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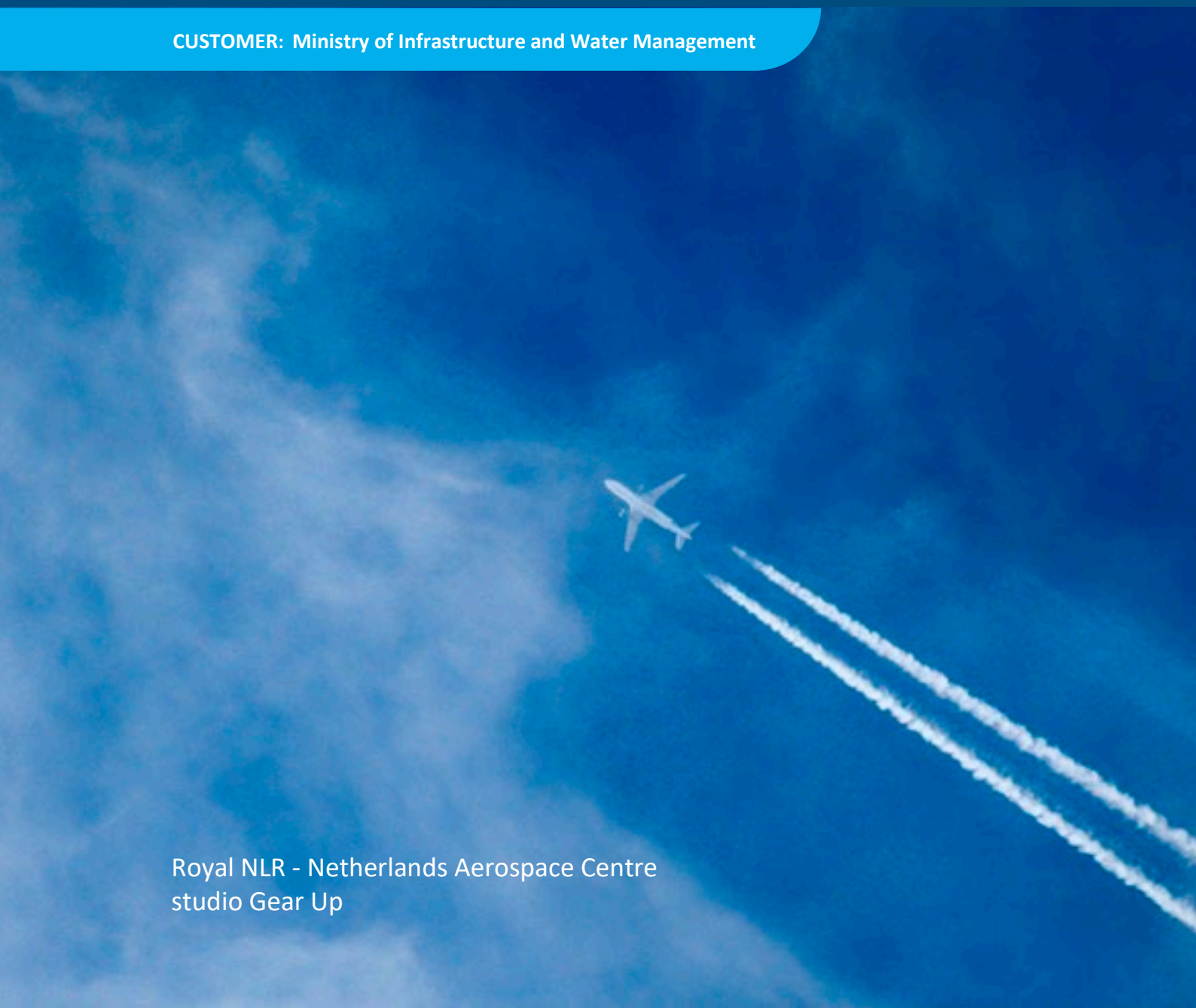
Administration of SAF deliveries via the CEPS

CUSTOMER: Ministry of Infrastructure and Water Management



Royal NLR - Netherlands Aerospace Centre
studio Gear Up

Accelerating the future of aerospace

Administration of SAF deliveries via the CEPS

Problem area

For logistical, cost, safety and environmental reasons, the preferred way to transport aviation fuels from production locations to airports is typically via pipeline (networks). In the Netherlands, the Central European Pipeline System (CEPS), an interconnected pipeline system, is a crucial piece of infrastructure to supply aviation fuels to airfields, e.g., from the Rotterdam harbour area to Amsterdam Airport Schiphol. To comply with European and national legislation for sustainable aviation fuel (SAF), it is necessary to show proof of physical delivery of SAF at the airport. This physical delivery at specific airports is however not guaranteed when SAF is transported via the CEPS, such that – in the current regulatory framework – the CEPS cannot be used for delivery of quantities of SAF that are intended to count towards mandates or targets. As the alternative – a segregated supply of SAF – would increase logistics challenges, costs, environmental burden and possibly safety risks, a solution to allow the administrative delivery of SAF via the CEPS is desired.

Description of work

The Dutch Ministry of Infrastructure and Water Management has asked Royal NLR and studio Gear Up to explore how administrative SAF deliveries via the CEPS can work and, subsequently, to recommend how the administrative system could be set up to facilitate the transport of SAF via the CEPS.

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To map the administrative system of SAF deliveries via the CEPS, desk research was performed and expert interviews were conducted with stakeholders along the entire value chain. Next, administrative solutions were explored that could facilitate compliance, which covers the traditional “paper trail”, the Guarantee of Origin concept, the Union Database, and the European Blockchain Services Infrastructure. Finally, both short and long-term solutions are recommended, including recommended changes to European and national legislation to accommodate SAF deliveries via interconnected pipeline systems, such as the CEPS.

Results and conclusions

On the short-term, it is recommended to make provisions in Dutch law which allow for the mass balance approach, currently applied to interconnected pipeline systems, to be complemented with an administrative system. This administrative system should enable the allocation of sustainability properties SAF to fuel which has been transported via the CEPS.

On the long(er)-term, the Dutch government is recommended to pursue all efforts to ensure that the EU recognises the current regulatory hurdles of transporting SAF via interconnected pipeline systems and provide specific amendments to several EU legislative frameworks, as presented in this study, that could allow for the transport of SAF via interconnected pipeline systems, such as the CEPS, and to allow proof of administrative delivery instead of physical delivery.

In this study various options to prove administrative delivery are evaluated and compared.

Applicability

The findings of this study apply to the transport of SAF via interconnected pipeline systems, but could also be applied to other (liquid) fuels transported via such systems. The study findings and recommendations are based on legislation and regulation applicable at the time of publication. Changes in legislation and regulation might invalidate (certain) findings and recommendations.

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Executive summary

The CEPS is an important asset to supply the sustainable aviation fuels in the Netherlands

The demand for sustainable aviation fuel (SAF) is set to significantly rise in the coming decades, driven by measures laid out in several policy frameworks. The distribution of aviation fuels from production locations to airports is typically best achieved through pipeline networks, for logistical, cost, safety and environmental reasons. Almost half of the aviation fuel uplifted in the Netherlands are transported via the Central European Pipeline System (CEPS), an international jet fuel pipeline network owned by NATO. The CEPS is of major importance for the fuel supply to Amsterdam Airport Schiphol and other major civil airports in Belgium, Germany, Luxembourg and France as well as for fuel supply to military airports in these countries. The Rotterdam port area is a major entry point for SAF, and a significant share of European SAF production is located there.[1] Therefore, the CEPS is an important asset in the distribution of SAF, and indispensable to supply the volumes required by the increasing legislative SAF targets.

However, deliveries of SAF to airports via the CEPS cannot be proven for EU legislative purposes, because the regulatory frameworks require evidence of physical delivery, which cannot be arranged or demonstrated via the CEPS, as is further explained below.

Research question

In anticipation of a legal solution, the Ministry has asked NLR and studio Gear Up to explore how deliveries of SAF via the CEPS could be administratively tracked. Specifically, the Ministry would like to understand how several potential administrative systems for tracking SAF delivered via interconnected pipeline systems could work, how they would connect proof of SAF injection to claims of SAF extraction and uplift at airports, possibly drawing inspiration from Guarantee of Origin systems as well as solutions applied in other Member States.

SAF distributed via the CEPS cannot be used to meet EU renewable energy and climate targets

The distribution of SAF via the CEPS faces a regulatory hurdle. To prove compliance with the SAF mandate of the ReFuelEU Aviation regulation, and to prove use of SAF in the frame of the EU Emissions Trading System (EU ETS) both require that SAF is physically present at airports. This is specified respectively in mass balance certification rules (for ReFuelEU Aviation), with rules from the Renewable Energy Directive (RED) and in the monitoring and verification rules (for EU ETS). Additionally, the national reporting of renewable energy deployment and emission reduction achievements (for the RED and for national and international agreements) requires that the location where SAF is physically delivered is known.

However, physically steering the flow of individual batches of SAF transported via the CEPS, from a specific injection point to a specific extraction point, is not possible, this would impact the operational capabilities of the CEPS too much. The CEPS works as a banking system. Company A sells aviation fuel to another Company B, and transports the volume via the CEPS. Company A injects a volume, and Company B extracts an equal volume. However, the molecules are not the same, and the physical SAF volume may even end up at another extracting Company C, and it is unknown to Company C that they are extracting physical SAF molecules. The timing of injection and extraction is decided by the CEPS management via pumping schemes, and is not necessarily time-synchronised with selling and buying processes.

[1] Neste currently expands their production capacity in Rotterdam to 2.7 million tonne products including 1.2 million tonne SAF from 2027 onwards, which will make it the largest SAF production in the EU.

This implies that, while the ReFuelEU Aviation and the EU ETS require proof of physical delivery of SAF to airports, it is not possible to prove physical delivery via the CEPS. Therefore, in the Netherlands, SAF that is delivered via the CEPS, is currently not recognised as a SAF delivery in the frame of ReFuelEU Aviation or the EU ETS.

Rules are explained differently by other Member States and the European Commission

Other Member States do allow transportation of SAF via the CEPS. For instance, SAF volumes are physically injected in the Ghent port area in Belgium and are then administratively claimed at Frankfurt airport in Germany. The German regulator accepts SAF that is transported via the CEPS in the frame of EU ETS monitoring and reporting. SAF that is injected in Ghent and extracted at Zaventem is accepted by the Belgian government in the frame of ReFuelEU Aviation.

In discussions on the delivery of renewable fuels (including SAF) over connected infrastructure, especially the mass balance rules of the RED are subject to different interpretations. Some Member States interpret the rules as allowing to allocate an injected volume to an extracted volume. This is more widely accepted for the transportation of biogas via natural gas grids, even in the Netherlands. In Spain, liquid renewable fuels can be transported via the country-wide Exolum pipeline system, via a banking system similar to the CEPS, although it must be noted that a renewable fuel injection in Exolum almost guarantees the final fate of that renewable fuel in the Spanish market – whereas a SAF injection in CEPS can end-up in any of the CEPS connected Member States.

However, the mass balance rules of the RED only allow to reassign the sustainability aspects of the *biofuels* that entered a mixture to outgoing *biofuels*. The mass balance does not allow volume allocation of injected renewable fuels volumes to specific (largely non-renewable) extracted volumes. In fact, it dictates that the outgoing flows from a mixture have the *mixed* physical composition of that mixture.

The European Commission has suggested that transportation of SAF via the CEPS is allowed within the mass balance rules. However, European and Dutch court rulings made clear that this interpretation of mass balance is incorrect, that mass balance is only to be used for the sustainability aspect, and that the physical composition of all outgoing flows is the same as the mixture in the system.

Only if administrative proof of delivery is accepted, SAF can be delivered in the Netherlands via the CEPS

Once SAF is injected in the CEPS it is de facto guaranteed that it will end-up in the EU aviation sector.[2] Therefore, by injection of SAF in the CEPS, their contribution to ReFuelEU Aviation and EU ETS can considered to be achieved. It is therefore recommended that the RED and the Monitoring and Reporting Regulation of the EU ETS are changed to accept a proof of physical injection of SAF instead of requesting proof of physical delivery to airports. Following this, the rulesets for Member States national statistics accounting should be adapted accordingly.

These frameworks can only be changed during planned revisions. It is therefore recommended that the Dutch government, like other Member States, accepts administrative SAF delivery on the short-term, instead of requiring physical deliveries – even if this is not yet facilitated in EU legislation. Based on conversations with RVO (Netherlands Enterprise Agency), it appears that The Netherlands does not object such an administrative solution, provided that it is sufficiently secured. On the long(er)-term the EU should recognise the current regulatory hurdles of transporting SAF via interconnected pipeline systems and make amendments to several EU legislative frameworks to unambiguously allow this as well.

[2] In principle all the kerosene that is injected in the CEPS will end-up in EU civil or military aviation. No fuels are extracted from the CEPS for (re)export.

Various administrative solutions are possible

Administrative delivery of SAF via the CEPS can be confirmed on basis of proof that:

- there is a contract for the delivery of SAF between an ingress and an egress point; and
- the CEPS bank accounts at each side confirm the delivery of an agreed volume of aviation fuel, identified by a unique delivery code; and
- volume measurements and subsequent calculations at the ingress point confirm the physical share of SAF in the delivery; and
- the Proof of Sustainability information is carried over from the ingressed volume of fuels to the egressed volume.

There are various ways to facilitate the collection of this proof, and reporting to auditors and regulators:

- By “paper trail”, composed of data collected and exchanged by the companies involved, which is externally audited. Companies that currently transport SAF via the CEPS (outside the Netherlands) use this method.
- By using a Guarantee of Origin (GO) system, as used for biomethane transport via the natural gas grid in the Netherlands. To make this work for international SAF deliveries, Member State cooperation is required.
- Through the European Blockchain Services Infrastructure (EBSI), companies could have an Organisational Wallet, to simplify and secure data exchanges. The Organisational Wallet could record transactions of SAF transported via the CEPS between Member States in a systematic way, providing improved transparency for the regulator.
- The Union Database (UDB), which is launched to trace renewable fuels along their supply chain, was also considered, but does not seem a suitable alternative, as it does not serve to prove delivery of a renewable fuel and it offers limited transparency to the regulator.

Recommendations

At the moment that the Netherlands approves administrative delivery of SAF for RED, ReFuelEU Aviation and EU ETS compliance purposes, it is expected that traders will use the paper trail for their transactions. The Dutch government / European Commission could require that the proof becomes more transparent and more secure by using a Guarantee of Origin or Organisational Wallet.

Enabling transactions via a GO system requires specific action by VertiCer (in the Netherlands) or the Association of Issuing Bodies (for cross-border trades). The latter option will likely require more development time than the former.

Since the Organisational Wallet is merely a method to collect and provide evidence of transactions in a systematic and transparent way, it does not at the start require the involvement of many stakeholders. The system could be developed by a small number of ingressing and egressing companies in close consultation with NEa. It is recommended to develop a pilot to demonstrate how Wallets can register administrative SAF deliveries over the CEPS. The pilot should cover the specification of what data is included/transferred, a sequence diagram (overview of all the information flows), protocols (that specify how data is collected/measured/proven, and how data is transferred). This pilot should connect to the ongoing innovation pilot of RVO (Netherlands Enterprise Agency), NOVE (association of fuel distributing companies), TNO (Netherlands Scientific Research) and NEN (Royal Netherlands Standardisation Institute) who develop a digital product passport for renewable fuel deliveries. It is recommended to embed the pilot and the developed protocol into a CEN standard to enable adoption by parties in more Member States. The pilot should be instigated by the Dutch government, and the government should articulate what requirements they have for the administrative proof, both for the purpose of compliance with EU ETS and ReFuelEU Aviation, as well as for EU statistical reporting purposes (clarification of which Member State can claim consumption of SAF). In parallel, the government should assess how to allow for this administrative solution in Dutch and EU legislation.

Contents

Abbreviations

ACRONYM	DESCRIPTION
ASP	Amsterdam-Schiphol Pipeline
CEPS	Central European Pipeline System
CO_2	Carbon dioxide
CoA	Certificate of Analysis
DPO	Defensie Pijpleiding Organisatie
EC	European Commission
ERE	Emissiereductie Eenheid
EU	European Union
EU	European Union
EU ETS	EU Emission Tradings System
GHG	Greenhouse gas
GO	Guarantee of Origin
HBE	Hernieuwbare Brandstofeenheid
HEFA	Hydoprocessed Esters and Fatty Acids
ICAO	International Civil Aviation Authority
ISCC	International Sustainability and Carbon Certification
KEV	Klimaat- en Energieverkenning
MRR	Monitoring Reporting Regulation
NATO	North Atlantic Treaty Organisation
NEa	Nedelandse Emissie autoriteit
NEN	Koninklijk Nederlands Normalisatie Instituut
NLR	Royal NLR - Netherlands Aerospace Centre
NOVE	Nederlandse Organisatie Voor de Energiebranche
PBL	Planbureau voor de Leefomgeving
PoS	Proof of Sustainability
RCF	Recylced Carbon Fuel
RED	Renewable Energy Directive
RFNBO	Renewable Fuel of Non-Biological Origin
RVO	Rijksdienst voor Ondernemend Nederland
SAF	Sustainable Aviation Fuel
SBC	Synthetic Blending Component
TNO	Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek
UCO	Used cooking oil
UDB	Union Database

1 Introduction

1.1 Background

Pipeline systems provide an important option for sustainable aviation fuels to match supply and demand
The demand for sustainable aviation fuel (SAF) is set to grow rapidly in the coming years and decades, driven by legislative and regulatory frameworks including the ReFuelEU Aviation,[3] the Renewable Energy Directive (RED)[4] and inclusion of the aviation sector in the EU Emissions Trading System (EU ETS).[5] The demand for SAF is further explored in Section 2.1.

The distribution of SAF from production locations and port hubs to airports is best achieved through pipeline networks, for logistical, cost, safety and environmental reasons. The Central European Pipeline System (CEPS), an international jet fuel pipeline network owned by NATO, represents an important option to distribute SAF to 7 civil and 22 military airports in the Netherlands, Belgium and Luxemburg and parts of France and Germany. Since almost half of the aviation fuels currently uplifted in the Netherlands are transported via the CEPS, use of this pipeline is desired for reaching SAF targets in the Netherlands, certainly when required SAF volumes increase. Also, for Dutch production of SAF in the Rotterdam port area, the option to distribute SAF via the CEPS is an important asset. The functioning of the CEPS is discussed in detail in Section 2.3.

Pipeline deliveries do not always comply with monitoring and certification rules
Distribution of SAF via the CEPS faces a regulatory hurdle. The legislative and regulatory frameworks noted above require that SAF is physically present at the airports. This is specified in mass balance certification rules (for RED and ReFuelEU Aviation) and monitoring and verification rules (for EU ETS). Also, the national reporting of emission reduction achievements (for national and international agreements) requires that the location where SAF is physically deployed is known. Further details on the regulatory requirement of physical SAF delivery are given in Appendix B.

But, directing SAF through the CEPS from injection location to desired airport is not possible, and physical tracking is complex, as is set out in Chapter 2. It is thus not possible to prove compliance with the legislative and regulatory frameworks, or the climate targets, on basis of SAF supplied via the CEPS. The Netherlands therefore does not recognise SAF that is delivered via the CEPS for compliance with the frameworks.

The Neste Rotterdam SAF production facility is directly connected to the CEPS, but their ingress in the CEPS would not be recognised for delivery to Schiphol. Therefore, they currently ship SAF to the Amsterdam port area, where their injection into the Amsterdam Schiphol Pipeline (ASP) is recognised for delivery to Amsterdam Schiphol Airport, because the ASP is unbranched and it is certain that any SAF injected in the Amsterdam port will be extracted and uplifted at Amsterdam Schiphol Airport.

[3] Regulation (EU) 2023/2405 of 18 October 2023, on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation), corrected version 26 February 2024.
[4] Directive (EU) 2018/2001 of 11 December 2018, on the promotion of the use of energy from renewable sources (recast), consolidated version 16 July 2024.
[5] Directive 2003/87/EC of 13 October 2003, establishing a system for greenhouse gas emission allowance trading within the Union, consolidated version 1 March 2024.

At the same time, some European Member States *do* allow delivery of SAF and other renewable fuels via the CEPS and similar pipeline systems. For instance, German airports are supplied with SAF that is ingressed in the CEPS in Ghent, Belgium,[6] and Neste transmits SAF via the CEPS from Gent to Brussels Zaventem Airport.[7] Germany allows SAF that is delivered via the CEPS to German airports to count as a renewable fuel in the frame of ETS and ReFuelEU Aviation, following a "mass balance approach".[8] Similarly, Belgian federal government has confirmed that it is possible to report SAF transported via the CEPS as a renewable fuel under ReFuelEU Aviation.[9] The Belgian government considers the CEPS, to work the same as the gas grid "which allows mass balancing", and that they "don't see the need for confirming the physical delivery of SAF at the airport if the mass balances are correct". While this explanation of the mass balance principles is wider than the interpretation of several courts (see Appendix B), it is clear that the Belgian and German government use the same "mass balance" terminology to allow SAF transport via the CEPS.

Also, the European Commission (EC) seems to suggest that dedicated deliveries of renewable fuels (SAF and biomethane) over pipelines that also transport fossil-based fuels, by injection and later "unmixing" of the renewable fuel comply with the legislative frameworks.[10] The difference in implementation of EU rules between the Netherlands and other Member States creates an unequal playing field and hinders the scale-up of SAF production and use in the Netherlands.

The incompatibility of the legislative requirement for physical delivery of SAF to airports, with the practical working of the CEPS is understood by the Dutch Ministry of Infrastructure and Water Management, and is a starting point for this current study. Based on conversations with the Dutch RVO, it appears that The Netherlands does not object an administrative solution to enable administrative delivery of SAF via the CEPS, provided that the solution ensures integrity and transparency, and that it will be sufficiently secured in the regulatory framework. For the interested reader, Appendix B includes a detailed analysis of the legislative texts and how they are interpreted in other Member States and in Appendix C it discussed what would have to be changed in the legislative and regulatory texts.

[6] Confirmed by Neste, by email to studio Gear Up, 22 September 2025.
[7] Neste 2023, Website item: Brussels Airlines starts new year with a first delivery of Neste MY Sustainable Aviation Fuel to Brussels Airport via CEPS pipeline.
[8] A report by the German Environment Agency UBA (part of the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection) states that the "German government permits the CEPS under the EU ETS, which follows a mass balance approach" [UBA 2025, Policy incentives for the uptake of sustainable aviation fuels (SAFs)]. Note that the interpretation that mass balance allows the delivery of SAF via the CEPS is different than the interpretation of several courts, as is explained in Appendix B. German Emissions Trading Authority (DEHSt), part of UBA has confirmed by email to studio Gear Up, 10 November 2025 that the CEPS may be used for delivery of SAF and that this is in accordance with Articles 53 and 54 of the EU Monitoring and Reporting Regulation (EU) 2018/2066 (MRR), and that SAF via the CEPS "can be — and most likely will be — used to meet obligations under RED and ReFuelEU Aviation within Germany".
[9] Confirmed by the Federal Public Service (FPS) on Economy, SMEs, Middle Classes, and Energy (effectively a federal ministry of economic affairs), by email to studio Gear Up, 29 October 2025, stating that "We consider it to be the same as the gas grid which allows mass balancing. In the spirit of the regulation, it is clear it should be allowed since the alternative would be to transports all SAF via trucks. We don't see the need for confirming the physical delivery of SAF at the airport if the mass balances are correct".
[10] This is confirmed in two separate emails. EC DG MOVE explains that SAF delivery via the CEPS is possible: "As long as a physical link exists, the obligation can be complied with. Mass-balance is fully recognized under ReFuelEU Aviation and the UDB and aviation fuel suppliers can use pipelines for compliance. The word choice "physical" might be a bit confusing, but there is no need to verify that the exact molecules reached the airport." [EC DG MOVE, email 21 March 2025]. Earlier, EC DG ENER suggested that biomethane injected in an interconnected pipeline can be freely allocated to energy units that exit the pipeline, and that the reason is that they are part of the same mass-balancing system, based on the definition of "interconnected infrastructure" in Article 2 of the Implementing Regulation 996 [EC DG ENER, email 10 January 2023]. The same definition also includes liquid fuels, which would imply that the same rules would apply for liquid renewable fuels transported over interconnected infrastructure such as the CEPS.

1.2 Research question and reading guide

The Ministry has asked NLR and studio Gear Up to explore how deliveries of SAF via the CEPS could be administratively tracked. Specifically, the Ministry would like to understand how several potential administrative systems for tracking SAF delivered via interconnected pipeline systems could work, how the proof of SAF injection could be connected to claims of SAF extraction and presence at airports, and to draw inspiration from Guarantee of Origin systems as well as the practical solutions applied in other Member States.

The study focuses on identifying specific physical and administrative challenges related to tracking volumes of SAF distributed via the CEPS, from the point of injection up to the point of extraction from the network. The goal of this study is to identify possible solutions that could be used or developed to transfer renewable fuel characteristics from an injecting to an extracting organisation, for fuels that are transmitted over the pipeline, for reporting and demonstrating compliance under different regulatory frameworks.

To obtain deeper insights into the physical and administrative aspects related to the CEPS, desk research is combined with expert interviews. As well as identifying the possibilities in the current legislative framework, and the extent to which administrative and legislative changes are necessary to facilitate the transfer of renewable fuel characteristics of SAF which is transported through the CEPS for regulatory compliance and reporting purposes.

In Chapter 2 of this report, technical background for this study is provided, specifically on SAF and the CEPS. In Chapter 3, possible administrative solutions to facilitate administrative delivery of SAF via the CEPS are outlined. Finally, in Chapter 4, the key findings from this research study are summarised and recommendations are provided.

Furthermore, Appendix A provides background information on different chain of custody models. Appendix B details relevant legislative and regulatory texts, and the reporting requirements set, with respect to proving SAF deliveries over connected infrastructure networks, such as the CEPS. Appendix C documents required changes in EU legislative and regulatory frameworks, to accommodate for SAF deliveries via the CEPS. Finally, Appendix D provides an overview of the consulted organisations for expert interviews.

2 Background on SAF and the CEPS

2.1 Targets and ambitions for SAF uptake in the aviation sector

Civil as well as military flights departing from European airports will use increasing amounts of SAF. This is supported by policy instruments, such as ReFuelEU Aviation (EU 2023/2405), the EU Emissions Trading System EU ETS (includes civil aviation) and EU ETS2 (fuels supplied to military aviation[11]). The ReFuelEU Aviation regulation mandates fuel suppliers to deliver a share of SAF to Union airports. This share will increase every five years. By 2030, fuel suppliers need to ensure that 6% of the fuels they deliver to Union airports is SAF. Of that 6% SAF, part should be synthetic SAF, being of non-biological origin. This sub-share, too, will continue to increase until 2050. By 2050, SAF must make up 70% of all aviation fuel, with a sub-mandated share of 35% synthetic SAF. The ETS does not mandate renewable fuels, but incentivises their use, as operators do not have to surrender emissions allowances for the use of SAF.

In addition to the aforementioned European mandate, the Netherlands has committed itself to more ambitious targets of 14% SAF use by 2030 and 100% by 2050.[12] Building on this, a "SAF roadmap" was developed with stakeholders, "to accelerate and positively stimulate movement towards the targets set for the production and uptake of SAF in the Netherlands".[13] The increased ambition for 2030 implies an additional uptake of 8%.

According to the 2024 Climate and Energy Outlook, prepared by the Netherlands Environmental Assessment Agency)[14], the total energy consumption of aviation fuel in the Netherlands in 2030 is expected to range from 154 PJ to 190 PJ, corresponding to a "low" and "high" case scenario on the basis of adopted and expected policy measures and sector developments. This suggests 210 to 260 kilotonnes of SAF are required to meet the 6% mandate and 490 to 605 kilotonnes are required to meet the national ambition of 14%.

From 2035, the minimum share of SAF under the ReFuelEU Aviation regulation increases to 20%. Based on the projected volumes of aviation fuel in 2035 in the Netherlands, in the "low" and "high" scenario presented in aforementioned outlook, this ranges from 149 PJ to 190 PJ. This translates into an approximate annual volume of between 680 and 860 kilotonnes of SAF, as shown in Figure 1. Furthermore, given that there is a "flexibility mechanism" in place under ReFuelEU Aviation which allows fuel supplier to average SAF blending obligations across EU airports until 2035, the volumes of SAF delivered to Europe from the Netherlands could be even higher in the coming decade.[15]

[11] In 2023, the ETS scope was expanded. A separate trading system was introduced, known as "ETS2", and includes road transport, buildings and small industry. The Netherlands also includes military aviation via an opt-in.
[12] Werkgroep Duurzame Brandstoffen' (WDB) 2021, WDB Action programme.
[13] Deloitte 2025, National SAF-roadmap.
[14] PBL KEV, 2024, Tabellen Klimaat-en Energieverkenning 2024, Tabel 39b: Energieverbruik per modaliteit sector mobiliteit in petajoule (vastgesteld en voorgenomen beleid)
[15] European Commission report COM(2025) 59: The ReFuelEU Aviation SAF flexibility mechanism.

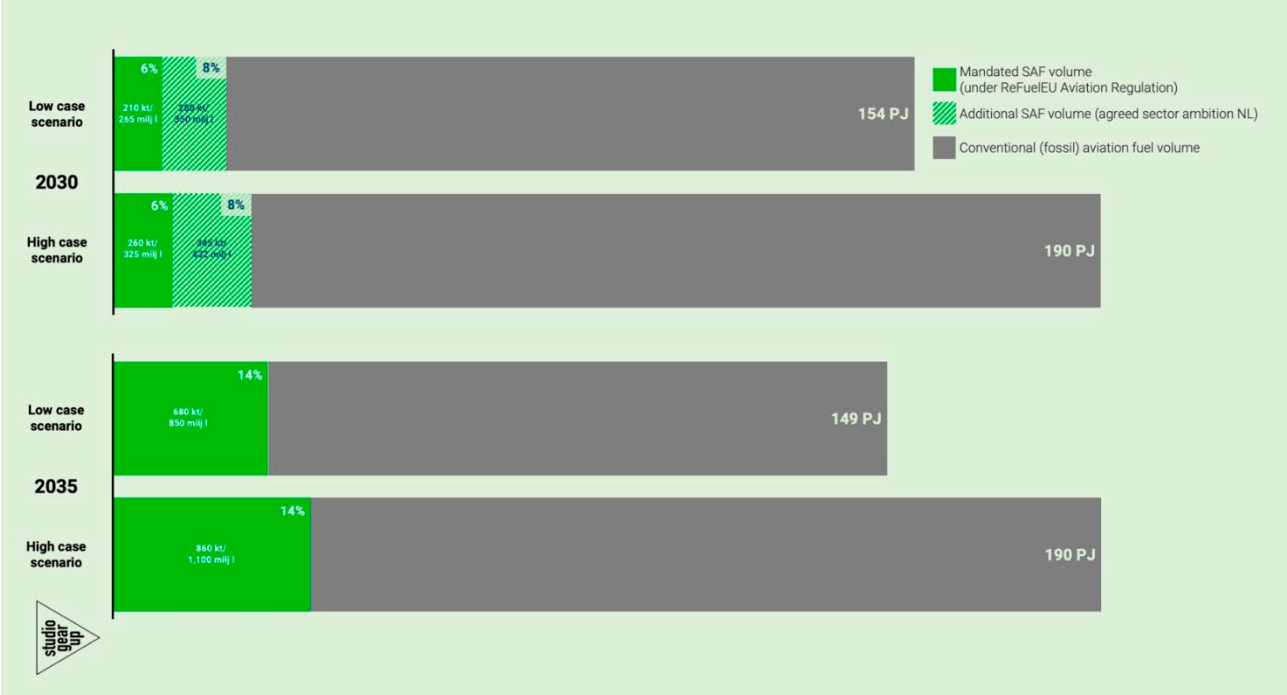

Figure 1: Predicted volume of SAF required in the Netherlands according to a "low case" and "high case" scenario based on PBL KEV (2024) forecast of the total energy consumption of aviation fuels in 2030 and 2035, mandated volumes under ReFuelEU Aviation and additional volume to meet sector ambition

2.2 Sustainable aviation fuels

Categories of sustainable aviation fuels

SAF is made from renewable resources and can be used to substitute conventional (fossil) aviation fuel. They are defined by the European Commission in Article 3(7) of the ReFuelEU Aviation regulation. The legislation distinguishes several categories of SAFs and other alternative aviation fuels based on the feedstock:

- SAF produced from waste and residue biomass feedstocks listed in Annex IX-B of the Renewable Energy Directive, such as used cooking oil.
- SAF produced from feedstocks in Annex IX-A of that directive, which requires more advanced conversion technology.
- Renewable synthetic aviation fuels, which in turn consist of two types:
  - Renewable fuels of non-biological origin (RFNBOs), also known as "e-fuels", produced on basis of hydrogen from electrolysis using renewable energy, combined with eligible sources of CO_2.
  - Recycled carbon aviation fuels (commonly known as RCFs), produced from residual fossil carbon or energy, such as carbon monoxide in flue gas, or waste plastics.

A range of alternative aviation fuel types has been technically approved for use in the aviation sector. These fuels, after blending with conventional aviation fuel to a maximum specified fraction, and after quality certification, are "drop-in", meaning they are compatible with the aircraft engines in the existing fleet of aircraft. There are also other types of alternative aviation fuels that are "non-drop-in" which require different aircraft types (such as H_2 fuelled aircraft), these fuels are not categorised as SAF by the European Commission. For a visual summary, refer to Figure 2.

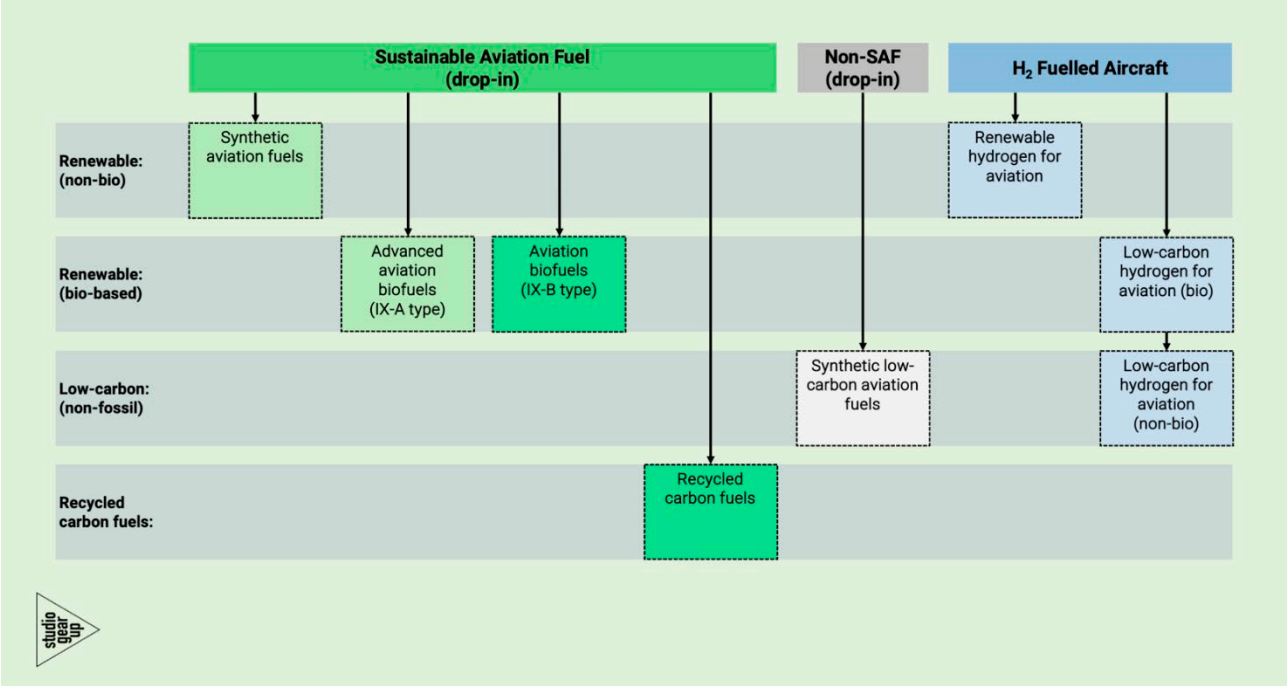

Figure 2: Categorisation of different types of alternative aviation fuels [EC 2023, Regulation (EU) 2023/2405 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation). Visual overview developed by studio Gear Up

Technical blend limits

Jet fuel transported via the CEPS has to meet the ASTM D1655 specification, the *Standard Specification for Aviation Turbine Fuels*. This is developed by ASTM International (formerly known as the American Society for Testing and Materials). This specification details the requirements for Aviation Turbine Fuels, often called conventional aviation fuel, more specifically of the Jet A and Jet A-1 type, and the testing procedures to show that fuel meets these requirements. This is also often called *conventional aviation fuel*. This includes properties such as density, and details regarding its composition such as maximum sulphur mass and maximum aromatics volume.

SAF is the blend of a Synthetic Blending Component (SBC) (that meets sustainability criteria which are in itself not considered by ASTM) and Aviation Turbine Fuel that meets the D1655 specification. Requirements for SBCs are captured in the ASTM D7566 specification, the *Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons, and thus regulated by ASTM*. Eight different SBCs have been approved as of September 2025, with several others still undergoing the approval process. Each of these SBCs are synthesized following a certain conversion technology (often called pathway), and are typically named after the conversion technology used to create them. For example, an SBC created from used cooking oil (UCO) using the Hydroprocessed Esters and Fatty Acids (HEFA) conversion technology, is typically named HEFA (and post blending HEFA SAF). Since each conversion technology produces a (slightly) different SBC, there are specific blending criteria per SBC, defined in the annexes to D7566, to ensure that the SBC and the final product (SAF) meet the fuel specifications. Any fuel released to all requirements of the D7566 specification meets the requirements of D1655, and shall be regarded as D1655 fuel (Jet A(-1)).

One of the most important properties to consider for blending is the level of aromatics, which cannot be lower than 8% in the final blend, following D7566. The majority of approved SBCs do not contain aromatics, and thus rely on the aromatics in conventional aviation fuel, that meets D1655, to determine how much can be blended. Besides the lower limit of 8% aromatics by volume in the blend, D7566 also specifies that blends cannot contain more than 50% SBC by volume for most SBCs, and in some cases 10% SBC by volume, depending on the composition of the SBC.

2.3 SAF delivery via the CEPS pipeline network

Current jet fuel and SAF delivery to Schiphol

Amsterdam Schiphol Airport represents approximately 94% of the total energy demand in Dutch aviation.[16] Over 90% of the jet fuel fueled at Schiphol is delivered through one of two pipelines. One pipeline runs directly from the Port of Amsterdam to Amsterdam Schiphol Airport, known as the Amsterdam Schiphol Pipeline (ASP). This transports approximately 2 billion liters of jet fuel to Schiphol each year.[16] The CEPS connects Rotterdam and Amsterdam Schiphol Airport. The Dutch part of the CEPS is managed and operated by the Defence Pipeline Organisation (Defensie Pijpleiding Organisatie, DPO). Amsterdam Schiphol Airport is by far the largest customer of the CEPS in the Netherlands, and the only Dutch civil airport connected to the CEPS, receiving up to 2 billion litre per year, out of a total of approximately 4.5 billion litre that passes through the Dutch part of the CEPS annually.[17] The combined volume of these two pipelines suggests that approximately 4 billion litres of kerosene are delivered via pipeline to Schiphol airport each year.

Alternatively, jet fuels can be, and partially are, delivered by road tank trucks to the airport tank farm. Given that approximately 4 billion litre of jet fuel is delivered to Amsterdam Schiphol Airport via pipeline (combined volume of the ASP and the CEPS), and understanding that this represents 90% of Schiphol's uplift, it is estimated that about 0.4 billion litres are delivered by road. This would represent about 13 thousand truck movements of each 30 thousand litres.

Role of the CEPS in meeting targets and ambitions

With a similar volume of fuel delivered via the ASP pipeline as via the CEPS, these alternative delivery routes (other than via the CEPS) are also options to meet the upcoming SAF mandates in the coming decades. However, given that the CEPS is connected to SAF production and storage in the Rotterdam port area, which represents a significant proportion of European SAF production and storage, this pipeline network represents an effective connection point for renewable fuel producers who are located in the Rotterdam area to deliver to Amsterdam Schiphol Airport. Furthermore, the CEPS also establishes a connection between the Rotterdam port area with major airports in surrounding Member States. Currently, due to the rules that do not recognise SAF delivery via the CEPS, Neste ships SAF to Amsterdam port (by barge) and injects it there in the ASP to supply Amsterdam Schiphol Airport, even though it has a direct connection between their Rotterdam SAF production facility and Amsterdam Schiphol Airport via the CEPS.

Considering that the current fuel standards apply a 50% maximum blend limit of SAF with conventional jet fuel, around 1 billion litres of SAF could technically be delivered to Schiphol, based on the current volumes delivered via ASP. This volume alone would be enough to exceed the 14% sector ambition for the Netherlands by 2030 (based on the scenarios presented in Section 2.1). As well as fulfilling a majority of the Dutch share of the mandated volume under the ReFuelEU Aviation regulation in 2035, which could require up to 1.1 billion litres of SAF to be delivered to the Dutch market (in the high case scenario). This emphasises that the CEPS could play a vital role in assisting the Netherlands to deploy higher SAF volumes which will be required to meet the 2030 SAF target and sector ambition. Moreover, the ASP can only deliver to Schiphol. Delivery of SAF to other airports would still benefit from the CEPS.

Given the mandated amount of SAF in the coming decades, developing a solution for administratively tracking volumes of SAF transported via the CEPS will be integral to supporting the sector in meeting the upcoming SAF targets.

[16] Arcadis 2024, Research infrastructure sustainable energy carriers for aviation (in Dutch).
[17] Defensie 2023, Pijpleidingnetwerk (website).

Details on the CEPS infrastructure

The CEPS is the largest petroleum pipeline system in ownership of NATO, spanning physically across five countries: Belgium, France, Germany, Luxembourg and the Netherlands, and is managed by aforementioned NATO Member States as well as the United States (due to US bases connected to the CEPS on European soil). The pipeline network supplies a combination of military and civil airports. The network, spanning over 5,000 km in distance laying underground, mainly transports jet fuel, but is also suited for transport of other fuel types. The CEPS transports approximately 12.9 billion litres of jet fuel per year, with the majority of transported fuel for civil purposes. The CEPS is connected to 29 NATO-owned military depots, as well as 6 depots for non-military use, and also functions as a depot itself. It connects to different military and civil airfields, refineries, civil depots and ports located in these five countries, see Figure 3.[18]

The CEPS is organised as a "mesh network", which means it is possible to reroute fuels during their transport. The pipeline system operates 24/7. The majority of the pipelines of the network transport fuels in one direction, but are technically able to transport in both directions. However, this is unwanted as this leads to higher maintenance.

The Dutch Defence Pipeline Organisation (DPO) manages the Dutch part of this system on behalf of NATO. The DPO is responsible for arranging an efficient pumping plan to transport fuels through the system between suppliers, storage locations and end-users. There is a central depot located in Pernis, which transports jet fuel to a variety of airports, including Schiphol, their largest civilian customer.[19]

Injection, transport, and withdrawal

Fuel injected into the CEPS is mainly brought in via a direct pipeline connection with a refinery and sometimes by sea vessels. Delivery can also be from road tankers or rail tank cars (but these vehicles are not owned by the CEPS). Jet fuel constitutes approximately 80% of the total volume of fuels that pass through the CEPS. The other 20% are known as "ground fuels" (diesel, gasoline, heating oil and naphtha) and are typically transported from point-to-point via the pipeline. The Dutch section of the CEPS is dedicated to jet fuel, no other fuels are transported through this section.

[18] NATO 2021, Central Europe Pipeline System (CEPS) (website item).
[19] Defensie 2023, Pijpleidingnetwerk (website).

Figure 3: The pipeline network of NATO CEPS (Central European Pipeline System) for kerosene in Western Europe. Commercial airports connected to the CEPS are identified by a green icon [*CIM and CCMP 2024, the CEPS network*]

"Ground fuels" do not impact the quality of jet fuel which is transmitted through the system. Due to high pressure, there is hardly any co-mingling of fuels at the interface (where both fuels "meet"). The interface is collected and dealt with by the client (DPO is not responsible for dealing with these interfaces). The line must be set to jet fuel again once these "ground fuels" have been transported, to ensure proper functioning of the network.

There are multiple intermediate depots where jet fuel is 'co-mingled' and where the fuel is recertified before release, to ensure the fuel meets the required quality specification. The fuel is eventually delivered to an end point for extraction, usually another depot, where there is another check on the quality, a complete fuel specification analysis, before it is eventually sent onward to the airport.

The CEPS operates a "banking system"

The CEPS operates a "banking system" for jet fuel supplied via the network. This operates exactly like a bank in the sense that if you deposit cash, you are able retrieve this cash elsewhere, but you may not receive the same notes. For jet fuel this means that if jet fuel is injected in the network on behalf of Organisation A at an ingress point, Organisation A can take jet fuel out at an egress point, but these will not be the same molecules.[20]

Parties receive a unique "delivery code" from the CEPS banking system upon injection, which confirms that a batch has been delivered. This delivery code is also linked to information at the extraction point, which means that fuels transported via the CEPS cannot be reported twice. On a weekly basis, fuel suppliers to the CEPS receive a list of codes with how much fuel has been injected and from which of their locations.[21]

Transporting SAF via the CEPS

For fuel quality monitoring reasons all fuel that enters the CEPS is fully followed administratively from ingress to egress point. If for some reason fuel is found that does not comply with the fuel specification (is "off spec"), it would have to be taken out of the network. Such off spec fuel can usually be blended with fuel that meets the specifications ("on spec") to become on spec again, allowing it to be released into the network again after recertification. This implies that even off spec fuel is not or rarely discarded outside the CEPS and will usually still find its way to an airport and be uplifted in aviation.

Most of the SAF delivered to the CEPS is delivered from the Ghent and Rotterdam areas, with observed blend rates of up to 45%. At an ingress point data is supplied from the fuel supplier to the operator (DPO in the case of the Netherlands) related to each batch of fuel, in a *Certificate of Analysis* (CoA), which shows that the fuel meets the technical specification, and generally also states the share of SAF, if present. Therefore, it would be possible to follow SAF in the network, if information would be disclosed on the CoA of the incoming fuel.

However, in storage tanks and depots in the network fuel can combined and split, complicating traceability. Additionally at the egress points, where fuel is delivered into tanks (further along the supply chain), stratification can occur, due to the different densities of fuel batches. Therefore, when fuel is taken from such a tank or depot, it is not possible to know whether it is a SAF blend or a conventional aviation fuel. This means that even if SAF were to be transported directly via the CEPS from a specific ingress point to a specific egress point, there can still be issues with tracing the SAF blend further downstream. As the CEPS operates more than 200 storage tanks, it would be very time consuming to test and trace the SAF content of each and every batch of fuel passing through the system. As the volume of SAF required to be delivered to airports will be increasing in the coming years, stopping individual batches for additional test may not be a workable solution. While it could be technically possible, it would come at a loss of flexibility in the system, and strongly limit the volume of fuel that can pass through the system.

The CEPS only has egress points at EU airports (civilian or military). This guarantees that any aviation fuel that is injected is used for EU aviation.[22] Although there are multiple storage facilities and depots in the network, fuel never leaves the network through these locations.

[20] Based on interview with NATO, owner and operator of the CEPS, They organise fuel transfers via a "banking system".
[21] Information on the "delivery code" from interviews with Neste.
[22] As noted earlier in this section, some "ground fuels" are also transported via the CEPS. But they hardly mingle with the aviation fuels and are extracted separately. This implies that most aviation fuel that is injected will eventually be used as aviation fuel. The tiny part that could possibly mingle with ground fuels, will still be used in the EU, and achieve the same greenhouse gas savings by replacing fossil ground fuels.

3 Exploring solutions for administrating SAF deliveries via the CEPS

If administrative proof of SAF delivery would be accepted, then this would require proof that:

- there is a contract for the delivery of SAF between an ingress and an egress point; and
- the CEPS bank accounts at each side confirm the delivery of an agreed volume of Jet-A1, identified by a unique delivery code; and
- volume measurements and subsequent calculations at the ingress point confirm physical the share of SAF in the delivery; and
- the Proof of Sustainability information is carried over from the ingressed volume of fuels to the egressed volume.

Along renewable fuels supply chains, information between selling and buying companies is usually exchanged via a "paper trail" of contracts, bills of lading and Proofs of Sustainability that only exist in the administration of both companies involved. Renewable fuel transactions are recorded in the Union Database, to avoid double claims. When renewable energy is traded over networks (such as power grid or natural gas grid), guarantees of origin are used to connect sellers and buyers. Finally, it is proposed to consider the EU Digital Identity Wallet to secure the integrity of transactions, and to provide transparency to regulators. In Figure 5 these options are compared for credibility and transparency of information and for the speed of implementation.

3.1 "Paper trail" documents

The tracking of administrative SAF deliveries via the CEPS could immediately be arranged on basis of the CEPS bank account statements. These statements include information of transaction volumes in combination with the codes of the sending and receiving parties. Each transaction is uniquely identifiable on the transaction statement. Each ingress can be linked to a *Proof of Sustainability* (PoS), and on basis of the (calculated) blend fraction the volume of SAF in the transaction can be calculated.

Without interfering with the CEPS administration, an independent organisation could match the information from the buyer and seller, confirm the transaction of SAF and transfer the Proof of Sustainability information, see Figure 4. This provides the buyer with administrative proof of SAF in their possession. This method of reporting and forwarding data on SAF volumes and their sustainability over the CEPS is already practiced, for instance for SAF deliveries from Gent to Zaventem or Frankfurt, and accepted by the auditors of voluntary schemes.

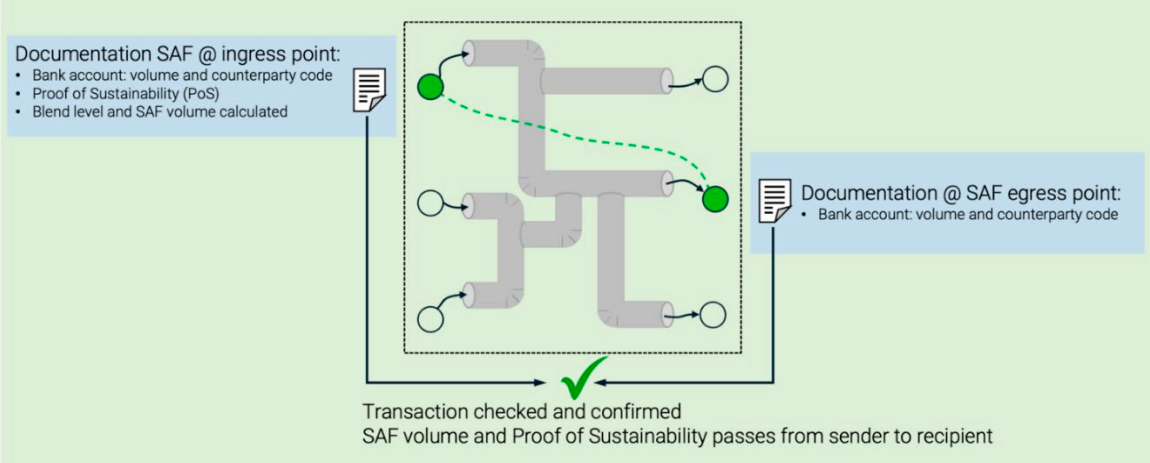

Figure 4: Information transaction from seller to buyer

	Example	How could it work for CEPS?	Credibility of information	Speed of implementation	Transparency of information	Initiative
EU Digital Identity Wallet	Developed by EC for secure, easy and systematic digital transactions	European Digital Identity Wallet, utilising European Blockchain Services Infrastructure (EBSI)	The system guarantees that information is verifiable, secure, integer and tamper-proof	Requires developing a "use case" for the CEPS and onboarding several parties	Improved supply chain transparency to regulator; data secure for all actors across the chain	Several ingress and egress companies, in cooperation with NEa can develop first scheme
Union database (UDB)	Developed by EC to avoid fraud and irregularities by double claims of renewable fuels	Registration of transactions over CEPS in UDB does not proof mass balance rules	Central database which ensures no double claims, but still requires on-premise auditing	UDB is operational – SAF transactions via CEPS can be registered – requires auditor verification	Auditors and regulators can check transactions recorded in UDB, requires decision for access	European Commission
Guarantee of Origin (GO)	Biomethane trade over the Dutch natural gas grid	A digital certificate that proves transaction of SAF volumes and sustainability over CEPS	Information is verifiable, secure, integer and tamper proof	Fast in the Dutch context, following the case of the gas grid. More complex to implement cross-border.	Covers only part of the supply chain - regulator can check transactions	Dutch government assigns Verticer – EC assigns Association of Issuing Bodies
"Paper trail" documents	Most common practice today in renewable fuel trade. Already practiced for SAF over the CEPS	Transferring a "delivery code" and information on the Proof of Sustainability (PoS) – partially free form	Irregularities by human error are possible – usually corrected later	Immediate: SAF over CEPS administration already in practice in Germany, Belgium	Requires regular auditing per location, it is usually impossible to oversee entire supply chains	Individual companies

Figure 5: Potential administrative solutions to track and prove SAF deliveries via interconnected pipeline systems, and how they compare on various aspects, as discussed in this chapter

3.2 Guarantee of Origin

The information on the transaction can be more systematically administrated via a "Guarantee of Origin" (GO) system. At the ingress point, a GO is issued (created) which constitutes a digital proof of the SAF volume injected into the CEPS and its sustainability characteristics. While the product is not physically tracked (becomes anonymous in the pipeline system), the GO is sold to an egressing party, as an administrative proof of delivery.

In the Netherlands, the issuing body VertiCer is mandated by the government as the Guarantee of Origin service provider. Therefore, a GO system for SAF transport that completely occurs within the Netherlands (having both ingress and egress in the Netherlands), could therefore be arranged by VertiCer, if the Dutch government requests this. VertiCer, in close cooperation with the NEa, has arranged this for the trade of gaseous biomethane over the natural gas grid (see **Box 1**). In the case of biomethane, the information included on the Proof of Sustainability is uniquely linked to a Guarantee of Origin, to cover the proof of delivery via the gas grid and allow the transfer of the PoS information from a supplier to a buyer.

Cross-border trade of GOs between Member States flow via the Association of Issuing Bodies. To enable cross-border trade of SAF GO would therefore require initiative by that organisation, likely instigated by multiple Member States or the European Commission.

Box 1: Guarantee of Origin system: example case of the gas grid in the Netherlands
In the Netherlands, biomethane transported over the natural gas grid can be counted for RED purposes, if it was injected in the Netherlands. Proof of delivery of that biomethane and compliance with the sustainability criteria is supported by a guarantee of origin system operated by VertiCer.

This works as follows: First, a Proof of Sustainability (PoS) is generated for biomethane which has been produced from renewable sources. When the biomethane is injected in the grid, the information included on the PoS is linked to a Guarantee of Origin (GO). VertiCer is the designated GO institution in the Netherlands whom are responsible for issuing these GOs.

3.3 Union Database

The Union database (UDB) has been set up by the European Commission for the purpose of tracing liquid and gaseous fuels in the transport sector, in accordance with Article 31a of the RED. The UDB is intended to support Member States with the auditing of renewable fuel supply chains and of claims made by obligated parties. Since the UDB provides information from source to end-user in one system, the chain of custody information becomes more integer: every batch can only be claimed once. This provides more certainty on the chain of custody than what can be given via documents that travel between producers, traders and obligated parties. The European Commission confirms that the objective of the UDB is to avoid double counting and to mitigate the risks for irregularities or fraud.[23] The UDB may also give insight to Member States with regard to cross-border transactions.

[23] European Commission, Union Database for Biofuels, Public Wiki, Website – About the Union Database.

Note that the UDB is not primarily intended for proving compliance. It can only confirm integrity of trades (see above), but not that the mass balance rules have been correctly followed. That would still have to be confirmed by auditing. Proof of delivery would still involve documentation by the involved ingressing and egressing parties, and regular auditing.

Note that the ETS Monitoring and Reporting Regulation in Article 53a.4 states that the aircraft operator "may use the data recorded in the Union database" to '[demonstrate] compliance [that there has not been double counting of specific volumes of eligible aviation fuels].' Again, this does not mean that the Union database can be used to proof delivery of SAF.

While the UDB will assist in mitigating the risk of double counting and the transfer of data between parties for reporting and compliance purposes, without an administrative system in place to track volumes of sustainable aviation fuels transported via the CEPS, it remains impossible to claim that fuels transported via the CEPS have arrived at an individual airport.

3.4 Digital Identity Wallet

New digital technology systems (such as, blockchain and distributed ledger technologies) can be used to develop an administrative system for tracking SAF transported via the CEPS. This would permit the secure transfer of verified information between actors, and enable that data can be transferred and compared between different systems (interoperability) while minimising administrative burden.

A digital solution could be developed on basis of the European Blockchain Services Infrastructure (EBSI) developed by the European Commission,[24] as part of their digital strategy. The CEPS could present a use case for developing a trusted registry system, which could be arranged as an "Organizational Wallet" to provide digital credentials to users.[25]

[24] More information on the EBSI conformant wallet can be found here.
[25] In line with the EU Digital Wallet legislation eIDAS2, trusted digital identies are for instance developed by Fides.

The aim of the larger development of the European Digital Identity Wallet project (part of the eIDAS2 regulation), is to create digital trust. The project introduces organisational wallets which will simplify and secure data exchanges between companies, enhance traceability and also enable stronger supervision. The Organisational Wallet serves the purpose to issue evidence of transactions, holding information of the right certification and the independent verification.

The Digital Identity Wallet, or Organisational Wallet, can be combined with the development of creating digital product passports, information records that contain essential information of a product.

For renewable fuels, such as SAF, the development of a digital product passport is already in development in an innovation project with RVO in the Netherlands, sector parties such as NOVE (association of fuel distributing companies), TNO (Netherlands organisation for applied scientific research) and NEN (Royal Netherlands Standardization Institute). The passport will record the required information on the product renewable fuel, like the required sustainability information and perhaps a Certificate of Origin.

The Organisational Wallet and the Digital Product Passport for renewable fuels or specifically for SAF will enable to create Digital Traceability Events. These events provide data on the “What, When, Where and How” and allow partners to trace products end-to-end.

In practical sense, it is recommended that CEPS users would first onboard on the use of the Organisational Wallet and will work with their ICT-providers to implement the issuing of Digital Traceability Events[26] with verifiable credentials that are machine readable and cryptographic verifiable and therefore interoperable across technology platforms.

A shared agreement on the digital data of SAF (volume, fraction, link to PoS or GO) could be a good point of departure. It is recommended to adopt the use of a Digital Product Passport if available to ensure the interoperability and therefore the possibility to link data. For transactions of fuels transported via the CEPS, an approach or “protocol” will need to be developed and agreed on, for use by all the CEPS ingressing and egressing parties. In the digital environment for the transaction this could possibly take the shape of a dedicated template for the CEPS. Following a revision of Implementing Regulation (EU) 2022/996, to allow for volume allocation of SAF via interconnected pipeline systems such as the CEPS, voluntary schemes should revise the rules in their guidance documentation, to explicitly facilitate the possibility of utilising digital technology solutions to provide proof of administrative deliveries.

The information of Digital Traceability Events, linking to the Digital Product Passport and linking to the issuing organisation create together a comprehensive overview of data. This can be analysed in what is called a “graph”. A supervising body, like the Dutch Emission Authority (NEa), could make queries to analyse the data. The graph of the SAF transport via the CEPS can also be connected to link with other data or other graphs, such as data in the UDB or fiscal data, for the purpose of cross checks.

In short, the organisational wallet could provide support for how to record the information and actions on SAF transmitted via the CEPS. Technical solutions for verifiable digital credentials, cryptographic verification and techniques to link data are available in the market. In this way a strong information position for auditing and supervision could be established with minimal administrative burden.

[26] https://ec.europa.eu/digital-building-blocks/sites/spaces/EBSI/pages/475267168/Conformant+wallets the European digital identity project links to the UN Transparency Protocol, https://spec-untp-fbb45f.opensource.unicc.org an initiative that wants to achieve global interoperability in linking data.

4 Recommendations

Strict requirements in EU legislation are incompatible with SAF deliveries via the CEPS. However, the scale-up of SAF production and application necessitates pipeline deliveries. It is recommended that the Dutch government, like other Member States, accepts administrative SAF delivery instead of requiring physical deliveries – even if this is not yet facilitated in EU legislation. It would help if the European Commission could communicate if they intend to change the RED and ETS rules accordingly in the future.

The combination of a delivery contract between the both parties, the transaction code in the CEPS bank account, metering information at the ingressing party (on the share of SAF in a consignment) and the sustainability information on the Proof of Sustainability (PoS), encompass all the data needed for the administrative proof of SAF delivery including the compliance with sustainability requirements.

There are various ways to facilitate the collection of the evidence, and reporting to auditors and regulators:

- The current practice is essentially by “paper trail”: the companies involved in a transaction collect and exchange information and data on their own initiative and in their own manner. An auditor, on behalf of the voluntary scheme, checks the documents on both sides of the transaction and confirms the carryover of the renewable fuel and its sustainability characteristics. Companies that currently transport SAF via the CEPS (outside the Netherlands) use this method.
- A Guarantee of Origin (GO) system can more systematically organise transactions between multiple companies over a connected infrastructure. This has for instance been arranged by the Dutch government in an assignment to GO administrator VertiCer, and approved by NEa, for biomethane transport via the gas grid, but only for injection and extraction within the Netherlands. Cross-border transactions would have to be enabled by the Association of Issuing Bodies, who sets rules for issuing, trading and redeeming of GOs across Member States. This would likely require that multiple Member States take a joint initiative, via their national GO administrators.
- The European Commission developed a digital strategy, with a European Blockchain Services Infrastructure (EBSI). In this infrastructure, companies will have an Organisational Wallet, to simplify and secure data exchanges, such as transactions, between companies. The CEPS would be a good candidate to provide a use case for the Organisational Wallet for cross border transactions of fuels transported via the CEPS. Organisations that use the CEPS should onboard on the Organisational Wallet, and include the national supervising authority (NEa in the Netherlands) in the development of a ruleset (“scheme”) specifically for transactions that involve transport via the CEPS. For renewable fuels, such as SAF, the development of a Digital Product Passport is already in development in an innovation project with RVO and sector parties such as NOVE (association of fuel distributing companies), TNO (Netherlands organisation for applied scientific research) and NEN (Royal Netherlands Standardization Institute). The passport will record the required information on the product, like the required sustainability information and perhaps a Certificate of Origin. The Organisational Wallet could record transactions of SAF transported via the CEPS in a systematic way. The ruleset per type of transaction can be developed such that only transactions that comply with the regulations are accepted. This avoids transactions that in hindsight may not be accepted (and reduces human error). Finally, the system can be expanded on both sides, so that a SAF or any other renewable fuel can be followed from feedstock source to end-user. The Organisational Wallet thus has a much wider potential scope than a GO system. The system provides improved transparency for the regulator. In a way, it builds on the paper trail and GO methods (that provide information via a ruleset: the What), but strengthens the transparency of information by using a digital system (the How).

Note that the Union Database (UDB) also traces renewable fuels along their supply chain and records transactions. The purpose of the Union Database, however, is to avoid double counting, but does not serve to prove a delivery of a renewable fuel. Also, the quality of the data that is entered in the UDB is subject to human error and must be (regularly) confirmed by auditors. Review by the national supervising authority requires authorisation on a case-by-case basis.

At the moment that the Netherlands approves administrative delivery SAF for RED, ReFuelEU Aviation and EU ETS compliance purposes, it can be expected that traders will immediately use the paper trail for their transactions. The UDB will ensure there are no double claims, but does not assist in the transfer of information. It is recommended that the Dutch government / European Commission requires that the proof becomes more transparent and more secure, by using a Guarantee of Origin or Digital Wallet.

Enabling transactions via a GO system requires specific action by VertiCer (in the Netherlands) or the Association of Issuing Bodies (for cross-border trades). The latter option will likely require more development time than the former.

Since the Digital Wallet is merely a method to collect and provide evidence of transactions in a systematic and transparent way, it does not at the start require the involvement of many stakeholders. The system could be developed by a small number of ingressing and egressing companies in close consultation with NEa.

To accelerate the development of such a Digital Wallet for SAF transactions over the CEPS, it is necessary to define which information should be included and what the rules for transactions are. It is recommended to develop a pilot to demonstrate how Wallets can register administrative SAF deliveries over the CEPS. The pilot should cover the specification of what data is included/transferred, a sequence diagram (overview of all the information flows), protocols (that specify how data is collected/measured/proven, and how data is transferred). This pilot should connect to the ongoing innovation pilot of RVO (Netherlands Enterprise Agency), NOVE (association of fuel distributing companies), TNO (Netherlands Scientific Research) and NEN (Royal Netherlands Standardisation Institute) who develop a digital product passport for renewable fuel deliveries. It is recommended to embed the pilot and the developed protocol into a CEN standard to enable adoption by parties in more Member States.The pilot should be instigated by the Dutch government, and the government should articulate what requirements they have for the administrative proof, both for the purpose of compliance with EU ETS and ReFuelEU Aviation, as well as for EU statistical reporting purposes (clarification of which Member State can claim consumption of SAF). In parallel, the government should assess how to allow for this administrative solution in Dutch and EU legislation.

Appendix A Chain of custody variations

To understand the current rules and reporting requirements, it is first necessary to understand the options for documenting the delivery and use of renewable fuels.

The delivery of renewable fuels and use in final transport is usually proven by documenting the chain of custody. Chain of custody models are ways to ensure traceability of volumes or of sustainability attributes, for instance to assist proving compliance with legislation Figure 6 shows a visual representation of four chain of custody models, with (from left to right) a decreasing connection between the documentation and the physical reality.

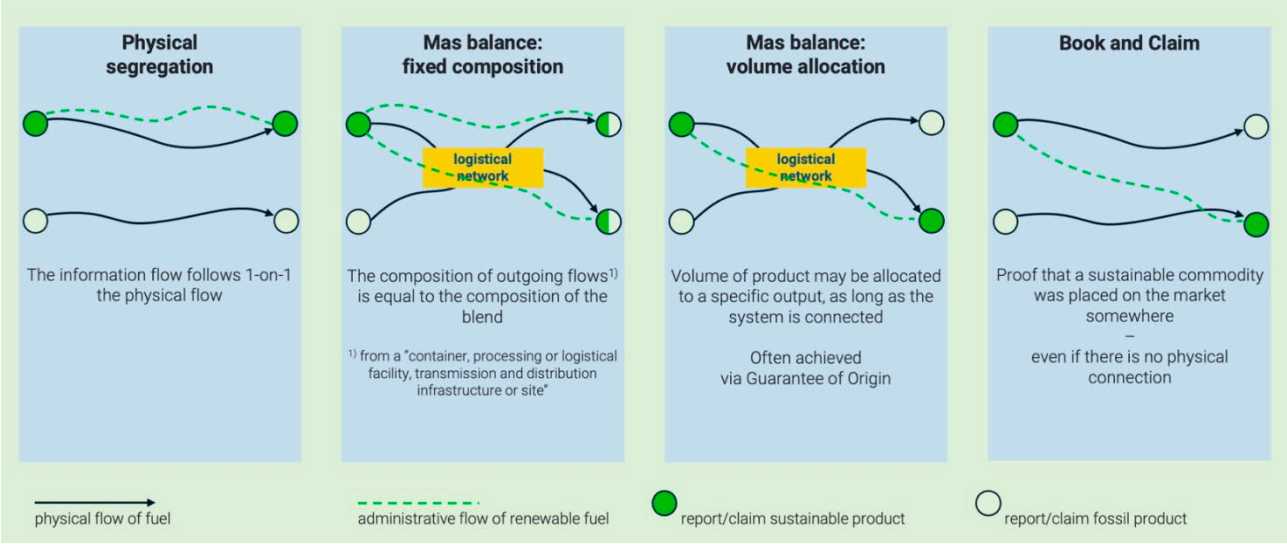

Figure 6: Visual representation of different chain of custody models

A full connection between the documentation and the physical reality is only achieved by **physical segregation**. The product that leaves a sender is 100% physically the same as what arrives at the receiving point. The product can still be a blend of products, but during this transport step, there is guaranteed no physical change. The appeal of this approach is that the physical presence of sustainable molecules in combination with their (sustainability) documentation is proven at every stage of the supply chain. However, this comes with costs: it requires dedicated infrastructure (for instance only transport by truck or unbranched pipelines), leads to rigidity of operation and is difficult to scale. And, most relevant for the frame of this current study, shared infrastructure cannot be used.

A **mass balance approach as formulated in the Renewable Energy Directive** (**RED)** allows physical mixing of consignments. It effectively assumes: "what goes in, must come out". The term mass balance, however, is understood in different ways by different stakeholders.

In the frame of the RED, the mass balance has two dimensions.

(1) All the outgoing flows of a blend have the same physical composition as the blend. This is based on the assumption that as soon as a renewable fuel is blended in a fossil fuel, for instance in a tank, a plant, or a connected infrastructure, the physical flows cannot be unblended.

(2) However, the rules of the RED do allow that sustainability information is selectively allocated to outgoing flows. In other words, this information must be unblended.

For instance, by combination of all inputs, it is known that a tank contains 30% renewable fuels. All the outgoing flows therefore contain 30% renewable fuels. However, the 30% initially consisted of batches of biofuels with different sustainability characteristics. One can selectively steer this sustainability information to one outgoing flow. Furthermore, the regulations require that the sustainability characteristics of each ingoing flow are kept “as is”. For instance, it is not allowed to average emission reduction achievements by combining values of different consignments (effectively: every consignment must individually meet the requirements).

Outside the RED, mass balance rules often allow that volumes of renewable fuels can be allocated to selected outgoing flows of mixtures that contain both renewable and fossil components. In Figure 6, this is called **volume allocation**. In Appendix B it is explained why this is not allowed by the RED. Volume allocation is often, but not necessarily, documented via Guarantee of Origin (GO) systems.

Book and claim systems completely decouple the documentation from the physical delivery. Producers issue certificates for products that they put on a market. Users, elsewhere, acquire and retire those certificates to support a usage claim, regardless of the physical molecules they receive. This creates maximum flexibility across time and geographies. Where volume allocation is limited to a connected network, book and claim can stretch over larger markets that are not physically connected.[27] For instance, somebody could place a fuel on the market in Greece, but sell the sustainability information of that fuel in the Netherlands. Book and claim may also be documented via GO systems.

[27] On the other hand, the difference between volume allocation and book and claim is somewhat artificial. In connected infrastructure some flow directions never take place, but would still be allowed for the documentation flow.

Appendix B Current rules and reporting requirements for aviation

This Appendix presents the current rules and reporting requirements for aviation regarding proof that SAF is delivered to an airport via pipeline. 0 presents a summary overview of the current rules and reporting requirements; Appendix B.2 provides details for the Renewable Energy Directive; Appendix B.3 provides details for the ReFuelEU Aviation Regulation; Appendix B.4 provides details for the EU Emissions Trading Scheme; Appendix B.5 provides details for the Carbon Offsetting and Reduction Scheme In Aviation; and Appendix B.6 provides details for reporting requirements on a national level.

Appendix B.1 Summary of current rules and requirements

Table 1: Overview of issues regarding compliance with legislative and regulatory frameworks, that require proof of SAF delivery to airports, or that provide rules for such proof

Legislative or regulatory framework	Considerations regarding proof that SAF is delivered to airport via pipeline
Renewable Energy Directive (RED)	• Requires proof of physical delivery • Interpretation of these rules is confirmed by court decisions[28] • Netherlands allows exception for the delivery of biogas if injected in the Netherlands and complemented by Guarantee of Origin • With regard to SAF, some countries such as Belgium and Germany have different interpretation: they recognise SAF delivery via the CEPS for compliance with EU ETS or ReFuelEU Aviation • European Commission writes there is no need to verify that the exact (SAF) molecules reach the airport[29]
ReFuelEU Aviation	• Proof of SAF delivery must follow RED mass balance rules • Between 2025-2034 the obligation can be met via a Union-wide weighted average of all SAF delivered to all Union airports, rather than via deliveries to individual airports – this may directly allow delivery via the CEPS even when the recipient airport is unknown • From 2035 onwards, the Regulation obliges fuel suppliers to make blended SAF available at every Union airport • European Commission will explore options to trade SAF compliance, to enable "administrative" SAF delivery to airports without a physical connection to a SAF supply. While this could provide flexibility for parties to prove compliance via others that can physically receive SAF, it is not a solution for the physical delivery as such.
EU Emissions Trading System (ETS)	• Monitoring and verification rules require that SAF is physically present in airport fueling system, in order to be "zero-rated" by obligated aircraft operators and demonstrated with a Proof of Sustainability
Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)	• No requirement of physical delivery of "CORSIA eligible fuels" (SAF and other low carbon jet fuels) to airport • Verification of claims are based on purchase records, transaction reports, fuel blending records, and certification documents
National reporting	• National reporting for Dutch climate agreement, EU RED and international climate obligations require detailed insights in which fuels were delivered to which sectors

[28] In the case of BP France vs the French Ministry of Economic Affairs, and in the case of Lukoil vs the Dutch Emission Authority. For details see Footnotes 31 and 32.
[29] Mail communication from DG MOVE to the CEPS Program Office, see Footnote 33.

Appendix B.2 Mass balance rules in the Renewable Energy Directive

The Renewable Energy Directive (RED) is at the core of renewable fuel policy in the EU. It provides rules for proving the delivery of renewable fuels via a chain of custody system, and for proving the compliance with sustainability requirements. Other legislation, such as the ReFuelEU Aviation regulation, largely refers to the rulesets of the RED.

According to those rules, the physical delivery of renewable fuels must be proven. However, the formulation of the rules is complex. Some stakeholders (including Member States and the European Commission (EC))have a different and wider interpretation of the rules than the interpretation of several courts, and allow volume allocation. In Chapter 3, it is explained that a certain degree of volume allocation is indeed desired to optimise the delivery of SAF. But to understand the solution, the complex mass balance rules of the RED must first be unraveled.

The RED requires that sustainability and greenhouse gas reduction claims for renewable fuels are verified through a mass balance chain of custody system (Article 30). The Directive explicitly allows volumes with different sustainability profiles to be mixed, provided that those characteristics are properly allocated when product consignments leave the mix. Implementing Regulation (EU) 2022/996 further specifies the operational rules on mass balance. Article 19 of the Implementing Regulation sets the detailed obligations that voluntary schemes (such as ISCC EU) must enforce when they certify operators' mass balance bookkeeping.

Recital (5) of the Implementing Regulation explains that the "mass balance system aims to reduce the administrative burden for demonstrating compliance […] by allowing mixing of raw material and fuels with differing sustainability characteristics and by allowing reassignment of the sustainability characteristics in a flexible manner to consignments withdrawn from such a mixture" It effectively provides flexibility in the assignment of sustainability characteristics to specific outgoing batches from a blend. This flexibility is subject to strict requirements.

Recital 5 of the Implementing Regulation further explains that the system "allows mixing of raw material and fuels with differing sustainability characteristics and […] re-assignment of those characteristics in a flexible manner to consignments withdrawn from such a mixture." In other words, once a batch has been verified before it enters a mixture, its sustainability attributes may later be booked to an equivalent volume taken from that same mixture, provided that robust bookkeeping keeps the total inputs and outputs in balance over the chosen accounting period.[30]

The Implementing Regulation details out several key requirements and definitions. Firstly, Article 19.2 (c) states that raw materials or fuels are only part of a mixture when they are, amongst others, physically identical and, amongst others, stored in the same "interconnected infrastructure, processing or logistics facility, transmission and distribution infrastructure or site". Interconnected infrastructure is defined in Article 2 (18) and includes pipeline networks for liquid fuels, such as the pipeline network of the CEPS.

Article 19.2 (i) confirms that fossil fuel or product and biofuel or product can be blended, but states that if fossil is blended with bio, then the information on the sustainability and greenhouse gas emission reduction characteristics attributed to the blend should correspond to the physical proportion of bio in the blend.

[30] The appropriate accounting period for the mass balance system is 12 months for agricultural and forest biomass and 3 months for all other economic operators, including for biofuels, as per (EU) 2022/996, Article 19.2 (l).

Several court cases have clarified how the law should exactly be interpreted. Both the case of bp vs the French Ministry of Economic Affairs[31] and the Raad van State vs Lukoil case in the Netherlands[32] clarify that the mass balance system is a bookkeeping method designed to demonstrate that biofuels meet the EU sustainability criteria under the RED, ensuring that only certified, sustainable volumes are counted toward national targets, renewable energy obligations, or financial support. The courts stress that the system shows which inputs can be allocated to which outputs in terms of sustainability, but that it is not intended to establish or measure the actual physical bio-content or renewable energy share in a given consignment of blended or co-processed fuel. For that, authorities may require other forms of evidence (such as ^{14}C testing). This implies that the physical composition of fuel that is delivered from a system, still must represent the physical share.

The Netherlands has applied this interpretation of how the mass balance system should be applied and has therefore set an additional requirement of evidence at the point of delivery for proving the physical delivery of a biofuel to the transport sector. To generate renewable fuel credits (HBEs (Hernieuwbare Brandstofeenheid) or EREs (Emissiereductie Eenheid)), which can be used for compliance to the RED in the national context, a supplier must provide physical evidence of the renewable fraction at the point of release to the market**,** by means of sampling and analysis of the fuel delivered to the end-user. This is, in most cases, a ^{14}C test. For liquid fuels moving through a shared pipeline this is problematic, because any bio-content is unavoidably diluted on the way.

Interpretation in other Member States

Some other Member States have applied the EU mass balance system differently, accepting the use of mass balance principles for demonstrating *both* sustainability and physical delivery of biofuels. While this is not the correct and legal interpretation, the EC has given off signs that this is acceptable to them.[33] In Spain, renewable fuels are transported via a country wide pipeline network, where claims of renewable fuel use are based on administrative delivery rather than physical proof, similar to what would be required for the CEPS (see **Box 2**).

[31] In case C-624/22 of BP France SAS vs the French Ministre de l'Économie, des Finances et de la Souveraineté industrielle et numérique, the French Council of State (Conseil d'État) asked the European Court of Justice for a ruling on what the mass balance can and cannot be used for. The ruling states that the mass balance monitoring system [is] intended to assess and justify the sustainability of raw materials and biofuels, and their mixtures, and not to regulate the evaluation of the share of energy from renewable sources contained in fuels […] [CJEU BP France case (C-624/22)].

[32] In the case of Lukoil vs the Dutch Emission Authority NEa, the Dutch Council of State (Raad van State) refers to the BP France case and reiterates that the mass balance system is only intended to proof sustainability aspects of biofuels, but that it cannot be used to proof that a batch of fuels contains a certain amount of biofuels [Raad van State 2025, Uitspraak 202004292/1/R4, ECLI code ECLI:NL:RVS:2025:1157].

[33] Mail communication from DG MOVE to the CEPS Program Office which expressed that for fuel suppliers "As long as a physical link exists, the obligation can be complied with. Mass-balance is fully recognized under ReFuelEU Aviation and the UDB and aviation fuel suppliers can use pipelines for compliance. The choose of word of "physical" might be a bit confusing, but there is no need to verify that the exact molecules reached the airport" [Email EC DG Move to CEPS, 21 March 2025].

Box 2: Example of mass balance solution: Exolum pipeline system in Spain

In Spain, batches of fossil fuels (diesel, gasoline, kerosene) and liquid renewable fuels (in blends with fossil fuels) are transported across the country via the Exolum pipeline network.

This network is recognised as a "single site" under national regulations. This means that when a volume of biofuel is injected at one location, it can be claimed at another location, even if this location is not physically connected to the same pipeline. Due to the delivery of products to these unconnected areas, the Exolum network does not meet the definition of "connected infrastructure" in Implementing Regulation (EU) 2022/996. Deliveries between unconnected areas therefore only count towards national targets.

Fuels that are fed into Exolum's "interconnected infrastructure" (that is, the part that is indeed interconnected) can be considered part of a blend and are subject to a single mass balance according to the Renewable Energy Directive.

As explained in the main text, the Directive does not allow that such volumes would be claimed as physical deliveries at the extraction point: according to the Directive's rules any physical extraction would have the same composition as the blend in the pipeline system.

But it should be noted that the pipeline system only covers Spain. Any injection of a renewable fuel in the pipeline system will therefore very likely end-up in the Spanish market. The Exolum system does have several tank terminals, from which there is some export to Portugal, France and other countries, but that export is limited. Fuels injected in Exolum are therefore assumed to physically end-up in the Spanish market, and can therefore count towards the RED target.

Based on that assumption, obligated parties can claim the physical delivery of fuels even when traded via the Exolum network. Exolum has full oversight of the injection and extraction of fuels across its network and organises documentation for transactions involving sustainable products, to ensure that double counting does not occur. Fuel suppliers with an Exolum account can operate within the system.[1]

Appendix B.3 ReFuelEU Aviation

The ReFuelEU Aviation sets mandates on the delivery of sustainable aviation fuels (SAF) to the European aviation sector and, therefore, is a key policy instrument to drive demand for renewable fuels. In Article 4.1 it requires that fuel suppliers “make available” minimum shares of SAF at specific timeframes, at each Union airport.

Article 3 (8) defines sustainable aviation fuels as fuels complying with the sustainability and lifecycle emissions savings criteria laid down in Article 29 of the Renewable Energy Directive (RED) and which are certified in compliance with Article 30 of that Directive. This inherently makes the same challenges that apply to RED compliance also applicable for compliance with the ReFuelEU Aviation.

However, an assessment of the obligations laid out in ReFuelEU Aviation shows a clear willingness of the European Commission (EC) to create more flexibility in compliance. In Article 4.6, the Regulation states that fuel suppliers *may* demonstrate compliance with this obligation by making use of the mass balance system described in the RED, as if the mass balance system is not obligatory. Also, a reference to the mass balance system in this article is not logical, unless it is meant to create flexibility, as the Article 3(8) already implied that the mass balance system has to be applied. While it may be the desire of the EC to create such flexibility, it cannot be legally justified in this way.

Furthermore, the ReFuelEU Aviation includes a so-called a flexibility mechanism. Article 15.1 allows fuel suppliers, between 2025 and 2034, to meet the obligation as a Union-wide weighted average of all SAF delivered to Union airports. From 2035 onwards, the Regulation obliges fuel suppliers to make blended SAF available at every Union airport. Moreover, Article 15.2 directs the Commission to identify and assess ways to improve this flexibility mechanism further. This includes exploring possibilities for setting up or recognising a system of tradability of SAF compliance to enable sustainable aviation fuel supply to airports without there being a physical connection to a supply site. This means that at least for the period that the flexibility mechanism applies there is no need to physically deliver sustainable aviation fuel to each Union airport. It is unclear if it still requires proof that SAF is delivered to some (identifiable) airports, before it can balance the shortage at other airports.

Also, the notion of a physical connection to a supply site, which will be a requirement after 2034 when the flexibility mechanism period ends, does not per se imply that the actual sustainable molecules required by the mandates need to be delivered to each individual Union airport. It may instead imply that all Union airports have to be connected to infrastructure in which the required volumes of SAF are physically injected. This distinction is important, as it would allow for SAF to be injected into interconnected infrastructure to which multiple airports are connected, without ensuring that specific molecules end up at specific airports, effectively moving upstream the point where physical delivery is monitored and verified for compliance purposes to the point of injection into an interconnected network.

By Article 15 of the ReFuelEU Aviation regulation, the Commission is requested to identify options to improve or change flexibility mechanism. Subsequently, in their report on the ReFuelEU Aviation SAF flexibility mechanism,[34] the EC observes that “[once] blended and certified, the blended SAF can use the same distribution infrastructure as conventional aviation fuel. This includes “[…] also interconnected infrastructure as defined by Implementing Regulation (EU) 2022/996, which allows liquid fuels to be transported through pipeline networks (e.g. NATO-CEPS and the Exolum Pipeline System) using a mass-balance distribution approach.” The Commission’s reference to allowing the use of a mass balance distribution approach only makes sense if it is meant to create additional flexibility for

[34] Report by the European Commission to the European Parliament and Council on The ReFuelEU Aviation SAF flexibility mechanism COM(2025)59 final, in response to the obligation in ReFuelEU Aviation Article 15.2.

compliance or shows that different explanations of what constitute a mass balance exist at the Commission. The CEPS is specifically mentioned as such a distribution infrastructure used for conventional aviation fuels. The Commission's report, furthermore, emphasises the usefulness of the mass balance approach: "The fact that a large share of the aviation internal market is currently supplied through a network of pipelines makes the mass-balance approach a very efficient and cost-effective way of ensuring that blended SAF can reach many airports that are currently beyond the bigger hubs and fuel infrastructure managers should not raise administrative, procedural or any other kind of barriers to entry to render more difficult or prevent the supply of blended SAF through their interconnected infrastructure (e.g. fuel pipeline)." It seems that the Commission interprets the mass balance as being capable of volume allocating ingressed SAF batches to individual egress points.

While Article 15 tasked the Commission to (amongst others) identify options to improve the flexibility mechanism, the ReFuelEU Aviation regulation itself established the mechanism. The Commission was not tasked to work out or explain the mechanism, and it is important to note that the European Commission is not authorized to interpret EU law. Only courts of justice have authority to explain Union law.

Appendix B.4 EU Emissions Trading System

EU Emissions Trading System (EU ETS1)

The EU Emissions Trading System (EU ETS1) includes aviation emissions from aircraft operators who fly within the (European Economic Area) and flights which depart to Switzerland and the UK. This places an obligation for eligible aircraft operators to purchase allowances, which represent the right to emit one tonne of CO_2eq. Eligible aviation fuels which meet the sustainability and greenhouse gas saving criteria laid out in the Renewable Energy Directive (RED) can be "zero-rated" under EU ETS. This means that any emissions derived from the use of these fuels are not counted towards the carbon cap, removing the requirement to surrender allowances corresponding to the use of these eligible fuels. This must be demonstrated through appropriate certification and documentation, using a Proof of Sustainability (PoS), a document used to verify that sustainable fuels meet the sustainability criteria laid out in the RED.[35]

The Monitoring and Reporting Regulation (MRR, EU 2018/2066) lays out a framework for the monitoring and reporting of emissions from defined sources under the EU ETS. As outlined in Article 53a the aircraft operator is required to monitor and report the amount of sustainable aviation fuels attributed to each flight or aerodrome pair.

There are two options for aircraft operators to meet these reporting requirements:

1) Demonstrate the delivery of sustainable aviation fuel in physically segregated and identifiable batches directly to an individual aircraft.
2) Demonstrate the physical delivery of the sustainable aviation fuel to the fuelling system of the departure aerodrome (not the individual aircraft), which must be accompanied with purchase records.[36]

Therefore, reporting eligible sustainable aviation fuels as "zero-rated" under EU ETS requires providing proof of physical delivery to, at least, the fuelling system of the departure aerodrome. Note that this requirement in the Monitoring and Verification Regulation that SAF must be physically present at the airport where it is claimed, was only added by an amendment in September 2024.

EU Emissions Trading System for road, buildings, and additional sectors (EU ETS2)

During the 2023 revisions of the ETS directive a separate and adjacent emissions trading system was introduced known now as "EU ETS2". This separate and adjacent trading system covers emissions from the road sector, building sector, and a number of small industry sectors (which are not in the scope of EU ETS1). While military aviation is excluded from the scope of EU ETS1 and ReFuelEU Aviation, in specific cases, certain Member States have chosen to "opt-in" for fuels used for defence purposes under EU ETS2. This is the case in the Netherlands which means that fuels delivered for Dutch military aviation purposes will be covered by the ETS2.[37]

The obligation under EU ETS2 falls with the fuel supplier, which is at the point where excise duty is applied, even if these suppliers might be exempted from paying excise duties on certain fuels. To avoid potential gaps or double counting requires identifying ETS2 regulated entities, which in the context of the CEPS, could relate to the fuel supplier at the "ingress" point or the actor at the "egress" point who arranges the onward supply of aviation fuel to the airport/aircraft operator. For monitoring and reporting purposes, fuel suppliers must demonstrate which sector their customers fall under, to identify if fuel streams that are released to the market are supplied to an ETS1 (civil aviation) or ETS2 (military aviation) sector.

[35] NEa, Sustainable Aviation Fuels (SAF), https://www.emissionsauthority.nl/topics/ets-aviation/sustainable-aviation-fuels

[36] As outlined in Article 54a (5) of the Monitoring and Reporting Regulation MRR (EU) 2018/2066, where fuels physically delivered to an aerodrome cannot be attributed to a specific flight, the aircraft operator must provide evidence to the satisfaction of the competent authority that the eligible aviation fuel was delivered to the fuelling system of the departure aerodrome.

[37] This was confirmed in the letter from the Ministry for Climate and Energy on the Approach to Climate Policy (aanpak klimaatbeleid) of April 15th 2024.

Appendix B.5 Carbon Offsetting and Reduction Scheme for International Aviation

The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is an international policy mechanism developed by the International Civil Aviation Organization (ICAO). It requires aircraft operators to monitor and report emissions arising from international flights and targets the stabilisation of aviation emissions by requiring operators to offset emissions which raise above a specified baseline value.[38] CORSIA applies to international flights, between EEA countries and participating third countries. The scheme outlines 'CORSIA eligible fuels', which can be claimed by aircraft operators to meet the requirements. These eligible fuels must meet a specific sustainability criteria approved by recognised sustainability certification schemes.[39] By July 2026, the European Commission (EC) will carry out an assessment on CORSIA is sufficiently delivering on the goals of the Paris Agreement, to decide whether to maintain the intra-European scope of EU ETS or to extend the scope to include international departing and incoming flights.

The CORSIA scheme has been applied by the EC through the adoption of Delegated Regulation (EU) 2025/927 which outlines the rules for monitoring, reporting and verification of emissions for the CORSIA scheme in the EU context. This has been broadly aligned with the monitoring and reporting of emissions under EU ETS for reasons of administrative efficiency and to minimise compliance costs for aircraft operators. However, under CORSIA there is no requirement for aviation operators to demonstrate the physical delivery of 'CORSIA eligible fuels' at either an airport or aerodrome.[40] As detailed in Article 6 (4) of the Delegated Regulation and clause 2.2.4 in CORSIA legislation[41], the verification of 'CORSIA eligible fuels' shall be based on purchase records, transaction reports, fuel blending records, and CORSIA eligible fuels certification documents.

[38] ICAO, *Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*
[39] Approved sustainability certification schemes are outlined in Annex I of Delegated Regulation (EU) 2025/927
[40] Refer to Article 5 (2) and Article 6 (3) of Delegated Regualtion (EU) 2025/927 which outlines specific provisions in the monitoring, reporting and verification of CORSIA eligible fuels
41 Reference to clause 2.2.4 in Annex 16 - Environmental Protection - Volume IV - Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

Appendix B.6 Reporting requirements on a national level

Besides the information that is needed by fuel suppliers and aviation companies to prove the delivery of SAF for compliance purposes, Member States require this for their reporting obligations.

Obligation for Member States to report national energy and climate statistics
Regulation (EC) 1099/2008 outlines a common framework for the reporting of national energy statistics for Member States. This is based on physical flows and allocation in case of grids, based on input and output volume on a national level. The short assessment of renewable energy sources (SHARES) tool develops a harmonised methodology for EU countries to calculate the share of energy from renewable sources. This supports the reporting on achievement of the targets under Renewable Energy Directive (RED). For the purpose of reporting for national statistics it is required that Member States report on the quantities of (physical) aviation fuels delivered to aircraft.

For this reporting from the Member States to the European Commission, the proof of renewable fuels delivered in the national market must comply with the RED rules, including the mass balance rules. In the national support instruments, the Netherlands could deviate from these rules. However, they then cannot report the resulting renewable fuels volumes to the Commission.

The national accounting in the frame of (national and) international climate agreements requires a detailed insight in what emissions (and savings) were achieved in the national territory. For biofuels supply chains, emissions related to feedstock production may be counted in one country, while emission savings from replacing fossil with renewable fuels are located in the end-use country. If SAF distributed via the CEPS would be administratively used in the Netherlands, it is not clear if the Netherlands can make this claim in their national greenhouse gas accounts, or how this could be arranged by statistical transfers.

Appendix C Required changes in EU legislative and regulatory framework

This Appendix discusses what changes would be required in the EU legislative and regulatory framework, to enable that administrative proof of SAF transport via the CEPS is accepted, instead of the current requirement for physical delivery of SAF. A summary overview of the required changes is given in Table 2. Appendix C.1 presents a summary overview of the required changes in EU legislative and regulatory frameworks; Appendix C.2 provides details on the required regarding mass balance; Appendix C.3 provides details on the required changes regarding the scope of the Union Database; Appendix C.4 provides details on the required changes regarding the Implementing Regulation; and Appendix C.5 provides details on the required changes regarding the Monitoring, Verification and Reporting Rules.

Appendix C.1 Summary of required changes

Table 2: Overview of required changes in EU legislative and regulatory framework which relate to the transport of SAF via the CEPS

Legislation and article	Required change
Article 30 of RED (EU, 2018/2001)	• Widen the intended purpose of the mass balance system • Accept delivery via interconnected infrastructure (such as pipeline) mass balance chain-of-custody as sufficient evidence that a quantity of eligible fuels (such as SAF) have been physically delivered • Chain-of-custody is audited under a voluntary scheme and recorded in the Union database
Article 31a (2) of RED II (EU, 2018/2001)	• Extend the current provision in place for biogas "for the purpose of entering data into the Union database, the interconnected gas system shall be considered to be a single mass balance system" • Extend scope to include data on the transport of SAF via interconnected pipeline systems • Should connect to administrative system related to SAF transmitted via the CEPS
Implementing Regulation (EU, 2022/996)	• Include definition for "physically identical" • *"physically identical" means fuels meeting the same product specification / grade (e.g., Jet A-1, EN 590 diesel) within the tolerance ranges of the applicable standard* • Distinction between mass balance rules up until the blend point before injection into an interconnected infrastructure on the one hand, and on the other hand a mass balance for the pipeline network system, and then allow this as proof of SAF delivery to aircrafts
Article 39(3) and (4) of the MRR (EU 2018/2066)	• Expansion of provision that is currently applied solely to biogas fed into the gas grid • Include SAF received by an EU ETS aircraft operator from an interconnected pipeline network (such as the CEPS) • Allow for "zero-rating" of SAF delivered through interconnected pipeline system with connection to airport fuelling facilities, in the frame of both ETS1 and ETS2

Appendix C.2 Changes in the mass balance rules

As explained in Appendix B, the current text of the Renewable Energy Directive (RED) and its Implementing Regulation 2022/996 leave no legal space for allowing a flexible assignment of SAF volumes to outgoing batches from a shared pipeline or storage system where SAF is mixed with fossil aviation fuels. Nevertheless, there seems to be willingness at the side of the Commission and in several Member States to work on a solution to make this possible.

There may be several ways to realise this. One is to widen the intended purpose of the mass balance system in Article 30 of the RED. This can be achieved by amending the first paragraph of Article 30, as it sets out the intended purpose of the mass balance system, or by inserting an additional paragraph in this article altogether. Any amended or added text should have notions like:

- Member States shall accept for the delivery via interconnected infrastructure mass balance chain-of-custody as sufficient evidence that an equivalent energy quantity of fuels complying with Article 29 has been physically delivered to the relevant end-use sector, without requiring compositional testing of each outgoing consignment, under the following provisions:
    - the infrastructure boundary is defined (pipelines, connected terminals and tanks) and metered at all ingress and egress points
    - inputs, outputs, stock changes and technical losses are reconciled over a closed accounting period (e.g. one month)
    - the chain-of-custody is audited under a voluntary scheme recognised under Article 30(4) or a national scheme under Article 30(6) and recorded in the Union Database

Alternatively, but similarly, the Commission may consider to implement *network mass balance* (or any other term) as an additional concept that is very similar to the mass balance system for sustainability and GHG characteristics for biofuels, but has as its sole purpose to administrate and verify the delivery of sustainable fuels to end-use sectors. In this case, the Commission may have to adopt implementing acts specifying detailed rules for this *network mass balance*, including on the boundary setting, temporal balancing, loss accounting, and metering accuracy.

Appendix C.3 Extending the scope of the Union database

In the context of the Union database (UDB), a specific provision is applied for the gas grid. Article 31a (2) of RED II (EU, 2018/2001) states that "for the purpose of entering data into the Union database, the interconnected gas system shall be considered to be a single mass balance system". In the "event that the Member State decides to complement a mass balance system with a Guarantee of Origin system", such as the case of the gas grid in the Netherlands, the economic operators shall provide data on the injection and withdrawal of renewable gaseous fuels.

It should be considered by the Commission to adopt a delegated act to supplement the RED, to extend the scope of the data included in the UDB to include data on the transport of SAF via interconnected pipeline systems. The UDB should connect to the system to be developed for SAF transport via the CEPS. This will improve the traceability of data along the supply chain, and facilitate compliance and reporting obligations in the aviation sector.

Appendix C.4 Amending Implementing Regulation 2022/996

The Implementing Regulation 2022/996, which specifies rules on the implementation of the mass balance system can also be amended at several places to accommodate for administrative transfer of sustainability information of fuels transported via the CEPS. The definition of "physically identical" is missing in the Implementing Regulation. The addition of a definition would help to solve the issue if it includes something along the lines of: *"physically identical" means fuels meeting the same product specification / grade (e.g., Jet A-1, EN 590 diesel) within the tolerance ranges of the applicable standard*. Including such definition would have to be done with care and under specific provisions, such as that mass balance chain of custody principles may be applied with flexible allocation of sustainability and greenhouse gas (GHG) characteristics to outgoing batches, only for interconnected systems with clear boundaries and/or only for the delivery of fuels to end-use sectors.

Alternatively, the Implementing Regulation could be amended in a way that makes a distinction clear between mass balance up until the blend point and mass balancing for the trading to final user, as is proposed by the Draft Mass Balance Guidance document published by ISCC.[42] This distinction would have the following effect: (1) When sustainable feedstocks, intermediate products or fuels up until the blending point are mixed with fossil feedstock or fuels, no flexible assignment of sustainability characteristics would be allowed, but (2) when blended fuels would be mixed with other fuels (fossil or not) after the blending point, for the purpose of delivering to end-users, it would be allowed to apply flexible allocation of the blend proportion.

[42] ISCC 2025, ISCC EU Mass Balance Guidance Document Version 1.0.

Appendix C.5 Changes in the Monitoring, Reporting, and Verification rules

For the purpose of reporting sustainable aviation fuels as “zero-rated” under EU ETS there must be an adaptation in the current rules outlined in the Monitoring and Reporting Regulation (MRR). This must provide a solution for the situation in which aircraft operators, connected to pipeline systems (such as the CEPS), would like to report on sustainable aviation fuels injected “somewhere” in the system, but cannot demonstrate physical delivery to a specific aerodrome fuelling facility location.

The solution could follow the example of the situation in place for EU ETS economic operators who would like to apply an emission factor of zero to biogas which has been fed into a gas grid. Specific provisions are outlined in Article 39(3) and Article 39(4) of the MRR on the determination of the biomass fraction in the case of biogas transported via gas grid. Presenting a solution by forbidding the use of laboratory analyses for determining the biomass fraction of natural gas and allows an approach based on purchase records.

It is recommended that the Commission considers an expansion of this provision, which is currently applied solely to biogas fed into the gas grid, to include sustainable aviation fuels received by an EU ETS aircraft operator from an interconnected pipeline network (such as the CEPS).[43] In this case, the pipeline system must be connected directly to the aerodrome fuelling facilities and there should be an administrative system in place to determine the sustainable fraction of the aviation fuel delivered to the airport.

[43] It is also suggested that the Commission consider that provisions are made for all renewable energy carriers connected which are transported via interconnected infrasture systems, for which the proof of physical delviery cannot be determined.

Appendix D Overview of consulted organisations

In Table 3 and overview is presented of the consulted organisations for expert interviews in mapping the administrative system of SAF deliveries via the CEPS.

Table 3: Consulted organisations for expert interviews

Organisation	Role in relation to the CEPS
NATO	Owner of the CEPS, organises fuel transfers via bank account system
COMMIT	Part of the Ministry of Defence that supplies amongst others jet fuel for their aircrafts
The Defence Pipeline Organisation (DPO)	The institution that manages the Dutch portion of the international pipeline network
International Sustainability & Carbon Certification (ISCC)	Voluntary Certification scheme recognised by EU to prove sustainable fuel delivery under the Renewable Energy Directive. ISCC proposes methods to administratively prove SAF deliveries.
Nederlandse Emissieautoriteit (NEa)	The independent national authority responsible for implementing and monitoring the climate instruments for amongst others aviation fuel supplies and aircraft operators
VOPAK	Responsible for the storage and handling of aviation fuels, as well as direct injection into the CEPS
Neste	Aviation fuel supplier that injects SAF fuel into the CEPS at multiple locations.

Accelerating the future of aerospace

Royal NLR - Netherlands Aerospace Centre

NLR operates as an objective and independent research centre, working with its partners towards a better world tomorrow. As part of that, NLR offers innovative solutions and technical expertise, creating a strong competitive position for the commercial sector.

For over 100 years, NLR has been an ambitious applied research organisation, driven to keep innovating for the benefit of making aerospace more sustainable, safer, efficient and effective. Objectively and independently, we are now laying the foundation for a future meaningful, societal impact.
In a rapidly changing world, mobility and stability needs are constantly evolving. Aware of the social urgency, NLR helps pave the way for promising concepts to quickly see the light of day and transform into disruptive solutions or incremental improvements. We do this by combining a deep understanding of customer needs, multidisciplinary expertise and the use of our leading research facilities. In doing so, NLR plays a pivotal role between science, industry and government at home and abroad, bridging the gap between fundamental research and practical applications.
NLR is taking a leading role to achieve Dutch and European objectives. Together with our partners, we are working hard on a resilient and sustainable mobility system, and we support Dutch Defence in all military domains, with space and cyberspace playing an increasingly prominent role. From its headquarters in Amsterdam and Marknesse and our two satellite sites and in this way, NLR contributes to a safer and more sustainable society, strengthening the competitive position of Dutch industry.

For more information visit:
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studio Gear Up

studio Gear Up identifies and creates the best options to shift to a low-carbon economy, which will create new opportunities and markets for bio sourced and recycled materials.

studio Gear Up identifies and creates the best options to shift to a regenerative and defossilised economy, which will create new opportunities and markets for bio-sourced and recycled materials, in a way that pays respect to the planetary boundaries and improves the health of our planet and the people living in it.

studio Gear Up is an Amsterdam based independent advisory firm, focused on generating impact, founded in 2015. We assist clients in determining their best next steps in the changing policy and market context. We support them to determine a strategic position and/or develop new propositions that generate impact, both economically as well as environmentally. studio Gear Up helps understanding the transition to an emerging biobased, circular and climate neutral economy. Collaborative exploration of knowledge and networks, executing analyses, building sets of different scenarios to boost strategic considerations are examples of approaches taken.

For more information visit:
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