ALIGHT
SUSTAINABLE AVIATION

Detailed scheme and description of the organization tailored solution for delivering SAF in fellow and other airports

D 9.2

Version number:	1.0
Dissemination level:	PU (public)
Work package:	WP 9
Date:	31.08.2025
Lead beneficiary:	ADR
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957824

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List of main acronyms

Abbreviation	*Extended name*
ADR	Aeroporti di Roma
ASTM	American Society for Testing and Materials
AtJ	Alcohol-to-Jet
CPH	Copenhagen airport
CPK	Warsaw airport Centralny Port Komunikacyjny
DEF STAN	Defence Standard (UK military standard)
FCO	Roma Fiumicino Airport
FT	Fischer-Tropsch
GdF	Guardia di Finanza
HEFA	Hydroprocessed Esters and Fatty Acids
HRS	Hydrant Refueling System
IATA	International Air Transport Association
JIG	Joint Inspection Group
LTOU	Lithuanian Airports
PtL	Power-to-Liquid
SAF	Sustainable Aviation Fuel
VNO	Vilnius International Airport

Executive summary

This Deliverable provides a comprehensive overview of the organizational models and supply chain configurations currently supporting, or expected to support, the delivery of Sustainable Aviation Fuel (SAF) at ALIGHT partner airports. The objective is to offer a clear understanding of how SAF supply chains are structured in practice, which actors are involved and how responsibilities are distributed along the various phases of fuel procurement, logistics and handling.

Chapter 1 introduces the general architecture of a SAF supply chain, mapping all the key stakeholders typically engaged in the end-to-end process. These include SAF producers, traders and marketers, fuel suppliers, fuel farm operators, airport operators, and airlines. The chapter clarifies their respective roles and responsibilities across each stage of the supply chain, from upstream production and contracting to downstream logistics, airport reception, on-site storage, and final delivery to aircraft. This system-level view provides the foundation for understanding the coordination and integration challenges inherent to SAF deployment, as well as the interdependencies that exist between commercial, regulatory, and operational functions.

Chapter 2 presents a set of detailed case studies focused on the SAF supply chains implemented or under development at the four ALIGHT partner airports: Copenhagen (CPH), Rome Fiumicino (FCO), Vilnius (VNO), and Warsaw (CPK). For each location, the chapter describes the organizational structure adopted, the stakeholders directly or indirectly involved and how responsibilities, both operational and strategic, are allocated throughout the fuel supply process. Particular attention is given to the contractual arrangements in place, the type of SAF delivery model selected (e.g. physical supply vs. book & claim) and the level of integration with existing Jet A-1 infrastructure and protocols.

The following Figure 1 presents the main outputs for each partner airport analyzed, highlighting the distinctive elements of the supply chain and the stakeholders involved.

Copenhagen Airport (CPH)	
Supply chain approach	Mass Balance
Distribution method	Pipeline
Airport operator	CPH
Storage operator	Oiltanking Copenhagen, Samtank A/S
Fuel farm operator	BKL
Into-plane operators	SST Fuelling Services; Danish Refuelling
Main fuel suppliers	DCC & Shell Aviation; BP aviation A/S; Sasoil Denmark; Total Denmark, World Fuel Commodities Service

Rome Airport (FCO)	
Supply chain approach	Mass Balance
Distribution method	Pipeline
Airport operator	ADR
Storage operator	SODECO; IP Industrial
Fuel farm operator	SERAM
Into-plane operators	Levorato Marcevaggi; Carboil
Main fuel suppliers	IP industrial; Q8 Aviation, Ludoil, TotalEnergies

Vilnius Airport (VNO)	
Supply chain approach	Mass Balance
Distribution method	Train
Airport operator	LTOU
Storage operator	Oiltanking Copenhagen, Samtank A/S
Fuel farm operator	Baltjet
Into-plane operators	BGS; RSS Motors; Naftleft
Main fuel suppliers	

Warsaw airport (CPK)	
Supply chain approach	Mass Balance
Distribution method	Pipeline/Train
Airport operator	CPK
Fuel farm operator	PERN
Into-plane operators	To be defined
Main fuel suppliers	Orlen; AirBP Aramco Poland; UNIMOT

Figure 1. Main supply chain elements and stakeholders from partner airports

This Deliverable highlights key aspects of SAF supply chain configurations implemented in real airport settings. The analyses and surveys conducted among the partners first revealed that airport operators are not directly involved in fuel procurement or management activities. Instead, fuel sourcing is primarily the responsibility of the airlines, fuel handling is managed by the fuel farm operator, and commercial ownership remains with the fuel supplier throughout the process. Secondly, the analysis shows that once SAF is blended with Jet A-1, the downstream supply chain remains largely unchanged. There are no significant differences in the methods, tools, procedures, or standards used to handle either pure Jet A-1 or a Jet A-1/SAF blend. As a result, the roles and responsibilities of the various stakeholders through the supply chain remain unaffected by the introduction of SAF.

Introduction

This deliverable is part of project ALIGHT WP9 and it provides a detailed description of the organizational schemes and proposed operational solutions for the delivery of both SAF and Jet A-1, with specific reference to the partner airports involved in the project, namely Copenhagen Airport Kastrup (CPH), Roma Fiumicino Airport (FCO), Vilnius Čiurlionis International Airport (VNO), Warsaw Centralny Port Komunikacyjny (CPK), as well as to other airports interested in adopting similar models.

The document is in continuity with ALIGHT Deliverable D9.1, which provided a description of the different SAF supply chains with an exclusive focus on logistics, deepening those configurations from the perspective of the actors involved and their respective roles and relationships within the supply system.

By analyzing and comparing different SAF deployment experiences, this deliverable aims to highlight emerging best practices, identify potential gaps in coordination or infrastructure readiness, and support the development of robust, scalable supply chain configurations. The insights gathered serve not only to strengthen existing implementations but also to inform future decision-making at airports currently in earlier stages of SAF planning and design, offering concrete reference scenarios and organizational benchmarks for effective and replicable SAF integration across the European airport network.

The integration of Sustainable Aviation Fuel (SAF) within airports, as foreseen by the European RefuelEU Aviation Regulation, requires a coordinated and systemic approach involving all key stakeholders along the value chain. Defining the SAF supply chain, from production to the final delivery onboard the aircraft, is a fundamental step for operational implementation, which must be followed by the clear identification of the actors involved, their roles, and how they interact throughout the process.

In this context, stakeholder collaboration, including producers, suppliers, airports, into-plane operators, airlines, and competent authorities, is a critical enabler for the effective deployment and scalability of SAF. Understanding how each actor operates and coordinates helps identify potential technical, regulatory, and operational barriers, while also fostering the development of shared strategic solutions. A collaborative governance model is essential to ensure regulatory compliance, operational readiness, and the long-term sustainability of SAF integration within the European airport system, as well described in ALIGHT deliverable 6.2 which centers on SAF for Airport sustainability.

The methodology used to prepare this document involved conducting surveys and interviews with the main airport operators participating in the project—namely CPH, ADR, LTOU, and CPK—alongside additional meetings with fuel farm operators and airline companies to gain deeper insights into the practical and logistical aspects of SAF procurement and handling.

1 Stakeholder Engagement and Operational Procedures

This chapter provides a detailed analysis of the roles and interactions of the main stakeholders involved in the SAF supply chain in each partner airport, namely Copenhagen Airport Kastrup (CPH), Roma Fiumicino Airport (FCO), Vilnius Čiurlionis International Airport (VNO), Warsaw Centralny Port Komunikacyjny (CPK). It examines how responsibilities are distributed across the different phases of SAF deployment, from procurement to into-plane delivery, and explores the operational interactions and interdependencies between stakeholders.

The main evidence from the analyses is that the introduction of SAF has not changed operational fuel management activities at airports, such that the logistics chain remains largely unchanged, without requiring major infrastructure modifications. As a result, the stakeholders examined are primarily those already involved in Jet A-1 management, while, where applicable, additional actors related to SAF production are also included.

The chapter highlights any organizational or procedural gaps that may hinder the full and effective implementation of SAF within airport systems.

SAF supply chain

In the supply chain description, we begin by outlining the SAF production phase, highlighting the key stages of the process through the following Figure 2 that shows an hypothetical supply chain for the production of SAF:

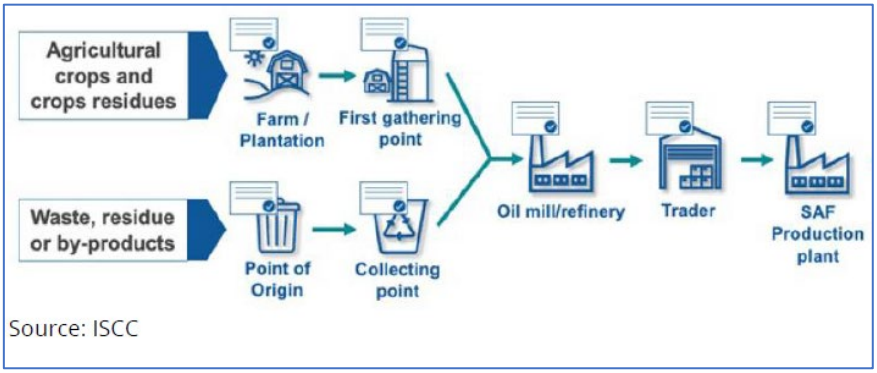

Figure 2. Hypotetical supply chain for SAF production[1]

First of all, it is important to highlight that SAF production varies depending on the feed stock used and, consequently, on the related production processes involved.

Three main generations of feedstocks have been identified for biofuel production:

- Edible fats and oils (food-grade);
- Waste fats, oils, and greases (FOGs);
- Agricultural residues and by-products from biomass and bio-based sources.

The different types of feedstocks are collected and sent to the refinery, where they are processed to produce the so-called neat SAF, synthesized hydrocarbons that meet the

requirements in any one of the annexes of ASTM D7566, which may then be used as a component in the manufacture of semi-synthetic jet fuel. ASTM D7566 does not include requirements for sustainability. No aircraft are certified to fly on neat SAF alone now.

Depending on the combination of feedstocks and production technologies used, multiple types of neat SAF exist. Each type differs in terms of production technology, cost, greenhouse gas reduction potential, environmental footprint, and feedstock origin. The main technological pathways include:

- **HEFA (Hydroprocessed Esters and Fatty Acids)**: any type of fat, oil, or grease (including waste oils) can be transformed into bio-oil, which is then refined into SAF using HEFA technology.
- **Alcohol-to-Jet (AtJ)**: sugars from biomass can be fermented into alcohols like ethanol or isobutanol, which are then converted into SAF through the AtJ process.
- **Fischer-Tropsch (FT)**: solid biomass, such as forestry residues or biogenic municipal waste (including bioplastics), can be gasified into syngas, a synthetic gas that is further processed into SAF using the FT method.
- **Power-to-Liquid (PtL)**: by leveraging renewable electricity, hydrogen is produced through water electrolysis and combined with carbon dioxide (captured either from the atmosphere or industrial emissions) to generate synthetic gases. These intermediates are then converted into SAF via FT or AtJ technologies.

A fundamental aspect along the SAF supply chain is ensuring that the fuel is accompanied by appropriate quality and sustainability certifications. These certifications must track all stages of fuel production and management and must go through all stakeholders involved in order to demonstrate that the SAF meets key environmental, social, and economic criteria, ensuring compliance with international standards and reinforcing credibility and transparency throughout the entire value chain.

Neat SAF is blended with Jet A-1 in varying proportions to produce what will hereafter be referred to simply as SAF.

Once blended, the fuel is tested in accordance with the ASTM D7566 specification. If it meets all the required parameters, it is then recertified under the ASTM D1655 standard, which officially classifies it as Jet A-1. From that point on, the fuel has the same properties as conventional aviation fuel and can be handled, stored, and distributed using the same operational procedures as standard Jet A-1.

Once the SAF is produced, it can reach the airport following two different configurations of supply chain[2]:

- **Independent from the Jet A-1 supply chain**: when SAF blended is delivered to the airport in through a different logistics pathway **(*physical segregation approach*).**

- **Integrated with the Jet A-1 supply chain**: when SAF is blended with Jet A-1 at a certain point along the supply chain, and the fuel arriving at the airport is a mixture of the two components ***(mass balance approach).***

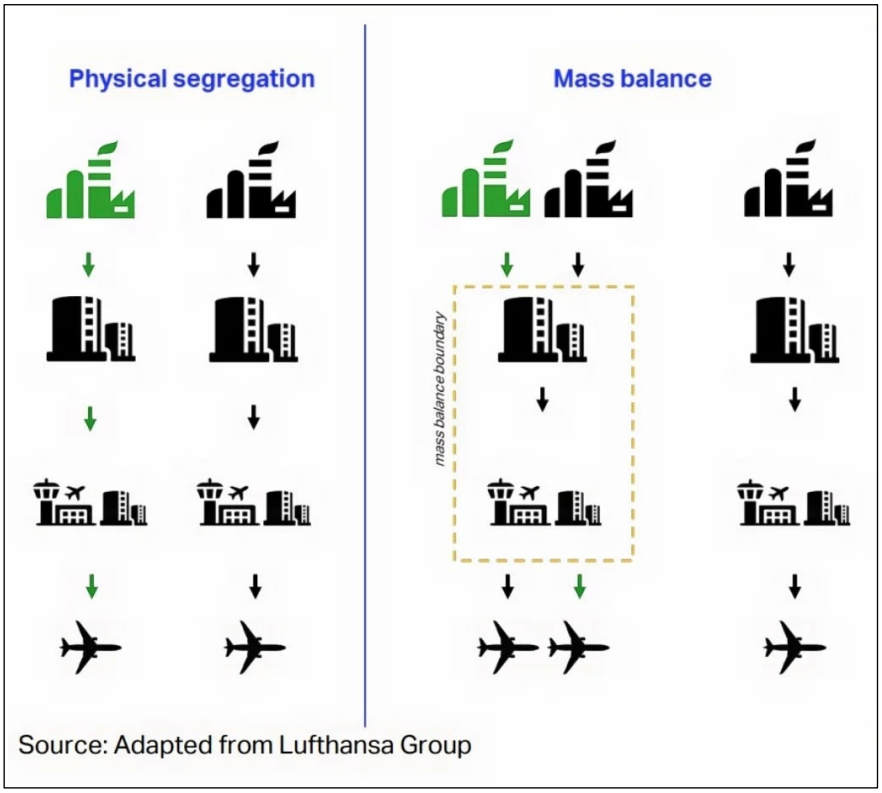

Figure 3. Physical segregation and Mass balance supply chain scheme[3]

Unlike the Physical Segregation approach, which requires infrastructure such as storage tanks or fuel trucks totally dedicated to SAF, the Mass Balance approach allows to handle both SAF and Jet A-1 with the same facilities, since they are mixed in the same fuel. In addition, the existing infrastructure has no technical limitations in handling blending with low SAF rates, so the airport does not need to make new investments, exploiting the actual supply chain. This approach, thus, simplifies airport logistics, but on the other hand it increases the complexity in tracking and monitoring the sustainable portion of fuel handled.

SAF stakeholders

Whether the SAF is managed according to the physical segregation approach or mass balance approach, the type of actors involved in its management does not change. Synthetically we can represent them as follows:

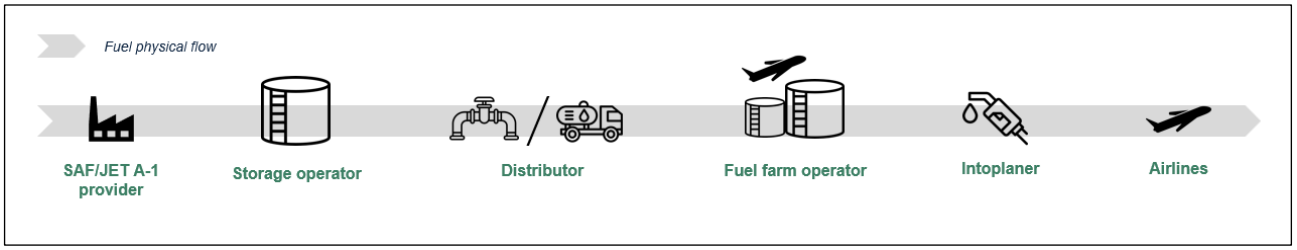

Figure 4. Physical supply chain

The SAF/Jet A-1 produced by the fuel manufacturer is typically transported by ship or truck to intermediate storage facilities, from which it is then delivered to the airport storage managed by the fuel farm operator by truck, train or pipeline. The fuel farm operator, in addition to managing on-site storage within the airport, is also responsible for fuel distribution, which can be carried out either by truck or, in larger airports, through a Hydrant g Refueling System (HRS) and then transferred to the aircraft via intoplane operators.

From a commercial point of view, airlines purchase SAF from Fuel suppliers, which are the companies that hold commercial possession of the fuel during all transportation and handling activities, from intermediate storage sites all the way into the airport.

The commercial supply chain is illustrated in Figure 5.

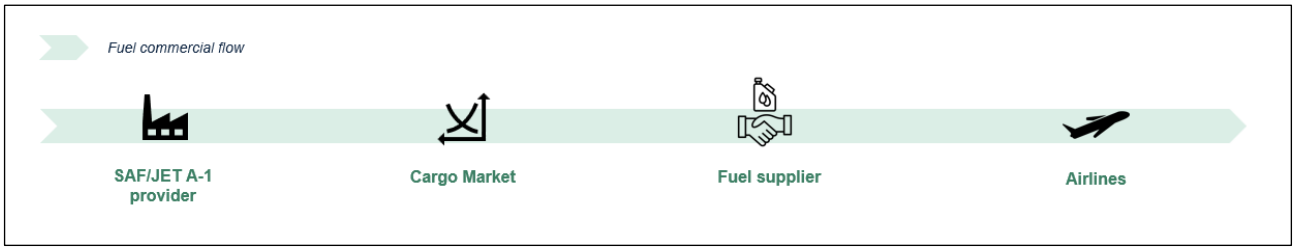

Figure 5. Commercial supply chain

From a commercial perspective, the SAF is totally comparable to the Jet A-1, and its ownership transfers from the bulk fuel purchased on the cargo market to the fuel supplier, who sources it from SAF/Jet A-1 providers. The cargo market is a spot market for jet fuel involves the trade of fuel cargo delivered by ship or truck to ports, refineries, or logistics terminals. It is not governed by a central authority; instead, prices are set based on benchmarks provided by agencies such as Platts, Argus, and OPIS. The fuel supplier then enters into contractual agreements with storage sites and fuel farm operators for the storage and transit of the fuel. For fuel procurement, the fuel supplier signs a direct supply contract with the airline, while operational refueling services are managed through service agreements with into-plane operators.

In the aviation sector, Jet A-1 fuel can be procured through two main channels: the cargo (spot) market and direct supply agreements with producers. In the spot market, fuel is traded in large physical quantities, known as cargos, and negotiated for delivery at specific locations, typically port or coastal terminals. From there, it is transferred to airport storage facilities via pipeline, truck, or barge. These spot transactions are defined by their physical nature: the product

changes hands at a set location, whether via pipeline or overwater (e.g., barge or cargo vessel), with offers always made in bulk, typically from 5,000 barrels (around 800 m^3) up to 50,000 barrels (over 7600 m^3)[4]. This market offers flexibility but is sensitive to price fluctuations and requires knowledge of refining hubs that match regional wholesale needs. Alternatively, fuel suppliers may opt for annual or multi-year contracts directly with producers, benefiting from more stable pricing, predictable logistics, and easier traceability. In both cases, the fuel must comply with strict international standards, including AFQRJOS (Aviation Fuel Quality Requirements for Jointly Operated Systems) and JIG (Joint Inspection Group) guidelines, and is subject to rigorous quality control procedures throughout the supply chain to ensure its suitability for aviation use.

To sum up, the main stakeholders involved in the SAF supply chain are listed below, together with their main activities and interactions:

- **SAF/Jet A-1 provider**
  - Produce Jet A-1 or SAF through conventional or advanced processes (e.g. HEFA, Fischer-Tropsch, PtL)
  - Sell Jet A-1 or SAF to the Cargo Market or directly to Fuel Supplier, providing documentation for traceability and sustainability
- **Fuel Suppliers**
  - Purchase and transport fuel (Jet A-1 and/or SAF) from producers to airports via ships, trains, trucks, or pipelines
  - Buy fuel at Cargo Market or directly from Producers
  - Sells the fuel to airlines or other operators, providing documentation for traceability and sustainability
- **Distributor**
  - Operates the transportation of fuel to the airport, but does not hold commercial ownership of it
  - May own the transportation infrastructure
  - Signs service contracts with Fuel Suppliers. Distribution companies are often directly controlled by fuel supplier companies
- **Storage Operator**
  - Manage storage infrastructure at ports and airports, ensuring proper quality control and inventory management
  - May own the storage infrastructure
  - Remunerated for fuel management and storage service through contracts with Fuel Suppliers
- **Fuel Farm Operator**
  - Oversee storage and transfer of fuel within the airport, including hydrant systems and truck refueling operations
  - Does not directly own the infrastructure within the airport
  - Is responsible for fuel handling within the airport but does not hold commercial ownership

    - Remunerated for fuel management and storage service through contracts with Fuel Suppliers
- **Into-Planer**
    - Carry out the physical refueling of aircraft, ensuring safety, traceability, and compliance with technical standards
    - Has an agreement with the fuel farm operator to use the airport's infrastructure
    - Signs service contracts with Fuel Suppliers
- **Airlines:**
    - Purchase aviation fuel (Jet A-1 and/or SAF), and integrate SAF into sustainability strategies
    - It records the amount of SAF purchased, even though the actual volume physically loaded onto its aircraft may not be precisely known
    - Signs supply contracts with Fuel Suppliers

Other relevant stakeholders are:

- **Airports operators:**
    - Oversee all airport activities and strategies
    - Facilitate on-site infrastructure and logistics for Jet A-1 and SAF delivery and support decarbonization initiatives
    - Do not have a direct role in procurement or fuel handling activities
- **Regulatory Authorities:**
    - Set and enforce policies and compliance rules (e.g. ICAO, EASA, FAA, ENAC) including mandates for SAF usage

2 Airport Case Studies

This chapter presents an analysis of the case studies from the partner airports. It describes the fuel supply chains in place, identifies the key stakeholders involved, and outlines their respective roles and interrelations within the supply chain.

All information related to consolidated supply chains reflects the situation as of the date of preparation of this deliverable.

2.1 Copenhagen Airport (CPH)

Copenhagen Airport (CPH) experimented with SAF procurement as early as 2023 with an agreement for the first delivery of SAF, aimed at seeing what the best set-up for the new supply chain might be. Below is a summary of the key elements that characterized these tests, and then a description of the supply chain arrangement that was consolidated. For an in-depth description of the first delivery of SAF, see ALIGHT Deliverable 3.2, where they have already been presented specifically.

2.1.1 **2023 – First Delivery for SAF**

The first delivery conducted at CPH for the supply of SAF involved multiple stakeholders, with Air Greenland (airline company) and DCC (as fuel supplier) playing a central role during the initial phase.

The negotiation process between these two parties lasted approximately six months and resulted in an agreement to implement a 5% SAF blend in the total fuel volume required to operate the Kangerlussuaq Airport (SFJ) in Greenland and Copenhagen (CPH) route for one year – equivalent to 700,000 liters of neat SAF.

It was agreed that the first delivery of the SAF blend would be transported in a segregated DCC fuel truck from Belgium to Denmark and subsequently delivered to BKL's fuel farm at CPH. All following deliveries would instead be shipped to the Touchstone port and unloaded into DCC's dedicated storage tanks. From there, the SAF blend would be transferred to BKL's fuel farm at CPH via the jet fuel pipeline.

For SAF delivery, DCC established a key collaboration with BKL, the pipeline and hydrant service provider at Copenhagen Airport (CPH). During the execution of the pilot test, two different approaches for transporting and handling SAF were adopted:

- **Scenario 1**: initial delivery, the blended SAF is carried out using a dedicated fuel truck operated by DCC, which transported the fuel from Belgium directly to BKL's fuel depot at CPH. The usage of segregated fuel trucks ensures full traceability of the SAF supply chain.
- **Scenario 2**: long-term delivery, the SAF is carried out by sea, arriving at the Port of Prøvestenen, located 7 km from the airport, where it is stored in dedicated tanks

managed by DCC before being transferred to the airport blended with Jet A-1 via the existing jet fuel pipeline.

At Copenhagen Airport, where BKL is responsible for managing fuel storage and refueling operations, truck deliveries are uncommon but may be used under special circumstances, and in the first scenario this option was chosen in order to ensure the maximum level of control and traceability of SAF.

Scenario 1

The first SAF batch, blended at 5% with Conventional Aviation Fuel (CAF), was transported in dedicated, segregated trucks from Belgium to CPH. This method ensured full traceability and minimized operational risks. Upon arrival, SAF underwent quality checks in line with JIG standards, it was unloaded into the airport's intermediate fuel farm, and then introduced into the hydrant refueling system, where it was co-mingled with conventional jet fuel for aircraft refueling.

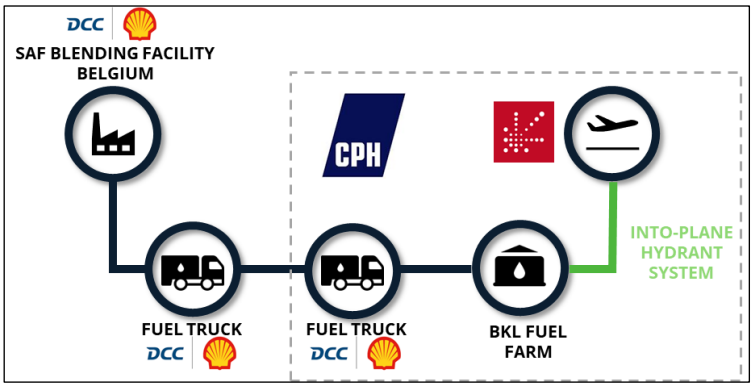

Figure 6. CPH first delivery - Scenario 1 supply chain

Scenario 2

After the initial delivery, regular supply operations were established. SAF was shipped by sea to the Port of Prøvestenen, where it is stored in dedicated tanks reserved exclusively for customers who request SAF. From the terminal, the fuel is transported through the existing jet fuel pipeline to Copenhagen Airport. Once it reaches the airport's intermediate fuel farm, SAF blends are managed using the same logistical and safety protocols as conventional aviation fuel, including final aircraft refueling via the underground hydrant system.

Regarding quality controls, at the Prøvestenen terminal, the fuel undergoes conformity testing in accordance with ASTM and JIG standards before being pumped through a pipeline to CPH. Additional quality checks are performed at the airport's intermediate fuel farm before the fuel is finally distributed to aircraft.

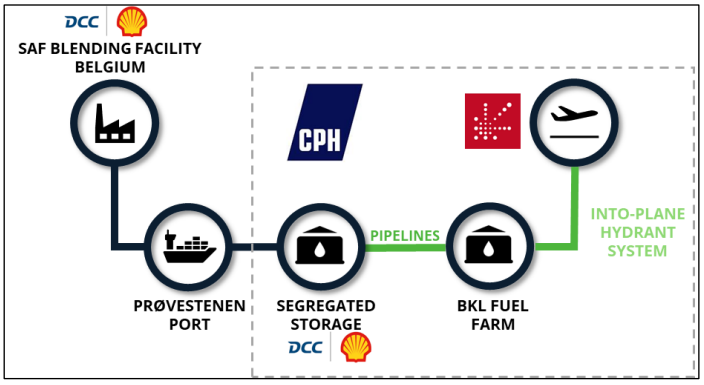

Figure 7. CPH first delivery - Scenario 2 supply chain

2.1.2 **Today - Consolidated supply chain**

The supply chain described in Scenario 2 for Copenhagen Airport (CPH), which involves maritime transport to the Prøvestenen terminal and pipeline delivery to the airport, represents the established logistical configuration for the site at the time of writing this Deliverable (08/2025). The only exception, compared to a SAF-specific setup, is the absence of a dedicated storage tank: SAF and Jet A-1 arrive already blended at the airport and they are treated as one single fuel.

Therefore, the fuel supply chain at Copenhagen Airport remains essentially unchanged with the integration of SAF, except for the upstream production phase, which lies outside the airport's direct operational scope. The incorporation of SAF, in fact, occurs downstream of production, within the existing and well-established logistics infrastructure used for conventional Jet A-1 fuel. As a result, the key stakeholders already involved in the handling and distribution of Jet A-1 will also be responsible for managing the blended SAF arriving at the airport. This includes activities such as transport, storage, quality control, and refueling operations.

Figure 8 shows the consolidated physical supply chain.

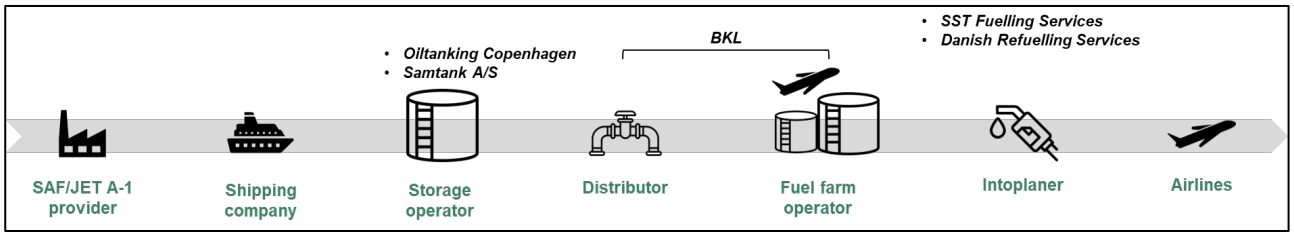

Figure 8. CPH physical supply chain

The following section provides an overview of the main stakeholders active in CPH fuel supply chain, outlining their roles and responsibilities in managing both conventional aviation fuel and the SAF blends now entering the system.

Jet A-1/SAF provider

- **Neste:** one of the world's leading producer of sustainable aviation fuel (SAF) and renewable diesel. It provides neat SAF made from renewable raw materials such as used cooking oils and animal fats. The company produces high-quality renewable fuels exclusively from renewable raw materials, with an annual capacity of approximately 5.5 million tons[5], through refineries located in Finland, the Netherlands, Singapore, and a joint venture with Marathon Petroleum in Martinez, California.
- **Shell** operates one of the most extensive refueling networks globally, supplying fuel, lubricants, and sustainable solutions across more than 60 countries[6]. In 2022, Shell strengthened its commitment to sustainable aviation by acquiring EcoOils, a company that recycles waste oils into feedstock usable in the HEFA pathway. Shell has also invested in LanzaJet, a leading sustainable fuels technology company and producer. This investment not only supports the development of sustainable fuels but also gives Shell the opportunity to sublicense LanzaJet's Alcohol-to-Jet (AtJ) technology and make further investments in building large-scale production facilities in the coming years.
- **Statoil (now Equinor):** is a Norwegian multinational energy company headquartered in Stavanger, primarily active in the petroleum sector and operating in 36 countries[7], with growing investments in renewable energy. In the field of Sustainable Aviation Fuel (SAF), Equinor has partnered with waste-to-clean-fuels company Mana and research institution NORCE to develop a waste-to-SAF production plant in Mongstad, on Norway's western coast.
- **BP**: BP is one of the leading companies in the supply of jet fuel to both commercial and military customers. Every day, its trained and dedicated staff safely and efficiently refuel over 6,800 aircraft across more than 40 countries. Jet fuel is available at approximately 600 locations worldwide. BP is also a producer of Sustainable Aviation Fuel (SAF), which is currently made primarily from used cooking oil and animal fat waste.
- **Totsa** (TotalEnergies Trading & Shipping): Part of TotalEnergies, actively engaged in advanced biofuel research (algae, microalgae, eFuels) and eSAF initiatives across Europe. Is one of the global leaders in commodity and oil product negotiation and is recognized for its expertise from Singapore to Houston, via Geneva, Paris and Dubai.

Fuel ownership typically lies with the fuel supplier or the company that imported it. This may be a large trader, a producer, or an integrated logistics operator.

Fuel suppliers

- **DCC & Shell Aviation**: In partnership with Shell Aviation Denmark, DCC was the first in Denmark to establish large-scale SAF storage at Oiltanking Copenhagen, enabling pipeline delivery of SAF to CPH. Is the largest distributor of aviation fuel in Denmark, serving global airlines and private aircrafts owners. For sustainable aviation is engaged in Green Power Denmark's PtX partnership.
- **BP Aviation A/S**: is a subsidiary of the BP group, specialized in aviation fuel supply. It operates globally and is responsible for providing conventional Jet A-1 fuel as well as

promoting and marketing Sustainable Aviation Fuel, leveraging BP's infrastructure, investments, and logistics networks in the biofuels sector.

- **SASOIL Denmark**: it is a Danish company based in Kastrup Copenhagen that specializes in the import, wholesale distribution, and sale of petroleum fuels, particularly for aviation use. Its core business focuses on the supply of Jet A-1 to the airport and transportation sectors.
- **Total Denmark:** affiliated with TotalEnergies; involved in marketing both conventional jet fuel and advanced biofuels, aligning with parent company eSAF R&D. Has been active in Denmark since 1964, serving the markets of industrial, automotive and marine lubricants, plus aviation fuel, bitumen and special fluids.
- **World Fuel Commodities Service:** a global fuel marketer offering Jet A-1 and branching into SAF supply solutions for airlines at CPH (no specific production site cited yet) sell and deliver liquid fuels, operational services, technology, renewable energy, and other sustainability solutions to its clients through its marine and aviation divisions.

Once the fuel enters the pipeline leading to the airport, ownership typically transfers to the fuel marketers/traders who have purchased it to supply the airlines. These entities also manage the input-output balance for accounting and environmental purposes (e.g., SAF reporting).

Storage operator

- **Oiltanking Copenhagen:** partnered with DCC & Shell to store SAF at its Prøvestenen terminal; connects via pipeline directly to CPH. It is a company active since 1972 in the storage logistics of liquid products such as fuels, chemicals, gases, and biofuels. It is one of the world's largest independent operators of tank terminals for the storage of bulk liquids. The company currently owns and operates around 70 terminals in over 20 countries across five continents, with a total storage capacity exceeding 20 million cubic meters. Its clients include oil companies, traders, refineries, and airport operators, particularly for the handling of Jet A-1 and Sustainable Aviation Fuel (SAF).
- **Samtank A/S:** is a Danish company owned by OK a.m.b.a and Uno-X Mobility Denmark, primarily engaged in the import, storage, and distribution of petroleum fuels. Operating eight major tank facilities across four cities, the company plays a key role in supplying fuel to OK and Uno-X gas stations nationwide. With around 40 employees, SAMTANK ensures the stable and efficient handling of various fuel types, focusing on reliable supply chain operations.

Oiltanking and Samtank are the tank farm service providers at CPH. Jet fuel arrives in the country by sea, then it is transported by large oil tankers, and it is delivered to the storage terminal at Prøvestenen, located 7 km from Copenhagen Airport. Once docked, the fuel is pumped into the terminal's high-capacity storage tanks, where it undergoes a rigorous testing protocol conducted by an authorized third-party entity (independent inspection) to ensure compliance with the required quality standards.

Fuel farm operator

- **BKL (Brændstoflageret Københavns Lufthavn):** together with its affiliated companies, owns and operates the entire aviation fuel infrastructure at Denmark's largest airport. This includes all underground pipelines, storage tanks and service vehicles. The company manages the full process of fuel delivery and handling aircraft, overseeing more than 900 million liters annually. BKL is jointly owned by several major industry players, including BP and Shell. Operates the on-airport fuel farm and hydrant system; prepared to handle SAF blends in coordination with its pipeline upgrade plans.

From the pier, the jet fuel is transferred through a dedicated and segregated pipeline into the terminal, where it is carefully distributed among various storage tanks. From these tanks, the fuel is then pumped through a main pipeline directly to the airport. At the airport, the fuel is stored in internal tanks managed by the tank farm operator, BKL.

Distribution to individual aircraft stands is carried out via the underground Hydrant Refueling System (HRS), ensuring efficient and safe delivery to each aircraft. Once in the airside area of the airport, the fuel undergoes additional filtration and rigorous quality control checks to confirm the absence of water and impurities, guaranteeing full compliance with the Recertification Certificate requirements.

For monitoring purposes, BKL is responsible for tracking the volumes of fuel handled throughout the year. This information is compiled into an annual report, which is then shared with Copenhagen Airport to ensure transparency and proper oversight of all fuel handling operations.

Into-Plane operators

- **SST Fueling Services:** conducts apron fueling operations; capabilities extend to SAF blends contingent on fuel supply agreements.
- **Danish Refueling:** licensed operator capable of delivering into-plane SAF; coordination with marketers and farm operators ensures compliance with safety and blend standards.

The refueling operations using dispensers are carried out by the into-plane service providers SST Fueling Services and Danish Refueling.

Airlines

RefuelEU applies to all airlines; however, the ones listed here are highlighted as they were among the first to take concrete steps in SAF procurement.

- **Air Greenland:** active user of the SAF supply chain at CPH; first to enter into an SAF offtake agreement with DCC & Shell, supporting domestic SAF use since 2021
- **SAS:** is a Scandinavia's leading airline, with main hubs in Copenhagen, Oslo and Stockholm. They are reducing carbon emissions through using more sustainable aviation fuel, investing in new fuel-efficient aircraft, contributing towards the industry target of net zero CO2 emissions by 2050.

To purchase SAF, airlines companies interface exclusively with Fuel Marketers, agreeing with them on the amount of fuel required.

The main elements related to the supply chain and stakeholders present at Copenhagen Airport are summarized in Table 1.

Copenhagen airport (CPH)	
Supply chain approach:	Mass Balance
Distribution method to the airport:	Pipeline
Distribution method to the pit	HRS
Airport operator:	CPH
Storage operator:	• Oiltanking Copenhagen, • Samtank A/S
Fuel farm operator:	BKL
Into-plane operators:	• SST Fueling Services • Danish Refueling
Main fuel suppliers:	• DCC & Shell Aviation • BP aviation A/S • Sasoil Denmark • Total Denmark • World Fuel Commodities Service

Table 1. CPH synthesis

2.2 Rome Fiumicino Airport (FCO)

Roma Fiumicino Airport (FCO) experimented with SAF procurement as early as 2021 with an initial pilot test phase aimed at seeing what the best set-up for the new supply chain might be. Below is a summary of the key elements that characterized these tests, and then a description of the supply chain arrangement that was consolidated. For an in-depth description of the pilot tests, see ALIGHT Deliverable 3.2, where they have already been presented specifically.

2.2.1 **2021/2022 - Test pilot for SAF**

In October 2021, a SAF blend was introduced at Fiumicino Airport for the first time, with delivery carried out via dedicated trucks to ensure the SAF remained segregated from other fuels within the airport. The two main stakeholders of the initiative were Aeroporti Di Roma (ADR), the company that manages Rome's Fiumicino and Ciampino airports, and Eni. Typically, airlines are responsible for procuring fuel through direct agreements with oil companies, and ADR does not participate in the procurement process. However, since ADR was the main promoter of the SAF test initiative, supported by strategic partners, the SAF procurement agreement was directly signed between Eni and ADR.

Unlike conventional fuel purchases, the SAF blend was designated for use by a specific ITA Airways flight departing from FCO, rather than for general airport operations. Eni and ADR agreed to conduct two separate pilot tests, carried out in 2021 and 2022, with the goal of assessing infrastructure and operational requirements related to SAF handling and fueling at the airport.

Test 1: SAF delivery via truck

The first supply of a SAF blend at Fiumicino Airport (FCO) was carried out on October 15, 2021, using segregated tank trucks provided by Eni. ADR coordinated the delivery, ensuring that all necessary authorizations and logistical arrangements were in place. The Post Holder Movement Office at ADR led the preparatory phase, managing access permits for the Eni driver and organizing a series of coordination meetings with representatives from Eni, SERAM (the Fuel airport depot operator) and Levorato Marcevaggi as intoplaner. These meetings served to define the operational, regulatory, and customs procedures for transporting the SAF blend from the fuel depot at the Port of Civitavecchia to the aircraft.

As a result of these discussions, a dedicated procedure for unloading and transferring the SAF blend was established. Meanwhile, ADR's Safety Management System team worked closely with SERAM to review the safety implications of using a SAF blend, confirming its full compatibility with Jet A-1 under international standards ASTM D1655 and Def Stan 91-091.

In the days preceding the delivery, ADR's Security Manager coordinated with the Air Border Police to establish a security protocol covering: the arrival of the Eni tanker at the customs gate; verification checks on the driver and vehicle; an escort by ADR Security and Guardia di Finanza (GdF) to SERAM's depot; GdF's supervision of the transfer from the Eni tanker to Levorato Marcevaggi's into-plane vehicle; and the return of the Eni tanker to the customs exit.

On the day of the delivery, ADR monitored all operations to ensure compliance with the pre-agreed plan, managing communications related to any logistical changes and coordinating with customs and GdF.

Before entering the SERAM depot, a series of checks were conducted on the tanker, including: a safety briefing for the driver, verification of seal integrity, customs documents, and quality certifications. Once cleared, the tanker was weighed and escorted through the airport by ADR and SERAM personnel, following safety protocols including fire safety, access control, and spill containment.

SERAM staff collected a fuel sample for standard quality tests, including water detection and density measurement. Once approved, the tanker was cleared for offloading. The SAF transfer, which followed a process similar to defueling, was jointly managed by Levorato Marcevaggi and Eni, and overseen by a GdF official who witnessed the unsealing of the system. Once decanted, the SAF blend was used to refuel seven ITA Airways aircraft. The operation was considered complete only after the tanker was entirely emptied and double-checked for residual fuel. The empty tanker was then escorted back through the customs gate and exited the airport.

This first-ever SAF delivery at FCO was successfully completed using a segregated truck supply chain. The seven ITA flights that received the SAF blend departed that same morning: four headed to Milan Linate (LIN), one to Venice (VCE), one to Bologna (BLQ), and one to Amsterdam (AMS).

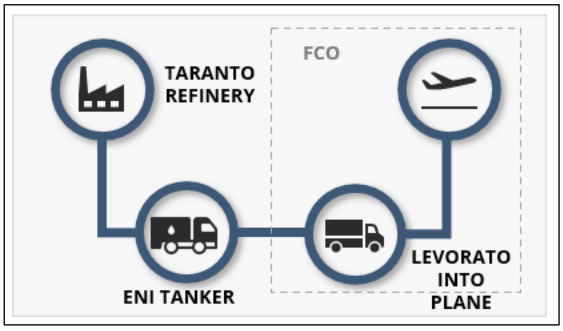

Figure 9. FCO Pilot - Test 1 supply chain[8]

Test 2: SAF delivery via pipeline

The second test on SAF conducted at FCO led ADR involved the delivery of a SAF blend via pipeline. The delivery took place in March 2022; the objective was to demonstrate how the SAF blend could be integrated into the existing infrastructure following the same fuel handling and delivery procedures common to Jet A-1.

The ship coming from Eni's refinery in Livorno loaded with about 3000 tons of SAF blended arrived at Civitavecchia Port; the fuel was unloaded at a coastal depot connected to FCO through a long network of pipelines. The SAF blend arrived at FCO following BAU procedures using existing fuel handling infrastructure, stored at FCO's fuel farm managed by SERAM, and

ultimately uplifted to selected ITA Airways aircrafts via a mass balance chain of custody approach through the hydrant distribution system.

Results for the second test allowed ADR, Eni, and ITA Airways to demonstrate the feasibility of transporting a SAF blend using existing pipelines and its successful delivery following a mass balance approach without having to increase costs associated with fuel transport, handling, storage, and delivery.

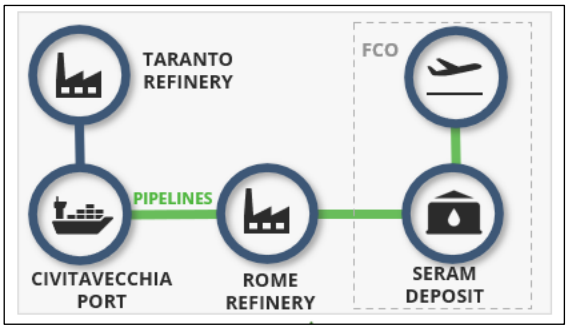

Figure 10. FCO Pilot - Test 2 supply chain

2.2.2 **Today - Consolidated supply chain**

The supply chain tested in Test 2 for FCO, based on maritime transport followed by pipeline delivery to the airport, represents the established logistical configuration for the site, with SAF and Jet A-1 arriving already blended at the airport and being treated as one single fuel. The only difference in the consolidated supply chain is the presence of two ports (Civitavecchia and Rome) and two consequent pipelines for the delivery of blending fuel to the airport.

Therefore, the fuel supply chain at Rome Airport, at the time of writing this Deliverable (08/2025), remains essentially unchanged with the integration of SAF, except for the upstream production phase, which lies outside the airport's direct operational scope. The incorporation of SAF, in fact, occurs downstream of production, within the existing and well-established logistics infrastructure used for conventional Jet A-1 fuel. As a result, the key stakeholders already involved in the handling and distribution of Jet A-1 will also be responsible for managing the blended SAF arriving at the airport. This includes activities such as transport, storage, quality control, and refueling operations.

Figure 11 shows the consolidated physical supply chain.

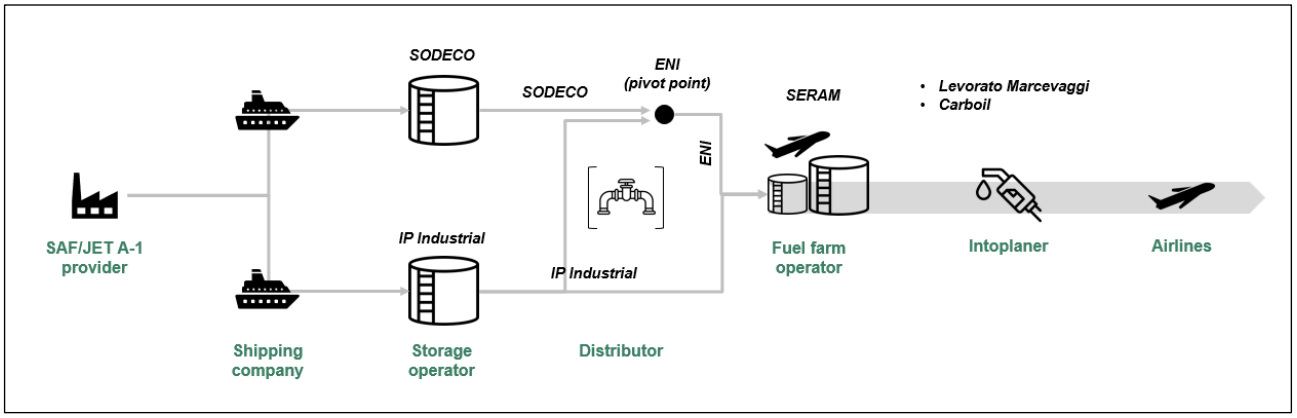

Figure 11. FCO physical supply chain

Below is a breakdown of the key stakeholders involved at each stage of the Jet A-1 supply chain at Rome Fiumicino Airport:

Jet A-1/SAF provider

- **Eni** it is a leading player in the Italian and international energy sector, and a producer of SAF. The company is converting its traditional refineries, such as those in Gela and Venice, into biorefineries to produce advanced biofuels, including sustainable aviation fuels. ENI is actively collaborating with airports and airlines to promote SAF adoption and support the decarbonization of the aviation sector.

Currently, ENI is the only producer of SAF in Italy, with production taking place at its biorefineries in Gela and Venice. In contrast, when it comes to conventional Jet A-1 fuel, there are multiple producers active in the market.

Fuel suppliers

- **IP Industrial:** it is an established aviation fuel supplier in Italy. While not currently a direct producer of SAF, it plays a key role in the fuel supply and logistics chain and may integrate SAF blends into its operations in the future, aligning with the industry's transition toward more sustainable fuel alternatives.
- **World Fuel Service:** is a World Kinect company, headquartered in Miami, Florida. WFS sell and deliver liquid fuels, operational services, technology, renewable energy, and other sustainability solutions to its clients through its marine and aviation divisions.
- **Ludoil:** it is an integrated energy group active in the sectors of energy logistics and the distribution of both traditional and renewable fuels for road, air and maritime transport.
- **TotalEnergies:** it is a global integrated energy company that produces and markets energies: oil and biofuels, natural gas and green gases, renewables and electricity.

Those described are the main fuel suppliers of the 8 currently operating at FCO.

Fuel suppliers such as IP Industrial, TotalEnergies and Ludoil do not produce jet fuel directly, but instead they procure it in bulk on the international Cargo Market. These companies play a

key role in the fuel supply chain by importing, storing and distributing aviation fuel to airports across the country, including Fiumicino. While they are not currently SAF producers, their infrastructure and commercial networks will be essential in facilitating the scaling and distribution of SAF in the near future.

Storage and pipelines operators

- **SODECO:** a company belonging to the Ludoil Group, it operates through an integrated logistics system located in Civitavecchia which, with a total storage capacity exceeding 400,000 cubic meters, is among the largest in Italy
- **IP Industrial:** it operates a complex logistics system with a high storage capacity (5 million cubic meters). It operates through the Rome logistics hub, which ensures the supply of Jet fuel to the airports of Fiumicino and Ciampino.

The transportation infrastructure for Jet A-1 and SAF at Rome Fiumicino Airport relies on two distinct pipeline systems that originate from the coastal storage terminals in Civitavecchia and are managed by different operators, ensuring a flexible and resilient fuel supply chain.

The first pipeline is managed by SODECO. This pipeline system includes a 63-kilometer, 12-inch underground pipeline that transfers aviation fuel from the SODECO 4 terminal to ENI's pivot point at Pantano di Grano, and from there directly to Fiumicino Airport. This infrastructure supports both Jet A-1 and SAF distribution and adheres to JIG 1530 quality standards, ensuring product integrity throughout the logistics chain.

The second pipeline, independently managed by IP Industrial, connects the storage depot located at the port of Rome through two distinct routes: one passes through the ENI logistics hub at Pantano di Grano, while the other reaches Fiumicino Airport directly, representing an alternative supply route for aviation fuel, helping to diversify and strengthen the reliability of the supply chain.

The existence of these separate pipeline channels, managed by distinct entities, enhances operational flexibility, enables competitive supply arrangements and supports the integration of SAF through mass balance systems.

Fuel farm operator

- **SERAM**: it is responsible for the management and operation of fuel storage and distribution systems at Fiumicino Airport. It plays a critical role in enabling the integration of SAF into the fuel supply chain, ensuring that SAF blends are properly handled, stored, and delivered to aircraft in compliance with technical and regulatory standards.

The on-site storage facility at Fiumicino Airport is managed by SERAM, which oversees the safe handling, storage, and distribution of aviation fuels. In addition to its logistical role, SERAM also operates as a bonded (customs) warehouse, enabling the storage of fuel under customs control. This status facilitates an efficient management of fuel imports and taxation and plays a key role in supporting the seamless integration of SAF within international supply chains.

Fuel is transported to aircraft via the Hydrant Refueling System (HRS), an underground pipeline network that ensures efficient, continuous, and safe delivery of fuel directly to aircraft parking stands. The HRS at Fiumicino Airport is managed by SERAM, which is responsible for its operation, maintenance, and safety compliance. This system significantly reduces the need for fuel truck movements on the apron, enhancing operational efficiency and minimizing environmental and safety risks. As SAF becomes increasingly integrated into airport operations, the HRS plays a crucial role in enabling its seamless distribution to airlines.

Fuel monitoring is managed by SERAM through systematic checks on both incoming and outgoing fuel volumes.

SERAM is also responsible for overseeing the various safety procedures within the airport perimeter and for quality control and carries it out in accordance with international standards.

Into-Plane operators

- **Levorato Marcevaggi:** it is one of the main into-plane fueling operators at Fiumicino Airport. It is responsible for the final step in the fuel supply chain: directly refueling aircraft on the apron.
- **Carboil**: is another key into-plane operator at Fiumicino, providing refueling services to several airlines. As SAF adoption increases, Carboil is positioned to play a vital role in ensuring proper handling and delivery of sustainable fuels, maintaining high safety and environmental standards.

Aircraft refueling operations at Fiumicino Airport are performed using mobile dispensers, which are specialized vehicles equipped to pump fuel directly into aircraft tanks. These dispensers are connected to the Hydrant Refueling System (HRS), an underground pipeline network that supplies fuel from the on-site storage facility to aircraft stands.

The HRS is managed by SERAM, while the actual refueling activities are conducted by authorized into-plane service providers, including Levorato Marcevaggi and Carboil. These operators are responsible for ensuring safe, timely, and compliant refueling operations in coordination with airline schedules and airport ground handling teams.

As the adoption of SAF increases, into-plane providers will play a crucial role in managing the operational aspects of SAF delivery, ensuring correct blending, traceability, and quality control at the point of use.

Airlines

RefuelEU applies to all airlines, however ITA Airways has been one of the first to take actions on a voluntary basis in FCO in SAF procurement and is therefore highlighted in the below section.

- **ITA Airways:** is the Italian national airline, is actively committed to sustainable aviation and has already operated flights using SAF blends in collaboration with ENI and ADR

(Aeroporti di Roma). The airline participates in national and international initiatives aimed at increasing SAF usage and reducing its carbon footprint.

Procurement is initiated by the airline, which requests a specific quantity of fuel from the Fuel Suppliers**.**

Main elements related to the supply chain and stakeholders present at Rome Airport are summarized in Table 2.

Rome airport (FCO)	
Supply chain approach:	Mass Balance
Distribution method to the airport:	Pipeline
Distribution method to the pit:	HRS
Airport operator:	ADR
Storage operator:	• SODECO • IP Industrial
Fuel farm operator:	SERAM
Into-plane operators:	• Levorato Marcevaggi • Carboil
Main fuel suppliers:	• IP Industrial • World Fuel Service • Ludoil • TotalEnergies

Table 2. FCO synthesis

2.3 Vilnius Airport (VNO)

At the time of writing this Deliverable (08/2025), Vilnius Airport has not yet implemented any SAF integration. However, the supply chain described in this chapter for Jet A-1 already outlines the roles of the stakeholders with a view to future SAF handling.

2.3.1 Today - Consolidated supply chain

The fuel supply chain at Vilnius Airport (VNO), at the time of writing this Deliverable (08/2025), follows a Mass Balance approach. Currently, the supplier Orlen purchases Neat SAF from a third-party producer and blends it with Jet A-1 on-site at 2% at its own production facility. The blended fuel is then transported by rail to the airport's fuel depot. After passing quality checks conducted by the depot operator, the product is collected by refueling operators and delivered by truck directly to the aircraft wing, following the same logistical flow as Jet A-1. The airport does not have a Hydrant Refueling System (HRS) for fuel distribution and refueling, and there are no plans to implement one in the future.

The airport operator, LTOU, is not directly involved in fuel procurement, nor in the logistical or operational phases, which are managed by the fuel farm operator.

As in other airports, the fuel supply chain at Vilnius Airport remains essentially unchanged with the integration of SAF, except for the upstream production phase, which lies outside the airport's direct operational scope. The incorporation of SAF, in fact, occurs downstream of production, within the existing and well-established logistics infrastructure used for conventional Jet A-1 fuel. As a result, the key stakeholders already involved in the handling and distribution of Jet A-1 will also be responsible for managing the blended SAF arriving at the airport. This includes activities such as transport, storage, quality control, and refueling operations.

Figure 12 shows the consolidated physical supply chain.

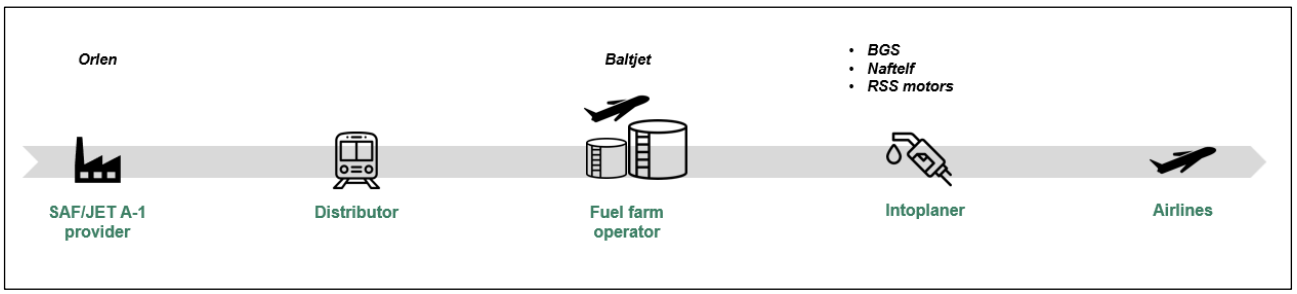

Figure 12. VNO physical supply chain

The operational fuel management activities within the airport, as well as all the procedures, did not change with the introduction of SAF, nor did the actors performing them.

The key stakeholders outlined below have been involved in VNO SAF supply chain or have supported its spot delivery and integration within the airport's existing infrastructure.

Jet A-1/SAF provider

- **Orlen Lietuva**: it is a member of the group of the Polish Oil Concern ORLEN S.A., a leader of the refining sector of Central and Eastern Europe. Operates the most advanced refinery built in the former Soviet Union and the only one in the Baltic states. Technologies applied in the refinery and consistent process improvement allow ORLEN Lietuva to make high-quality products in compliance with the specific standards of the countries we operate in.

Currently, the SAF producer has a formal contract with Fuel Suppliers, ensuring a steady and regulated supply of fuel. There are no contractual agreements directly involving the airport.

Fuel suppliers:

- **BGS**: company which provides aviation ground-handling and aircraft support services to 10 airports in 5 countries throughout Central and Eastern Europe. Since 2008, it became the first independent ground handling company in Europe to receive the IATA Safety Audit for Ground Operations (ISAGO) certificate.
- **Naftelf**: company part of the TotalEnergies Aviation organization.
- **RSS motors**: founded in 2006, it is a provider of jet fueling services to local and international airlines. The company is specialized in surface aircraft maintenance and fuel supplies.

The Fuel Suppliers are responsible for procuring fuel directly from production facilities and managing its delivery to the airport. Fuel transport is entirely under the responsibility of the suppliers, too, without any participation in terms of coordination, oversight or handling by the airport. The Fuel Suppliers use their own transport vehicles for fuel delivery operations.

Fuel suppliers purchase pre-blended fuel directly from the producer, who is responsible for acquiring the SAF and carrying out the blending process at their own facilities. The entire blending and procurement operation is managed independently by the producer, and the airport managing body does not have access to or involvement in these procedures.

Fuel farm operator

- **BaltJet**: based in Lithuania, the head office is in Trakai. It operates in the Warehousing and Storage industry. The company was established on August 23, 2021. There are currently (at 2025) 14 people employed by Baltjet UAB.

BaltJet serves as the manager of the airport's fuel depot. Its core responsibilities include overseeing fuel depot operations, managing the collection of fuel samples, and ensuring rigorous control of fuel quality standards. At present, no modifications or upgrades are planned for the storage infrastructure in relation to SAF.

The airport managing body has assumed responsibility for overseeing and controlling the entire process related to SAF implementation. It is actively employing monitoring and control

mechanisms to track all SAF operations within the airport. In contrast, traditional Jet A-1 fuel was not subject to such monitoring; only fuel quality checks were performed by the fuel depot operator.

The fuel depot operator is directly responsible for conducting quality control procedures, while the airport verifies the related documentation to ensure compliance and proper application. For SAF deliveries at VNO airport, the same quality control procedures used for conventional fuel will be applied, including for random fuel deliveries. No other stakeholders are involved in the SAF handling process inside the airport.

Into-Plane operators

BGS, Naftlef and RSS motors, described as fuel suppliers, are also the into-plane operators at VNO. They maintain constant collaboration with the airport managing body to ensure the coordination and safety of all fuel-related operations. Although SAF will be introduced, no additional procedures or operational changes are currently foreseen.

Security and safety operator

Airport managing bodies are responsible for overseeing quality control procedures and are fully involved in all aspects related to fuel security, with no other stakeholders directly supervising fuel operators in this area. As for safety, the airport ensures that third-party operators implement appropriate monitoring and control measures. The introduction of SAF does not entail any changes to the current roles or procedures in these domains.

Airlines

RefuelEU applies to all airlines; however, the ones listed here are highlighted as they were among the first to take actions on a voluntary basis in SAF procurement.

- **SAS:** is a Scandinavia's leading airline, with main hubs in Copenhagen, Oslo and Stockholm. They are reducing carbon emissions through using more sustainable aviation fuel, investing in new fuel-efficient aircraft, contributing towards the industry target of net zero CO2 emissions by 2050.

SAS is one of the three airlines which today have long-term contracts with the fuel operator covering both Jet A-1 and SAF. Five airlines do not have any contracts, while one airline holds a short-term contract. All airlines purchase SAF through fuel operating companies, sourcing it exclusively from a single producer that is Orlen Lietuva.

The main elements related to the supply chain and stakeholders present at Vilnius Airport are summarized in Table 3.

Vilnius airport (VNO)	
Supply chain approach:	Mass Balance
Distribution method to the airport:	Train

Distribution method to the pit:	Fuel truck
Airport operator:	LTOU
Fuel farm operator:	BaltJet
Into-plane operators:	• BGS • Naftleft • RSS motors
Main fuel suppliers:	• BGS • Naftelf • RSS motors

Table 3. VNO synthesis

2.4 CPK (New Warsaw Airport)

CPK Airport is not yet operational, therefore, the supply chain described below represents the expected pattern once procurement and fuel management activities are in place. Similarly, the stakeholders listed below are those expected to be involved in the SAF supply chain or to support its future spot delivery and integration into the airport infrastructure once the site becomes active.

2.4.1 Planned Supply chain

The fuel supply chain at CPK Airport will be organized following a Mass Balance approach. Blending fuel deliveries are expected to be carried out primarily by rail, utilizing a dedicated railway line, while road transport, using either the fuel suppliers' own trucks or third-party carriers, will serve as a complementary or alternative solution in case of rail service disruptions. Although a portion of the supply may also be delivered via pipeline, rail is expected to remain the main mode of transportation.

Both domestic and international operators, often subsidiaries of fuel producers, will be involved in the logistics chain. Orlen is expected to act as a SAF supplier by purchasing Neat SAF and blending it before delivery.

Fuel distribution to aircraft will primarily take place through a Hydrant Refueling System (HRS), using dispensers directly connected to aircraft on the aprons. Where the HRS will not be available, fueling will be carried out by specialized tanker trucks.

Maintenance services have not yet been defined but are expected to be outsourced to external companies with specific technical expertise. In the long term, a pipeline system is being planned to connect the refinery directly to the airport, with the aim of improving the efficiency and security of the fuel supply chain.

As with other airports, the presence of SAF in fuel at Warsaw Airport is not expected to result in changes in infrastructure or procedures compared to the operation of Jet A-1 alone.

Figure 13 shows the supply chain planned for CPK Airport.

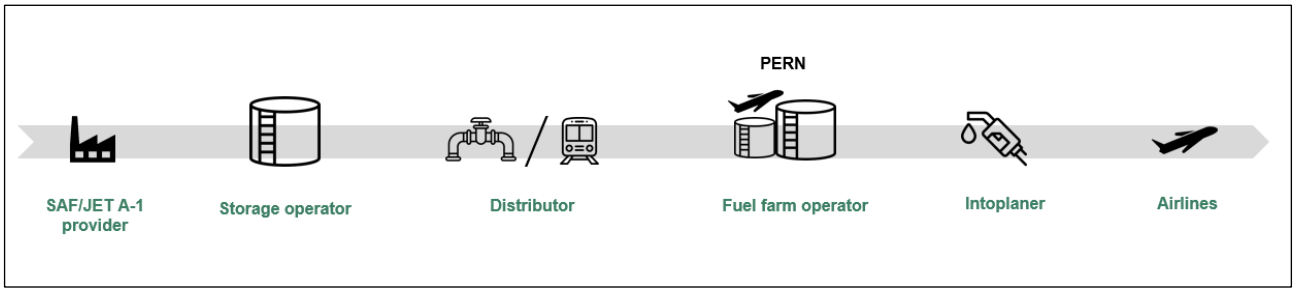

Figure 13. CPK physical supply chain

The main stakeholders involved in the CPK supply chain for Jet A-1 are described in this paragraph.

Jet A-1/SAF provider

Currently, there are two entities in Poland with the potential capacity to produce both SAF and Jet A-1 fuels. CPK anticipates that the majority of aviation fuel supply will be sourced from domestic producers.

Fuel Suppliers

Currently, there are three main suppliers of Jet A-1 aviation fuel operating in Poland:

- **Orlen**: it is the largest Polish oil refiner and fuel distributor, Orlen plays a key role in the national aviation fuel market, offering both production and logistics capabilities.
- **AirBP Aramco Poland**: joint venture that brings together global expertise from BP and Aramco, this supplier ensures international standards in fuel quality, safety, and supply chain reliability.
- **UNIMOT**: an independent energy company that has recently expanded its activities in the aviation sector, providing flexible and competitive Jet A-1 supply solutions.

These companies form the backbone of the current aviation fuel supply chain in Poland, with growing potential to support both conventional and SAF development in the coming years.

Fuel farm operator

- **PERN**: is the leading company in oil and fuel logistics in Poland, fully owned by the State. Through an extensive infrastructure, it operates 23 fuel storage bases across the country with a total refined fuel capacity of approximately 2.4 million m³, alongside 4 crude oil storage facilities exceeding 4.1 million m³ .PERN's assets include over 2,500 km of pipelines transporting crude oil and refined products between strategic hubs, such as the Naftoport terminal in Gdańsk and the Płock refinery, and maintaining national energy security through a broad network of storage and transit facilities

As of today, the establishment of a joint venture is envisioned by the fuel logistics specialist PERN and CPK Airport. As it currently stands, fueling operations at CPK will be managed through the establishment of a dedicated joint venture company. This entity will be formed in partnership with one or more industry players, combining operational expertise with strategic oversight. CPK Airport probably retain a minority stake in the joint venture, having influence on control over key decisions and alignment with the airport's long-term development strategy. This structure is intended to guarantee high standards in safety, efficiency, and service quality, while also enabling flexibility in adapting to future market and technological developments, including the integration of SAF.

As for external distribution, subsidiaries of fuel producers or specialized third party rail companies. CPK is currently in initial consultations with multiple potential Into-Plane (ITP) Operators who may potentially provide this type of wingtip refueling service. CPK assumes minimum 2 ITP operators at the airport, among the main national and international players in the into-plane refueling sector. CPK has engaged them in an initial round of consultations for the provision of

wingtip refueling services. Since the project is still in the design phase, no final decisions have been made yet. As for now, in the case of distribution via the HRS (Hydrant Refueling System) for SAF and/or Jet A-1 fuel, the responsibility for the operation and maintenance of the distribution system will lie with the airport fuel system operator.

Airlines

- **LOT Polish Airlines:** is the national airline of Poland and one of the 12 oldest airlines still in operation worldwide. LOT is actively committed to advancing aviation sustainability and has partnered with SkyNRG, a global leader in SAF. As part of this collaboration, LOT has purchased SAF from SkyNRG to support the decarbonization of its flight operations.

The procurement phase involves direct engagement with the airlines, which negotiate and enter into agreements with fuel suppliers to ensure a reliable and consistent supply of fuel necessary to support their flight operations. These contracts are typically tailored to meet the airlines' operational needs, including volume commitments, fuel quality standards, and delivery logistics, playing a critical role in maintaining efficient and sustainable airline operations.

The main elements related to the supply chain and stakeholders present at Warsaw Airport are summarized in Table 4.

Warsaw airport (CPK)	
Supply chain approach:	Mass Balance
Distribution method to the airport:	Pipeline / Train
Distribution method to the pit:	HRS
Airport operator:	CPK
Fuel farm operator:	PERN
Into-plane operators:	*To be defined*
Main fuel suppliers:	• Orlen • AirBP Aramco Poland • UNIMOT

Table 4. CPK synthesis

3 Examples of other airports

The analysis carried out revealed that the main European airports are moving forward according to the same approaches presented in this Deliverable.

To date, no public available studies have shown significantly different evidence regarding the supply chains and stakeholders involved in SAF management compared to what has been presented in the previous chapters.

For more specific insights related to other airports, it would be necessary to contact the relevant fuel farm operators.

4 Conclusions and best practices

The analysis conducted with the four ALIGHT partner airports confirms that the introduction of Sustainable Aviation Fuel has not led to significant structural changes in the existing fuel supply chain, nor has it modified the roles of the key stakeholders involved.

Operational activities across the supply chain are essentially identical to those for conventional Jet A-1 fuel. This seamless integration is largely due to the fact that SAF, when delivered as a blended product is compliant with the same technical specifications outlined in ASTM D1655. As a result, it can be handled using the same infrastructure, procedures, and quality control systems as pure Jet A-1 fuel, without requiring major adjustments in terms of storage, transport, or aircraft refueling assets or operations.

From a fuel management perspective as well, the introduction of SAF has not led to significant changes at the airports examined. Commercial ownership of the fuel remains with the fuel suppliers, often the same entities that provide Jet A-1, and in no case has the introduction of new types of stakeholders or new relationships between parties been observed.

Airport operators are not directly involved in the procurement or sourcing of SAF, consistently with their role in the Jet A-1 supply chain. These responsibilities remain with fuel suppliers and airlines, which manage the commercial agreements and coordinate the logistics of delivery.

Finally, it is worth noting that none of the operators contacted reported any gaps to be addressed in the existing supply chains, which can therefore be considered well-established for the coming years.

Although this report focuses on specific case studies from the ALIGHT project, the findings appear consistent with practices observed across many European airports, highlighting a general alignment in operational approaches.

Consolidated Practices

- **Standardized Operations**: SAF blended to ASTM standards can be integrated into existing airport fuel systems without operational changes, ensuring continuity and reliability.
- **Roles in the Supply Chain**: the procurement and delivery of SAF remain under the purview of fuel suppliers and airlines, with airport operators playing a supporting role limited to infrastructure availability and coordination.
- **Supply Chain Models**: current SAF supply chains replicate those used for Jet A-1, indicating that no additional logistical complexity is introduced when SAF is blended and delivered according to established protocols. All airports analyzed adopt the mass balance approach to SAF traceability, allowing blending within existing systems while maintaining accountability over volumes and sustainability claims.
- **Considerations for Segregated SAF**: while physical segregation of SAF could enhance traceability, it requires dedicated infrastructure and procedures. This model is

considered more suitable for new airport developments rather than retrofitting existing ones, due to its cost and complexity.

5 References

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[5] Neste – company website
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