Briefing – May 2025

Unlocking e-SAF's potential for the EU competitiveness and energy independence

The case for prioritising e-SAF in the Sustainable Transport Investment Plan

Summary

Sustainable Aviation Fuels (SAFs) are indispensable to the decarbonisation of aviation, with e-SAF offering the only truly scalable and sustainable long-term solution.

Despite a strong regulatory framework under the Fit for 55 package and ReFuelEU Aviation, e-SAF projects in the EU have yet to reach Final Investment Decision. This is due to high capital and operational costs, a lack of long-term offtake agreements, and insufficient revenue certainty — a market failure that existing EU mechanisms have not been able to resolve.

The Sustainable Transport Investment Plan (STIP) represents a unique and timely opportunity to correct this imbalance. By focusing its support on the most strategic SAF pathway – e-SAF – the STIP can catalyse the deployment of clean aviation fuels while boosting the EU's industrial competitiveness, energy independence, and jobs.

To do so, the STIP should embed a comprehensive mechanism, such as a European Hydrogen Clearing House (EHCH). The EHCH would operate through double-sided auctions, matching fuel producers and buyers (e.g. airlines), while ensuring price stability and demand aggregation. This would de-risk production through long-term contracts and contract for differences for e-SAF, enabling scale-up while ensuring alignment with the EU's competitiveness goals.

Prioritising e-SAF through the STIP is not only a climate imperative – it is a strategic investment in Europe's position as a global leader in sustainable aviation fuels and clean energy.

1. Introduction

Sustainable Aviation Fuels (SAFs) are critical for the decarbonisation of the aviation sector both in the short-term as they can already be used in conventional aircraft and in the medium to long-term as the primary solutions for long-haul flights when electrification and hydrogen technologies will enter the market.

The Fit for 55 package and ReFuelEU Aviation have established a regulatory framework to support the adoption of SAF. However, they have not sufficiently driven the market investments needed to scale production across all SAF types, particularly/i.e. e-SAF. Similarly, support mechanisms, which we will explore later in this briefing, such as the **SAF allowances, Innovation Fund and Hydrogen Bank, have not been able to address the market failure e-SAF faces.**

While **the current framework has provided essential demand signals and predictability, it has not yet succeeded in aligning supply and demand at scale**: producers still lack the long-term revenue certainty needed, while airlines face high fuel costs and the risk associated with being first movers.

Albeit the **potential for the EU to be a leader in e-SAF production with more than half of the world's production capacity, no project has yet reached Final Investment Decision (FID**). The high CAPEX associated with these projects, as well as OPEX cost and ultimately final fuel price, have not attracted the offtake agreements needed to kick-start production. This shows a clear market failure which, for example, bio-SAFs do not face, as they are already in the market, have lower production costs and are already used by airlines.

The differences between e-SAF and biomass-SAF are not limited to the challenges they face but also include their sustainability and scalability. E-SAF is the only truly sustainable and scalable SAF, whilst bio-SAFs face a plethora of limitations in terms of sustainability, competing uses, fraud risks and scalability already in the short and medium-term.

Hence, **there is a unique opportunity for the Sustainable Transport Investment Plan (STIP) to make a sound and long-term investment in the type of SAF that can deliver real emissions reduction and that can be deployed at scale – that is e-SAF.** As mentioned by Sustainable Transport and Tourism Commissioner Tzitzikostas in his keynote address at the 2025 A4E's Summit "[M]ore effort and investment are needed to scale up e-SAF, which is a key part of our ambition (…) The upcoming Sustainable Transport Investment will outline how we will support e-SAF".

By providing a conducive environment for e-SAF production and offtake, the **STIP** would not only make a long-term investment in the EU's clean tech competitiveness and energy independence. It **could also act – by supporting e-fuels in the aviation and maritime sector – as an enabler of the EU's clean hydrogen industry and economy and catalyst for the development of a world-leading e-fuels industry anchored in the Union**.

The EU has a first-mover advantage in e-SAF and the STIP represents an unique opportunity to consolidate that leadership, avoid past industrial policy failures, and turn early momentum into lasting strategic autonomy and industrial resilience.

2. Making the right long-term investment – e-SAF

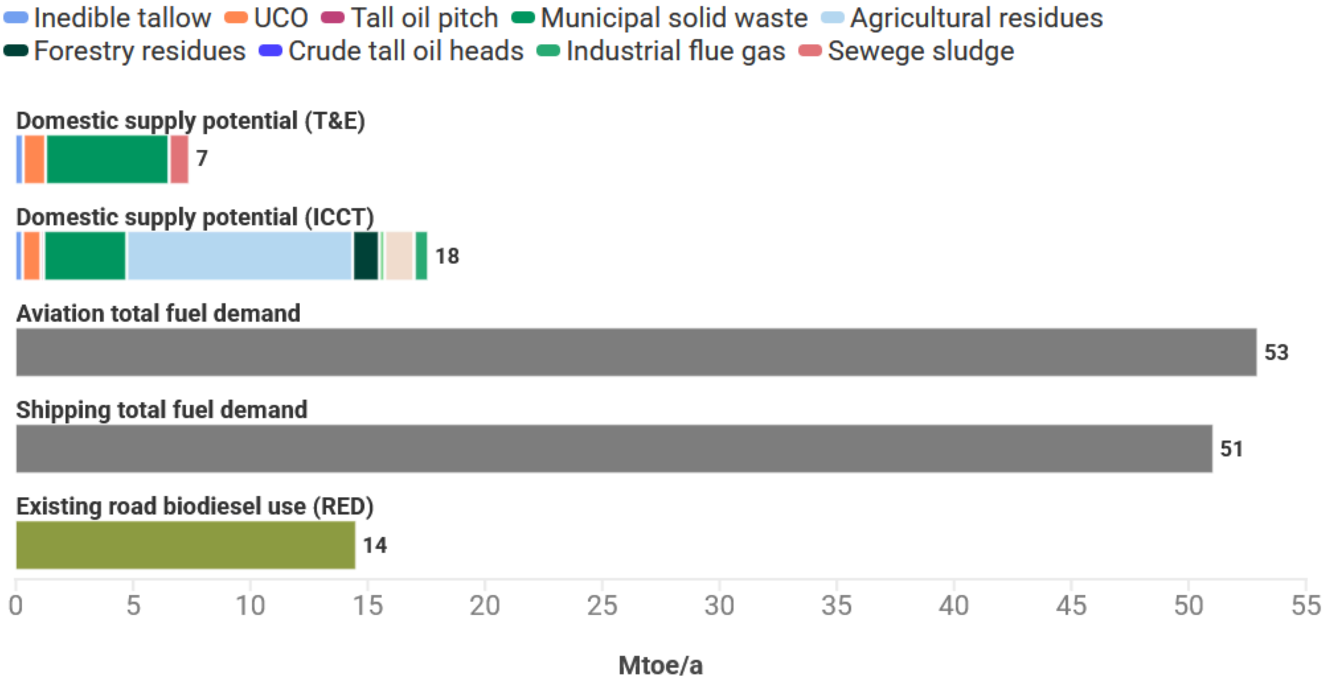
Not all SAFs are equally sustainable and scalable. Hence, the STIP should prioritise the most scalable and sustainable option from a long-term investment perspective in the EU's energy independence and industrial development.

SAF derived from biofuels can – in some specific cases – **be sustainable but they are not scalable and are far from sufficient to meet the EU's long-term aviation decarbonisation needs**. For instance, **biofuels made from waste oils and animal fats**, such as used cooking oils (UCO) can be sustainable if locally produced. However, their domestic availability in Europe is severely limited and increasing reliance on imports has already raised concerns around fraudulent practices, weak certification, and unsustainable feedstock origins, particularly from Asia.

Advanced biofuels from non-oily residues, such as forestry and agricultural residues or municipal solid waste also face limitations. Their current use in other sectors, uncertain climate benefits, technical immaturity and limited feedstock availability mean they are not a fully scalable option to meet aviation's energy and decarbonisation needs.

Even under optimistic scenarios, bio-SAF sourced from domestic feedstocks will not be capable of supplying more than a small share of aviation's future fuel demand, nor even a large part of the 2035 ReFuelEU target (around 13% according to T&E and 34% according to ICCT) as shown by the figure below.

Domestic advanced biofuels can be sustainable, but little potential to underpin a genuine Clean Industrial Strategy



Source: T&E. Based on ICCT (2024), Availability of biomass feedstocks in the European Union to meet the 2035 ReFuelEU Aviation SAF target, and T&E (2024), The Advanced and Waste Biofuels Paradox in House T&E Analyses. Biodiesel analysis is for the year 2035.

In contrast, e-SAF offers a genuinely scalable and sustainable option. Unlike bio-SAF, e-SAF can be scaled up without relying on constrained or controversial feedstocks. Importantly, if produced domestically, it strengthens the EU's energy autonomy and supports industrial development in clean tech.

The STIP must prioritise technologies that can deliver real and long-term decarbonisation. Focusing on bio-SAF risks locking the EU into an unsustainable and short-lived pathway. E-SAF stands out as the best long-term investment the EU could make to decarbonise aviation, promote energy independence, and lead the clean industrial transition.

3. The challenges faced by e-SAF

Despite the clear advantages of e-SAF in terms of scalability and sustainability, **no project has yet reached FID**, and **only a few airlines have entered the e-SAF space**. The majority of airline agreements are still MoUs – non-binding and therefore weaker – while firm offtake agreements, which represent stronger commitments, remain rare. In Europe, only IAG, Cargolux and Norwegian have so far entered into such firm offtake agreements, as evidenced by T&E's SAF Observatory.

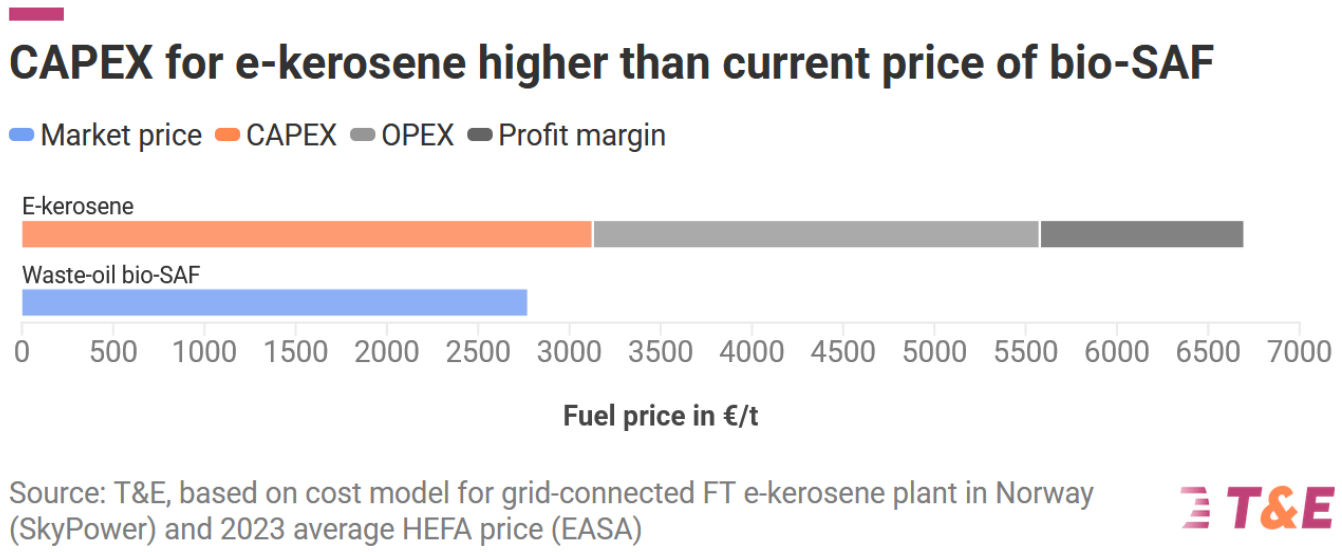
In contrast, bio-SAF is already commercially available and used by airlines, and production is projected by the European Commission to be sufficient to meet the 2034 ReFuelEU targets, according to its SAF flexibility mechanism report.

3.1 An industry in need of revenue certainty

High initial capital expenditure (CAPEX) and operational expenditure (OPEX) are key barriers for e-SAF projects compared to biofuels. Based on T&E estimates, the CAPEX for e-SAF facilities is currently at least two times higher than for a conventional aviation biofuel plants treating waste oils, driven by the complexity of synthetic fuel production, the high cost of renewable electricity, electrolyzers, and CO_2 capture equipment.

As shown by the figure below, the capital cost alone for e-SAF can exceed €3,000 per tonne of annual production capacity, which is higher than the 2023 average market price of waste-oil biofuels (~€2,768/tonne).

In addition, OPEX remains substantial, particularly due to energy intensity and feedstock costs, leading to uncertain returns on investment (ROI) and perceived project risk, making biofuels more attractive and e-SAF projects seem more risky. For example, the operational expenditure per tonne for an e-SAF plant could be almost as high as the market price of waste-oil bio-SAF.



As a result, **e-SAF project developers require medium- to long-term revenue certainty** (10–20 years), alongside a **robust regulatory framework guaranteeing predictable demand**, to secure financing and reach FID.

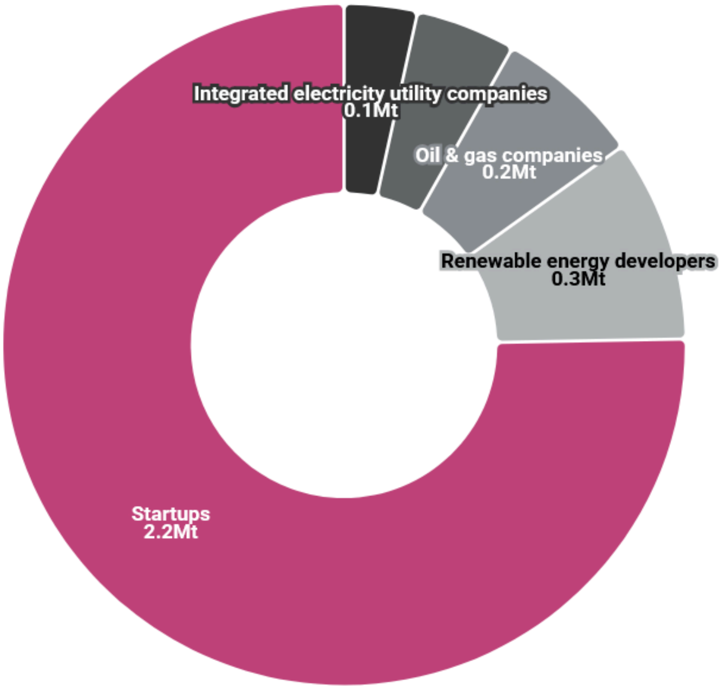
This is essential to unlock the €1–2 billion per plant typically needed upfront. Without predictable, stable cash flows over time, investors and lenders are unwilling to commit capital, particularly for first-of-a-kind (FOAK) plants. Long-term offtake contracts are crucial to de-risking e-SAF projects and are needed to demonstrate that future revenues will be sufficient to cover operating costs, service debt, and deliver returns.

However, **securing such long-term agreements (10–20 years) with airlines is a major challenge**. The jet fuel market traditionally operates on short-term contracting cycles, making long-term commitments uncommon. Airlines are also reluctant to lock themselves into higher-cost fuel supply agreements fearing competitive disadvantage as first movers, as e-SAF costs are projected to decrease with its scale-up.

Moreover, **there is a notable absence of incumbent jet fuel suppliers in the e-SAF market**. Despite their dominant position and investment resources, these players are largely absent from investment, production, and procurement activities related to e-SAF.

Startups develop most of Europe's e-kerosene capacity

Announced European annual e-kerosene production capacity by developer type in million tonnes (Mt)



Source: T&E • Include announced projects as of May 2025. Classification based on lead project developer in the case of consortia.

Instead, **the development of the e-SAF market is driven largely by start-ups**, which often lack the financial resources necessary to absorb high risks, and therefore depend heavily on long-term offtakes and revenue stability to present a viable investment case to investors.

The STIP provides an opportunity to address the current market barriers e-SAF faces, given that as shown by the following section current EU mechanisms have not been able to fully overcome them.

3.2 Issues of current EU mechanisms supporting e-SAF

The **current EU financing mechanisms** that can promote the uptake of e-SAF **have not proven sufficient to deliver the incentives necessary for both production and offtake**. Four funding mechanisms will be explored in this section: the SAF allowances, the Innovation Fund, the European Hydrogen Bank and European Investment Bank.

The **SAF allowances**, established under the Emissions Trading System (ETS) and allocated to airlines to bridge the price gap between SAF and fossil jet fuel, fall short of addressing the core needs of e-SAF producers. While these allowances represent a subsidy pool of €1.6 billion over 2024–2030 (approximately €230 million per year assuming a carbon price of €80/t), their design is ill-suited to support the development of e-SAF.

In particular, the allowances **do not facilitate two critical requirements for the e-SAF market: (a) securing long-term offtake agreements and (b) providing revenue certainty**. The current mechanism distributes allowances ex-post, on a first-come-first-served and annual basis, requiring airlines to first purchase and use SAF before receiving support. This creates significant uncertainty for airlines and undermines the incentive to enter into long-term procurement agreements, which are essential for de-risking and financing e-SAF projects.

Moreover, the SAF allowances are likely to be consumed almost entirely by bio-SAF, as the only SAF type currently available. Without any earmarking for e-SAF, there is a substantial risk that by the time e-SAF enters the market, most or all of the allowances will have already been used to support biofuels.

The **EU Innovation Fund**, also funded by the ETS, awards grants through calls to support the development and deployment of low-carbon technologies via CAPEX and OPEX support. Albeit offering valuable funding, it **does not specifically target e-fuels**. Instead, e-SAF projects must compete with a broad range of technologies that typically have lower CAPEX and OPEX profiles.

Additionally, **the Fund's strong emphasis on cost efficiency and project maturity in project selection disadvantages first-of-a-kind (FOAK) e-SAF plants**, whose higher upfront costs and operational risks do not fit as well to the Fund's awarding criteria compared to more mature solutions. For instance, only three e-SAF projects have received support from the Innovation Fund compared to seven biofuels projects.

Although the Fund provides valuable support for feasibility studies and pilots, it **lacks sustained, long-term financial mechanisms** to help FOAK e-SAF projects move to commercial scale. As evidence, **none of the three e-SAF projects awarded Innovation Fund grants have yet reached FID**, and one of the projects (HySkies) has been cancelled in 2024.

The **European Hydrogen Bank**, backed by the EU Innovation Fund, aims to accelerate the scale-up and use of green hydrogen and its derivatives by offering OPEX support through competitive auctions. However, the Bank **presents similar shortcomings to the mechanisms**

previously discussed, as its support – in the form of a fixed premium per kilogram of renewable energy produced – is awarded primarily on a cost efficiency basis. This makes it difficult for e-SAF projects to compete.

Moreover, the level of financial support provided is insufficient for e-SAF producers. **The Bank's first auction awarded subsidies of less than €0.5/kg of hydrogen, which falls short of what is needed to offset the operating costs of e-SAF production** even in advantageous locations, such as Spain and Norway (e.g. €5-6/kg of hydrogen). In the second auction, despite a larger budget and higher awarded premiums (up to €1.88/kg for a maritime project in the dedicated maritime basket), most winning bids still fell in the range of €0.20–0.60/kg.

It is no coincidence that **no e-SAF project was successful in the first and second auction**. This outcome **reflects a mismatch between the Bank's current design and the specific needs of e-SAF projects**. Nonetheless, the inclusion of a dedicated maritime basket in the Bank's second auction indicates that a tailored call for e-SAF addressing its needs could be envisaged.

In addition, the Hydrogen Bank **lacks strong de-risking mechanisms** (such as long-term guarantees or loan supports) that could stabilise returns for investors and project developers.

The **European Investment Bank (EIB)**, the EU's public lending institution, plays a key role in supporting sustainable investments and mobilising private capital. However, like the Hydrogen Bank, the EIB's financial instruments are **not specifically designed to address the unique challenges faced by e-SAF projects, such as the need for dedicated de-risking mechanisms for FOAK facilities with high upfront capital requirements**.

This misalignment is evident in current funding patterns: to date, the EIB has supported only one small-scale e-SAF project, compared to six projects focused on biofuels. This reflects a broader trend across EU financing mechanisms, where more mature and lower-risk technologies but with lower scalability potential (i.e. biofuels) tend to receive disproportionate support. As a result, high-impact yet capital-intensive solutions like e-SAF are left without the tailored financial tools required to scale.

In summary, although the EU has different funding and policy mechanisms, they are **not yet designed to meet the unique investment and offtake challenges faced by e-SAF projects**.

4. A European Hydrogen Clearing House as a comprehensive mechanism under the STIP

A key problem emerging from existing EU mechanisms **is the lack of targeted and tailored support for e-SAF production and uptake**. While SAF allowances, the Innovation Fund, and the Hydrogen Bank offer partial solutions, they fall short of addressing the specific structural challenges e-SAF projects face. Measures like dedicated calls for e-SAF under the Innovation

Fund and Hydrogen Bank, or progressive earmarking of SAF allowances for e-SAF, would be beneficial but would only partially solve the issue.

Producers of e-SAF require not only access to grants or subsidies but, fundamentally, **long-term revenue certainty and robust demand aggregation mechanisms** to make projects bankable. Current mechanisms mainly incentivise short-term procurement behaviour, which is insufficient for capital-intensive and (high-risk) first-of-a-kind e-SAF facilities.

To bridge this gap, a **more comprehensive mechanism is needed** — one that goes beyond isolated funding windows and short-term financial incentives.

4.1. What does the European Clearing House look like?

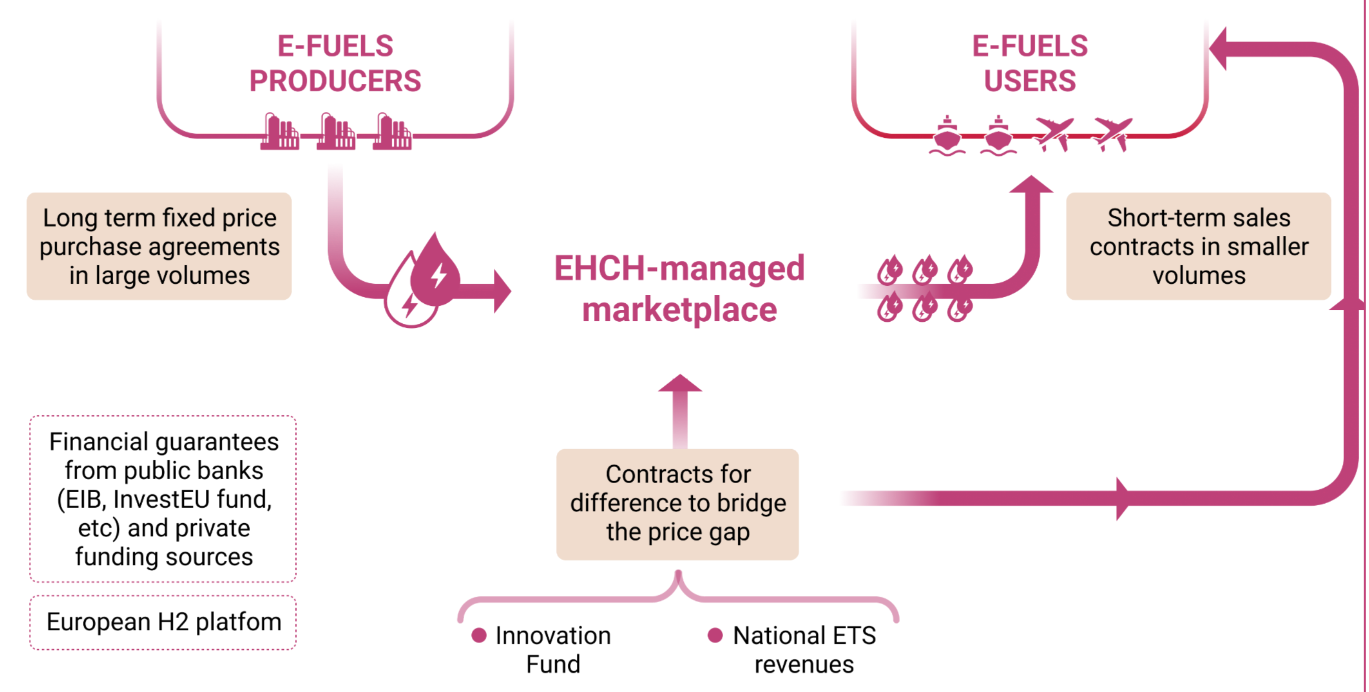
The STIP should envisage an upgrade of the Hydrogen Bank into a European Hydrogen Clearing House (EHCH) so as to ensure full prioritisation on EU produced e-SAF and its uptake. **The EHCH would act as a market intermediary**, drawing inspiration from the H2Global model, **running double-sided auctions** on the producers and offtakers side.

On the **supply side**, the EHCH would procure e-SAF from producers through long-term contracts in large volumes at fixed price to be awarded via a competitive bidding, thus ensuring a cost-efficient use of resources. On the **demand side**, it would resell the e-SAF to offtakers through short-term contracts for small volumes. This resale would happen through demand-side auctions – organised by the EHCH within its managed marketplace – in which offtakers would bid for the available e-SAF.

By aggregating demand from multiple airline and/or fuel suppliers offtakers and offering long-term guaranteed contracts to producers, the EHCH would provide the revenue certainty needed by producers and required for investors while allowing airlines to access flexible supply volumes, thus reconciling the mismatch between production needs and user procurement practices.

The EHCH would complement – not replace – regulatory instruments, such as ReFuelEU Aviation and ETS obligations. By enabling supply and demand to converge under a structured and de-risked framework, it would fill a critical missing piece in the EU's e-SAF strategy.

European Hydrogen Clearing House: igniting the e-fuels market



Source: T&E

4.2. Funding of the European Hydrogen Clearing House

The ECHC should be funded by the sector, following the example of the UK Revenue Certainty Mechanism, **by using both EU and national ETS revenues**.

For instance, the EHCH **would deploy a contract-for-difference (CfD) mechanism** funded through the recycling of ETS revenues, bridging the cost gap between e-SAF and fossil jet kerosene. By offering upfront revenue guarantees, the EHCH could reduce perceived investment risk and accelerate the scale-up of e-SAF production.

According to T&E's estimates, earmarking just 25% of aviation-related EU ETS revenues (approximately €2.5 billion over 2025-2034) could be sufficient to support around 87% of the mandated e-SAF volumes between 2030 and 2034. This would assume the use of CfDs to bridge 20% of the current price gap between e-SAF and fossil kerosene, which is estimated at around €1,000 per tonne.

If the ETS were expanded to cover all departing flights from the European Economic Area, the same 25% share of revenues could fully support 100% of the mandated e-SAF volumes and potentially even close the entire price gap, offering a cost-effective and scalable solution to accelerate e-SAF deployment.

The EHCH should also be supported by adequate financial guarantees, notably by the EIB. The EIB should increase its support to hydrogen-derived fuels like e-SAF over biofuels within its green investment portfolio. In this way it could rebalance its lending priorities to high-impact and long-term solutions to decarbonise hard-to-abate sectors, like aviation, where e-SAF offers the only scalable decarbonisation pathway.

Should the publication of the STIP be delayed and consequently the establishment of the EHCH, a first e-SAF focused pilot auction could be envisaged under H2Global. This would ensure momentum is not lost and could provide for valuable insights in the establishment of the EHCH. The pilot auction could be funded by national aviation-related ETS revenues by Member States and encouraged by the European Commission.

5. Conclusions: Seizing the opportunity given by e-SAF

The EU has laid the foundation for SAF uptake with the ReFuelEU Regulation, yet the market signals and current tools to scale up the most strategic SAF pathway – e-SAF – remain insufficient. As a result, the e-SAF market is still nascent, with more than 40 industrial-scale projects in Europe in the pipeline, but none have reached Final Investment Decision.

The STIP now presents a timely and essential opportunity to close this investment and policy gap. Only e-SAF offers the full package Europe needs: true scalability, the highest sustainability credentials, and deep alignment with Europe's clean industrial competitiveness.

To realise this potential, the STIP must act strategically, with a clear prioritisation of e-SAF over bio-SAF and mechanisms that de-risk both production and offtake. The establishment of a European Hydrogen Clearing House would serve as the cornerstone of this strategy, offering long-term revenue certainty, demand aggregation, and investor confidence — all while ensuring alignment with EU industrial and energy goals.

The EU cannot afford to lose this lead. By prioritising and building an e-SAF strategy under the STIP, the EU can turn its climate ambitions into industrial advantage, secure its clean energy sovereignty, create jobs, and build a globally competitive e-SAF industry — made in Europe, for Europe, and for the climate.

Further information

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