



BRIEFING - OCTOBER 2024

Implementing the EU's e-SAF mandate

A first look at ReFuelEU penalties for fuel suppliers

Summary

From 2025, in application of the European ReFuelEU Aviation regulation, EU aviation fuel suppliers will have to incorporate a minimum of so-called sustainable aviation fuels (SAF) into the fuel mix they supply to EU airports. The implementation of this mandate is supported by a system of penalties dependent on the price of SAF, the levels of which will be set by Member States by the end of 2024. Fuel suppliers who fail to meet their quotas will face penalties of at least twice the price difference between fossil kerosene and SAF. This briefing shows that **paying the penalties under RefuelEU would always be more costly than complying with the mandate, as long as the penalties are based on accurate price references.** This is an important long term signal for the deployment of SAF.

However, despite the prospect of paying high penalties, **legacy jet fuel suppliers are currently not involved in any major e-kerosene projects in Europe**¹. This wait-and-see attitude jeopardizes the success of e-kerosene projects across the EU, which would need the financial capabilities of oil companies to develop. **Jet fuel suppliers must start supporting the development of the e-kerosene market now**, either by investing directly in the companies behind existing projects, by signing offtake deals with them, or by developing their own projects. There are currently at least 36 large-scale industrial projects looking for buyers and investors in Europe.

Only biofuels (mostly derived from waste oils and fats) are currently produced and sold in the EU. The price estimates available for this type of SAF would lead to a penalty close to 4,000 EUR per tonne. For so-called synthetic fuels, or e-kerosene, the penalty is more difficult to determine, as they are not yet available on the market. According to T&E's estimates, **e-kerosene could be sold for 4,900 to 9,000 EUR per tonne, resulting in a penalty of 8,100 to 16,300 EUR per tonne of fuel not supplied.**

Paying the penalty also does not exempt fuel suppliers from filling their quotas, which are simply carried over to the following year. Over the years, this mechanism makes the cost of non-compliance with the mandates very high, particularly for e-kerosene: if they totally fail to develop this fuel, suppliers could have to pay collectively up **to 292 billion EUR in penalties between 2030 and 2035.** Even if the pace of introduction of e-kerosene on the market is just delayed by two years², suppliers will still have to pay up to 175 billion EUR of penalties between 2030 and 2035. In comparison, **producing enough e-kerosene** to comply with ReFuelEU mandates from 2030 to 2035 should cost a total of up to 37 billion EUR, **nearly 5 times less than paying the penalty.**

¹ Transport & Environment. (2024). [The challenges of scaling up e-kerosene production in Europe; How is e-kerosene developing in Europe?](#) (2024, June 24).

² I.e. 0% in 2030-31, 1.2% in 2032-33, 2% in 2034-35.

Individually, all fuel suppliers risk facing high penalties if they do not supply e-kerosene. For example, if a supplier like Air bp, with its 28% market share, is two years late on the pace of introduction of e-kerosene, it could have to pay close to 9 billion EUR in penalties between 2030 and 2032, and another 19 billion EUR by 2035. **If Air bp does not supply any e-kerosene between 2030 and 2035, it will lose nearly 50 billion EUR in penalties over that period**, whereas producing enough e-kerosene to comply with ReFuelEU represents a total cost of 6 billion EUR over the same period.

In case of non-compliance, this briefing shows that significant amounts of money risks being wasted away in penalties, instead of being used to produce, buy or invest in e-kerosene. For example, in our delayed scenario, in 2032, fuel suppliers would have to pay collectively up to 26 billion EUR in penalties, which is equivalent to the production cost of up to 4.6 Mt of e-kerosene, or 9.3% of total EU jet fuel consumption, well-above the minimum 2% target set by ReFuelEU Aviation as of 2032.

Any SAF mandate is as good as its enforcement mechanism, this is why T&E recommends the following to national policymakers:

- It is most urgent to put an end to the uncertainty surrounding the level of the SAF and e-SAF penalties, which deprives project developers from the visibility they need to build their business cases. **Member States must disclose their penalties by the end of 2024, as required by ReFuelEU.**
- To ensure consistency across the EU, Member States should base themselves on the price references contained in the forthcoming EASA report on ReFuelEU implementation, granted that report provides realistic estimations of e-SAF prices. Setting the penalties **above 9,000 EUR per tonne** would ensure they are higher than the price of e-kerosene in all scenarios.
- **Penalties will have to be updated regularly** to take into account probable price fluctuations and ensure they remain always higher than the price of SAF.
- Enforcing ReFuelEU is an opportunity to **improve the transparency of the jet fuel market**. For example, EASA's annual technical report should include data about the annual volumes of jet fuel supplied by the main aviation fuel providers in Europe.

Introduction

After two years of negotiations, [ReFuelEU Aviation](#) was adopted by EU legislators in October 2023 and entered into force in January 2024. The regulation set out a clear trajectory for the uptake of sustainable aviation fuels (SAF) in the EU until 2050 by introducing mandatory SAF quotas as of 2025. However, some implementation details remain to be determined as the quotas enter into force, including the level of the penalties that will apply to fuel suppliers who fail to meet their blending obligations. This paper attempts to shed some light on this crucial issue, pending first decisions by EU Member States.

1. Which level of penalties for fuel providers who don't meet the SAF quotas?

1.1. What does ReFuelEU say?

The enforcement of ReFuelEU is based on a financial penalty system described in Article 12. Fuel suppliers are not the only parties facing penalties under ReFuelEU: airlines and airports also have obligations to comply with, but this paper focuses on the penalties applicable to fuel suppliers. To ensure that fulfilling the SAF mandates is cheaper than not complying, the penalties applying to fuel suppliers have to amount to **at least twice the difference in price between SAF and conventional aviation fuel**, multiplied by the amount of fuel that is missing to reach the minimum targets set by RefueleEU. A distinct penalty must be set up for synthetic aviation fuels (referred to as “e-kerosene” or “e-SAF” in this briefing), following the same pricing differential method as the general SAF penalty.

The exact level of the penalties will be determined **at Member State level** by 31 December 2024 and could vary across the EU based on three parameters:

- The level of the multiplier applied to the price differential factor (at least two);
- The average price of fossil kerosene and SAF in a given country;
- **The methodology applied to determine the prices in question.** ReFuelEU remains quite vague on the matter. It is only stated that Member States have to use “*verifiable and objective criteria*”, including the price information contained in the European Aviation Safety Agency (EASA)’s annual technical report on the implementation of ReFuelEU. The first of such reports is expected by the end of 2024.

Pending the publication of EASA’s first technical report, T&E has tried to determine what the penalties for fuel suppliers could amount to per missing tonne of bio- and e-SAF in the following sections.

1.2. Determining the SAF penalty

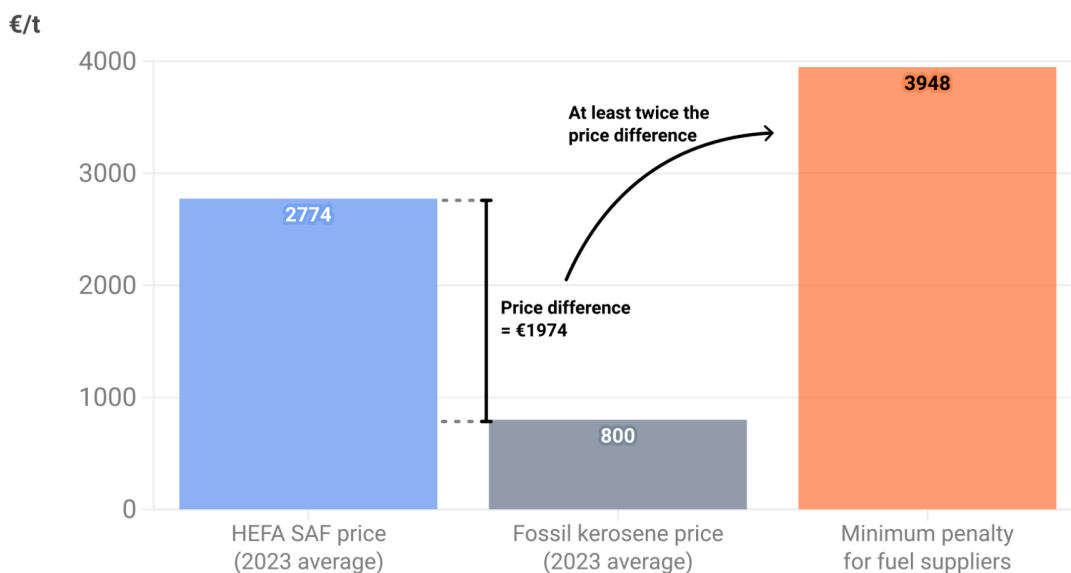
Since e-kerosene is not commercially available yet, the general SAF penalty will only be based on the average price of bio-SAF, mostly HEFA SAF (made from waste oils and fats). According to data from Quantum Commodity Intelligence, in 2023, the average spot price of SAF on the ARA³ hub was **2,774 EUR** per metric tonne. Assuming an average fossil kerosene price of 800 EUR per tonne⁴, that would lead to a minimum penalty of **3,948 EUR** per tonne.

It is worth noting that SAF prices fluctuated a lot over 2023, with a peak above 3,000 EUR per tonne from January to March, followed by a drop to less than 2,400 EUR per tonne in July, and a new increase to 3,000 EUR per tonne in September. SAF prices have experienced a steady decline since then and collapsed to 1,677 EUR per tonne in June 2024⁵. **It will be important for Member States to adjust the SAF penalties regularly, especially if they use the minimum two multiplier, ideally on a yearly basis, to take these price fluctuations into account and ensure that penalties stay higher than the cost of SAF.**

ReFuelEU penalties could near minimum 4,000 EUR per tonne of HEFA SAF in 2025

HEFA SAF penalty estimate based on average fossil kerosene and HEFA SAF prices in Europe in 2023

■ HEFA SAF price (2023 average) ■ Fossil kerosene price (2023 average)
■ Minimum penalty for fuel suppliers



Sources: IATA and Quantum Commodity Intelligence



³ Amsterdam-Rotterdam-Antwerp.

⁴ IATA [jet fuel price monitor](#).

⁵ Quantum Commodity Intelligence.



1.3. Determining the e-SAF penalty

Since e-kerosene is not commercially available yet, determining the e-SAF penalty is a more difficult exercise than for bio-SAF. Several techno-economic studies published in recent years have estimated production costs of e-kerosene, but results vary a lot, mainly due to assumptions taken regarding electricity prices. According to a literature review performed by researchers from the German Aerospace Center (DLR), the average minimum production cost of e-kerosene amount to 3,216.3 USD (**2,820.7 EUR**) per tonne⁶.

Actual market prices in 2030, when the e-kerosene quotas enter into force, will certainly be much higher, mainly because these literature estimates rely on optimistic electricity price assumptions, sometimes as low as 0.04 EUR per kWh⁷. In our analysis, the most optimistic price for renewable electricity is 0.05 EUR per kWh, in line with Concawe's price projections for Southern Europe in 2020 and 2030⁸. Moreover, in practice, projects often suffer delays as they struggle to secure funding or face technical issues, which impacts production costs. Another key factor to consider is that e-kerosene projects will probably require high investment return rates as they are deemed risky by investors and lenders⁹. Besides, as no e-kerosene project has managed to secure a final investment decision yet in Europe, supply is likely to be constrained, at least during the first years of the mandate. The more supply-constrained the market will be, the higher the margins e-kerosene producers will be able to apply. For these reasons, **a bottom-up approach (e.g. via industry surveys) should be taken by competent authorities like EASA to ensure the price references communicated reflect future market prices as closely as possible.**

According to Transport & Environment's own estimates of e-SAF prices, **the minimum e-SAF penalty could range between 8,134 and 16,302 EUR per tonne.** This broad range results from the wide range of e-kerosene selling prices, **from 4,867 EUR to 8,951 EUR per tonne**, depending on renewable electricity prices. T&E built three pricing scenarios based on different assumptions of renewable electricity prices (0.05 - 0.07 - 0.13 €/kWh). All scenarios assume a 60% margin, and flue gas from power stations as a CO₂ source. These assumptions are summed up and detailed in the [methodological note](#) of this briefing.

⁶ Braun, M., Grimme, W., & Oesingmann, K. (2024). [Pathway to net zero: Reviewing sustainable aviation fuels, environmental impacts and pricing](#). *Journal of Air Transport Management*, 117, 102580.

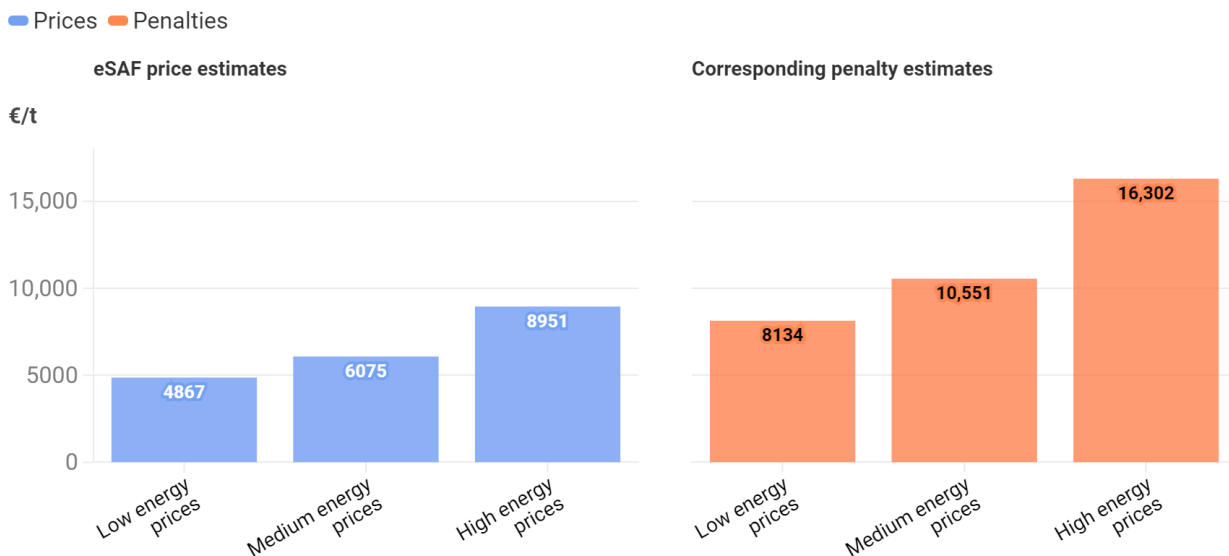
⁷ Schmidt, P., Batteiger, V., Roth, A., Weindorf, W., & Raksha, T. (2018). [Power-to-liquids as renewable fuel option for aviation: a review](#). *Chemie Ingenieur Technik*, 90(1-2), 127-140.


⁸ Concawe. (2022). [E-Fuels: A techno-economic assessment of European domestic production and imports towards 2050](#) (Concawe Report 17/22).

⁹ European Investment Bank. (2024). [Financing sustainable liquid fuel projects in Europe: Identifying barriers and overcoming them](#).

ReFuelEU e-kerosene penalties could range from 8,100 to 16,300 EUR per tonne in 2030

Projection of eSAF prices and ReFuelEU penalties in 2030 (in EUR per tonne)



Source: Concawe, T&E (assuming fossil jet fuel price is 800€/t) • Energy prices - low: 5 cts/kWh; medium: 7 cts/kWh; high : 13 cts/kWh. 

Policy conclusions - T&E recommendations

- 1. Ending the uncertainty.** Too much uncertainty still surrounds the level of penalties Member States will adopt, particularly for e-kerosene. Such uncertainty is not helping e-kerosene projects, which need visibility to support their business case. Member States must disclose their penalties as soon as possible, and **no later than 31 December 2024**, as required by ReFuelEU.
- 2. Harmonization.** To ensure consistency across the EU and maintain a level playing field, Member States should base themselves on the price references contained in the forthcoming EASA report on the implementation of ReFuelEU, granted that report takes the right approach to determine e-SAF prices (i.e. industry surveys and/or in-house model based on realistic energy prices and margin assumptions). According to T&E's estimations, e-SAF penalties should not be lower than ~ 8,100 EUR per tonne. Setting them **above 9,000 EUR per tonne** would ensure they are higher than the price of e-kerosene in all scenarios.
- 3. Regular updates.** Penalties will have to be updated regularly to take into account probable price fluctuations and ensure they remain always higher than the price of SAF.

2. The cost of fuel supplier’s potential failure to comply with the e-kerosene mandate

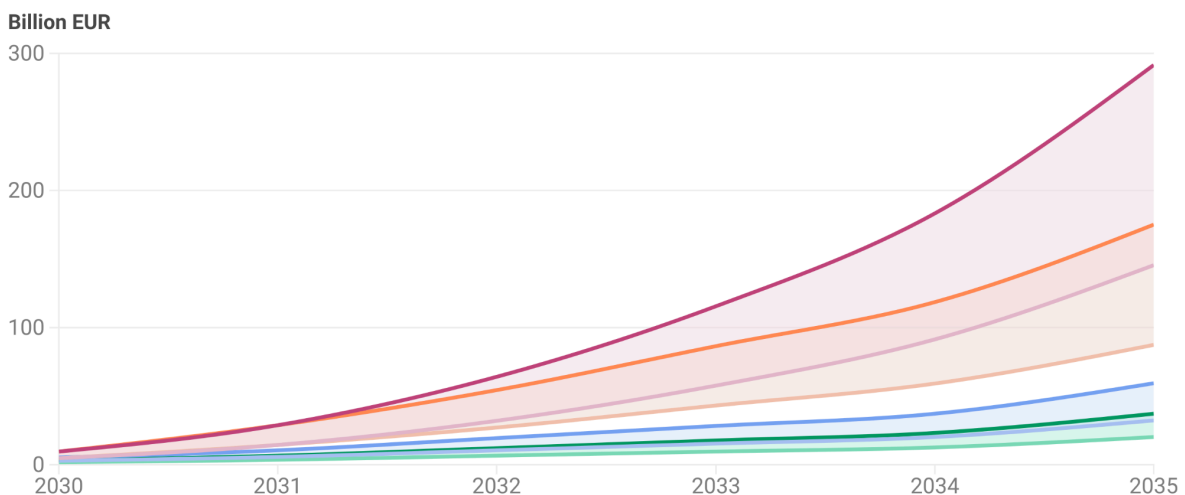
The findings above show that if set properly, penalties in ReFuelEU act as an effective incentive for compliance. As ReFuelEU is a supply-side mandate, fuel suppliers bear primary responsibility for the success of the mandate. Over a few years, the total cost of non-compliance for fuel suppliers with the ReFuelEU e-SAF targets is driven up by the follow-up obligation described in Article 12(8). Not only are non compliant fuel suppliers liable to a penalty for missing SAF quantities for a given year, but **they also still have to supply the market in the following year with a quantity of SAF equal to those missing quantities**, on top of their obligation for that year.

To date, big oil companies and fuel traders were the main players on the aviation fuel market and are expected to play a similar role for SAF. However, so far, big oil companies are not involved in any major e-kerosene projects¹⁰. T&E revealed that, by the end of 2023, none of the 25 industrial scale e-kerosene projects announced in the European Economic Area had reached a Final Investment Decision (FID) yet¹¹. Their passivity towards e-SAF investment could prove very costly, as the results of the analysis show below.

Not complying with ReFuelEU will be much more costly than producing e-kerosene

Comparing e-kerosene cumulative production cost, revenues and penalties over 2030-2035

- Cumulative e-kerosene **production** cost over the period in case of compliance (high and low scenario)
- Cumulative e-kerosene **revenues** over the period in case of compliance (high and low scenario)
- Cumulative e-kerosene **penalties** over the period in case of **delayed compliance** (high and low scenario)
- Cumulative e-kerosene **penalties** over the period in case of **failing to comply** (high and low scenario)



Source: T&E • Based on low medium and high scenarios (costs = 3,042; 3,797 and 5,594; prices = 4,867; 6,075 and 8,951; penalties = 8,134; 10,551 and 16,302 €/tonne, respectively)

¹⁰ Ibid. NB: Shell pulled out from the HySkies project ([source](#)). Small pilot projects by Total ([in the UAE with Masdar and Siemens](#), and at the Leuna refinery in Germany) and Saudi Aramco ([joint venture with Repsol in Bilbao, Spain](#)).

¹¹ Transport & Environment. (2024). [The challenges of scaling up e-kerosene production in Europe.](#)

As the table below indicates, if the first drops of e-kerosene are not delivered in 2030, in total, fuel suppliers will have to pay collectively **5 to 10 billion EUR in penalties**, which would have been enough to produce between 1.6 and 1.7 Mt of e-kerosene, or 3.2 - 3.5% of the EU's jet fuel consumption (well above ReFuelEU's 1.2% target)¹². These penalties amount to the investment costs necessary to **kickstart between 8 and 16 e-kerosene facilities**¹³.

If the pace of introduction of e-kerosene was delayed by two years, in 2032, aviation fuel suppliers would pay collectively 13 to 26 billion EUR in penalties, which would have been enough to produce between 4.2 and 4.6 Mt of e-kerosene, representing 8.5 to 9.3% of the EU's jet fuel consumption. In this delayed scenario, where e-kerosene supply only reaches 2% in 2035, fuel suppliers would pay between 87 and 175 billion EUR in penalties between 2030 and 2035. **If e-kerosene was still not deployed at all by 2035, fuel suppliers would pay between 145 and 292 billion EUR in penalties over 2030-2035.**

Mandates, shortages and penalties in both delayed and non compliance scenarios						
	E-kerosene mandate as per ReFuelEU (% of fuel mix)	Corresponding e-kerosene uptake in the EEA (Mt) ¹⁴	Cumulative e-kerosene shortage in the EEA (Mt) in case of delayed compliance ¹⁵	Total penalties in delayed scenario (billion EUR)	Cumulative e-kerosene shortage in the EEA (Mt) in case of full non-compliance ¹⁶	Total penalties in full non-compliance scenario (billion EUR)
2030	1.2%	0.6	0.6	4.8 - 9.6	0.6	4.8 - 9.6
2031	1.2%	0.6	1.2	9.6 - 19.2	1.2	9.6 - 19.2
2032	2%	1	1.6	12.8 - 25.6	2.2	17.6 - 35.3
2033	2%	1	2.0	16 - 32.1	3.2	25.7 - 51.5
2034	2%	1.7	2.0	16 - 32.1	4.2	33.8 - 67.7
2035	5%	2.5	3.5	28.2 - 56.5	6.6	54 - 108.3
<i>Total over the period</i>		6.6	10.7	87.4 - 175.1	17.9	145.5 - 291.5

¹² Based on low and high production cost scenarios (3,042 and 5,594EUR per tonne of e-kerosene, respectively).

¹³ Based on an upfront investment cost of 610 million EUR for a plant with an annual e-fuel production capacity of 160,000 tonnes in Norway, [according to Nordic Electrofuel](#), who is developing one of the most advanced e-kerosene pilot plant projects in Europe.

¹⁴ Total fuel burnt in a "no action scenario" is calculated based on a yearly traffic growth of 2.2%, and a 1.1% yearly fuel efficiency improvement, following T&E's roadmap modeling assumptions. Impacts of the additional costs from FF55 adopted policies (ETS carbon price and costs of SAF penetration resulting from RefuelEU mandates) on demand are taken into account to calculate final fuel burnt. At the time of writing this report, the European Taxation Directive (ETD) was not adopted.

¹⁵ I.e. 0% e-kerosene in 2030-31. 1.2% in 2032-33. 2% in 2034-35. Lower range is based on T&E low energy prices scenario. Higher range is based on T&E's high energy prices scenario.

¹⁶ I.e. 0% e-kerosene between 2030 and 2035. Lower range is based on T&E low energy prices scenario. Higher range is based on T&E's high energy prices scenario.

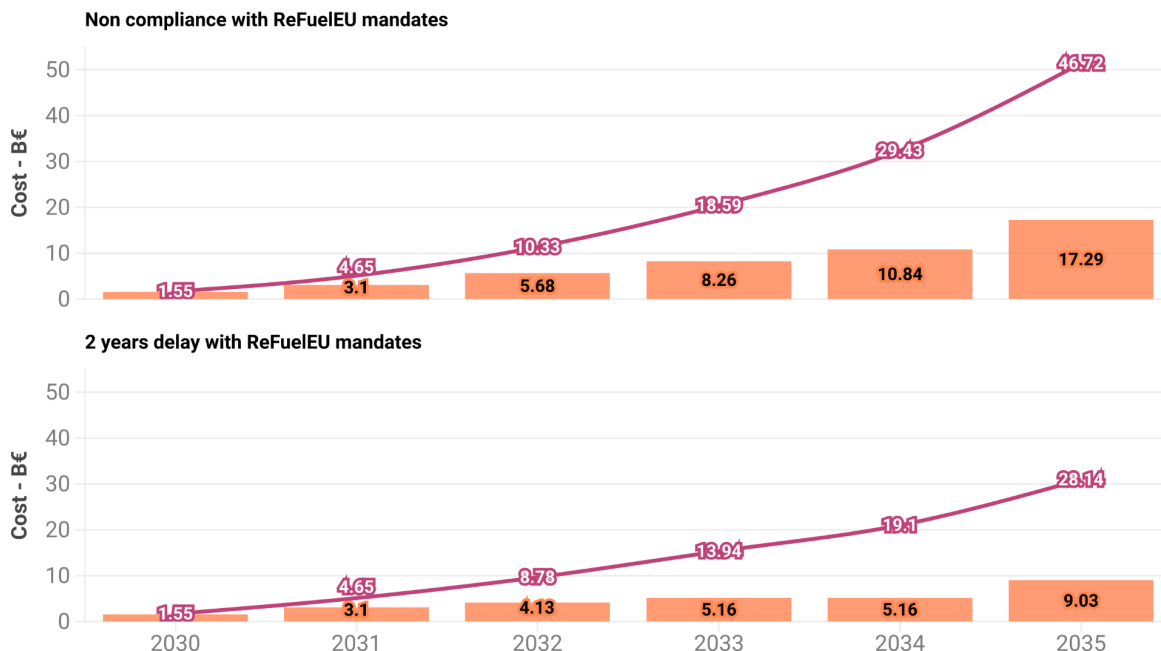
To put things in perspective, producing enough e-kerosene to comply with ReFuelEU from 2030 until 2035 should **only cost between 20 and 37 billion EUR in total, over 7 times less than paying penalties**. Revenues from the sale of e-kerosene are expected to reach between 32 and 59 billion EUR.

The high overall cost of non-compliance will impact suppliers individually as well. For example, as one of the largest suppliers of jet fuel in Europe with its 28% market share¹⁷, **Air bp** (the aviation division of bp) risks paying particularly high penalties for failing to meet its commitments. Based on our middle price scenario, if Air bp was two years late on the pace of introduction of e-kerosene, **it would have to pay close to 9 billion EUR in penalties between 2030 and 2032, and another 19 billion EUR by 2035**. If it does not supply any e-kerosene between 2030 and 2035, it will lose nearly 50 billion EUR in penalties over that period, whereas producing enough e-kerosene to comply with ReFuelEU represents, in comparison, only a cost of 6 billion EUR over the same period. Running similar calculations for other jet fuel suppliers would have required access to the volumes of jet fuel they sold in Europe over recent years, but **that data was not publicly available**.

Not complying with the ReFuelEU e-kerosene subtargets could cost nearly 50 billion euros to a jet fuel supplier like Air bp by 2035

Annual and cumulative costs of non-compliance for Air BP delivering roughly 12 Mt of jet fuel annually to EU airports

■ Cumulative cost - Medium scenario ■ Annual cost - Medium scenario



Source: T&E, Air bp • Considering a penalty price of 10,551€/t (medium scenario)



¹⁷ See the methodological note for more details about this assumption.



Conclusion

RefuelEU relies on a dissuasive system of penalties for its implementation. Due to the follow-up obligation, not-complying with the SAF targets will be very costly for fuel suppliers, in particular when it comes to e-kerosene. Yet historical jet fuel suppliers are not involved in any major e-SAF project in Europe at the moment. The longer they wait to secure e-kerosene, the more costly it will result for them, unless they plan to pass non-compliance costs on to airlines and their passengers.

To mitigate the cost of non-compliance with ReFuelEU, **jet fuel suppliers must start supporting the development of the e-kerosene market now**, either by investing directly in the companies behind existing projects, by signing offtake deals with them, or by developing their own projects. There are currently at least 36 large-scale commercial e-kerosene projects looking for buyers and investors in Europe, all at risk of failure without the support of legacy jet fuel suppliers¹⁸.

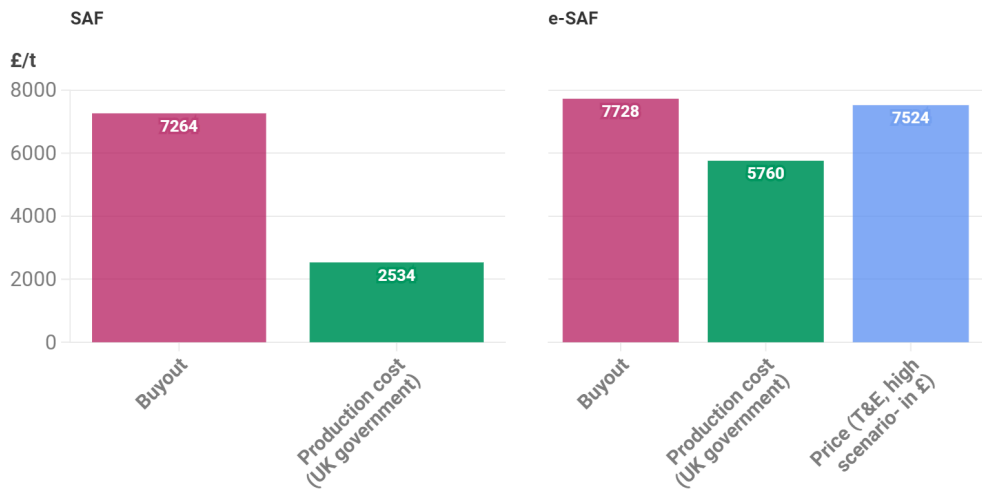
What about the UK SAF penalties and cost of non-compliance?

The [UK SAF mandate](#) foresees the purchase of certificates from other SAF suppliers through a trading system and **a buyout option that relieves fuel suppliers from their obligation to supply fuels**. The buyout prices stand at **7,264 £** (8,611 EUR) per tonne for SAF and **7,728 £** (9,161 EUR) per tonne for e-SAF specifically, which is above production costs for both the most expensive advanced biofuels and e-fuels made with DAC according to the UK government's own cost modeling. That level is also above T&E's most pessimistic pricing scenario, in which e-kerosene would reach a maximum of 7,524 £ (8,951 EUR) per tonne. Therefore, it should always be more expensive to pay the penalty than to produce or purchase e-kerosene in the UK.

However, the UK e-SAF targets are much lower than in the EU and **the mandate does not include a follow-up obligation like ReFuelEU**, which significantly reduces the total cost of non-compliance for UK fuel suppliers.

¹⁸ [How is e-kerosene developing in Europe?](#) (2024, June 24). *transportenvironment.org*.

UK SAF penalties higher than production costs and prices, but lack follow up obligation



Sources: UK government, Transport & Environment (2024) • Production cost estimate based on pessimistic 2022 values for waste-to-liquid from MSW and FT e-fuels made with DAC and nuclear power based on UK SAF mandate modelling • Price estimate based on T&E's modeling, with energy prices of 0.13 €/kWh and a 60% margin



4. Annex - Methodological note

Fuel prices

To calculate HEFA SAF and e-SAF penalties, it is necessary to estimate the prices of these fuels, along with the price of fossil kerosene. The average price for fossil kerosene in 2023 was **800 EUR** per tonne, as reported by [IATA's jet fuel price monitor](#). The average price for HEFA (biofuel) SAF in 2023, calculated using data from Quantum Commodity Intelligence, was **2,774 EUR** per tonne.

We conducted an analysis to establish assumptions regarding the price of e-kerosene. It is important to note that most e-kerosene industrial projects are still in early stages of development, and consequently, significant uncertainties remain regarding production costs, and prices at which e-kerosene will be sold in the coming years. To perform our analysis, we based our models on information and data from the available literature to the best of our knowledge, aiming to provide a clear and objective view of putative e-kerosene penalties under ReFuelEU legislation.

We estimated e-kerosene prices assuming a production through the Fischer-Tropsch process, using green hydrogen from electrolysis and CO₂ from point sources. We calculated these prices as the sum of the cost of production and the profit margin. The production cost is calculated using an in-house model based on Concawe¹⁹. The input parameters of this model can be found in the table below. We considered three cost scenarios corresponding to low, medium and high electricity prices. E-fuels projects are capital-intensive and high returns on investment are to be expected²⁰. We therefore considered margins of 60%. This resulted in three e-kerosene price estimates.

E-kerosene prices modeling	Low price scenario	Medium price scenario	High price scenario	Source
	Assumptions			
Renewable electricity source	EUS, PV/wind hybrid	EUC, PV/wind hybrid	EUN, offshore wind	
Renewable electricity price (€/kWh).	0.05	0.07	0.13	Concawe 2022
Renewable electricity - Load factor	57%	45%	46%	Concawe 2022
Electrolyser CAPEX (€/GJ H ₂)	6.68			<i>T&E based</i>

¹⁹ [Concawe 2022](#): E-Fuels: A techno-economic assessment of European domestic production and imports towards 2050

²⁰ [Nordic Electrofuel](#)

Electrolyser CAPEX (corrected for load factor) (€/GJ H ₂)	11.72	14.84	14.52	on BNEF 2024 ²¹
Electrolyser efficiency	66%			T&E
CO ₂ capture technology	Point source			
CO ₂ price without electricity cost (€/tCO ₂)	12.3			Concawe 2022
CO ₂ capture energy requirement (GJ/tCO ₂)	3.3			Concawe 2022
Results				
E-kerosene levelized cost of production (€/t)	3,042	3,797	5,594	T&E
E-kerosene Price (€/t)	Margin 60% 4,867	6,075	8,951	T&E

Penalty calculations

As defined by Article 12 of the RefuelEU Aviation regulation, fuel suppliers who fail to comply with the ReFuelEU mandates are liable to a fine. The value of this fine will be determined by each Member State. However, the minimum fine value must be at least twice the difference between the price of a tonne of SAF (HEFA SAF or e-kerosene) and the price of a tonne of fossil kerosene.

To estimate the cost of penalties, we considered an extreme scenario where jet fuel suppliers would meet ReFuelEU biofuel mandates but would not supply any e-kerosene. According to ReFuelEU, if fuel suppliers do not fill their quotas, the amount of required SAF is carried over to the following year. We also included a less extreme scenario, where jet fuel suppliers would start to supply e-kerosene with a delay of two years (in 2032). The e-kerosene shortage and supply for these two scenarios are presented in the table below.

We considered annual penalties as the cumulative e-kerosene shortage in a given year, multiplied by the price of the e-kerosene fine. To estimate the overall cost of non-compliance at the EU level over the 2030-2035 period, we summed the amount of annual penalties from each year.

²¹ BloombergNEF 2024: Hydrogen Electrolyzer Overcapacity Hasn't Cut System Costs

E-kerosene mandates, shortage, and supply at the EU level		2030	2031	2032	2033	2034	2035
EU 27 kerosene consumption (Mt) ²²		48.9	49.2	49.4	49.7	49.7	49.8
ReFuelEU E-kerosene mandate ²³	(%)	1.2%	1.2%	2%	2%	2%	5%
	(Mt)	0.59	0.59	0.99	0.99	0.99	2.49
Non compliance scenario	Yearly e-kerosene shortage (Mt)	0.59	0.59	0.99	0.99	0.99	2.49
	Cumulate e-kerosene shortage (Mt) <i>i.e. yearly shortage + shortage from previous years</i>	0.59	1.18	2.17	3.16	4.15	6.64
Delayed compliance scenario (two years delay)	Yearly e-kerosene supply (Mt)	0	0	0.59	0.60	0.99	1
	Yearly e-kerosene shortage (Mt)	0.59	0.59	0.39	0.40	0	1.49
	Cumulate e-kerosene shortage (Mt) <i>i.e. yearly shortage + shortage from previous years</i>	0.59	1.18	1.57	1.97	1.97	3.46

Cumulative cost of non compliance for a given fuel supplier - Air bp's case study

Few jet fuel suppliers report their fuel volumes publicly. Furthermore, based on internal reports, and available data online, it is often not possible to accurately estimate a volume at the

²² Total fuel burnt in a "no action scenario" is calculated based on a yearly traffic growth of 2.2%, and a 1.1% yearly fuel efficiency improvement, following T&E's roadmap modeling assumptions. Impacts of the additional costs from FF55 adopted policies (ETS carbon price and costs of SAF penetration resulting from RefuelEU mandates) on demand are taken into account to calculate final fuel burnt. At the time of writing this report, the European Taxation Directive (ETD) was not adopted.

²³ Shares of SAF referred to in Article 4 from [ReFuelEU Aviation](#)

European Union level. For the current analysis, we chose to focus on Air bp volumes of kerosene supplied in Europe because Air bp data is easily accessible on [their data portal](#).

To estimate cumulative penalties for Air bp, we estimated the volumes of e-kerosene they should supply to meet ReFuelEU mandates. Based on this, we calculated the e-kerosene shortage from 2030 to 2035, and multiplied these volumes by the e-kerosene fine. In 2023, Air bp reported a supply of 355 thousand barrels of kerosene per day, or 16.7 Mt for the year 2023²⁴. However, this volume includes sales in non EU27 countries in Europe, such as the UK or Norway. Based on CAPA data²⁵, we estimated that among the 281 airports in Europe where Air bp supplies jet fuel, 206 are based in the EU, or 73%. We applied this ratio to the kerosene volume, to estimate that Air bp supplied 12.2 Mt of kerosene in the EU in 2023. By comparing this volume to kerosene consumption at the EU level in 2023 (43.3 Mt²⁶), we estimated that Air bp held 28% of the jet fuel supply market. This is a rough estimate as it assumes that Air bp supplies each airport with equivalent volumes of kerosene, which is obviously not the reality. We communicated these numbers to Air bp and at the time of publication, Air bp had not responded to our assumptions.

E-kerosene mandates, shortage, and supply at a jet fuel supplier level - example of Air bp		2030	2031	2032	2033	2034	2035
Air bp kerosene consumption estimation (Mt)		12.2	12.2	12.2	12.2	12.2	12.2
E-kerosene mandate	(%)	1.2%	1.2%	2%	2%	2%	5%
	(Mt)	0.15	0.15	0.24	0.24	0.24	0.61
Non compliance scenario	Yearly e-kerosene shortage (Mt)	0.15	0.15	0.24	0.24	0.24	0.61
	Cumulate e-kerosene shortage (Mt) i.e. yearly shortage + shortage from previous years	0.15	0.29	0.54	0.78	1.03	1.64

²⁴ Air bp's [full year databook 2023](#)

²⁵ [CAPA Data Centre](#)

²⁶ Stratras advisors

Delayed compliance scenario (two years delay)	Yearly e-kerosene supply (Mt)	0	0	0.15	0.15	0.24	0.24
	Yearly e-kerosene shortage (Mt)	0.15	0.15	0.1	0.1	0	0.37
	Cumulate e-kerosene shortage (Mt) i.e. yearly shortage + shortage from previous years	0.15	0.29	0.39	0.49	0.49	0.86

Further information

Camille Mutrelle

Aviation Policy Officer

Transport & Environment

camille.mutrelle@transportenvironment.org

Mobile: +32 490 51 10 73

Thomas Enriquez

Aviation data analyst

Transport & Environment

thomas.enriquez@transportenvironment.org

Alexander Kunkel

Aviation data analyst

Transport & Environment

alexander.kunkel@transportenvironment.org