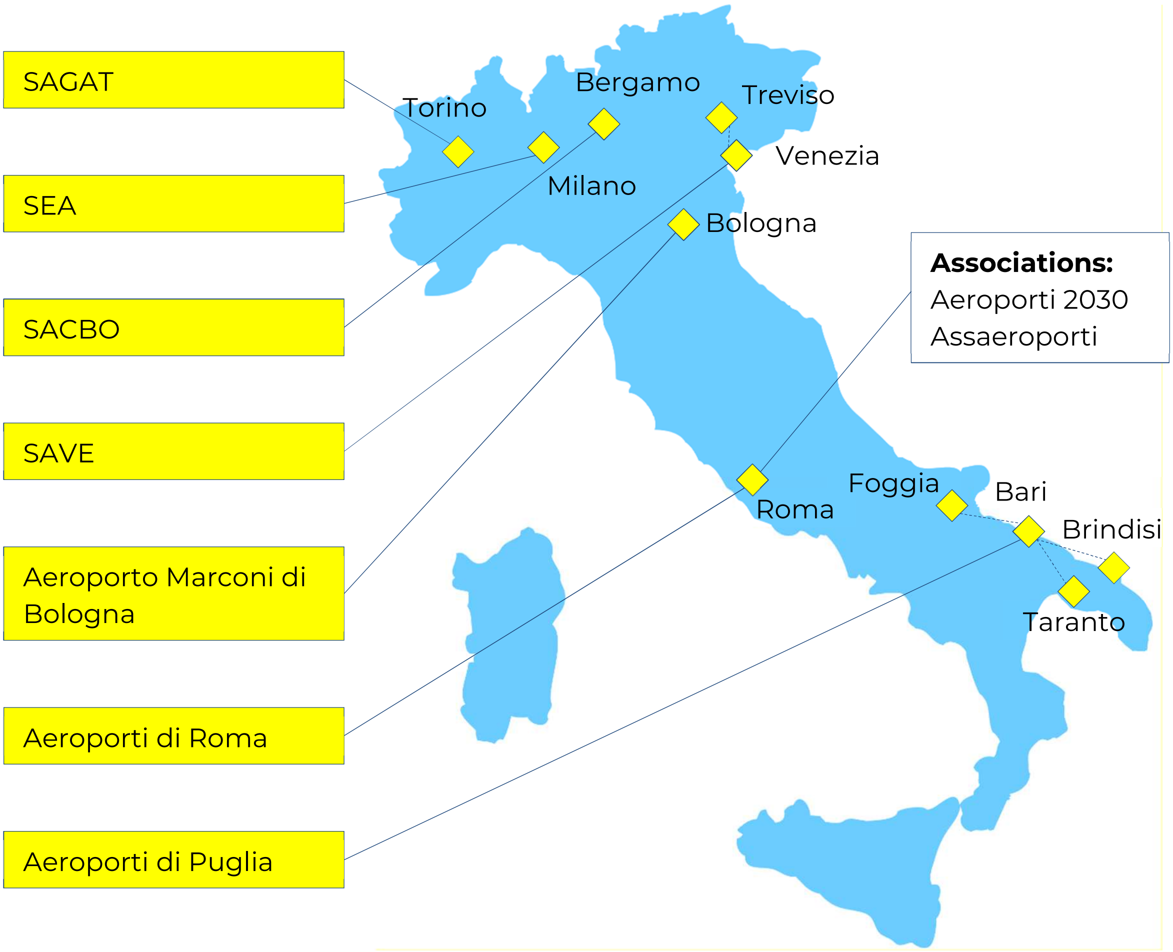


Figure 14 . Map of airport managing bodies participating in SAF questionnaires

Name	Locations inFigure 14	Known activities related to SAF
Airporti 2030 *(Association)*	Roma	Coordinator of the Infrastructures Working Group within the stakeholders' initiative "Pact for the decarbonization of the air transportation"
Aeroporti di Puglia S.p.A.	Bari, Brindisi, Foggia, Taranto	-
Aeroporti di Roma S.p.A.	Roma	SAF transport logistics tests in partnership with ENI and ITA Airways. EU project partner "ALIGHT". Promoter with ENI of the "Pact for the decarbonisation of air transportation"
Aeroporto Marconi di Bologna S.p.a	Bologna	-
Assaeroporti *(Association)*	Roma	-
SACBO S.p.A.	Bergamo	Planning of the construction of a fuel deposit for aviation fuels, including SAF
SAGAT S.p.A.	Torino	Partner of the EU project "TULIPS" and member of AZEA (EU Alliance for Zero-Emission Aviation)
SAVE S.p.A.	Venezia, Treviso	Collaboration with ENI on biofuel use for internal mobility
SEA S.p.A.	Milano Linate, Malpensa	Incentives to use SAF with reimbursement to operators of 500€/ton in 2023 and 800€/ton in 2024, with a funding allocation of 450,000€ in 2023 and 500,000€ in 2024.

Table 4 . Activities for SAF conducted by participating airport managing bodies

2.3 Operators of the fuel supply chain

Figure 15 illustrates the locations of aviation fuel producers, distributors and handlers and related trade associations, participating in the survey reported in Chapter 3. The representation is limited to the locations actually or potentially involved in activities concerning SAF. More details are given in Table 5, where the known SAF activities for each operator of the fuel supply chain are summarised.

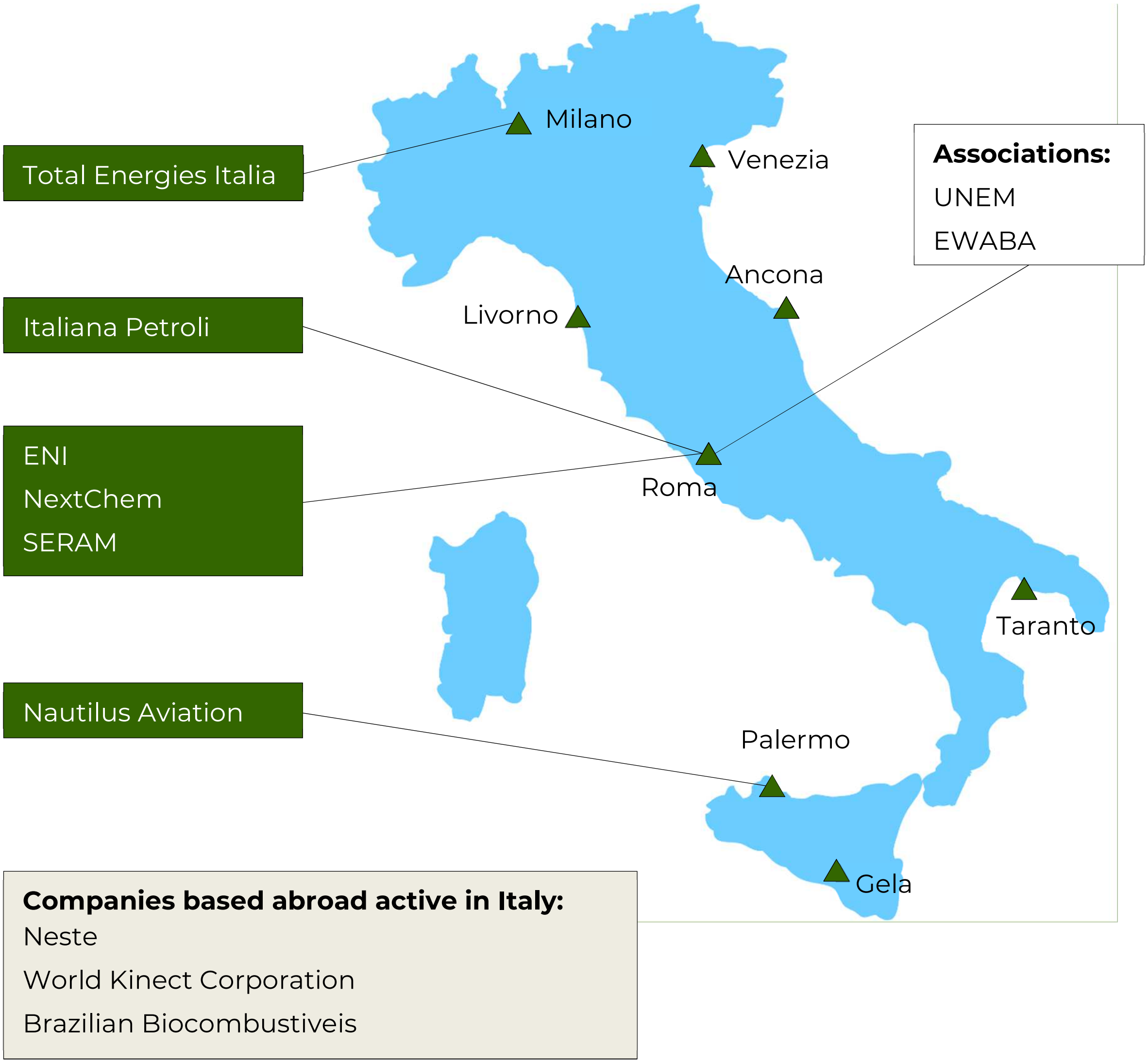


Figure 15 . Map of operators in the fuel supply chain participating in SAF questionnaires

Name	Locations in Figure 15	Known activities related to SAF
Brazilian Biocombustiveis Ltda	*Abroad*	Production of biofuels in Brazil and ongoing set-up of logistics network in Italy
ENI S.p.A.	Roma, Livorno, Taranto, Venezia, Gela.	Production of SAF "ENI Biojet" from 2021 and distribution at various airports in Italy (treatment of vegetable waste, waste oils and biomass in Gela plant and refining in Livorno plant). Other co-processing activities in Taranto plant. Promoter with Airports of Rome of the "Pact for the decarbonisation of air transportation"
EWABA (European Waste-based & Advanced Biofuels Association)	*Abroad*	Promotion at European level of policies to ensure a fair regulatory framework that can support production and use of biofuels
Italiana Petroli S.p.A.	Roma, Falconara Marittima (AN)	Research activities and adaptation of logistics
Nautilus Aviation S.p.A.	Palermo	-
Neste Oyj	*Abroad*	Production of SAF for over 10 years and with annual volume of about 100,000 tons
NextChem S.p.A.	Roma	Initiatives to produce SAF from waste gasification in Europe and worldwide. Through the subsidiary MyRechemical, process design consulting and feasibility studies for the integration of Waste-to-Syngas technologies.
SERAM S.p.A.	Roma	-
Total Energies Italia S.p.A.	Milano	Production of SAF in France from 2021 and regular supply at Le Bourget airport. In 2021, supply for flight tests with pure SAF of an Airbus helicopter with Safran engine and A321 Neo aircraft.
UNEM (Unione Energie per la Mobilità)	Roma	Support for policies to encourage the promotion and development of Low Carbon Fuels (LCFs)
World Kinect Corporation	*Abroad*	Distribution of SAF to customers in France, UK, Germany. Agreement with NESTE to increase supply of SAF in Europe (May 2023)

Table 5. Activity for SAF conducted by participating operators of fuel supply chain

2.4 AIRCRAFTS MANUFACTURERS

Figure 16 shows the geographical location of aircraft and subsystem manufacturers who have actively contributed to the survey. Representation is limited to locations that are actually or potentially involved in SAF activities. More details are given in Table 6, where the known SAF activities are summarized.

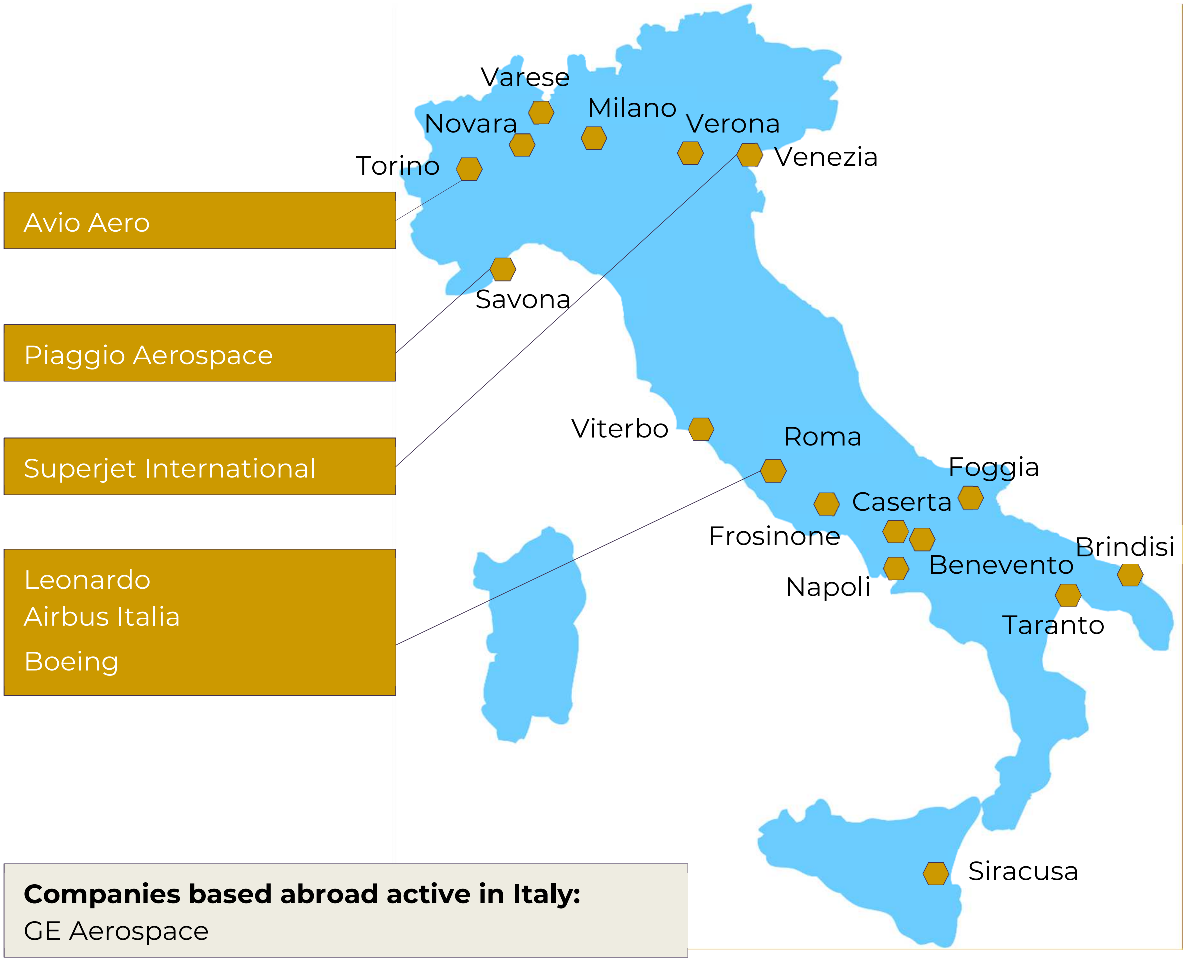


Figure 16. Map of the aircraft manufacturers participating in SAF questionnaires

Name	Location in Figure 16	Known activities related to SAF
Airbus Italia S.p.A.	Roma, Villafranca di Verona	Certification of all products for use with SAF up to 50%. Several flight tests with pure SAF, including on A321 Neo with both engines powered (2021). Agreements and partnerships with foreigner fuel producers (NESTE, Lanza-Jet, DG Fuels). Member of ACT FOR SKY (Japan).
Avio Aero S.r.l.	Torino, Brindisi, Pomigliano d'Arco (NA), Cameri (NO)	Engine and combustion engine testing to verify the impact of SAF use on performance and pollutant production
Boeing	Roma, Foggia, Grottaglie (TA), Brindisi, Milano, Pomigliano d'Arco (NA), Viterbo, Sigonella (SR)	Purchase of more than 22,000 tons of SAF from 2022. Experiments with pure SAF on B747 from 2018 (v. program "ecoDemonstrator") and first flight with B787 powered with pure SAF on the London-New York route in 2023. SAF research for over 20 years and B737 in-flight emission measurement activities in collaboration with United Airlines and NASA. Member of consortia (e.g.: Air-CRAFT, CCITNZ, ACT FOR SKY) and collaborations with governments (e.g., UAE, Japan, Ireland, Ethiopia, Brazil) and industry for the development of SAF. Partner in the "Sustainable Flight Fund" initiative with GE and United Airlines. Launch of the online portal "SAF Dashboard" for monitoring production capacity worldwide.
GE Aerospace	*Abroad*	Certification and standardization activities for the use of pure SAF with its products. Research activities on hybrid propulsion with SAF and hydrogen fuel cells (ARPA-E's REEACH program). Partner in the "Sustainable Flight Fund" initiative with Boeing and United Airlines. Launch of GE AEROSPACE 2023 INDUSTRY SURVEY with 325 attendees from 6 countries
Leonardo S.p.A. (Divisioni Velivoli, Aerostrutture e Elicotteri)	Roma, Benevento, Brindisi, Foggia, Frosinone, Grottaglie (TA), Nola (BA), Pomigliano d'Arco (NA), Torino, Varese, Venezia	Participation in national and European tables (e.g. RLCF) and cooperation agreement with ENI. First AW139 helicopter flight powered by pure SAF, in collaboration with Pratt & Whitney Canada (December 2023).
Piaggio Aerospace S.p.A.	Villanova d'Albenga (SV)	Experimental activities with 50% blended SAF.
Superjet International S.p.A.	Venezia	-
Tecnam	Capua (CE)	-

Table 6. Activity for SAF conducted by the participating Aircraft Manufacturers

2.5 Universities and Research Centers

Figure 17 illustrates the locations of univesities and research bodies participating in the survey reported in Chapter 3. More details are reported in Table 7, that summarizes the SAF research activities for each of the involved institutes.

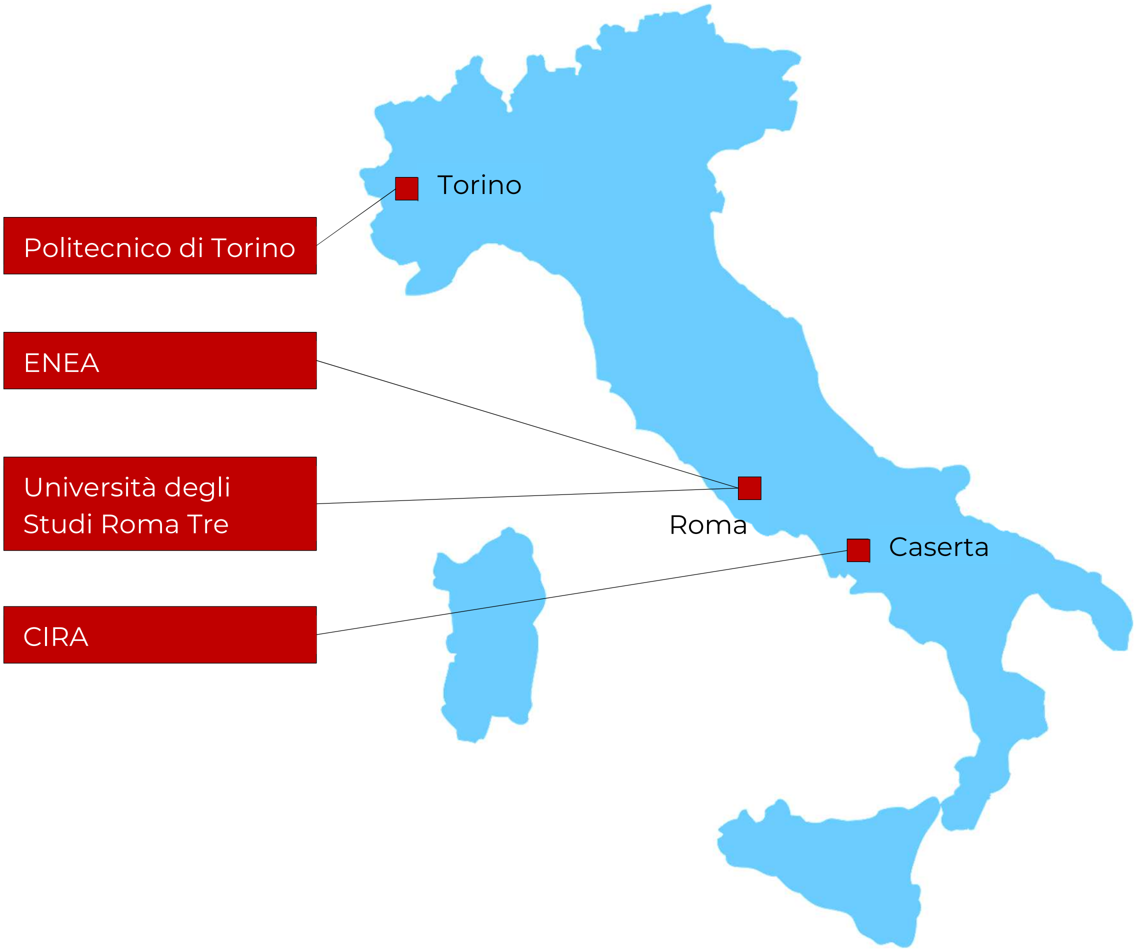


Figure 17. Map of universities and research centres participating in SAF questionnaires

In addition, the international research projects on sustainable fuels with the participation of Italian subjects from 2015 can be found in Table 8.

Name	Locations in Figure 17	Known activities related to SAF
CIRA **Dipartimento Affidabilità e Sicurezza**	Capua	-
ENEA **Dipartimento Sostenibilità dei Sistemi Produttivi e Territoriali**	Roma	Life Cycle Assessment (LCA) studies on SAF in the project Aviation with biofuels (ABC) and experimental analysis of the emissive and toxicological impact on human lung cells. Experimentation with Italian Air Force and CNR on the use of biofuels on military jets (2022). Public call Enac-ENEA for the selection of a project for the decarbonisation of the aviation sector with a focus on SAF. Start of research line with Politecnico di Milano for the development of e-fuel and the design of a pilot plant (September 2023).
Politecnico di Torino **Dipartimento Energia**	Torino	Cooperation agreement with the Ministry of Transport for the use of sustainable fuels in the transport sector (2022). Scenario, sustainability and market analysis through the research group "Fit4Foresight-FUEL". Publication in 2022 of the Report "Alternative Fuels: a strategic option for the Euro-Mediterranean area?".
Università Roma Tre **Dipartimento Scienze Politiche**	Roma	Study of the environmental impact of biofuels in urban road transport.

Table 7. Activity for SAF conducted by participating Universities and Research Centers

Duration	Project [Ref. 2,5]	Coordinator	Italian Participants	Objectives
2022 - 2025	TULIPs [18]	Politecnico di Torino	Politecnico di Torino	Quantifying the benefits of technological, non-technological and social innovations at airports
2020-2025	ALIGHT [19]	KOBENHAVNS LUFTHAVNE AS (DK)	Aeroporti di Roma SpA	Optimal conditions for SAF deployment at airports
2020 - 2024	BioSFerA [20]	Centre for Research and Technology-Hellas (GR)	Rina Consulting SpA	Develop cost-effective technology to gasify biogenic waste and residues to produce drop-in fuels for air and sea transportation
2018 - 2024	GreenFlexJET [21]	Università di Birmingham (UK)	Università di Bologna; ETA[4]; Sormec S.r.l.	Building a pre-commercial demonstration plant for the production of advanced biofuel for aviation, from waste vegetable oils and biomass from organic solid waste
2018 - 2022	BIO4A [22]	RE-CORD (IT) [5]	ENI S.p.A.; ETA	Demonstrate the production and industrial use of SAF from lipid residues (e.g. used oil)
2017 - 2020	JETSCREEN [23]	DLR (Germania)	Politecnico di Milano	Optimisation and risk assessment of alternative fuels through a platform, integrating design tools and generic experiments
2016 - 2021	SOLENALGAE [24]	Università di Verona	Politecnico di Milano	Increasing biomass production from microalgae
2015 - 2017	BECOOL [25]	Università di Bologna	CREA[6]; RE-CORD; ETA	Strengthen EU-Brazil cooperation on advanced lignocellulosic biofuels to increase biomass availability
2015 - 2017	BIOSURF [26]	Isinnova S.r.l. (IT)	Consorzio Italiano Biogas e Gassificazione	Increase the production and use of biomethane by eliminating non-technical barriers.

Table 8. Research projects on sustainable fuel with Italian participants from 2015

[4] ENERGIA, TRASPORTI, AGRICOLTURA S.r.l., Firenze
[5] Renewable Energy Consortium for Research and Demonstration, Scarperia (FI)
[6] Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

3 INVESTIGATION METHOD AND RESULTS

The method of investigation adopted for the definition of a SAF national roadmap has been conceived giving the discussion with the stakeholders a central role, therefore collecting their point of view in two phases:

- Step 1: Policy Selection. In this phase, stakeholders were given a questionnaire, called "policy selection", aimed at identifying the most effective policies in producing a positive impact on the development of the Italian SAF market;
- Step 2: Identification of measures for policy implementation. In this phase the stakeholders were given a new questionnaire, called "follow-up" and developed in collaboration with Università degli Studi Roma Tre, to determine an order of priority among the possible measures resulting from the policies selected during the first phase.

3.1 PHASE 1: POLICY SELECTION

The first step in this phase has been devoted to creating a "policy domain", a policy group to be submitted to stakeholders' assessments.

To this end, Enac has taken as reference the document "ECAC Guidance on Sustainable Aviation Fuels", published in February 2023 for the purpose of providing ECAC Member States with a guideline for the definition of national SAF policies ([27].

Based on approaches of international validity such as those adopted by ICAO and the World Economic Forum ([28]), which can also be found in the guideline published by ECAC, the policy domain has been defined in accordance with the classification illustrated in Figure 18, where 3 macro-areas can be identified:

- increase in SAF production or supply (Branch A),
- demand incentive (Branch B) and
- activation of the connections between supply and demand (Branch C).

This classification has been adapted to the Italian context and then simplified in order to present to the stakeholders an adequate number of options, and impact indicators to be used as metrics for the evaluation of each policy.

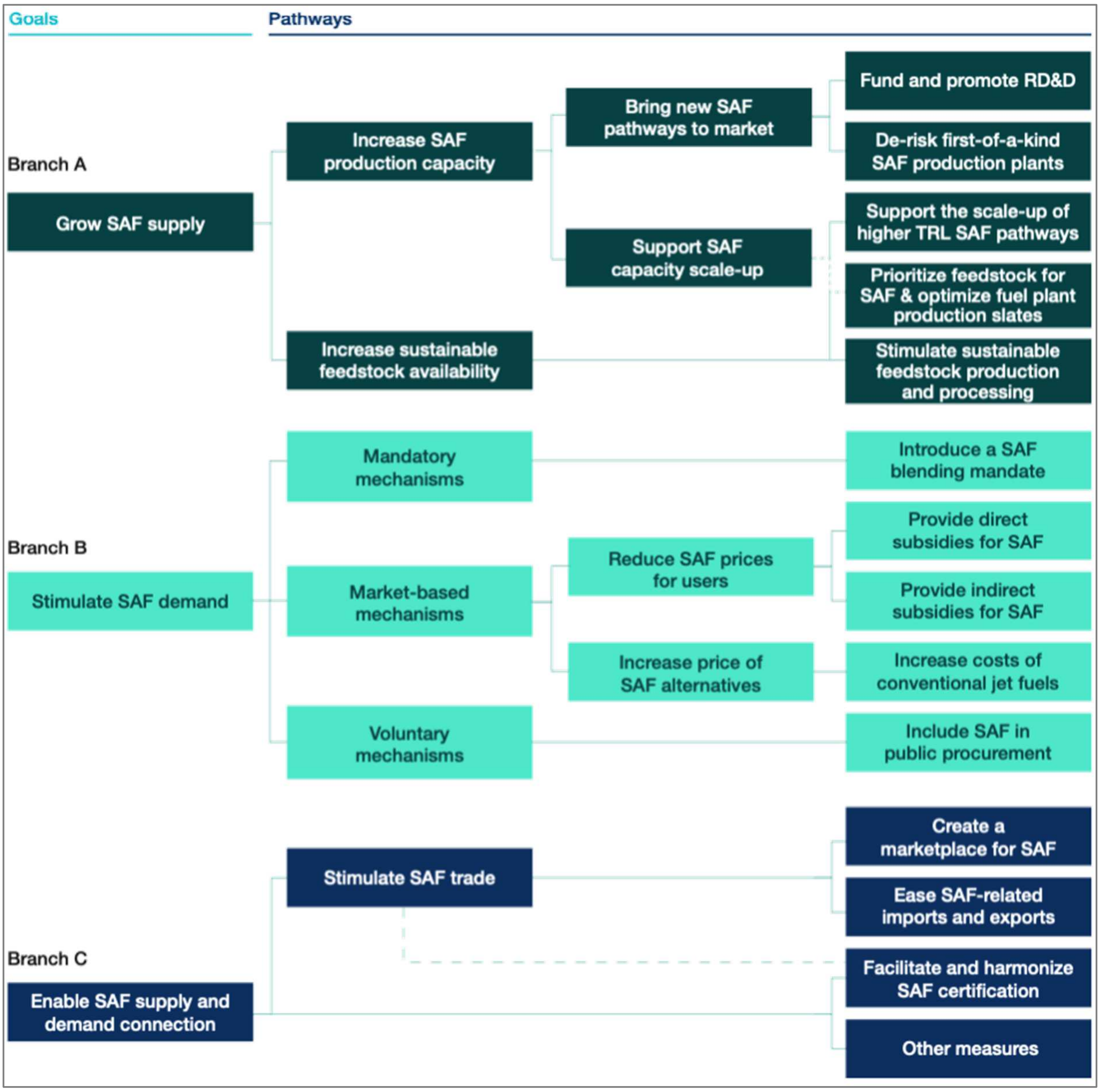


Figure 18. Classification of SAF policy according to the World Economic Forum toolkit ([28])

The policies have been divided in 3 macro groups:

1. policies adapted to the Italian context, including those already implemented or planned;
2. policies not suitable for the Italian context;
3. policies not belonging to any of the previous groups.

Group 1 policies, reported in Table 9, were considered useful to build a "baseline" package and it was not considered a priority to request their evaluation by stakeholders.

Ref. to [28]	Description
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 9. Policy baseline from ECAC guidance on SAF policy

The following Group 2 policies were excluded from the questionnaire:

- A/PO6: support to feedstock producers through insurance programmes;
- A/PO10: to recognise the benefits of SAF related to non-CO2 emissions, such as improving air quality or reducing the formation of contrails;
- B/PO11: introduction of blending mandates with increasing minimum SAF quotas;
- B/PO17: to impose a minimum quantity of SAF for military flights, state flights and commercial flights of public officials on duty.

The reasons for the exclusion of such policies are different: the A/PO6 was considered premature because it is linked to insurance instruments that typically are based on historical data from which the level of risk and economic conditions of the policies derive; the A/P010 is linked to aspects on which much research is still in progress in order to provide sufficiently reliable answers (e.g.: correlation between SAF typology and contrails); the B/PO11 is redundant with the RefuelEU Aviation Regulation; lastly, B/PO17 was not considered effective for the objective of creating a solid market based mainly on commercial flights.

Group 3 policies have been included in the questionnaire as they are in line with the following criteria:

- sufficiently different from baseline policies;

- adaptable to the Italian context;
- able to stimulate different viewpoints among stakeholders;
- not yet implemented in Italy.

3.1.1 Preparation of the Policy Selection Questionnaire

The Group 3 policies mentioned in the previous paragraph have undergone a process of adaptation and simplification, resulting in a reduction to 10 policies. As detailed in Table 10, these refined policies encompass various areas, proposing interventions to attract investment in SAF, create new production plants or expand existing ones, introduce tax reductions for SAF producers or users, and facilitate the entry of feedstock and the distribution of SAF across the territory.

A similar process was adopted to define impact indicators that reflect expectations regarding SAF production capacity, the economic impact on passengers, competitiveness among operators, energy independence, research stimulation, and public acceptance. These indicators were included in the questionnaire as outlined in Table 11. Stakeholders were then asked to respond to each question, assessing the impact of each of the 10 policies using the following ratings:

- strongly positive (questionnaire rating = 5)
- weakly positive (questionnaire rating = 4)
- negligible (questionnaire rating = 3)
- weakly negative (questionnaire rating = 2)
- strongly negative (questionnaire rating = 1)

Additionally, stakeholders were given the opportunity to provide free comments to express their perspectives on needs that should be addressed through national policies.

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** to produce 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 10. 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 11. Questionnaire regarding impact indicators for policies assessment

3.1.2 RESULTS OF THE POLICY SELECTION QUESTIONNAIRE

The questionnaire was sent to participants of the aforementioned National Observatory. Additionally, requests for expressions of interest were published on the Authority's website and social channels to extend the invitation to all potentially concerned organizations. The data obtained revealed many common aspects among the various stakeholder groups, summarized as follows:

- policy appreciation was driven mainly by the following expectations:
  - increase in the share of feedstock or intermediate products destined for SAF production;
  - 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 was the introduction of tax incentives for the use of SAF produced in Italy by aircraft operators (policy 6);
- many stakeholders expressed a desire for additional incentive measures, such as additional tax relief for SAF producers (policy 4) and feedstock producers (policy 5), tax-related rewards for those who produce or use SAF that are less polluting than others (policy 7), incentives to attract investment in the production chain (particularly policy 1);

- a further point of consensus among stakeholders was scepticism toward any national policies that are more ambitious than those set at the European level by the RefuelEU Aviation Regulation (policy 8).

This summary was derived from processing the data collected through the questionnaire, which are detailed in Appendix A.

The results are summarized in Table 12, where arrows indicate four levels of effectiveness: high (↑), medium-high (↗), medium-low (↘), and low (↓). The categories of stakeholders are indicated as follows:

- GAE: Airport Managing Bodies;
- OAE: Aircraft Operators;
- FCA: Fuel Supply Chain (manufacturers, distributors, and handlers);
- COS: Aircraft Manufacturers;
- UN-E: Universities and Research Centres.

	GAE	OAE	FCA	COS	UN-E
POLICY 1	↗ 66%	↑ 92%	↑ 100%	↗ 70%	↗ 69%
POLICY 2	↗ 61%	↑ 89%	↗ 68%	↑ 79%	↗ 59%
POLICY 3	↘ 44%	↑ 84%	↓ 0%	↑ 100%	↘ 41%
POLICY 4	↑ 79%	↑ 89%	↑ 85%	↑ 86%	↑ 100%
POLICY 5	↑ 91%	↑ 85%	↑ 92%	↑ 79%	↗ 72%
POLICY 6	↑ 100%	↑ 89%	↑ 81%	↑ 86%	↑ 100%
POLICY 7	↑ 92%	↑ 100%	↑ 83%	↗ 70%	↑ 93%
POLICY 8	↓ 0%	↓ 0%	↘ 40%	↓ 0%	↘ 45%
POLICY 9	↘ 27%	↗ 64%	↘ 39%	↗ 64%	↑ 93%
POLICY 10	↘ 34%	↑ 83%	↘ 41%	↑ 88%	↓ 0%

Table 12. Policies' levels of effectiveness according to stakeholders

A similar synthesis, limited to industrial stakeholders for the sake of graphical representation, is provided in the "policy table" shown in Figure 19.

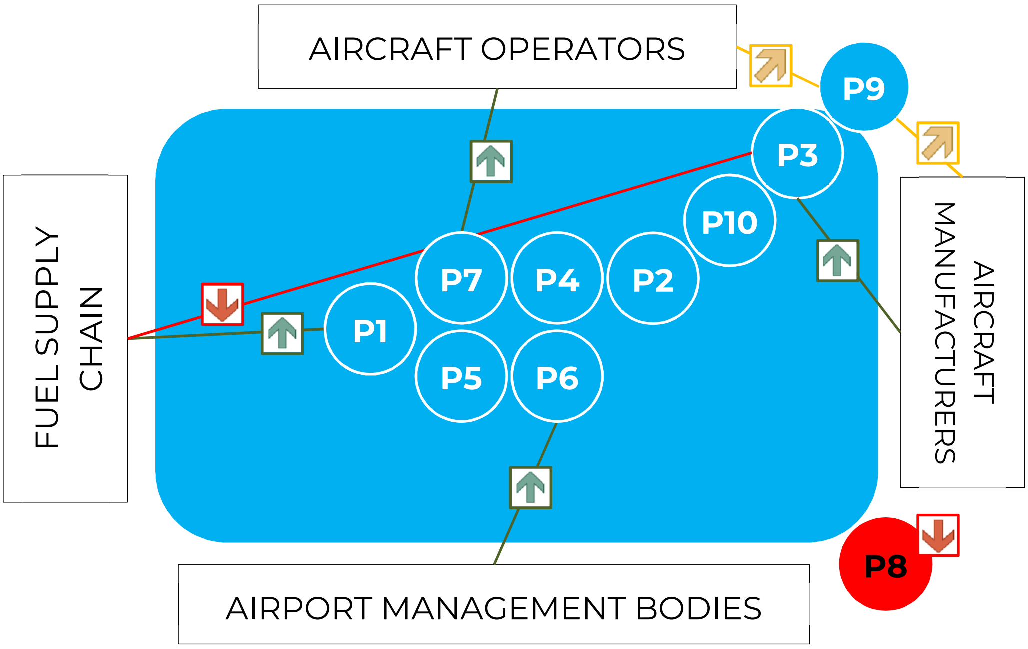


Figure 19. "Policy table": qualitative representation of the proximity between policy and stakeholders' vision

In addition, the data in Table 12 show that policy 3, which involves measures to encourage other transport sectors towards non-competing forms of decarbonisation (such as electricity), and policy 9, concerning a certificate transfer system (e.g., book & claim), were found to be partially effective by the operators of the fuel supply chain and airport managing bodies, respectively.

Regarding policy 3, the scepticism arises from the fact that, for market reasons, fuel production in refineries cannot be compartmentalized according to different transport sectors.

For policy 9, there is concern that a book & claim-like system, which removes the constraint for aircraft operators to uplift SAF at all airports, may slow the distribution of SAF across the national territory. It should be noted that the European Commission will evaluate a certificate transfer system to be included in the flexibility mechanism provided by the RefuelEU Aviation Regulation. The results of this assessment are expected by July 2024, so policy 9 has been considered, albeit subject to the aforementioned Regulation.

By combining the selected policies with those from the "baseline" group in Table 9, it is possible to construct a regulatory framework similar to that presented in [28]. This framework, represented here in Figure 20, is based on the same specific objectives (SO).

General Objective:
Balanced regulatory framework for SAF scaling-up in Italy

SO1. Demand-supply matching measures

- ✓ P9 - Transfer systems for SAF purchase certificate (e.g. Book & Claim)

- - - - -

Baseline:

- *C/PO20 - Globally or regionally recognized sustainability standards for feedstock supply*
- *C/PO21 - Support to SAF stakeholder initiatives*
- *C/PO22 - Support for the rolling-out of existing SAF production technologies and international capacity building initiatives towards developing countries*

SO2. Supply-side measures

For fuel suppliers based in Italy:

- ✓ P4 - Tax incentives for SAF producers
- ✓ P7 - Tax-related rewards for production & use of SAF with lower carbon intensity
- ✓ P1 - Incentives to mitigate SAF-CJF price gap
- ✓ P2 - Measures to attract private investments for SAF production scaling-up

- - - - -

Baseline:

- *A/PO1 - R&D funds*
- *A/PO4 - Eligibility of SAF production for tax relief and incentives*
- *A/PO9 - SAF benefits in carbon taxation/cap-and-trade systems*

SO3. Demand-side measures

For aircraft operators refuelling in Italy:

- ✓ P6 - Tax incentives for use of SAF by aircraft operators
- ✓ P7 - Tax-related rewards for production & use of SAF with lower carbon intensity

- - - - -

Baseline:

- *B/PO12 - Inclusion of SAF-related measures in existing plocies*
- *B/PO14 - Inclusion of SAF purchase related fees in fligth ticket*
- *B/PO15 - Aviation-specific price-in mechanism for GHG emissions from CJF*

SO4. Measures for feedstock security

- ✓ P5 - Tax incentives for feedstocks producers
- ✓ P10 - Reduce import barriers on feedstocks and intermediates intended for SAF production

Figure 20. Specific Objectves (SO) of the regulatory framework for SAF scaling-up in Italy

In addition to the specific objectives, Figure 20 also emphasizes the general objective: **"Defining a balanced framework for the development of the SAF market in Italy"**. As noted in the following summary and qualitatively illustrated by the key words in Figure 21, this objective reflects the most recurring themes in the stakeholders' comments regarding the needs to be addressed through these policies.

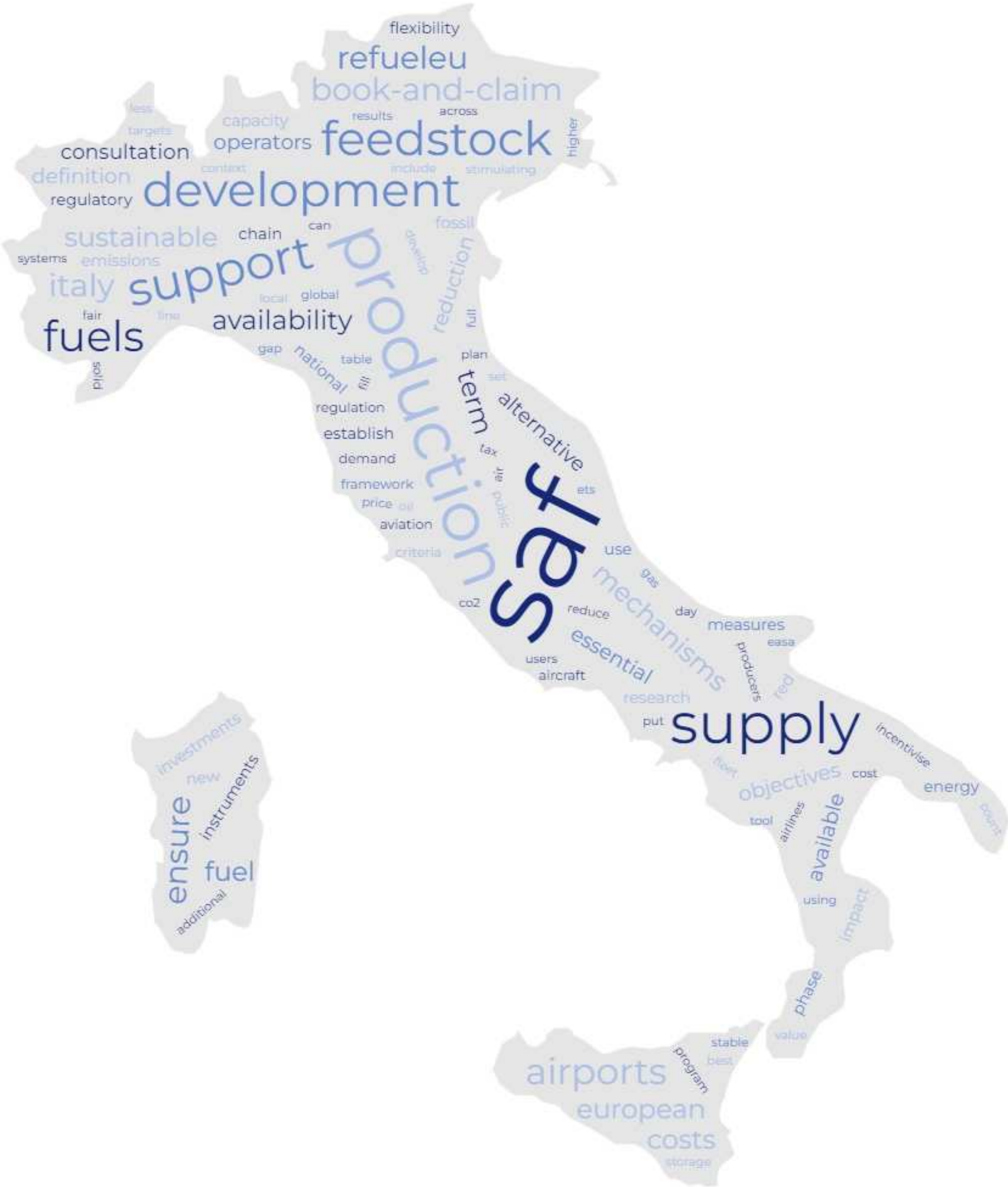


Figure 21. Word-cloud from stakeholders' comments included in phase 1 survey

At the conclusion of this paragraph, a summary of the comments submitted by stakeholders is provided by category:

- aircraft operators:
    - adopt a long-term strategy with a comprehensive set of measures that balances the Country's energy independence, the increase in SAF production capacity, and the reduction of the price differential compared to traditional fuels;
    - balance the obligations to use SAF with an appropriate incentive plan;
    - encourage the use of SAF at domestic airports, making their cost competitive with conventional fuels;
    - promote the development of distribution logistics and establish blending stations at airports;
    - implement a globally recognized certificate exchange system similar to book & claim.
- airport managing bodies:
    - establish a priority framework for the provision of SAF at Italian airports with fair and non-discriminatory criteria, considering the objectives of the Italian Airport System Masterplan;
    - revise the airport charges to reward aircraft operators using SAF, utilizing appropriately integrated program contracts;
    - adapt distribution and storage infrastructures to ensure an increasing supply capacity for SAF over time;
    - systematically monitor the evolution of SAF prices and production as well as SAF supply capacity;
    - share best practices and implementation models (e.g., for the RefuelEU Aviation Regulation), promoting initiatives to enhance collaboration within the aviation ecosystem.
- fuel supply chain operators:
    - create a regulatory framework that is harmonized with the international context and stable over time, encompassing regulatory, industrial, and technological dimensions;

  - balance supply and demand by aligning obligations with incentive mechanisms;
  - ensure a wide availability of feedstocks and a clear, stable framework to support ongoing and future investments;
  - develop refining and co-processing facilities extensively or convert conventional refineries into biorefineries, harmonizing SAF production with other renewable components used mainly in road transport;
  - ensure structural flexibility for operators through mechanisms similar to Book & Claim;
  - foster synergies between initiatives for producing sustainable aviation fuels and those for other types of mobility (e.g. land and sea), stimulating the development of integrated energy hubs;
  - support research and development activities related to synthetic SAF and alternative propulsion systems in the medium to long term.
- aircraft manufacturers:
  - introduce measures to support all actors in the value chain, particularly to bridge the current price gap between SAF and kerosene;
  - establish a clear and stable specification of eligible feedstocks for SAF production at the European level;
  - support the development of the EU Clearing House to coordinate and finance certification initiatives for new SAF and the production qualification of approved SAF;
  - support the global development of processes and standards for qualifying aeronautical materials compatible with various types of SAF;
  - develop global approaches and acceptable means of compliance for qualifying aircraft and their systems and components using different types of SAF;
  - focus research and development on SAF types that significantly reduce environmental impact and on alternative propulsion modes.
- universities and research centers:
  - consider tax incentives for SAF as an investment to reduce healthcare expenditure;

- explore the willingness of passengers, or shipping agents in the case of goods, to pay a surcharge for flying with SAF;
- continue the research on the correlation between SAF and the reduction of non-CO2 emissions (nitrogen oxides, sulphur, particulates, contrails, etc.);
- focus primarily on market regulation, taking the complexity of fuel cross-sectors into account, to determine a balance point that allows for the growth of supply and demand;
- open a debate in Europe on tax incentives, State aid regulations, and the budgetary flexibility of Member States;
- develop accurate communication strategies with citizens by the Government and involved stakeholders.

3.2 Phase 2: Identification of measures for implementation

In the first phase of the investigation, policies were identified among those on which most stakeholders shared a similar vision in terms of effectiveness. In the second phase, these policies were restructured to determine a set of possible lines of action, with several measures for implementation for each.

As detailed in [29] and further refined in [30], final output of a research carried out in collaboration with the Department of Political Science of the Università degli Studi Roma Tre, the structure of lines of action and measures is articulated as shown in Table 13. The new elements, not included in the first phase, are highlighted in yellow and relate to rules against tankering and the institution of a competent authority for their enforcement, both crucial aspects of the RefuelEU Aviation Regulation.

Lines of action	Measures for the implementation
L1. Attracting investment for SAF production in Italy by ensuring that the price differential with conventional fuels is lowered through:	M1.1. Tax subsidies to technology and infrastructure users directly employed in the supply chain of SAF, which will go to cover 50-95% of the price difference depending on the carbon intensity of the fuel used
	M1.2. The use of state-guaranteed contracts for difference, which ensure a price level of SAF that is similar to that of fossil fuels for a given year. The term of such contracts will be determined according to estimates on the time to market of different types of SAF
L2. Attracting investment to start or increase the SAF market through the	M2.1. Release of capital advances, which will be determined according to the technology and project developed in terms of emissions

Lines of action	Measures for the implementation
provision of government-guaranteed grants and low-interest loans, the timing of which will be determined according to the time to market of different production technologies through:	M2.2. Issuance of low-interest loans, which will be determined according to the technology and project developed in terms of emissions.
	M2.3. Combination of grants and low-interest loans where loans will play a more influential role in financing, which will be quantified depending on the technology and project developed in terms of emissions.
	M2.4. Combination of grants and low-interest loans where grants will play a more influential role in financing, which will be to be quantified depending on the technology and project developed in terms of emissions.
L3. Provide specific tax incentives for SAF producers with plants located in Italy (including blenders), establishing proportionality to the cost differential between SAF and conventional jet-fuel through:	M3.1. Decreasing taxes on SAF production, juxtaposed with incentives to facilitate its distribution, encouraging production and transportation for lower carbon intensity fuels
	M3.2. Increased taxes applied to fossil aviation fuels, the revenue from which will be used to reduce the cost difference between SAF and conventional fuels. To a lesser extent, tax relief will also be applied to low-carbon aviation fuels (LCAF).
	M3.3. A combination of the previous two measures
	M3.4. The strengthening of book & claim mechanisms, with attached transparency criteria and anti-fraud standards
	M3.5. Fiscal incentives that go toward rewarding virtuous behavior related to anti-tankering regulations, as well as a uniform refueling practice at airports in the European Economic Area
L4. Provide specific tax incentives for producers of raw materials or intermediate products for the production of SAF with plants located in Italy, establishing proportionality to the cost differential between SAF and conventional jet-fuel through:	M4.1. Tax exemption on imports of raw materials needed for the production of SAF.
	M4.2. Tax credit for investments made to expand or upgrade the production infrastructure of raw materials or intermediate products for the production of SAF.
	M4.3. Reduction in income tax for companies engaged in the production of raw materials or intermediate products for the production of SAF.
L5. Provide specific tax incentives for users of domestically produced SAF by establishing proportionality to the cost differential between SAF and conventional jet-fuel through:	M5.1. Tax breaks for SAF-using companies and fuel handlers and SAF distributors, which would make up the cost difference depending on the type and blending percentage of SAF used
	M5.2. Tax relief to be allocated to SAF users who do not rely on the "book and claim" mechanism, which will be allocated according to the volume and type of SAF used.

Lines of action	Measures for the implementation
L6. For both producers and users of domestically produced SAF, assign additional tax incentives that reward the lower environmental impact of SAF, taking into consideration the benefits related to both lower CO2 and non-CO2 emissions through:	M6.1. Tax incentives based on a bonus that follows a ranking among different types of SAF (synthetic, biofuel, recycled carbon, low carbon aviation fuels)
	M6.2. Tax incentives based on a bonus that takes only the emissions of the SAF employed into account
L7. To ensure the effectiveness of the policies put in place in the context of the transition to SAF, monitoring should fall especially on:	M7.1. Existing national supervisory authorities and bodies
	M7.2. Existing European authorities and control bodies
	M7.3. Authorities and control bodies created for this specific purpose

Table 13. Lines of action (L) and Measures for the implementation (M) indicated in the survey

The correlation between the policies proposed in the first phase and the structure of Table 13, is represented in the scheme of Figure 22 , in which the measures related to the RefuelEU Aviation Regulation introduced in this phase are highlighted in yellow.

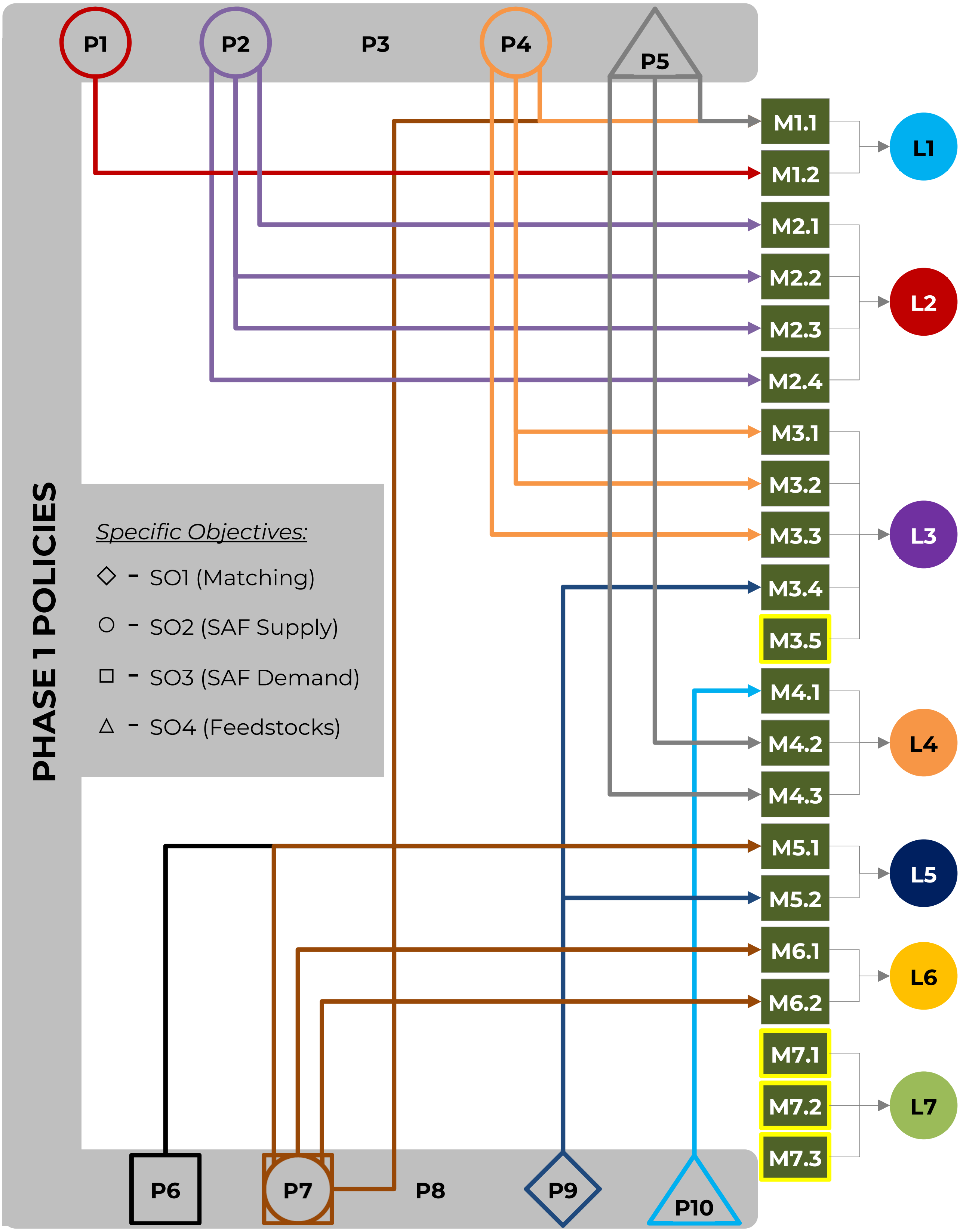


Figure 22. Connecting scheme between phase 1 policies (P) and the structure of lines of action (L) and measures (M)

3.2.1 Preparation of the follow-up questionnaire

In this second phase, the objective was to identify the most effective implementation measures using an approach similar to that of the first phase.

The structure, consisting of lines of action and measures, was used to create a "follow-up" questionnaire, which was submitted to the same group of stakeholders involved in the first phase.

Stakeholders were asked to evaluate, using the same scale from the first phase, the impact that the individual measures listed in Table 13 would have on facilitating the transition to SAF, following these guidelines:

- reflect the views of their respective organizations,
- focus primarily on direct spillovers,
- consider a short to medium-term time horizon (e.g., 5 years).

3.2.2 Results of the Follow-up questionnaire

The results of the questionnaire are summarised in Figure 23 and Figure 24, which illustrate the averages of the assessments made by the stakeholders involved. The detailed results of the individual categories of stakeholders are reported in Appendix B.

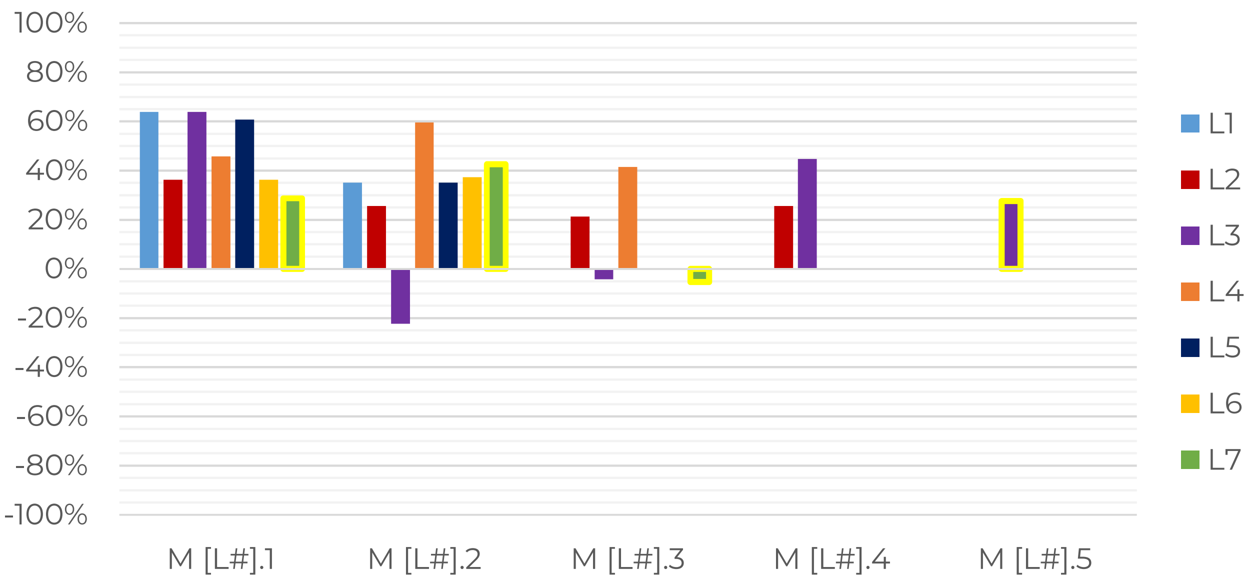


Figure 23. Average of stakeholders' assessments of measures (M) for the implementation of action lines (L)

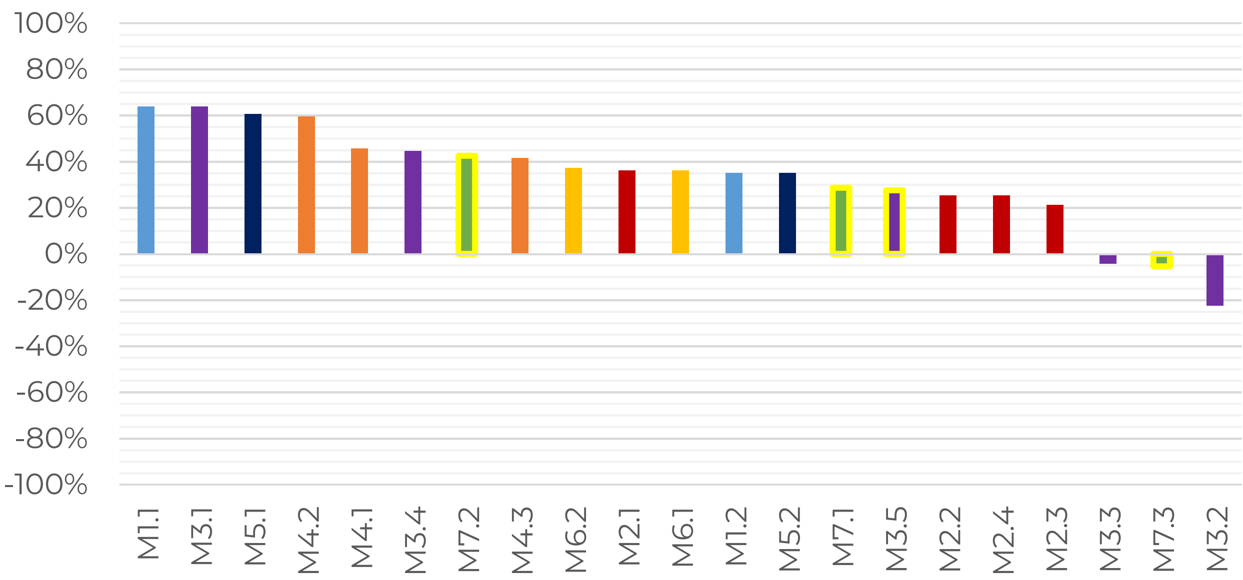


Figure 24. Implementation measures sorted by effectiveness

In particular, Figure 23 demonstrates that all action lines contain at least one positively assessed measure, validating the proposed structure.

Figure 24 displays the various measures ranked from most to least effective, based on the average estimates calculated for the entire sample interviewed. From this graph, as well as from the analogous graphs of the individual categories in Appendix B, it is evident that, except for measures M3.2, M3.3, and M7.3, all proposed measures have been considered effective and can be included in an implementation plan.

Additionally, Figure 24 provides a priority order for these measures, which is useful for planning the implementation of the action lines. It is also noteworthy that, excluding measure M7.3, the newly introduced measures at this stage were positively assessed both overall and by individual categories.

Considering these findings, it was deemed appropriate to review the structure of action lines and measures, excluding those with negative impacts and reordering them according to the indicated priority.

The result of this revision is shown in Table 14, where measures within the same action line that received lower assessments and cannot be considered complementary to the others are indicated as "alternatives."

Lines of action	Measures for the implementation
L1. Attracting investment for SAF production in Italy by ensuring that the price differential with conventional fuels is lowered through:	M1.1. Tax subsidies to technology and infrastructure users directly employed in the supply chain of SAF, which will go to cover 50-95% of the price difference depending on the carbon intensity of the fuel used
	M1.2. The use of state-guaranteed contracts for difference, which ensure a price level of SAF that is similar to that of fossil fuels for a given year. The term of such contracts will be determined according to estimates on the time to market of different types of SAF
L3. Provide specific tax incentives for SAF producers with plants located in Italy (including blenders), establishing proportionality to the cost differential between SAF and conventional jet-fuel through:	M3.1. Decreasing taxes on SAF production, juxtaposed with incentives to facilitate its distribution, encouraging production and transportation for lower carbon intensity fuels
	M3.4. The strengthening of book & claim mechanisms, with attached transparency criteria and anti-fraud standards
	M3.5. Fiscal incentives that go toward rewarding virtuous behavior related to anti-tankering regulations, as well as a uniform refueling practice at airports in the European Economic Area
L5. Provide specific tax incentives for users of domestically produced SAF by establishing proportionality to the cost differential between SAF and conventional jet-fuel through:	M5.1. Tax breaks for SAF-using companies and fuel handlers and SAF distributors, which would make up the cost difference depending on the type and blending percentage of SAF used
	M5.2. Tax relief to be allocated to SAF users who do not rely on the "book and claim" mechanism, which will be allocated according to the volume and type of SAF used.
L4. Provide specific tax incentives for producers of raw materials or intermediate products for the production of SAF with plants located in Italy, establishing proportionality to the cost differential between SAF and conventional jet-fuel through:	M4.2. Tax credit for investments made to expand or upgrade the production infrastructure of raw materials or intermediate products for the production of SAF.
	M4.1. Tax exemption on imports of raw materials needed for the production of SAF.
	M4.3. Reduction in income tax for companies engaged in the production of raw materials or intermediate products for the production of SAF.
L7. To ensure the effectiveness of the policies put in place in the context of the transition to SAF, monitoring should fall especially on:	M7.2. Existing European authorities and control bodies
	M7.1. Existing national supervisory authorities and bodies

Lines of action	Measures for the implementation
L6. For both producers and users of domestically produced SAF, assign additional tax incentives that reward the lower environmental impact of SAF, taking into consideration the benefits related to both lower CO_2 and non-CO_2 emissions through:	M6.2. Tax incentives based on a bonus that take only the emissions of the SAF employed into account - - - - - <u>*Alternative measure:*</u> *M6.1. Tax incentives based on a bonus that follows a ranking among different types of SAF (synthetic, biofuel, recycled carbon, low carbon aviation fuels*)
L2. Attracting investment to start or increase the SAF market through the provision of government-guaranteed grants and low-interest loans, the timing of which will be determined according to the time to market of different production technologies through:	M2.1. Release of capital advances, which will be determined according to the technology and project developed in terms of emissions - - - - - <u>*Alternative measure:*</u> *M2.4. Combination of grants and low-interest loans where grants will play a more influential role in financing, which will be to be quantified depending on the technology and project developed in terms of emissions*
	M2.2. Issuance of low-interest loans, which will be determined according to the technology and project developed in terms of emissions. - - - - - <u>*Alternative measure:*</u> *M2.3. Combination of grants and low-interest loans where loans will play a more influential role in financing, which will be quantified depending on the technology and project developed in terms of emissions.*

Table 14. Lines of action (L) and Measures for the implementation (M) ordered according to stakeholders' view

As outlined in the summary published by Enac on November 2023 ([17]), the structure of action lines and measures for implementation, organized by priority as shown in Table 14, aims to provide a comprehensive database of data and considerations. This database serves as a foundation for formulating a strategy that is shared with stakeholders, which can then be presented to political decision-makers.

4 Definition of a roadmap for SAF in Italy

Based on the results illustrated in the previous chapter, derived from the interaction with participants during the two phases of stakeholder engagement, a synthesis can be drawn, structured around Specific Objectives (SO), Lines of Action (L), and Measures (M).

Keeping in mind the connections between these elements, as outlined in Figure 22, it is possible to develop an implementation plan. This plan is organized according to the regulatory framework of Figure 20 and aligned with the priority order in Table 13.

This correlation applies to all proposed measures, except for those introduced in the second phase (M3.5, M7.1, and M7.2), which address aspects relevant to the RefuelEU Aviation Regulation.

Therefore, it is appropriate to add a fifth specific objective to the regulatory framework. This objective, consistent with the Regulation's role of national authorities, is called ***"SO5: RefuelEU Aviation Regulation enforcement".***

Before drafting an implementation plan, the following simplifications are considered useful:

- reduce the package of measures by excluding those indicated as alternatives;
- assign each measure to a single specific objective, selecting the most relevant one if there is more than one.

As a result of this second simplification, measure M1.1 has been allocated to the specific objective of increasing the supply of SAF (SO2), whereas the specific objective for stimulating demand (SO3) has been combined with measures M5.1 and M6.2.

Following these simplifications, a sub-objective - or Task (T) - can be defined for each selected measure, as shown in Table 15. In this table, Tasks are numbered with two digits that refer to their specific objective and the priority order of the measure they represent.

For the complete definition of the implementation plan, the start and end dates of each task still need to be introduced. For this purpose, the following considerations are useful:

- the general objective, defined as "Defining a balanced framework for the development of the SAF market in Italy," implies the need for parallel start and progress of activities associated to different specific objectives, at least the first 4;
- the minimum shares of SAF prescribed by the RefuelEU Aviation Regulation for the year 2030, which is 6% with 2% covered by synthetic fuels, will only be

achievable with appropriate incentives. Therefore, the implementation plan should be designed to produce its effects by that date.

Specific Objectives	Lines of action	Measures	TASK 2.1	TASK 2.2	TASK 3.1	TASK 4.1	TASK 4.2	TASK 1.1	TASK 5.1	TASK 4.3	TASK 3.2	TASK 2.3	TASK 2.4	TASK 1.2	TASK 5.2	TASK 5.3	TASK 2.5
SO1	L3	M3.4						■									
	L5	M5.2												■			
SO2	L1	M1.1	■														
	L1	M1.2											■				
	L2	M2.1										■					
	L2	M2.2															■
	L3	M3.1		■													
SO3	L5	M5.1			■												
	L6	M6.2									■						
SO4	L4	M4.2				■											
	L4	M4.1					■										
	L4	M4.3								■							
SO5	L3	M3.5														■	
	L7	M7.2							■								
	L7	M7.1													■		

Table 15. Correspondence between Measures (M) and Task (T), sorted from left to right in order of priority and grouped by Specific Objective (SO)

Considering the technical time required to activate the measures at the competent institutions and the additional lag between implementation and effects on the market, it is reasonable to assume an overall implementation plan duration of 3 years. This assumption leads to the planning hypothesis outlined in Table 16, which divides the time frame into semesters and staggers activities according to the previously determined order of priority. The application of each measure is not expected to conclude at the end of the 3 years. Instead, as indicated by the symbols in the last column (>), these measures should continue until deemed necessary.

The task descriptions in Table 16 differ from those of the measures for the sake of coinciseness and to enhance the integration of activities. For example, in SO5, as required by the RefuelEU Aviation Regulation, EASA needs to work in synergy with the national competent authorities.

Specific Objectives	Task n.	Description	Semesters					
			1	2	3	4	5	6
SO1. Demand-supply matching measures	T1.1	The strengthening of book & claim mechanisms, with attached transparency criteria and anti-fraud standards (ref. M3.4)						>
	T1.2	Tax relief to be allocated to SAF users who do not rely on the "book and claim" mechanism, which will be allocated according to the volume and type of SAF used (ref. M5.2)						>
SO2. Supply-side measures	T2.1	Tax subsidies to technology and infrastructure users directly employed in the supply chain of SAF, which will go to cover 50-95% of the price difference depending on the carbon intensity of the fuel used (ref.M1.1)						>
	T2.2	Decreasing taxes on SAF production, juxtaposed with incentives to facilitate its distribution, encouraging production and transportation for lower carbon intensity fuels (ref. M3.1)						>
	T2.3	Release of capital advances, which will be determined according to the technology and project developed in terms of emissions (ref. M2.1, or alternative measure M2.4)						>
	T2.4	The use of state-guaranteed contracts for difference, which ensure a price level of SAF that is similar to that of fossil fuels for a given year. The term of such contracts will be determined according to estimates on the time to market of different types of SAF (ref. M1.2)						>
	T2.5	Issuance of low-interest loans, which will be determined according to the technology and project developed in terms of emissions. (ref. M2.2, or alternative measure M2.3)						>
SO3. Demand-side measures	T3.1	Tax breaks for SAF-using companies and fuel handlers and SAF distributors, which would make up the cost difference depending on the type and blending percentage of SAF used (ref. M5.1)						>
	T3.2	Tax incentives based on a bonus that takes only the emissions of the SAF employed into account (ref. M6.2, or alternative measure M6.1)						>
SO4. Measures for feedstock security	T4.1	Tax credit for investments made to expand or upgrade the production infrastructure of raw materials or intermediate products for the production of SAF (ref. M4.2)						>
	T4.2	Tax exemption on imports of raw materials needed for the production of SAF (ref. M4.1)						>
	T4.3	Reduction in income tax for companies engaged in the production of raw materials or intermediate products for the production of SAF (ref. M4.3)						>
SO5. RefuelEU Aviation Regulation enforcement	T5.1	RefuelEU Aviation: improvement of compliance within the reporting cycle enforced by EASA (ref. M7.2)						>
	T5.2	RefuelEU Aviation: improvement of compliance within the enforcement carried out by the National Competent Authority (ref. M7.1)						>
	T5.3	RefuelEU Aviation: tax incentives for aircraft operators compliant to anti-tankering measures (ref. M3.5)						>

Table 16. Italian SAF Roadmap: implementation plan

The timeline for the tasks outlined in Table 16 has been designed to facilitate the gradual introduction of measures over three years, following a roadmap that can be summarized as in Figure 25. It is important to associate this timeline with the scheme in Figure 20 to integrate the previously defined "baseline policies".

SAF ROADMAP: A BALANCED REGULATORY FRAMEWORK FOR SAF SCALING-UP IN ITALY

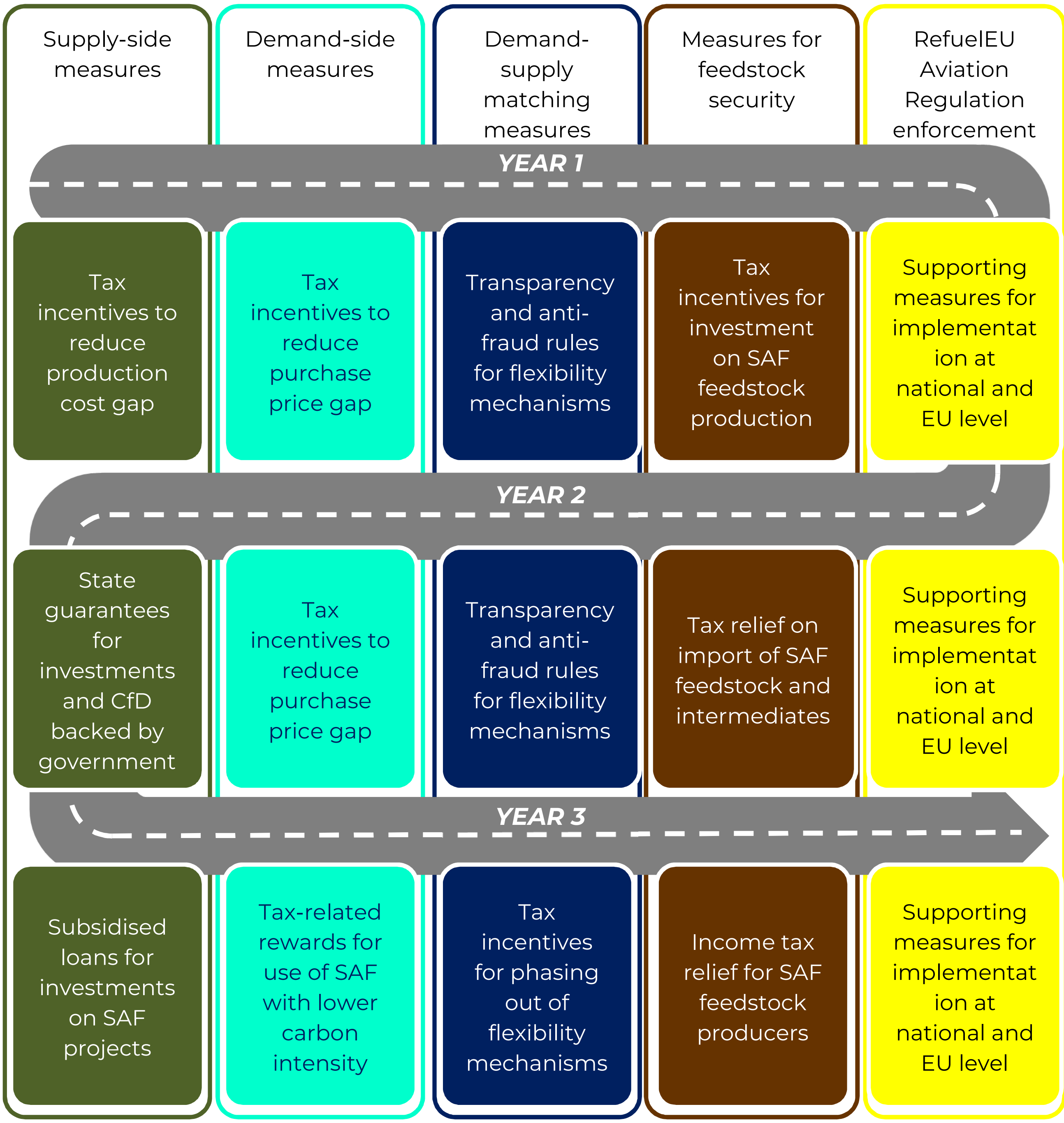


Figure 25. Italian SAF Roadmap: graphic summary of the implementation plan

5 CONCLUSIONS: THE ROADMAP IN THE NATIONAL CONTEXT

In conclusion, it is important to highlight several key elements of the national context, which are significant at the time of drafting this document and useful for understanding the potential impact of the proposed roadmap on the development of SAF.

In line with the Authority's vision expressed throughout this document, these elements should be seen as integral parts of a general strategy based on certain guidelines necessary for addressing the challenge of decarbonizing air transport in the short term:

- prioritize more mature propulsion technologies, with aeronautical engines powered by SAF preferred over those still under research, such as hydrogen or electric propulsion;
- in the selection and research of feedstocks for SAF production, give preference to biomass over organic feedstocks from waste or residues and feedstocks of non-biological origin;
- activate international supply chains that enable developing countries to play an active role in production and not only in feedstock supply.

The first element concerns the production capacity of SAF in Italy, where it is appropriate to reference the activities of ENI, the main fuel producer in the country. ENI has included SAF in its biofuel production business plans and aims to reach 300,000 tonnes per year by 2025 ([31]).

SAF produced by ENI is derived from waste feedstock, such as waste cooking oils, animal fats, and other biomass. This feedstock is transformed into biofuel at the Gela biorefinery. SAF are obtained from the distillation of biofuel at the Livorno refinery.

Through a joint venture with Snam, ENI also operates in the field of CO2 capture to reduce the carbon footprint of various industrial processes. Captured CO2 can be stored underground long-term (Carbon Capture and Storage, CCS) or used to produce fuels, chemicals, or building materials (Carbon Capture and Utilisation, CCU).

Enac considers the involvement of the main national producer, along with the entire production chain, crucial in the path toward decarbonizing air transportation. This particularly pertains to those "ready" for production, derived from biomass, to drive the decarbonization of air transportation. This approach also enables African countries to participate in the development of air transportation, making them active contributors to the necessary shift towards sustainable air transportation in accordance with ICAO principles and European legislation.

A second element concerns the activities carried out by airport managing bodies, which, as outlined in the RefuelEU Aviation Regulation, serve as an interface between producers and users of SAF. In this context, it is useful to reference both the activities of SEA S.p.A., the managing body of Milan Linate and Malpensa airports, and Aeroporti di Roma S.p.A., which manages Rome Fiumicino and Ciampino airports.

In 2023, SEA S.p.A. allocated €450,000 to encourage the use of SAF by aircraft operators, offering a contribution of €500 per ton of neat SAF purchased and paid for at the managed airports ([32]). This incentive has been offered by SEA also in 2024, allocating €500,000 and increasing the contribution up to €800 per ton. Additionally, SEA aims to make Malpensa the first Italian airport capable of distributing SAF through its pipeline.

Aeroporti di Roma S.p.A. has experimented SAF logistics at Fiumicino airport, transporting SAF from refineries by both land and sea, and integrating SAF into the pipeline connecting the airport with the port of Civitavecchia. Alongside ENI, Aeroporti di Roma S.p.A. is also a promoter of the "Pact for Decarbonisation," an initiative aimed at maintaining dialogue between stakeholders and institutions, and highlighting the SAF theme at COP28, held in Dubai from 30 November to 12 December 2023 ([31]).

The third element involves aircraft operators in Italy. In 2023, almost all of them conducted commercial flights with fuels containing SAF and launched initiatives to promote their use among customers. An example is the "Fly with SAF" program, launched in May 2023 by ITA Airways S.p.A. and DB Schenker Italy, allowing shippers to contribute to the purchase of SAF and reduce CO_2 emissions associated with the transportation of goods ([33]).

Additionally, Italian aircraft manufacturers and subsystem developers are engaged in testing and developing technologies to increase SAF compatibility with engines and onboard systems. Recent examples include flight tests with 100% SAF conducted in November 2023 by Leonardo Helicopters on Pratt & Whitney engines ([34]).

These elements result from complex, interconnected business processes characterized by higher risk levels than typical operations. The push towards SAF transition is evident among all the involved parties, driven not only by upcoming obligations from the RefuelEU Aviation Regulation but also by the market opportunities that SAF offer in terms of positioning within the circular and sustainable economy.

While there is a clear drive towards innovation promising net-zero emissions, the associated risks mean companies proceed cautiously. The feedback from stakeholders, summarized in paragraph 3.1.2, highlights the need to balance obligations with support measures that reduce the risks associated with the SAF transition within a stable regulatory framework.

This roadmap aims to capture these signals and to provide a comprehensible shape to the stakeholders' feedback, aiming to relate them to each other and to develop an implementation plan that aligns with the expectations of the majority. Several times and in various contexts, it has been emphasized that the primary priority is to promote SAF production, encouraging economies of scale to reduce the current cost differential between SAF and traditional fuels. This study indicates that, to foster SAF development in Italy, this priority should be coupled with other key priorities, such as stimulating demand, linking supply and demand, and ensuring the feedstock availability.

As explained in Chapter 4, the decision to structure the roadmap over a three-year period was driven by the need to achieve impacts by 2030, a critical date for supply targets set by the RefuelEU Aviation Regulation. While the duration can be modified, and different choices can be made about when to start specific measures, it is crucial to preserve the implementation order to maintain alignment with the expressed priorities.

Beyond considerations on potential policies, it is important to underline once again that the main obstacles to SAF introduction are the low availability of finished products in the market and the difficulty of sourcing feedstock. The dialogue with stakeholders has highlighted the urgent need to address these obstacles through a holistic approach that does not impose disproportionate limitations on potential feedstock and transformation processes.

Specifically, the strategy to bridge the short-term SAF production gap should focus on technologically and commercially mature solutions such as biofuels, derived from waste substances, residues, or biomass produced through dedicated crops. These must comply with the non-competition criteria with food and feed crops, as prescribed by the Renewable Energy Directive, and should be obtained from intermediate crops or degraded land unsuitable for agriculture.

This strategy would benefit the sector by increasing the availability of sustainable fuels and activating international supply chains, enabling developing countries to play a vital role in the production chain and benefit from the value generated through direct participation in the transition to net-zero emissions aviation.

Many of these countries have also a central role in ICAO's capacity-building programs, such as ACT-SAF ([35]), which are supported by around 90 Member States, including Italy (see Figure 26), and funded by both the Member States and the European Commission. Implementing these activities would include countries with feedstock but lacking necessary technologies to activate and industrial growth, enabling them to join the production chain and contribute to the challenge of aviation emissions reduction.

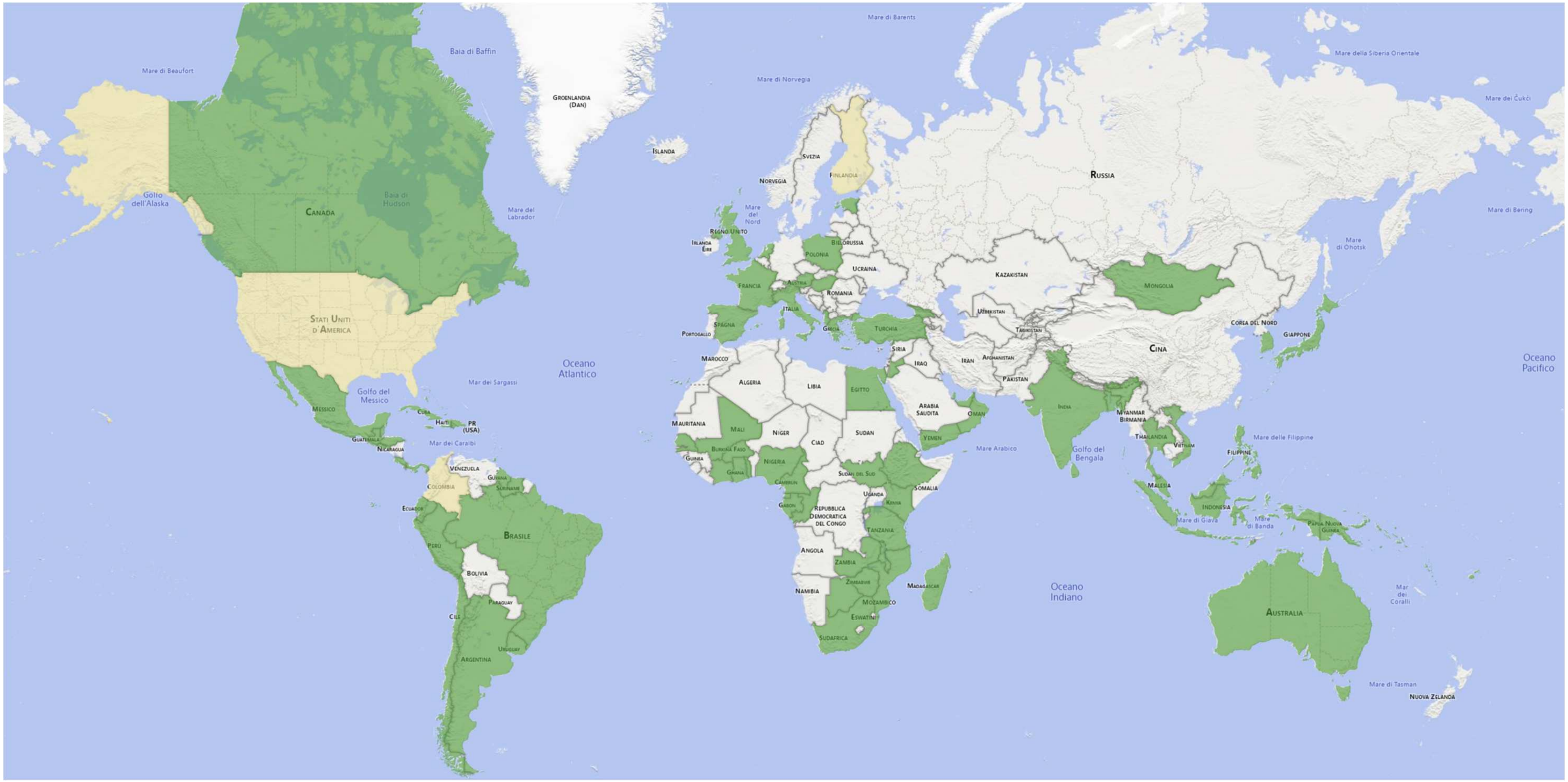


Figure 26. Map of Countries participating in the ICAO ACT-SAF program in June 2024

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GLOSSARY

Alliance for Zero Emissions Aviation (AZEA): alliance, established by the European Commission, of public and private partners with the aim of preparing the market for the entry into service of zero-emission aircraft.

Annex 16 ICAO: "Environmental Protection" annex divided in 4 volumes: Volume I - Aircraft Noise, Volume II - Aircraft Engine Emissions, Volume III - Aeroplane CO2 Emissions, Volume IV - Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Biocarburanti: fuel that is produced over a short time span from biomass, rather than by the very slow natural processes involved in the formation of fossil fuels.

Book & Claim: tracking method that guarantees the custody of information within the phases of a process. Applied to SAF, the information to be kept concerns data such as production batch and characteristics in terms of environmental impact of a given quantity of fuel. This information allows producers to generate a uniquely identified certificate, which can be purchased in advance (book) and anywhere - even in the absence of the physical product - by an airline operator, who can subsequently use it to claim its contribution to reducing environmental impact.

Cap-and-trade: see Emissions Trading System (ETS).

CORSIA: ICAO Carbon Offsetting and Reduction Scheme for International Aviation.

Climate and Environment Committee (CEC): commission that provides support to the ICAO Council on policies and programs relating to the climate impact of aviation and environmental protection.

Clearing House: in general, a service which facilitates and simplifies transactions among multiple parties. Applied to SAF, it refers to a technical body capable of supporting fuel producers in the SAF certification process according to current aeronautical standards.

Committee on Aviation Environment Protection (CAEP): ICAO technical committee assisting the Council in formulating new policies and adopting new Standards and Recommended Practices (SARPs) related to aircraft noise and emissions, and more generally to aviation environmental impact.

Contract for Differences (CfD): type of contract through which the selling and purchasing parties of a specific good or service agree to exchange money based on the change in value of that good or service during a predefined period of time. If the value of the good or service increases, the buying party makes a profit and the selling party makes a loss; vice versa if the value decreases.

Directorate-General for Mobility and Transport (DG-MOVE): Directorate General of the European Commission responsible for European Union policy for mobility and transport.

Emission Trading Scheme (ETS): cap-and-trade system the limits the total volume of GHG emissions from stationary installations (e.g.: industrial plants) and aircraft operators. The system allows trading of emission allowances so that the total emissions stay within the cap and the least-cost measures can be taken up to reduce emissions. ETS is part of Fit-for-55 package.

European Aviation and Environment Working Group (EAEG): ECAC working group which carries out assessments on European environmental priorities, on emerging themes, on the needs for harmonisation, coordination and support to ECAC States also in order to pursue a coordinated policy at European level for the implementation of ICAO resolutions.

European Civil Aviation Conference (ECAC): EU intergovernmental organization aiming to harmonize civil aviation policies and practices amongst its Member States and, at the same time, promote understanding on policy matters between its Member States and other parts of the world.

European Commission (EC): European Union's politically independent executive arm. It is responsible for drawing up proposals for new European legislation, and it implements the decisions of the European Parliament and the Council of the EU.

European Union (EU): economic and political union between 27 European Countries. Members are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

European Union Aviation Safety Agency (EASA): European aviation safety agency with the task of ensuring the safety and environmental protection of air transport in Europe.

Feedstocks: raw materials (or intermediate products) that are used to produce something in an industrial process.

Fit-for-55: package of proposals to revise and update EU legislation and to put in place new initiatives with the aim of ensuring that EU policies are in line with the EU's climate goal of reducing EU emissions by at least 55% by 2030 (baseline year 1990).

Fuel Task Group (FTG): CAEP working group that addresses technical issues relating to the environmental impact of aviation fuels, whose activities lead to the definition of standards included in ICAO Annex 16 Vol. IV (CORSIA).

Greenhouse gases (GHG): atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N20). Less prevalent - but very powerful - greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).

Hydrogen: the lightest and most abundant element in the universe, as well as a component at the base of hydrocarbons. Obtainable through various industrial processes, which determine the following non-exahustive classification:

- **Green:** hydrogen produced with energy coming from renewable sources like wind, water or sun.
- **Blue:** hydrogen produced from natural gas with a process of steam methane reforming, where natural gas is mixed with very hot steam and a catalyst. A chemical reaction occurs creating hydrogen and carbon monoxide. Water is added to that mixture, turning the carbon monoxide into carbon dioxide and more hydrogen. If the carbon dioxide emissions are then captured and stored underground, the process is considered carbon-neutral, and the resulting hydrogen is called "blue hydrogen."
- **Grey:** hydrogen produced from steam methane reforming (as for the "blue hydrogen") without any carbon dioxide capture.
- **Pink:** hydrogen produced by electrolysis of water powered by nuclear energy.

International Civil Aviation Organization (ICAO): specialized UN agency with expertise in the regulation and development of the Civil Aviation system for sustainable growth of the sector.

Life-Cycle Assessment (LCA): methodology for the evaluation of the effects that a product has on the environment over the entire period of its life. It can be used to study the environmental impact of either a product or the function the product is designed to perform. In the context of SAF, if usually refers to the assessment of GHG emissions over the entire lifecycle of the fuels.

Lower-Carbon Aviation Fuels (LCAF): fossil-derived fuels with a lower carbon-to-energy content than traditional fossil fuels. For instance, natural gas (methane) or propane have lower carbon content than conventional jet fuels (kerosene). The same definition applies to conventional jet fuels produced in such a way that part of the emitted CO2 is captured.

Long-Term global Aspirational Goal (LTAG): collective long-term global for international aviation of net-zero carbon emissions by 2050 in support of the UNFCCC Paris Agreement's temperature goal, adopted by the 41st Assembly of the International Civil Aviation Organisation (ICAO) in 2022.

Net-zero carbon emissions: defined as the condition in which "a*nthropogenic CO2 emissions are balanced globally by anthropogenic CO2 removals over a specified period*", according to the Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the science related to climate change.

RefuelEU Aviation: Regulation (EU) 2023/2405 "OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on ensuring a level playing field for sustainable air transport". ReFuelEU is part of the Fit-for-55 package.

Renewable and Low-Carbon Fuels Value Chain Industrial Alliance (RLCF): alliance between stakeholders promoted by the European Commission for the production and supply of low-carbon renewable fuels in the aviation and maritime transport sectors.

Renewable Energy Directive (RED): Directive (EU) 2018/2001, legal framework for the development of renewable energy across all sectors of the EU economy. RED is part of Fit-for-55 package.

Renewable Fuels of Non-Biological Origin (RFNBOs): renewable fuels of non-biological origin, synonym of synthetic aviation fuels.

Sustainable Aviation Fuel (SAF): aviation fuels derived form renewable sourcses, hence alternative to fossil-derived fuels, that meets sustainability criteria provide by authorities.

Synthetic Aviation Fuels: see Renewable Fuels of Non-Biological Origin (RFNBOs).

Tankering: practice in which aircraft operators uplift more aviation fuel than necessary at the departure airport, with the aim to avoid the refuelling at a destination airport where fuel is more expensive.

World Economic Forum (WEF): non-profit international organization for public-private cooperation, dedicated to identifying and addressing the most urgent challenges for global well-being and growth.

Appendix A: Phase 1 results in details

Figure 27 incates the number of responses received during the phase 1. The stakeholders are grouped as follows:

- **GAE**: airport managing bodies;
- **OAE**: aircraft operators;
- **FCA**: fuel supply chain (manufacturers, distributors, and handlers);
- **COS**: aircraft manufacturers;
- **UN-E**: universities and research centres.

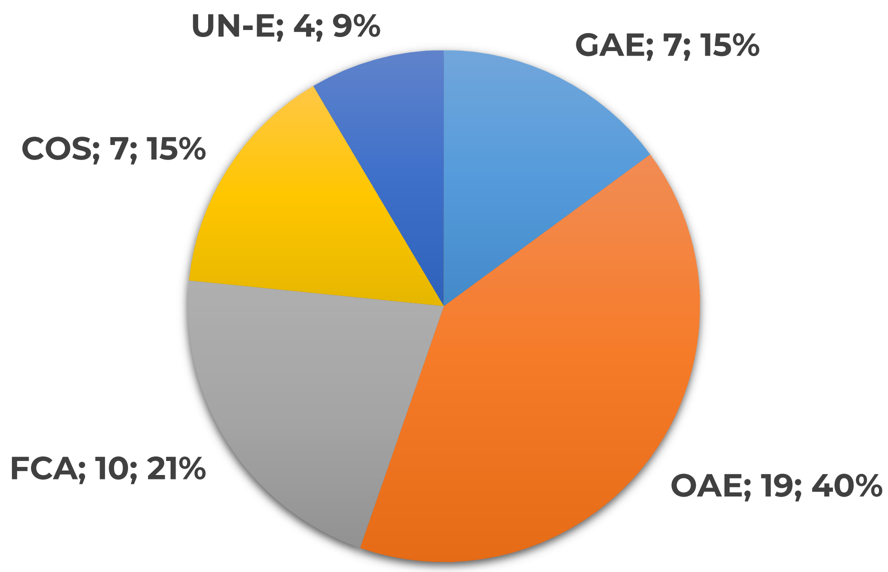

Figure 27. Phase 1 questionnaire: number of responses

The table reported in the following sections shows the average impact values of the policies, calculated for each category of stakeholder by associating the following numerical values with the evaluation scale proposed in the questionnaire:

- +100% strongly positive (questionnaire rating = 5)
- +50% weakly positive (questionnaire rating = 4)
- 0% negligible (questionnaire rating = 3)
- -50% weakly negative (questionnaire rating = 2)
- -100% strongly negative (questionnaire rating = 1)

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

	GAE	OAE	FCA	COS	UN-E
Q1	36%	61%	50%	50%	50%
Q2	36%	76%	75%	57%	31%
Q3	50%	76%	80%	36%	56%
Q4	43%	47%	30%	36%	63%
Q5	57%	47%	65%	71%	0%
Q6	36%	42%	50%	57%	25%
Q7	36%	50%	60%	36%	88%
Q8	29%	53%	40%	43%	50%
Q9	7%	24%	35%	29%	0%
Q10	21%	24%	15%	36%	38%
AVERAGE P1	**35%**	**50%**	**50%**	**45%**	**40%**

Table 17. Policy 1: details on average impact values

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

	GAE	OAE	FCA	COS	UN-E
Q1	50%	61%	55%	36%	38%
Q2	57%	74%	60%	71%	38%
Q3	43%	82%	65%	79%	75%
Q4	36%	39%	10%	50%	13%
Q5	43%	42%	35%	71%	25%
Q6	7%	29%	35%	43%	0%
Q7	50%	58%	55%	21%	88%
Q8	21%	55%	25%	64%	50%
Q9	7%	16%	20%	29%	13%
Q10	7%	29%	20%	21%	25%
AVERAGE P2	**32%**	**48%**	**38%**	**49%**	**36%**

Table 18. Policy 2: details on average impact values

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)

	GAE	OAE	FCA	COS	UN-E
Q1	57%	79%	30%	86%	38%
Q2	36%	63%	30%	57%	50%
Q3	7%	45%	35%	64%	50%
Q4	29%	63%	0%	64%	25%
Q5	21%	37%	10%	57%	13%
Q6	7%	32%	0%	57%	0%
Q7	43%	37%	5%	43%	50%
Q8	7%	50%	15%	57%	38%
Q9	0%	21%	0%	57%	0%
Q10	21%	32%	0%	29%	38%
AVERAGE P3	**23%**	**46%**	**13%**	**57%**	**30%**

Table 19. Policy 3: details on average impact values

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)

	GAE	OAE	FCA	COS	UN-E
Q1	57%	58%	50%	43%	75%
Q2	50%	68%	70%	71%	75%
Q3	64%	66%	70%	71%	75%
Q4	36%	50%	15%	64%	75%
Q5	71%	53%	60%	36%	25%
Q6	29%	39%	25%	57%	25%
Q7	43%	55%	55%	36%	63%
Q8	29%	47%	55%	64%	63%
Q9	21%	24%	30%	29%	0%
Q10	21%	26%	15%	43%	38%
AVERAGE P4	**42%**	**49%**	**45%**	**51%**	**51%**

Table 20. Policy 4: details on average impact values

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)

	GAE	OAE	FCA	COS	UN-E
Q1	93%	79%	70%	71%	88%
Q2	64%	61%	70%	36%	50%
Q3	36%	55%	65%	50%	50%
Q4	79%	63%	55%	71%	50%
Q5	57%	45%	60%	50%	38%
Q6	29%	32%	25%	57%	25%
Q7	43%	26%	40%	29%	38%
Q8	29%	55%	40%	71%	50%
Q9	21%	21%	35%	29%	0%
Q10	36%	29%	10%	21%	25%
AVERAGE P5	**49%**	**47%**	**47%**	**49%**	**41%**

Table 21. Policy 5: details on average impact values

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)

	GAE	OAE	FCA	COS	UN-E
Q1	64%	47%	45%	43%	50%
Q2	57%	58%	55%	64%	50%
Q3	57%	47%	70%	50%	75%
Q4	50%	53%	25%	50%	63%
Q5	79%	53%	65%	57%	38%
Q6	64%	68%	30%	71%	38%
Q7	43%	37%	35%	21%	63%
Q8	36%	37%	45%	71%	63%
Q9	21%	45%	40%	36%	25%
Q10	64%	39%	20%	50%	50%
AVERAGE P6	**54%**	**48%**	**43%**	**51%**	**51%**

Table 22. Policy 6: details on average impact values

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

	GAE	OAE	FCA	COS	UN-E
Q1	64%	61%	45%	50%	63%
Q2	71%	68%	50%	29%	50%
Q3	79%	66%	50%	29%	50%
Q4	64%	61%	40%	79%	88%
Q5	43%	63%	55%	50%	38%
Q6	36%	58%	55%	50%	25%
Q7	57%	37%	50%	43%	63%
Q8	21%	47%	45%	43%	25%
Q9	29%	47%	20%	36%	25%
Q10	29%	37%	25%	43%	63%
AVERAGE P7	**49%**	**54%**	**44%**	**45%**	**49%**

Table 23. Policy 7: details on average impact values

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)

	GAE	OAE	FCA	COS	UN-E
Q1	7%	3%	25%	29%	38%
Q2	0%	13%	40%	36%	25%
Q3	0%	11%	35%	43%	25%
Q4	-14%	5%	15%	-7%	13%
Q5	7%	-16%	20%	0%	13%
Q6	-14%	-13%	10%	-21%	13%
Q7	0%	0%	35%	14%	63%
Q8	-21%	-3%	20%	29%	38%
Q9	-29%	-16%	25%	7%	25%
Q10	50%	18%	50%	43%	63%
AVERAGE P8	**-1%**	**0%**	**28%**	**17%**	**31%**

Table 24. Policy 8: details on average impact values 8

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

	GAE	OAE	FCA	COS	UN-E
Q1	21%	39%	40%	36%	50%
Q2	36%	42%	35%	64%	50%
Q3	21%	39%	25%	50%	63%
Q4	-14%	34%	5%	43%	38%
Q5	7%	34%	45%	57%	50%
Q6	29%	34%	35%	36%	38%
Q7	0%	26%	15%	29%	50%
Q8	14%	42%	20%	57%	38%
Q9	0%	37%	35%	43%	50%
Q10	21%	18%	15%	14%	63%
AVERAGE P9	**14%**	**35%**	**27%**	**43%**	**49%**

Table 25. Policy 9: details on average impact values

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)

	GAE	OAE	FCA	COS	UN-E
Q1	43%	71%	55%	64%	13%
Q2	50%	61%	45%	71%	25%
Q3	36%	53%	50%	64%	38%
Q4	-7%	45%	20%	71%	13%
Q5	36%	55%	25%	50%	25%
Q6	29%	47%	15%	50%	13%
Q7	14%	37%	40%	50%	13%
Q8	-14%	34%	5%	29%	25%
Q9	-7%	32%	20%	50%	-13%
Q10	-7%	21%	5%	21%	0%
AVERAGE P10	**17%**	**46%**	**28%**	**52%**	**15%**

Table 26. Policy 10: details on average impact values

The following table summarizes, for each policy and for each category of stakeholder, the averages calculated on the impact items, reported in the last row of the previous ones:

	GAE	OAE	FCA	COS	UN-E
POLICY 1	35%	50%	50%	45%	40%
POLICY 2	32%	48%	38%	49%	36%
POLICY 3	23%	46%	13%	57%	30%
POLICY 4	42%	49%	45%	51%	51%
POLICY 5	49%	47%	47%	49%	41%
POLICY 6	54%	48%	43%	51%	51%
POLICY 7	49%	54%	44%	45%	49%
POLICY 8	-1%	0%	28%	17%	31%
POLICY 9	14%	35%	27%	43%	49%
POLICY 10	17%	46%	28%	52%	15%

Table 27. Phase 1 results: average impact values

In order to identify the policies considered more and less effective by the various categories of stakeholders, each column of the previous table has been reworked on a 0-100% scale in which the limit values correspond to the minimum and maximum scores of the evaluations given by the same category of stakeholders.

The results are reported in the following table, as well as in Table 12, where the arrows indicate 4 levels of policy effectiveness: high (↑); medium-high (↗); medium-low (↘); low (↓).

	GAE	OAE	FCA	COS	UN-E
POLICY 1	↗ 66%	↑ 92%	↑ 100%	↗ 70%	↗ 69%
POLICY 2	↗ 61%	↑ 89%	↗ 68%	↑ 79%	↗ 59%
POLICY 3	↘ 44%	↑ 84%	↓ 0%	↑ 100%	↘ 41%
POLICY 4	↑ 79%	↑ 89%	↑ 85%	↑ 86%	↑ 100%
POLICY 5	↑ 91%	↑ 85%	↑ 92%	↑ 79%	↗ 72%
POLICY 6	↑ 100%	↑ 89%	↑ 81%	↑ 86%	↑ 100%
POLICY 7	↑ 92%	↑ 100%	↑ 83%	↗ 70%	↑ 93%
POLICY 8	↓ 0%	↓ 0%	↘ 40%	↓ 0%	↘ 45%
POLICY 9	↘ 27%	↗ 64%	↘ 39%	↗ 64%	↑ 93%
POLICY 10	↘ 34%	↑ 83%	↘ 41%	↑ 88%	↓ 0%

Table 28. Policies' impact according to stakeholders' view

APPENDIX B: PHASE 2 RESULTS IN DETAILS

Figure 28 incates the number of responses received during the phase 2. The stakeholders are grouped as follows:

- **GAE**: airport managing bodies;
- **OAE**: aircraft operators;
- **FCA**: fuel supply chain (manufacturers, distributors, and handlers);
- **COS**: aircraft manufacturers;
- **UN-E**: universities and research centres.

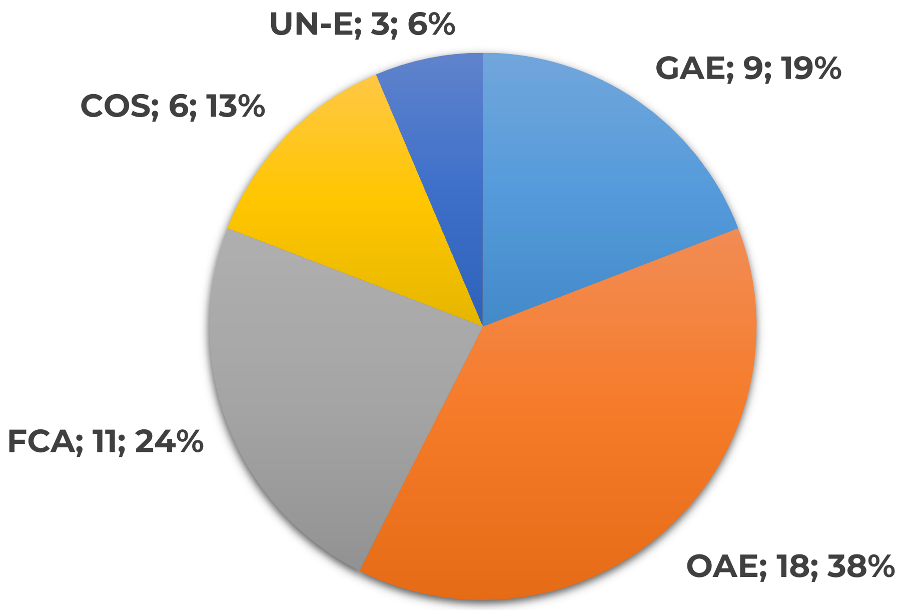

Figure 28. Phase 2 questionnaire: number of responses

The table reported in the following sections shows the average impact values of the policies, calculated for each category of stakeholder by associating the following numerical values with the evaluation scale proposed in the questionnaire:

- +100% strongly positive (questionnaire rating = 5)
- +50% weakly positive (questionnaire rating = 4)
- 0% negligible (questionnaire rating = 3)
- -50% weakly negative (questionnaire rating = 2)
- -100% strongly negative (questionnaire rating = 1)

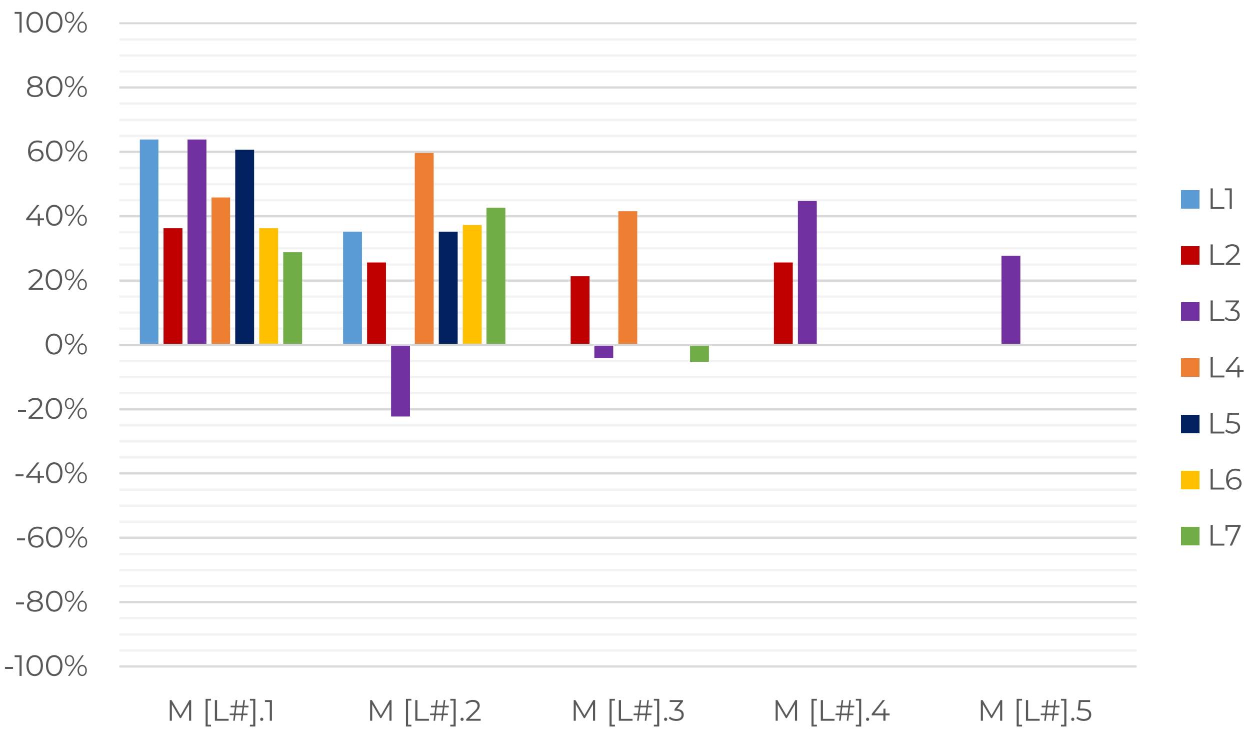

Figure 29. Average values of the evaluations from all the stakeholders in phase 2

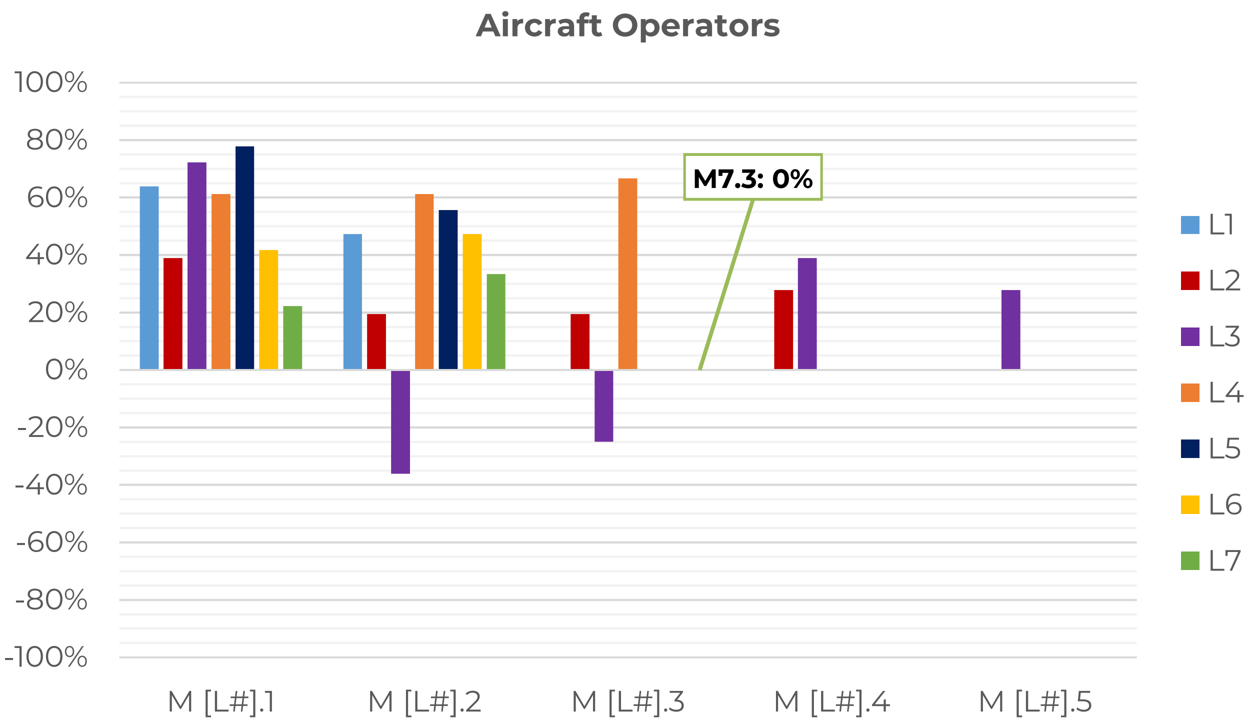

Figure 30. Average values of the evaluations from aircraft operators in phase 2

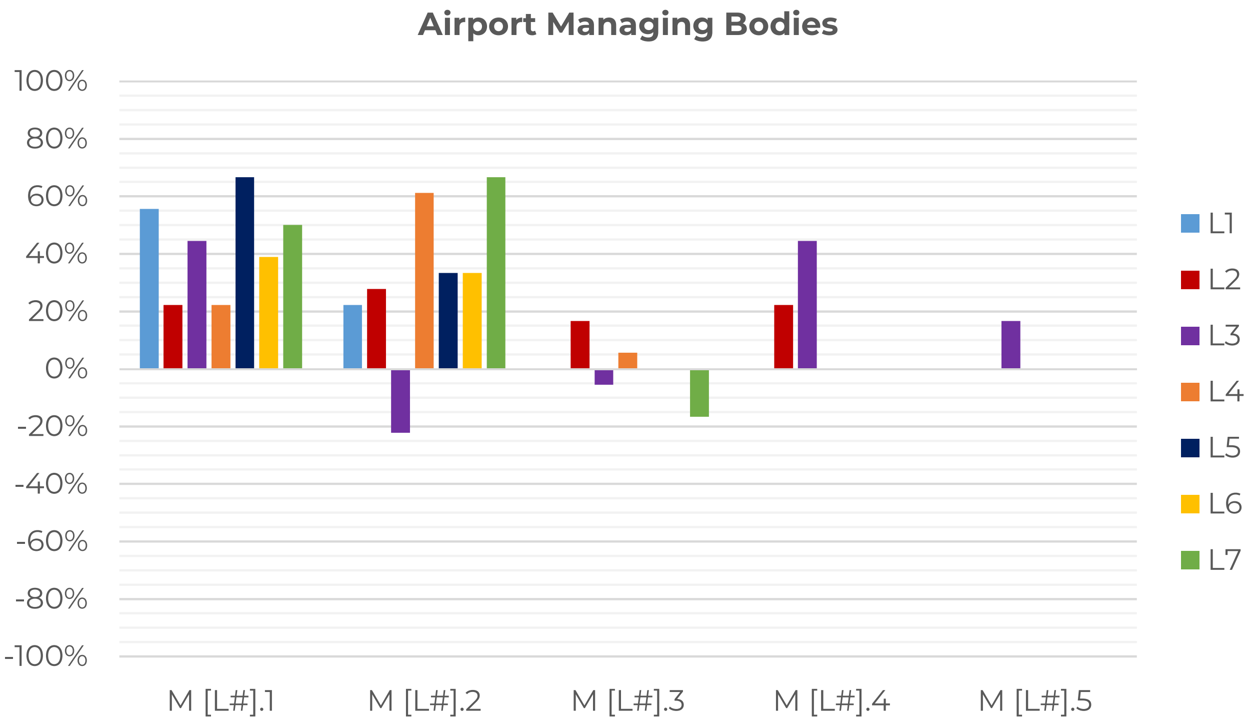

Figure 31. Average values of the evaluations from airport managing bodies in phase 2

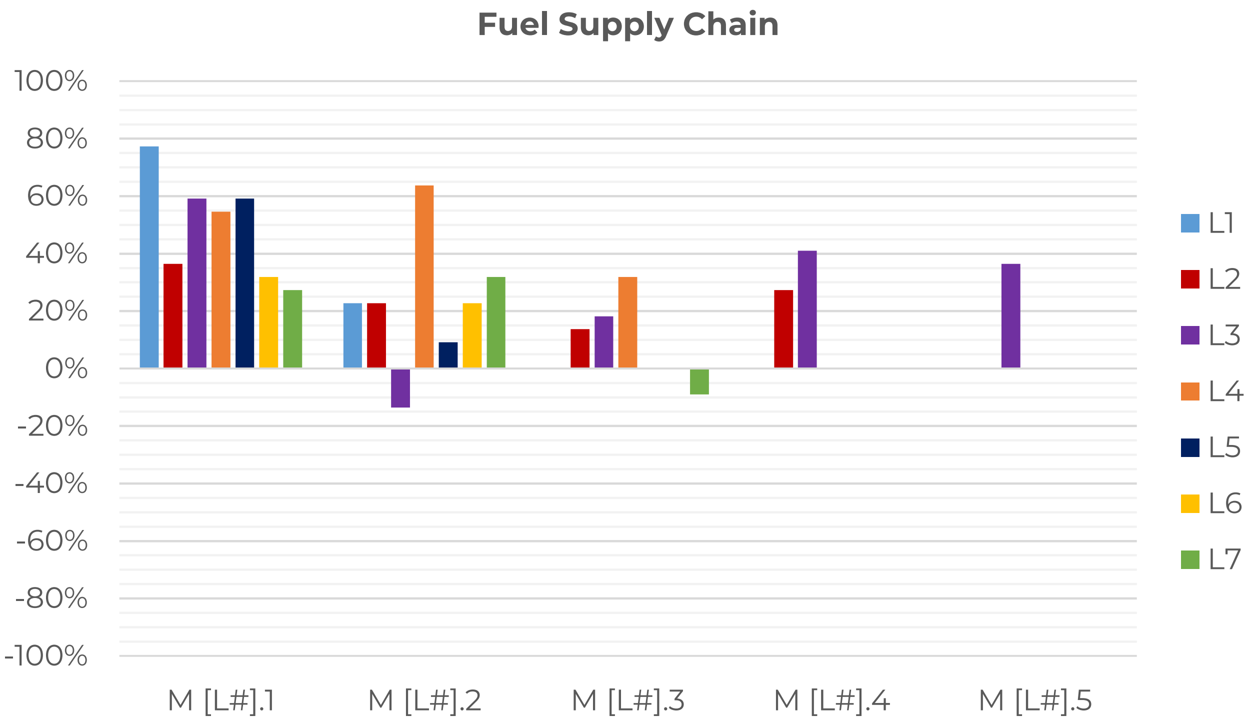

Figure 32. Average values of the evaluations from fuel supply chain operators in phase 2

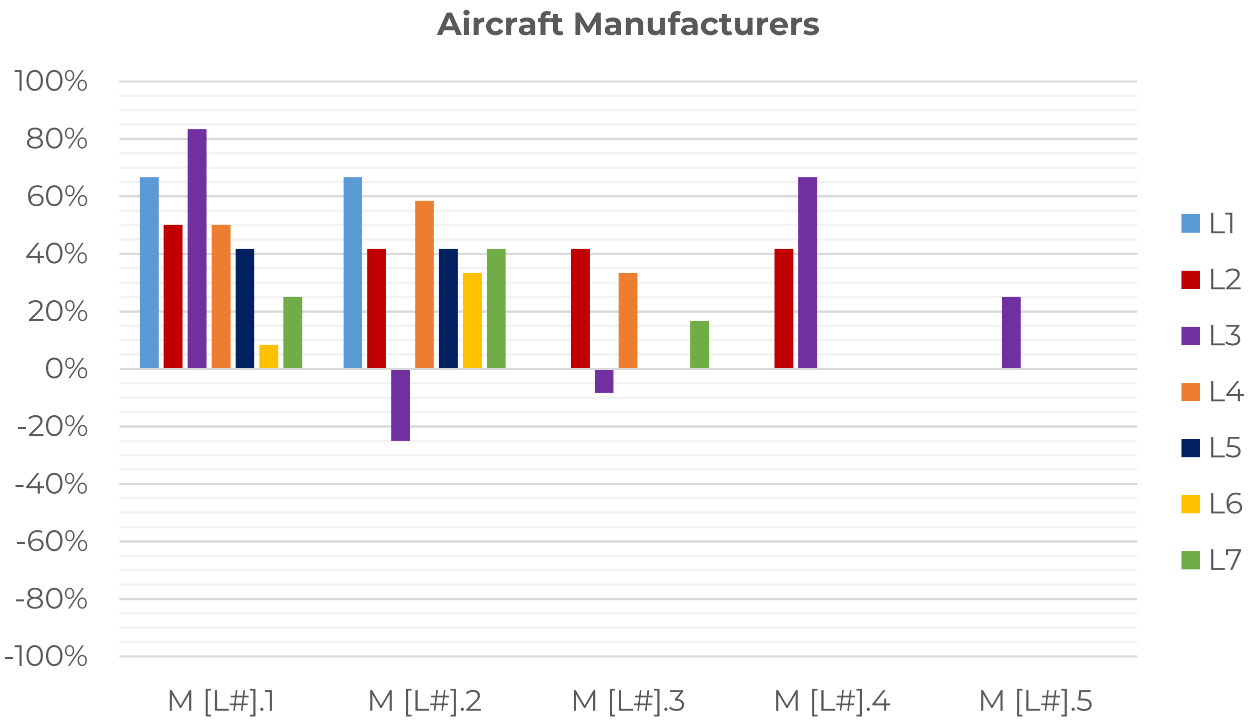

Figure 33. Average values of the evaluations from Aircraft Manufacturers in phase 2

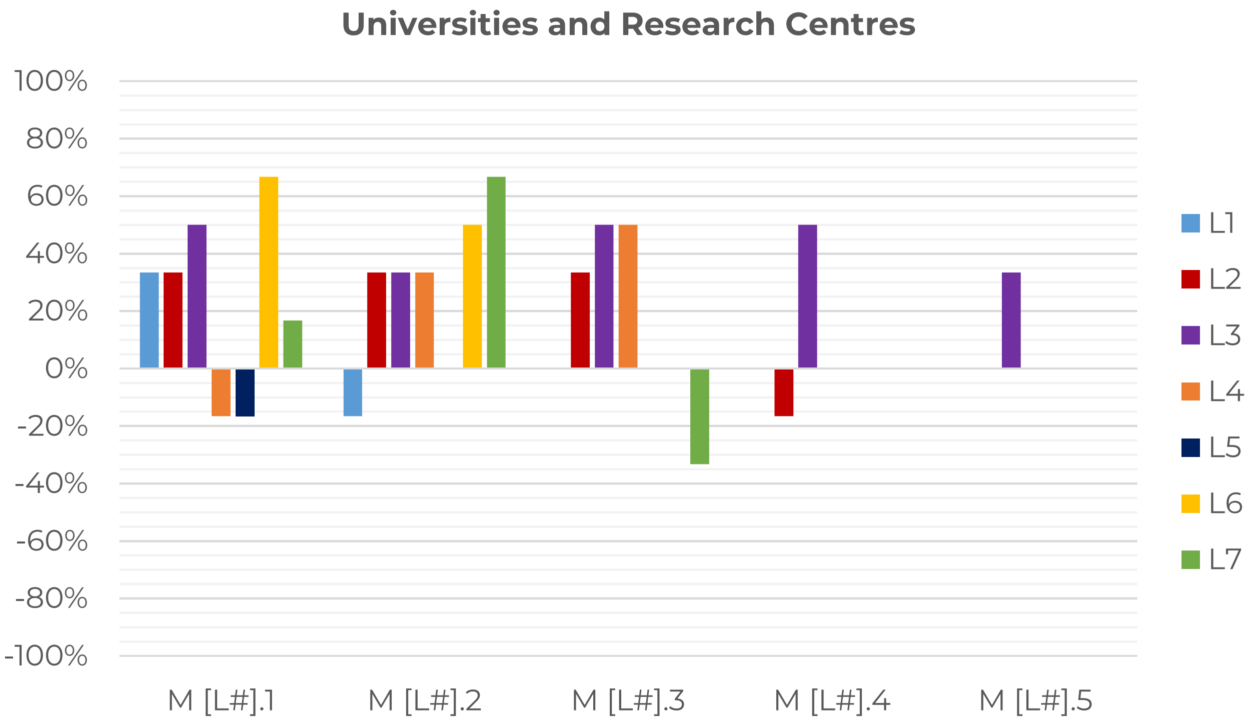

Figure 34. Average values of the evaluations from universities and research centres in phase 2

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