



BRIEFING - December 2024

The SAF Observatory

Is the aviation sector ready to transition to sustainable jet fuel?

Executive summary

T&E's SAF Observatory findings indicate that airlines are currently unprepared to transition to sustainable jet fuel. Of the 77 airlines assessed, none has acquired sufficient sustainable aviation fuels (SAFs) to qualify in category A, while 67 are in category D, as they do not purchase SAF, or they do so at levels too low to make a meaningful impact on emissions. Less than half of the airlines have established targets for SAF use, and none have set targets for e-kerosene.

SAF consumption is projected to rise from 0.15% to 1.3% for the airlines ranked in the study by 2030, which would reduce the aviation sector's greenhouse gas emissions by less than 1%. This is not even enough to offset growth in air traffic. Emissions reductions could be enhanced if airlines prioritised the purchase of e-fuels over unsustainable biofuels, as **e-kerosene currently accounts for less than 10% of SAF purchases, while crop-based biofuels comprise around 30%.**

There are notable differences in performance across regions. For instance, while European airlines have purchased less SAF than their North American counterparts, they are projected to achieve greater emissions reductions by 2030 due to higher volumes of e-kerosene and reduced reliance on crop-based biofuels.

Airlines are not solely at fault for their limited uptake of SAF, particularly e-kerosene. Many airlines are based in regions without supportive regulatory frameworks. Where such frameworks do exist, they often lack robust sustainability criteria, allowing problematic biofuels to proliferate. **Moreover, major oil companies, despite their profitability and capacity for investment, have largely neglected the e-kerosene market.**

Big oil companies, governments, and airlines can drive change to ensure the take-off of sustainable aviation fuels by following these recommendations:

- Oil companies should engage in the e-kerosene market by developing projects themselves or by investing in and/or buying e-kerosene from other companies.
- Countries without SAF mandates and/or frameworks should establish them, incorporating robust sustainability criteria to prevent the use of the least sustainable biofuels, whilst promoting e-kerosene.
- Countries already having SAF mandates and/or frameworks should limit the use of unsustainable biofuels, set e-kerosene sub-targets, and enforce robust penalties for non-compliance. Moreover, mandates should be complemented with incentives to drive SAF prices down, especially for e-kerosene, such as tax credits, grants, low-interest loans, state guarantees, contracts for difference.
- The EU should ensure the Clean Industrial Deal effectively complements the SAF mandate set by RefuelEU with incentives and regulatory measures. The Deal presents the opportunity to develop a robust strategy for e-kerosene fostering investment and production, whilst reducing the e-kerosene green premium.

- Airlines should focus on the quality and the scalability of the SAF they buy, rather than rely on unsustainable and non-scalable fuels if they want to achieve meaningful emissions reductions. Moreover, by signing early MoUs and offtake agreements with e-kerosene producers or directly investing in these projects, airlines can support the uptake of e-kerosene in the market.

Introduction - Why a SAF Observatory?

Over the past few years, a growing number of airlines worldwide have been purchasing Sustainable Aviation Fuels (SAF) – renewable fuels derived from biomass (known as biofuels) or produced by combining green hydrogen and carbon (so-called e-kerosene or e-fuels). The publicity surrounding these purchase agreements can give the impression that the aviation sector as a whole is finally taking meaningful steps towards reducing its climate impact by transitioning away from fossil fuels. However, the real picture is far more complex. While most of the attention is on the volumes of SAF airlines are purchasing, the quality and sustainability of the fuels themselves receive far less scrutiny.

This raises two critical questions: is the SAF that airlines are buying truly sustainable? Is it setting them on track to reach net-zero emissions?

T&E's SAF Observatory addresses these questions by ranking airlines based on their use of and commitments to SAF, with a focus on fuel sustainability. The Observatory also sheds light on the responsibility of major oil companies in the lack of development and uptake of e-kerosene, as well as the importance of regulatory frameworks.

1. Airline SAF uptake: a slow take-off

1.1. The ranking: few first movers, (too) many laggards

The SAF Observatory ranks a total of 77 airlines and airline groups worldwide from 0 to 100 based on their emissions reductions through SAF and their shares of advanced and waste biofuels and e-kerosene. Additionally, airlines can collect up to 50 bonus points through setting SAF and e-kerosene targets, investing in advanced biofuels and e-kerosene projects, signing memorandums of understanding (MoUs), letters of intent (LoIs) and offtake agreements with e-kerosene producers. A malus of 5 points is given to airlines that have purchased crop-based biofuels. Refer to the methodology in the [annex](#) of this briefing (p.10) for more details.

Based on the score achieved, airlines and airlines groups were divided into four ranking categories: D (0 - 24 points), C (25 - 49 points), B (50 - 74 points) and A (75 - 100 points).

Who is leading the way for SAF?

Rank	Airline group	Advanced & waste biofuels	e-kerosene	Emissions reduction	Bonus	Grade
1	Air France-KLM					B
2	United Airlines					C
3	Norwegian					C
4	IAG					C
5	Wizz Air					C
6	Air Transat					C
7	DHL Group					C
8	Southwest Airlines					C
9	JetBlue					C
10	Delta Air Lines					C

Source: T&E (2024), based on data from ICAO (2023), BNEF (2023), Stratas (2023), press announcements • Data shown reflects values up to August 2024, as data collection concluded then.



No airline ranks in category A, as, for now, no airline comes close to T&E’s “gold standard”, based on its [climate neutral aviation roadmap by 2050](#): an average of 5.2% emissions reduction from 2020 to 2035, at least 4.8% and 8.5% of advanced and waste biofuels in 2030 and 2035 respectively, and at least 2% and 10.4% of e-kerosene in 2030 and 2035 respectively.

Only one airline – the [Air France-KLM Group](#) – makes it into category B (with 61 points), due to its large purchases of waste-oil biofuels, which should enable the group to reduce its emissions by nearly 4% by 2030, provided that it uses genuine waste oils. The Group could improve its scoring and reach category A by converting its non-binding MoUs with several e-kerosene projects - led by Engie, EDF, Elyse Energy and the SAF+ Consortium - into firmer offtake agreements and/or investments.

The first ten spots of the ranking include several airlines that stand out for purchasing and/or investing in e-kerosene start-ups. Such is the case of [United Airlines](#), which signed a deal with

Dimensional Energy, and [International Airlines Group \(IAG\)](#), which concluded a large offtake deal with the start-up Twelve. [Norwegian](#) became co-owner of Norsk e-Fuel, while [Air Transat](#) pledged to purchase e-kerosene from the SAF+ Consortium. However, these airlines do not purchase enough SAF compared to their overall fuel uptake to achieve significant emissions reductions from now until 2030 and 2035, which prevents them from ranking higher than C.

With only one airline in category B (50-74) and nine airlines ranking in category C (25-49), the majority of airlines (67 out of 77, or 87%) score less than 25 points, thus falling into category D (0-24). Moreover, **almost half of the airlines even scored zero**. Not only are airlines doing too little when it comes to SAF, but many of them are not doing anything.

Why are most airlines far from take-off when it comes to SAF? In the following sections, we take a closer look at SAF target setting, the volumes and sustainability of the SAF purchased by airlines, and projected emission reductions.

1.2. SAF targets - many airlines still do not have them

Having a SAF target is far from a guarantee of actual SAF uptake. However, it is a first step, as any airline that is serious about its intention to reach net-zero should estimate how much SAF it will require to get there. Moreover, SAF targets can be a good benchmark against which to compare actual fuel uptakes.

Our analysis shows that **just under half of the 77 airlines ranked have set a SAF goal**. Among cargo airlines, the DHL Group and FedEx Express are the most ambitious as they aim to use 30% of SAF by 2030. Among passenger airlines, the SAS Group (using SAF equivalent to the Group's fuel consumption in Scandinavia), Norwegian (16% - 28%) and Ryanair (12.5%) have the highest 2030 commitments. 20 airlines have set a 10% target by 2030. These targets are higher than the ReFuelEU and UK mandate of 6% and 10% respectively for 2030. However, having a target is not synonymous with SAF uptake. **At the moment, most airlines are far from the trajectory to reach the targets they have set themselves.**

Furthermore, no airline has set a dedicated e-kerosene target, even though this fuel will have to be supplied to European airports as of 2030 (2028 in the UK).

1.3. SAF volumes: much more purchase are needed to reach targets

In 2023, the airlines in the ranking consumed more than 1.6 billion barrels of fossil kerosene, compared to only 2.6 million barrels of SAF, which made up **less than 0.15% of their jet fuel consumption**. Only two airlines had more than 1% of SAF in their jet fuel mix: DHL (3.3%) and Air France - KLM (1.1%).

Based on current offtake agreements and MoUs, the **airlines in the ranking have secured enough SAF to reach a SAF share of only 1.2% in 2030**, with differences depending on where

the airlines are based. With a projected SAF share of 1.3% in 2030, European airlines are still far from the 6% and 10% targets set by the EU and UK SAF mandates respectively. North American airlines have procured more SAF than European airlines: their current SAF offtakes amount to 2.7% of their projected fuel consumption in 2030, but a significant share of that SAF is made of unsustainable crop-based biofuels. Asian airlines have started to purchase SAF, but they still have a long way to catch up with European and American airlines. African and Southern American airlines have yet to start procuring SAF.

1.4. SAF sustainability: airlines are betting on the wrong type of SAF

While it is clear that airlines do not buy enough SAF, what is an even greater issue is that they still buy too many unsustainable biofuels, and not enough e-fuels. SAF varies greatly in terms of sustainability and scalability, with e-kerosene being the most sustainable and scalable and food and crop-based biofuels the least sustainable (see infobox below).

What are the different types of SAFs and how sustainable are they?

- **Biofuels derived from food and feed crops or vegetable oils**, such as corn or palm oil, are by far the least sustainable type of SAF. They can even be a cure worse than the disease, as their production drives deforestation and competes with food supply. They cannot be used to comply with the EU's SAF mandate.
- **Biofuels derived from waste oils and fats**, typically used cooking oils (UCOs) and animal fats, can be sustainable if produced from locally collected waste oils but available volumes will remain limited. There are high concerns in Europe over an increased reliance on fraudulent imports of waste oils from Asia.
- **Advanced biofuels derived from non-oily residues**, such as agricultural and forestry residues or municipal solid waste, are not fully sustainable because of the existing uses of agricultural and forestry residues, resulting in uncertainties around their actual emission savings.
- **Recycled carbon fuels** are produced from fossil wastes, such as plastics or industrial flue gases. Given efforts to increase recycling and to reduce waste, the sustainability of some of these fuels is questionable.
- **E-fuels (or e-kerosene)** which are produced by combining renewable hydrogen and carbon are the most sustainable type of fuel. The production of renewable hydrogen requires a significant amount of renewable electricity, which should be met by investments in new facilities in order not to compete with the direct electrification of other sectors. CO₂ can be captured from concentrated sources like the flue gas of

industrial facilities, or preferably directly from the atmosphere. Unlike biofuels, e-kerosene can be sustainably scaled-up to meet the energy needs of the aviation sector.

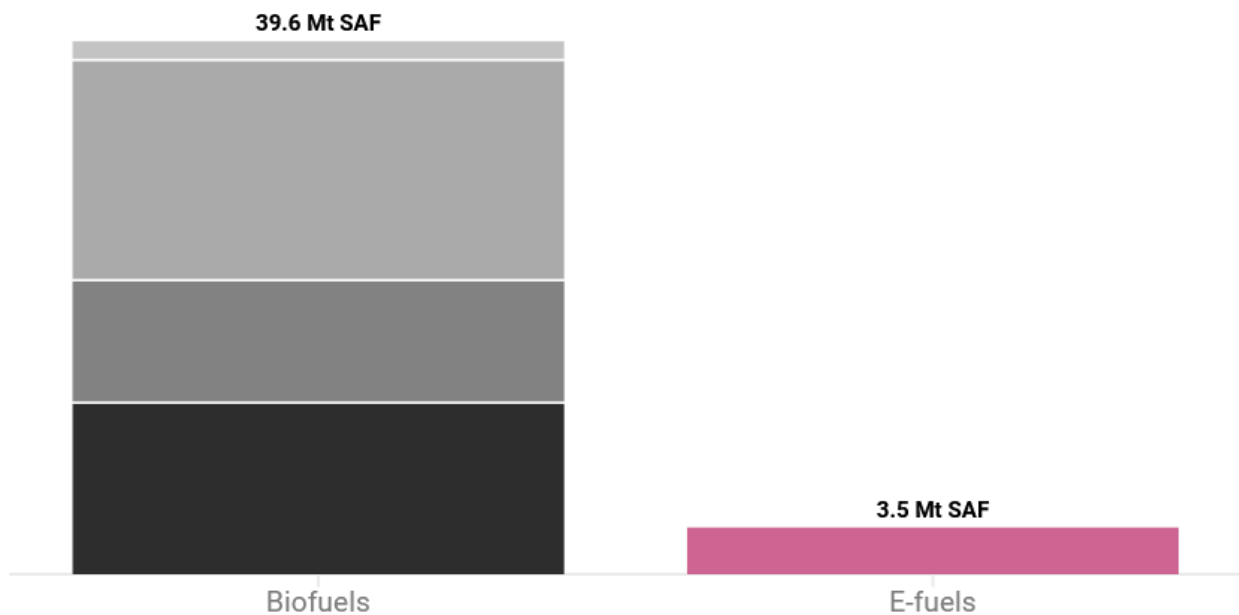
Many airlines in the ranking are relying on biofuels that, despite being labelled sustainable, are far from a true climate fix to the industry's climate problem. Biofuels derived from food crops, in particular, present a host of problems as they drive deforestation, biodiversity loss, and threaten food security. As for waste-based biofuels, they will always be constrained by the limited availability of the feedstocks they are derived from.

Only e-kerosene has the potential to be sustainably scaled up to meet the sector's demand while offering significant emissions reductions. Yet, **e-kerosene makes up less than 10% of SAF offtake volumes, whilst crop-based biofuels account for around 30%.**

Airlines are betting on the wrong kind of SAF

SAF offtake volumes (including investments, MoUs, and LoIs, for both past and future commitments)

- Food- and feed-crop biofuels
- Waste-oil biofuels
- Advanced biofuels
- Unknown SAF
- E-kerosene



Source: T&E (2024), based on data from ICAO (2024), BNEF (2024), Stratass (2024), and press announcements



Only 15 airlines in the ranking – all based in Europe and North-America – have committed one way or another to use e-kerosene. European airlines are leading the way with e-kerosene accounting for 15% of their SAF volumes, while it accounts for only 5% of North American airlines' volumes.

When it comes to biofuels, **North American airlines still rely heavily on crop-based SAF**, which represents nearly half (45%) of their offtake agreements, whereas **European airlines are largely betting on waste-based SAF, in particular waste oils and fats**, which represent more than half (55%) of their offtakes. One South American airline has committed to waste biomass, whilst Asian airlines have offtake agreements for SAF made from municipal solid waste, waste oil and food- and feed crops. African airlines have no commitment for any kind of SAF.

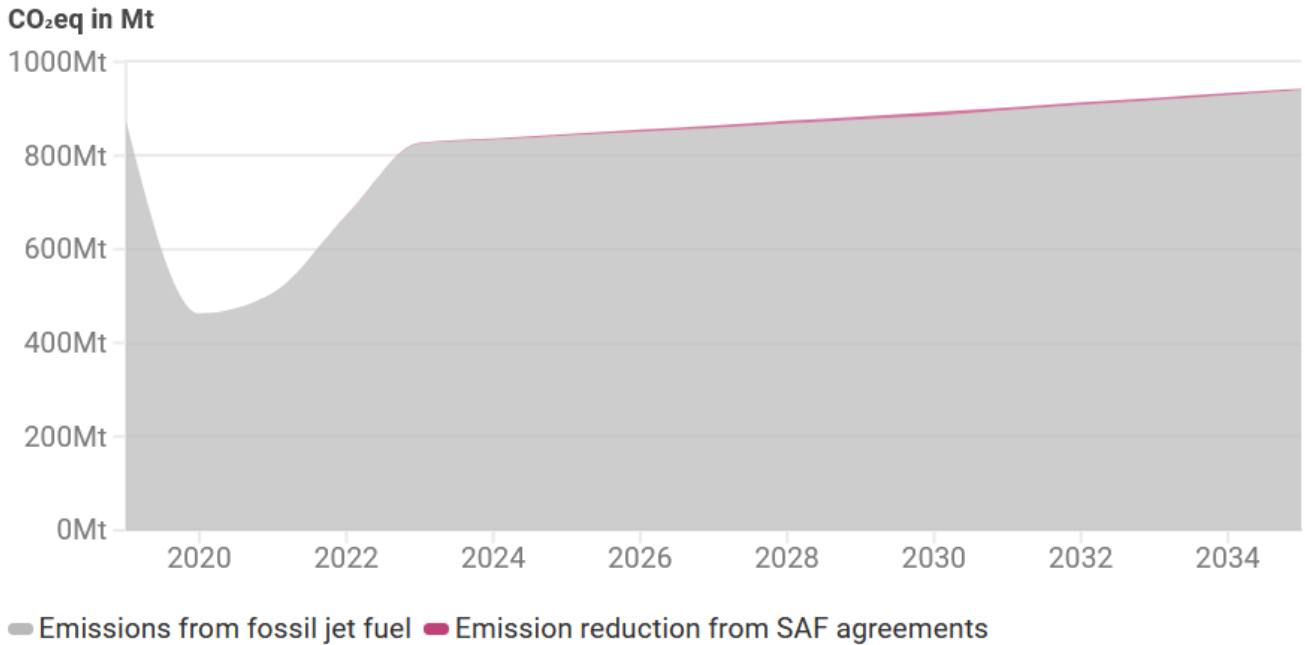
These disparities highlight the **critical role of regulatory frameworks and policies in steering airlines' commitments towards the most sustainable fuels.** In regions like Europe and North America, the presence of frameworks incentivising e-kerosene uptake has encouraged airlines to enter the market, although volumes remain still low. Moreover, restrictions on the use of crop-based biofuels, which cannot be used to comply with the EU's SAF mandate, can explain why this type of SAF is marginal in the projected fuel mix of European airlines.

1.5. Projected emissions reductions are not enough to compensate for the sector's growth

Current SAF offtake of the airlines of the ranking will reduce their emissions by around 0.9% in 2030. This reduction is not even enough to compensate for the sector's projected emissions growth over the coming years (incurred by traffic growth). Such a shortfall is not only due to the insufficient SAF volumes to which airlines are committing to, but also to the quality of SAF itself.

Current SAF agreements do not even compensate for aviation's emission growth

Emissions reduction from SAF agreements including MoUs and LoIs versus jet fuel emissions for airlines in T&E SAF observatory



Source: T&E (2024), based on data from ICAO (2024), BNEF (2024), Stratas (2024), and press announcements



This gap highlights a critical issue: even with increasing SAF usage, the reliance on biofuels, especially the less sustainable ones, will not bring the necessary reduction in aviation's carbon footprint. To achieve meaningful decarbonisation, there needs to be a clear shift to fuels which have the potential to scale sustainably and deliver substantial CO₂ emission reductions, notably e-kerosene.

Emission savings of 2.2% are expected from European airlines by 2030, while they should be limited to 1.2% in the case of North American airlines. This shows that looking only at volumes rather than the quality of SAF can be misleading. North American airlines have committed to more SAF than European airlines (2.7% vs 1.3%). However, European airlines will achieve higher emissions savings thanks to the better quality of the SAF they are purchasing and committing to (more e-kerosene and less unsustainable biofuels), driven by legislation not allowing the use of unsustainable crop-based SAF.

Without a strong regulatory framework to prioritise e-fuels and exclude the least sustainable biofuels, the current SAF trajectory risks becoming a missed opportunity: one that leaves aviation's climate impact largely unresolved while fostering a false sense of progress.

2. Big Oil's responsibility: established jet fuel suppliers are absent from the e-kerosene market

Airlines are falling short when it comes to SAF and e-kerosene in particular, but is it entirely their fault? Many external constraints shape their choices and must be taken into account, including the quantity, quality, and the affordability of the options they can choose from. Airlines are mostly purchasing fuels that are already widely available and currently cheaper than more sustainable alternatives which have yet to be fully scaled.

In that regard, **it is important to shift the focus on to the role of suppliers and their reluctance to transition away from fossil fuels.** Our analysis reveals that oil majors are nowhere to be seen on the map of e-kerosene supply, despite a key role they could play in that market.

Oil companies are long standing incumbent players in the jet fuel market. Given the recent development of frameworks mandating or incentivising SAF uptake, one would expect that their established market position would translate into active involvement in the SAF sector. This is especially the case in the EU and in the UK where minimum SAF supply quotas are mandated for jet fuel suppliers with **financial penalties** in case of non-compliance.

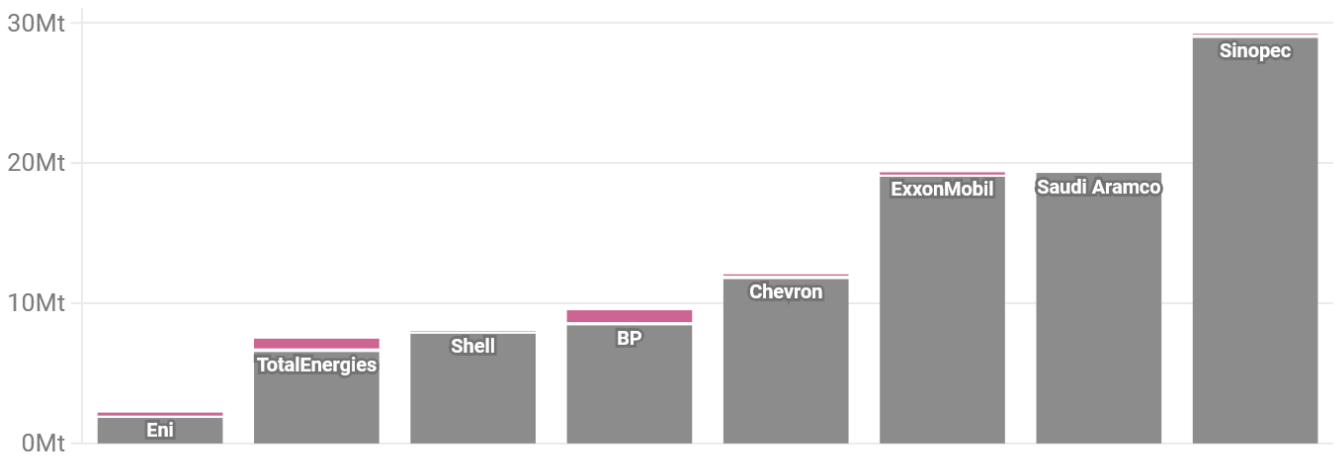
However, despite their dominant position in the jet fuel market and significant investment capacities, major oil companies are falling short in producing SAF and establishing offtake agreements, in particular in the case of e-kerosene. Except for a few demonstration projects, they have not announced any commercial plans to produce and sell e-kerosene. Shell used to be an exception as it was developing an industrial project with Vattenfall in Sweden ([HySkies](#)), but it decided to withdraw from it in July 2024. [Vattenfall cited](#) "a different belief in timelines for the project to be realised" to explain this decision.

Big Oil's plans are a drop of e-kerosene in an ocean of oil

Jet fuel production far exceeds operational and planned e-kerosene production of selected oil companies

■ Fossil jet fuel ■ E-kerosene (future) ■ Bio-SAF (operational) ■ Bio-SAF (future)

Jet fuel in Mt



Source: T&E (2024), based on BNEF (2024), Stratras (2024), and annual reports. • Fossil jet fuel production estimated via refinery throughput and net refining capacities based on 2023 annual reporting. Note that this is not a ranking of refiners. Assumptions about co-product shares taken from BNEF (2024) where available. Note that SAF outputs could vary if refiners opt to shift production from renewable diesel to SAF at certain facilities.



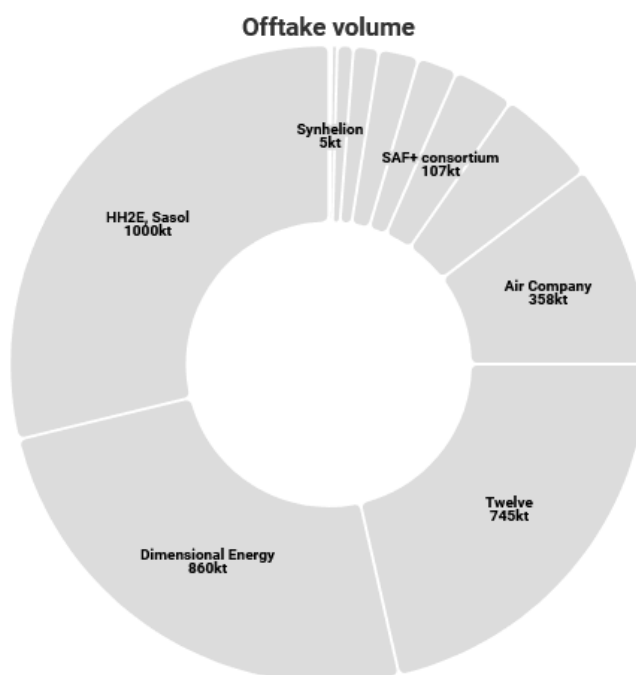
The minimal involvement of major oil companies from the e-kerosene market, is further evidenced by their current absence from e-kerosene binding and non-binding offtake agreements. This suggests that not only are they not producing e-kerosene, but they have also not initiated plans to procure and sell it to airlines.

The development of the e-kerosene market relies mostly on the shoulders of start-ups, which would benefit greatly from big oil companies' support via offtake agreements and/or direct investments.

Big Oil is missing from e-kerosene commitments

e-kerosene offtake agreements, investments, MoUs and Lols by producer

Big Oil Other producers



Source: T&E (2024), based on data from ICAO (2024), BNEF (2024), Stratas (2024), and press announcements



3. Legislation plays a key role in shaping up the SAF market

A conducive regulatory and policy environment is critical for driving SAF offtake agreements, fostering the uptake of sustainable fuel options such as e-kerosene, and ensuring the decarbonisation of the aviation sector. To effectively reduce aviation's carbon footprint, not only must frameworks mandate or incentivise SAF use, but they should also ensure that the right types of fuels – those that are both sustainable and scalable – are being promoted. This is where setting proper sustainability criteria for SAF becomes essential.

In the last few years, the predominant approach for encouraging SAF uptake has been target-based mandates, which require a minimum percentage of SAF in total jet fuel consumption or supply, such as in the case of Brazil, the EU, India, Indonesia, Japan, Malaysia, Norway, Singapore, and the UK. SAF mandates are also being discussed in seven countries including China, South Korea, Turkey and the United Arab Emirates. For example, the EU mandates a minimum share of SAF of 2% in 2025 increasing up to 67% in 2050 with a specific sub-target from 2030 (1.2%) for e-kerosene. The benefit of such an approach consists in the

demand certainty it gives to the market, especially in the long-term. However, if no mechanism is put in place to ensure the targets are met (e.g. fines/penalty) it risks being ineffective.

Contrasting with the target-based approach, Canada and the United States have favoured an incentive-based approach. For example, the US Inflation Reduction Act (IRA) offers tax credits for SAF production, rewarding producers based on the carbon intensity of the fuel. Specifically, e-kerosene is eligible for higher credits due to its lower lifecycle emissions. However, in the US, crop-based fuels are also incentivised through the Renewable Fuels Standard (RFS). These incentive-driven frameworks aim to stimulate the market by making SAF economically competitive, but without specific provisions for e-kerosene and strong sustainability criteria, there is the risk that cheaper SAFs – generally the least sustainable biofuels – will be prioritised. Furthermore, incentives are easily subject to political changes which might not support market certainty for producers.

Adopting both a target-based approach with non-compliance penalties and incentives to bridge the green premium would be ideal. In this regard, the EU could set an important precedent with the Clean Industrial Deal by proposing robust incentives and mechanisms for the production of e-kerosene complementing the targets set by ReFuelEU. **However, setting the right sustainability criteria is key.**

This brings us to a critical issue: most existing frameworks, especially outside of Europe, incentivise problematic biofuels including crop-based fuels like corn and soy or palm oil, which are linked to deforestation and biodiversity loss.

Only the EU and UK have excluded these crop-based biofuels from eligibility to meet their blending mandates due to these sustainability concerns, setting an important precedent that other countries should follow. As an example, the EU SAF mandate takes a life-cycle approach that requires biofuels to achieve GHG emissions savings of at least 65% to be defined as SAF. However, it also takes a 'feedstock approach' excluding certain fuels (e.g. palm- and soy-derived fuels) due to sustainability concerns not captured in the life-cycle analysis, such as fraud risks and emission displacement.

Despite the clear environmental advantages of e-kerosene, such as its low lifecycle emissions and potential for large-scale production, few policy frameworks actively promote its use. Currently, only frameworks in the EU, UK, and US have provisions or incentives that specifically encourage e-kerosene production and adoption. This is reflected in the fact that all airlines with e-kerosene offtake agreements or MoUs are based in Europe and North America, where such regulatory frameworks exist. In contrast, regions without such frameworks such as Asia, Africa, and South America lack any significant e-kerosene offtake agreements, underlying the importance of regulatory support.

The international framework: CORSIA

Many countries are still missing, or in few cases still developing, a SAF framework. At the international level, the International Civil Aviation Organization (ICAO) has developed the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which sets out a global framework to offset aviation emissions growth. CORSIA primarily focuses on carbon offsets rather than promoting the direct use of SAF to bring in sector emissions reductions.

Moreover, CORSIA's eligibility criteria for SAFs could be based on stronger sustainability standards, as it allows for the inclusion of unsustainable crop-based biofuels, such as those derived from soy or palm oil. This approach undermines efforts to transition to truly SAFs, as it fails to adequately incentivise the use of fuels with lower lifecycle emissions and higher scalability.

CORSIA's reliance on carbon offsetting and aspirational targets will hardly drive the necessary changes in the aviation sector to transition to the most sustainable SAFs. As a result, the effectiveness of CORSIA in promoting a genuine shift towards SAFs remains questionable, particularly when the focus should be on reducing emissions at the source rather than simply offsetting them.

4. Conclusions and recommendations

T&E's SAF Observatory highlights that airlines are not yet ready to transition to sustainable jet fuels and be on an effective flight path to net-zero. Out of 77 airlines ranked, none have reached category A, while the majority - 67 - fall into category D. This indicates that airlines are not purchasing enough sustainable fuels to significantly reduce their emissions.

SAF consumption is projected to rise from 0.15% to 1.3% for the airlines in this ranking by 2030, which would reduce the aviation sector's greenhouse gas emissions by less than 1%. This is not even enough to offset growth in air traffic. If airlines prioritised more sustainable SAF, such as e-kerosene, over less sustainable crop-based biofuels (which currently constitute 30% of SAF purchases), emission reductions would be higher.

However, airlines alone cannot bear the full responsibility for limited SAF adoption, particularly in regions where regulatory frameworks are weak or absent. Even in regions with SAF mandates, these often lack robust sustainability criteria, permitting the use of problematic biofuels with no incentives to use e-kerosene.

An additional factor to consider is the minimal involvement of traditional oil producers in the e-kerosene market. Despite their incumbent market position and financial resources, which

could be pivotal in scaling e-kerosene production, they continue investing in fossil fuels rather than shifting to clean fuels.

Big Oil companies, governments, and airlines can drive change to ensure the take-off of sustainable aviation fuels by following these recommendations:

- Oil companies should engage in the e-kerosene market by developing e-kerosene projects themselves or by investing in and/or buying e-kerosene from other companies.
- Countries without SAF mandates and/or frameworks should establish them, incorporating robust sustainability criteria to prevent the use of the least sustainable biofuels, whilst promoting e-kerosene.
- Countries that already have SAF mandates and/or frameworks should limit the use of unsustainable biofuels, set e-kerosene sub-targets, and enforce robust penalties for non-compliance.
- Countries with mandates should complement them with incentives to drive SAF prices down, especially for e-kerosene, such as tax credits, grants, low-interest loans, state guarantees, contracts for difference.
- The EU should propose a robust and bold strategy for the development of e-kerosene. It has a unique opportunity with the upcoming European Clean Industrial Deal to complement the mandate approach of ReFuelEU Aviation with regulatory measures and incentives to support e-kerosene production and investment, whilst reducing the green premium.
- Airlines should focus on the quality and the scalability of the SAF they buy, rather than rely on unsustainable and non-scalable fuels if they want to achieve meaningful emission reductions. Moreover, by signing early MoUs and offtake agreements with e-kerosene producers or directly investing in these projects, airlines can support the uptake of e-kerosene in the market.

Further information

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Sources

The analysis heavily relies on information from press releases and company announcements. The data and analysis reflects SAF agreements up to August 2024, as data collection concluded then. Links to many of these announcements can be found in the spreadsheet (Annex 2). In addition, we used the following sources for the analysis:

- SAF offtake agreements
 - [Bloomberg NEF - Airline SAF Procurement Tracker](#)
 - [ICAO SAF Procurement Tracker](#)
 - [Biofuels Central](#)
 - [Quantum Commodity Intelligence](#)
 - [CORSA emission factors](#)
 - Company websites
 - Airline annual reports
- SAF producers
 - [Bloomberg NEF - Global Renewable Fuel Projects Tracker](#)
 - [Stratas Advisors - Renewable Fuel Project Tracker](#)
 - [Argus - Renewable Fuel Project Tracker](#)
 - Company websites
 - Annual reports
- Fuel consumption
 - [OAG Airlines Schedule Data](#) for the period 2019-2023
 - Airline, fuel producer and fuel supplier annual and sustainability reports
- Airports with SAF
 - [ICAO SAF mandate map](#)
 - [Eurocontrol SAF map](#)
 - [OpenFlights](#)
 - Press announcements
- SAF legislation
 - [World Economic Forum SAF mandate map](#)
 - [ICAO SAF mandate map](#)

Annex 1: Questions & Answers

What is the purpose of this observatory, and who is the target audience?

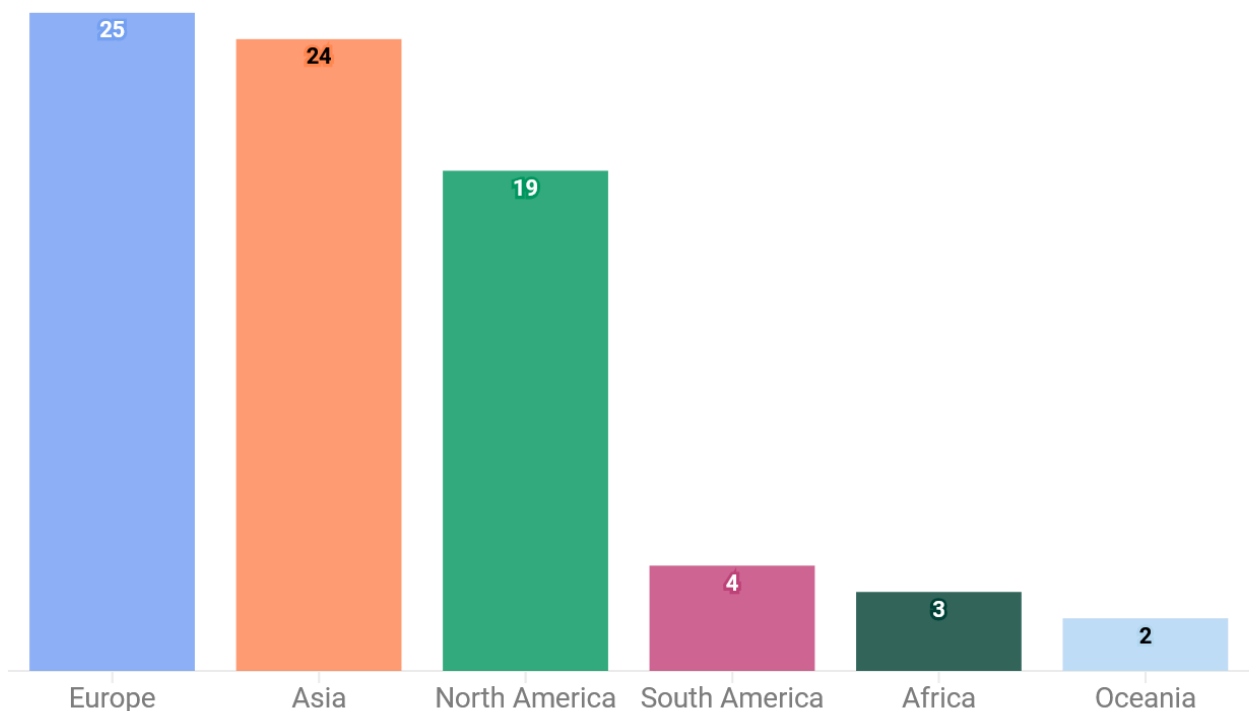
The ranking aims to evaluate airlines' progress in adopting sustainable aviation fuels (SAF) and transitioning to net-zero emissions. It provides transparency for stakeholders, including airlines, policymakers, investors, and the public, to drive action and accountability in the aviation sector. It also sheds light on the responsibility of major oil companies in the lack of development and uptake of e-kerosene, as well as the importance of regulatory frameworks.

How did you select the airlines?

The airlines and airlines group analysed were selected based on their size, fuel consumption, and SAF ambitions. These represent approximately 75% of global airline jet fuel consumption in 2023. The selection includes some of the largest global airlines as well as smaller carriers with SAF-related agreements.

Where are the airlines in T&E's SAF observatory based?

Europe Asia South America North America Oceania Africa



Source: T&E (2024)



How do you attribute points to the airlines?

The ranking is based on three main components:

- **Core criteria (up to 100 points):** Emissions savings through SAF, shares of advanced biofuels, and e-kerosene.
- **Bonus criteria (up to 50 points):** Ambition-related actions, such as SAF targets, e-kerosene non-binding agreements, and investments.
- **Malus criteria (-5 points):** Reliance on unsustainable food- and feed crop-based biofuels.

Points are awarded using data from airlines' reports, SAF agreements, and sustainability actions. Specific methodologies and assumptions are outlined in the annex.

How does an airline get an A, B, C or D grade?

Airlines are graded based on their total score:

- **A (75–100 points):** Significant SAF uptake, aligned with a credible path to net-zero emissions.
- **B (50–74 points):** Moderate SAF usage and commitments; on track to meaningful emissions reductions.
- **C (25–49 points):** Limited SAF uptake and ambition, not sufficient for substantial emissions reductions.
- **D (0–24 points):** Minimal or no SAF uptake or commitments; significant gaps in climate action; often reliance on a large amount of unsustainable crop-based biofuels.

Currently, no airline qualifies for category A. The majority, 87% (67 airlines), fall into category D.

Why did no airline achieve an A grade?

No airline achieved an A grade because none meets T&E's criteria for emissions reductions, SAF use, and commitments to advanced biofuels and e-kerosene. At the moment, no airline/airline group has sufficient e-kerosene and advanced biofuels purchases and offtake agreements to be aligned with T&E's aviation roadmap. More generally, current SAF offtake is not on track to get the aviation industry to net-zero in 2050: neither in terms of quantities nor in terms of the quality of the SAF used.

What would it take for an airline to score 100/100?

To score 100/100 points, airlines will have to meet T&E's "gold standard", based on its [climate neutral aviation roadmap by 2050](#): an average of 5.2% emissions reduction from 2020 to 2035, at least 4.8% and 8.5% of advanced and waste biofuels in 2030 and 2035 respectively, and at least 2% and 10.4% of e-kerosene in 2030 and 2035 respectively.

Why is e-kerosene emphasised so heavily in the report?

E-kerosene is the most sustainable and scalable form of SAF, offering up to 90% emissions reductions over fossil jet fuel. Unlike crop-based biofuels, e-kerosene avoids competition with food supply and deforestation risks. It is crucial for long-term decarbonisation of aviation.

Why do some airlines have a zero score despite using SAF?

This situation occurs when airlines rely heavily on unsustainable crop-based biofuels, which attract a penalty of -5 points. This reflects their reliance on fuels with high environmental and social impacts, such as those driving deforestation or competing with food supply. Additionally, a few airlines have significant offtake agreements for SAF from unknown sources without specifying the feedstocks used. We do not count such SAF towards the ranking as we cannot assess the emissions savings it provides.

Did the airlines have the opportunity to review the data?

Yes, all ranked airlines were given the opportunity to review and verify the data used for the ranking. However, only 21 airlines responded. The rankings will be updated annually or biannually, incorporating feedback from stakeholders where possible.

Which airlines are doing well?

- **European airlines** lead in sustainability due to regulatory frameworks that promote e-kerosene and exclude unsustainable crop-based biofuels. European airlines project higher relative emissions reductions by 2030 compared to other geographies despite lower SAF volumes (i.e. North American airlines).
- **North American airlines** have higher SAF offtake volumes but rely heavily on crop-based biofuels, limiting sustainability gains.
- **Airlines from Asia, Africa, and South America** lag significantly, with minimal SAF adoption or regulatory support.

Airlines in countries with robust SAF mandates and incentives, such as the EU and UK, demonstrate the most progress.

Do airports not shown on the SAF availability map not offer SAF?

The airport information provided is not exhaustive, and some airports offering SAF may not be listed. The tracker includes airports with a confirmed, steady SAF supply, as identified in the [ICAO Airports map](#) and the [Eurocontrol SAF map](#). It also highlights airports with current or future offtake agreements, excluding letters of intent and memorandums of understanding. Some of the airports not listed may have received batches of SAF in the past, but their current supply is unclear.

How does the report forecast emissions and SAF consumption?

The report forecasts emissions and SAF consumption by combining airline data, industry trends, and established methodologies. Key steps include:

1. **Baseline analysis:** We use airlines' reported fuel and SAF consumption data, supplemented by public reports and traffic schedules, to estimate current emissions and fuel use.
2. **Traffic growth & efficiency:** A conservative **2.2% annual growth rate** in air traffic is assumed together with a **1.1% annual improvement** in fuel efficiency, accounting for fleet modernization and operational enhancements. Note that [IATA](#), for instance, forecasts a significantly higher **global annual traffic growth of 3.8%** until 2043.
3. **SAF commitments:** SAF offtake agreements and MoUs are analysed, with volumes spread over agreement durations.
4. **Emission reductions:** Lifecycle emissions savings are calculated based on SAF types and the CORSIA methodology. Projections reflect SAF's share of total fuel use.

How reliable are the data sources for SAF agreements and emissions?

The ranking relies on publicly available data, including annual reports, environmental reports, press releases, and SAF project trackers. While airlines were invited to review the data, not all responded, introducing potential gaps. Future updates aim to incorporate additional feedback and verified data.

How do you address data gaps or inaccuracies in SAF agreements?

When data is unavailable, assumptions are made based on industry norms (e.g., SAF volumes spread evenly over agreement durations). Such estimates are conservative, ensuring credibility while highlighting the need for greater transparency from airlines. Please refer to the Annex 2 of the briefing for a more detailed explanation of the assumptions made.

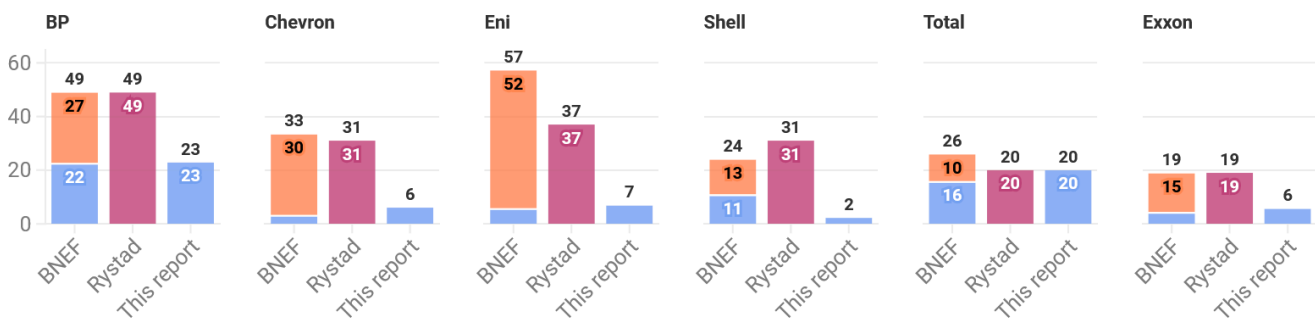
Why does the report suggest that oil majors are not committed enough to SAF when other reports imply the opposite?


According to a [recent report](#) by Rystad Energy, for instance, oil majors are betting on biofuels. Their analysis considers BP, Chevron, Shell, TotalEnergies, ExxonMobil and Eni, and finds a total biofuel production capacity of 260 thousand barrels per day. However, it does not differentiate between HVO (biodiesel) and SAF production. In contrast, our analysis focuses exclusively on SAF. The HVO and SAF production capacity we estimate based on the Bloomberg NEF Renewable Fuel Project tracker is consistent with Rystad’s assessment, but we exclude Shell’s biofuels project at the Shell Energy and Chemicals Park Rotterdam as it was [paused in July 2024](#). We find that SAF is only a small share of the selected oil majors’ total biofuel production.

Operational and planned SAF/HVO production capacity estimates for selected oil majors

Production capacity in thousand barrels/day

■ SAF ■ HVO ■ HVO/SAF



Source: T&E (2024), based on data by BNEF (Oct. 2024) and Rystad Energy (2024). Assume BNEF co-product shares; exclude paused/abandoned projects, but include Shell Energy and Chemicals Park Rotterdam biorefinery. This report includes selected producer outlooks for certain refineries compared to BNEF • Note that SAF outputs could vary if refiners opt to shift production from renewable diesel to SAF at certain facilities. 

Beyond quantities, it is crucial to highlight that oil majors are relying on the wrong feedstocks. Our analysis includes 27 projects aiming to produce SAF, with most of them betting on fats and oils (21) and only [one proposal](#) for an e-SAF project, led by Shell. In other words, the limited SAF production that Big Oil is planning is largely based on unscalable waste oils and fats, as well as

unsustainable virgin vegetable oils. Instead, oil majors should prioritise investment in sustainable and scalable alternatives such as e-kerosene—the only SAF with the potential to fully decarbonise the aviation sector.

Annex 2: Methodology

Introduction

This methodological annex provides a detailed explanation of the data collection, assumptions, limitations, and calculations used in the SAF observatory. It covers the offtake agreements, airline fuel consumptions, as well as feedstocks and emissions.

The ranking is based on publicly available information retrieved from airlines' and airline groups' financial and environmental reports, articles and press-releases on their offtake agreements, memorandum of understanding (MoUs), letters of intent (LoIs), investments and purchases of SAF. All the data retrieved was submitted to the ranked airlines and airline groups for review; however, only 21 airlines responded, introducing potential gaps in the data. Consequently, we cannot guarantee the completeness or correctness of the information provided. The ranking will be updated on a yearly or bi-yearly basis, unless the information is updated through direct input from stakeholders.

Methodology

We collected information on SAF agreements through desk research, using sources such as the ICAO SAF Project Tracker, Google News, Biofuels Central, Quantum Commodity Intelligence, and the BNEF SAF Tracker.

We only included SAF agreements that we could identify through public sources, such as press releases, project websites, or company reports. We linked these agreements with renewable fuel plants and their feedstocks based on data from Stratass and the Bloomberg NEF Renewable Fuels Tracker. We estimated emissions savings by considering the SAF pathway and the feedstocks used with the help of CORSIA emission factors. Where necessary, we estimated offtake periods and volumes based on information about renewable fuel plants and expected emissions savings.

We then selected 77 global passenger and cargo airlines to put the SAF agreements in context, based on airline size and SAF ambition. These airlines are a mix between some of the world's biggest airlines (in terms of passenger numbers and fuel consumption) and smaller airlines that have SAF offtake agreements were selected for the ranking. They were responsible for around 75% of global airline jet fuel consumption in 2023 (211 Mt out of [282 Mt of fuel](#)). We gathered information on the airlines' fuel and SAF consumption, as well as their SAF targets, from their annual reports, ESG reports, and traffic reports and flight schedules.

We then projected each airline's current fuel consumption into the future to estimate their expected emissions savings from SAF, as well as their SAF and e-kerosene shares up to 2035.

We only included standalone offtake agreements and agreements related to investments in this analysis, as we consider them more binding than MoUs and Lols.

Using this information, we ranked the different airline groups on a scale from 0 to 100. The aim of the ranking is to provide an overview where different airlines and airline groups stand in terms of their SAF agreements. The ranking awards 100 points for emissions savings and e-kerosene as well as advanced biofuels. Scoring 100 points would imply that an airline has a credible pathway to reduce its emissions until 2035 in line with T&E's 2022 aviation roadmap. In addition, we award 50 bonus points for SAF targets, investments, e-kerosene agreements and emissions reductions in 2024. This is because we are aware that SAF production still needs to be scaled up. Therefore, it is crucial that airlines send the right signals to fuel producers to help scale up SAF production. At the same time, this commitment needs to translate into emissions reductions which is why we reserve the right to reduce the amount of bonus points in future versions of this ranking. Finally, we award 5 malus points for airlines relying on food- and feed crop-based biofuels because of the problems associated with these fuels besides their high carbon emissions.

Analysis of SAF agreements

The analysis of the SAF agreements requires a range of assumptions that are explained in the following:

- **Neat SAF:** All SAF volumes are expressed in terms of neat SAF.
- **Equal shares:** Joint SAF purchases are evenly split between purchasing parties unless explicitly specified otherwise.
- **Spread across time:** For multi-year offtake agreements, we assume the airline consumes an equal portion of SAF each year over the duration of the agreement. In practice, some airlines may choose to use more SAF in later years, especially as mandates increase.
- **SAF blending:** When blends are purchased, the tracker lists the respective SAF shares. If no information is available, we assume a 40% blend, as this is a common blending ratio respecting the current ASTM certification limit of 50% SAF.
- **Estimate offtake durations:** If offtake durations are not specified:
 - Assume 5 years for agreements exceeding 5000 tonnes.
 - Otherwise, assume a one-time purchase.
- **Estimate start dates:** If start dates are not specified, assume:
 - An immediate start for operational SAF production facilities.
 - A start date aligned with the commencement of SAF production at the facility in question.
- **Delays:** If SAF projects are delayed, assume that the start of SAF offtake is also delayed.
- **Cancellations:** If SAF projects are cancelled or the producer has filed for bankruptcy, assume the SAF offtake is cancelled.

- **Offtake producer matching:** Offtake agreements are matched with renewable fuel projects based on the producer, offtake periods, volumes, and geographic location. Feedstocks are linked to offtake agreements based on the feedstocks used by the SAF producers.
- **Choosing feedstocks:** When several feedstocks are listed for a renewable fuels facility, use the feedstock with the highest carbon intensity to provide a lower estimate for emissions savings from the SAF offtake agreement.
- **ReFuel EU compliance:** For SAF uptake in the EU, assume biorefineries use the ReFuel EU-compliant feedstock with the highest carbon intensity, even if alternative vegetable oils are listed for road biofuels. This means that all hydroprocessing refineries supplying SAF to the EU are assumed to use waste oils, not virgin vegetable oils.
- **Unknown waste oils:** SAF made from waste oils, fats, and greases includes all non-virgin vegetable oils and feedstocks claimed as waste by SAF producers, unless specified otherwise. This might include feedstocks like palm oil production residues, which may not be eligible under ReFuel EU.
- **Municipal solid waste:** For SAF made from municipal solid waste, assume a 50% non-biogenic carbon fraction.
- **Recycled carbon fuels:** For SAF made from industrial flue gas, municipal solid waste, and some other novel pathways, the SAF may partly be a Recycled Carbon Fuel (RCF) and not a biofuel. We count RCFs towards T&E's advanced biofuel targets for simplicity, given the currently low volumes. This is to be revised in a future update of the SAF observatory.
- **e- and biofuel co-processing:** For SAF made using Power-Biomass-to-Liquid processes, where e-fuels and biofuels are co-produced, count the SAF towards T&E's e-fuel targets, as these volumes remain very limited (less than 0.01% of e-fuels offtake). This is to be revised in a future update of the SAF observatory as the number of offtake agreements with such projects increases.
- **Estimate volumes from emissions reduction:** When airlines claim emissions reductions but do not specify purchased SAF volumes, assume a 100% emissions reduction based on the CORSIA fossil fuel comparator (89 gCO₂eq/MJ) and an SAF lower heating value (LHV) of 44 MJ/kg to estimate the minimum SAF purchased.
- **Estimate volumes from flights:** If airlines report specific flights on which SAF was used but do not provide volumes, estimate SAF volumes based on flight schedules, aircraft type, and flight distance. Convert SAF blends to neat SAF using a density of 0.76 kg/l.
- **SAF not listed in CORSIA:** When SAF feedstock and/or pathway is not listed in CORSIA (e.g. SAF projects using novel pathways or carbon capture and geological storage without enhanced oil recovery), use the target carbon intensity provided by the producer.
- **Corn-based SAF:** Many airlines (Alaska Air Group, American Airlines Group, ANA Group, Delta Air Lines, Finnair, Hawaiian Airlines, IAG, JAL Group, Lufthansa Group, Qatar Airways Group, SAS Group and Virgin Atlantic) have offtake agreements for corn-based SAF with the fuel producer Gevo. Gevo [claims](#) that their corn-based SAF can reach a carbon intensity of approximately 39gCO₂e/MJ under CORSIA. We still decided to use CORSIA's default ethanol-to-jet emissions factor of 90.8gCO₂e/MJ for all US corn

grain-based SAF because it remains uncertain whether Gevo will actually achieve such emissions savings. Corn-based biofuels, as all food and feed biofuels, are not sustainable because of their inefficient use of land, competition with food security, negative impacts on the environment and their contribution to indirect land use change.

- **Unknown SAF like fossil fuel:** If no information on feedstock or carbon intensity is available, assume the SAF does not reduce emissions compared to fossil fuels.
- **Long-term offtake:** When airlines invest in a renewable fuels facility and agree to purchase all or most of the output, assume the airline takes 50% of the nameplate capacity output, with a jet fuel yield of 50% over 20 years, unless otherwise specified.
- **Freight forwarding:** When freight companies co-sponsor SAF purchases for their customers, we attribute the SAF consumption to their customers as we try to consider only scope 1 emissions whenever possible.

Analysis of airline fuel consumption

The analysis of the fuel and SAF consumption of airlines/airline groups requires a range of assumptions that are explained in the following:

- **European Airlines:** Estimate fuel consumption from 2019 to 2023 using OAG flight schedule data and T&E's in-house CO₂ emissions model unless annual reports provided more accurate information.
- **Financial years:** When airline fuel consumption is listed for the financial year in annual reports, approximate the calendar year's fuel consumption based on the financial year's data.
- **Estimates from fuel volumes:** We assume the density of fossil jet fuel to be 0.81 kg/l and the density of SAF to be 0.76 kg/l.
- **Estimates from emissions:** If annual reports list Scope 1 emissions for CO₂ or CO₂e, assume that all emissions are tailpipe emissions, with a carbon intensity (CI) of 3.168 gCO₂/MJ for jet fuel.
- **Estimates from air traffic:** When estimating fuel consumption based on air traffic data:
 - Assume 3.32 litres per 100 available seat kilometres (ASK).
 - Assume 22.1 litres per 100 available tonne kilometres (ATK).
 - Extrapolate both values with a 1.1% annual fuel consumption growth rate.
- **Estimates from energy consumption:**
 - When estimating fuel consumption based on energy consumption, assume a lower heating value (LHV) of 43 MJ/kg for fossil jet fuel and 44 MJ/kg for SAF.
- **Extrapolate 2023 fuel consumption:**
 - Assuming 2.2% annual growth in traffic.
 - Assuming 1.1% annual improvement in fuel efficiency.

- Note that this is a conservative estimate as the aviation industry still has not recovered from the Covid-19 pandemic in 2023 and global traffic growth rates are expected to be significantly higher than 2.2% ([ICAO](#), [IATA](#)).
- **Missing data:** When data for individual years is missing, estimate fuel consumption on a case-by-case basis (e.g. estimate consumption relative to 2019 values using trends in passenger numbers, available tonne kilometres, etc.).

Ranking Criteria

The ranking consists of core criteria, bonus criteria and a malus criterion:

- **Core criteria:** Emissions savings + SAF scale-up
 - Aligned with T&E's 2022 aviation roadmap.
 - **Example:** We assume that an airline with a fuel consumption of 1Mt in 2023, is going to use 16 Mt of fuel between 2020 and 2035 (Lower traffic during the pandemic and 1.1% annual fuel consumption growth from 2023 to 2035). To meet the targets set in T&E's aviation roadmap, this airline will need to buy 0.8 Mt of SAF including 0.4 Mt of e-kerosene in this period. Assuming zero LCA emissions for the SAF used, this implies an average of around 5% emissions reduction from 2020 to 2035.
 - Average emissions savings of 5.2% between 2020 and 2035 - **50 points**
 - **Example:** An airline with total estimated emissions of 10Mt CO₂eq between 2020 and 2035 buys SAF that will reduce its emissions by 0.1Mt CO₂eq emissions. This corresponds to emissions savings of 1% over this period and the airline is awarded 10 points.
 - Advanced and waste biofuel share of 2.5% in 2030 and of 8.5% in 2035 - **10 + 10 points**
 - **Example:** An airline is expected to use 1.25% of advanced biofuels in 2030 and 4.25% in 2035. Accordingly, it receives 10 points.
 - E-kerosene share of 2% in 2030 and of 10.4% in 2035 : **15 + 15 points**
- **Bonus criteria:** Ambition for SAF, scalable advanced biofuels (no waste-oil biofuels) and e-kerosene
 - SAF target: **5 points**
 - E-kerosene target: **5 points**

- Only count targets that go beyond legal mandates
 - **Example:** An airline has a 5% SAF target for 2030, but no e-kerosene target. It receives 5 points.
- Advanced biofuel investments: **5 points**
 - Do not count investments into crop-based and waste-oil biofuels projects
 - **Example:** An airline invests \$1 million into a biofuels project using municipal solid waste. It receives 5 points.
- E-kerosene investments: **10 points**
 - **Example:** An airline invests \$1 million into an e-fuels project. It receives 5 points.
- E-kerosene MoUs, Lols: **5 points**
 - Only count MoUs and Lols with offtake volumes greater than 1000 tonnes.
 - **Example:** An airline has an MoU with an e-kerosene producer to purchase most of their plant's output. It receives 5 points, but the offtake volume is not counted towards the core points.
- E-kerosene offtake agreements: **10 points**
 - Only count offtake agreements and investment with offtake guarantees greater than 1000 tonnes.
 - **Example:** An airline has an offtake agreement with an e-kerosene producer to purchase most of their plant's output. It receives 10 points, and the offtake volume is counted towards the core points.
 - **Example 2:** An airline invests into an e-kerosene producer and agrees to purchase most of the plant's output. It receives 10 points for the offtake agreement, 10 points for the investment, and the offtake volume is counted towards the core points.
- 2024 emissions savings: **10 points**
 - Reward early movers who are using SAF to reduce their emissions by up to 0.2% this year.
 - **Example:** An airline has an offtake agreement that reduces its emissions by 0.1% this year. Accordingly, it receives 5 points.
- **Malus criterion:** Reliance on food- and feed crop-based biofuels
 - Offtake agreement for food- and feed crops: **-5 points**

- Only count offtake agreements and investment with offtake guarantees greater than 1000 tonnes.

Analysis of jet fuel and SAF production of selected oil companies

The analysis of the jet fuel and SAF production of selected oil companies mainly relied on the Bloomberg NEF Renewable Fuel Project Tracker (Oct. 2024) and the Stratas Renewable Fuel Project Tracker (Oct. 2024) as well as annual reports.

- **2023 jet fuel refining:** Estimate fossil jet fuel production estimated via refinery throughput and net refining capacities based on 2023 annual reporting.
- **Projection:** Do not project refinery capacities since refiners might decrease refining capacity even when demand for refined products is growing.
- **Company selection:** This is not a ranking of refiners. Other refiners such as Petrobras, Valero, Marathon Petroleum Corporation, China National Petroleum Corporation and Rosneft refine similar volumes of jet fuel.
- **Co-product shares:** Assumptions about co-product shares taken from BNEF (2024) where available. Note that SAF outputs could vary if refiners opt to shift production from renewable diesel to SAF at certain facilities.

Limitations

While attempting to be comprehensive, this study suffers from a series of limitations due to limited time, data availability and uncertainty around future projections:

Uncertainty around SAF agreements

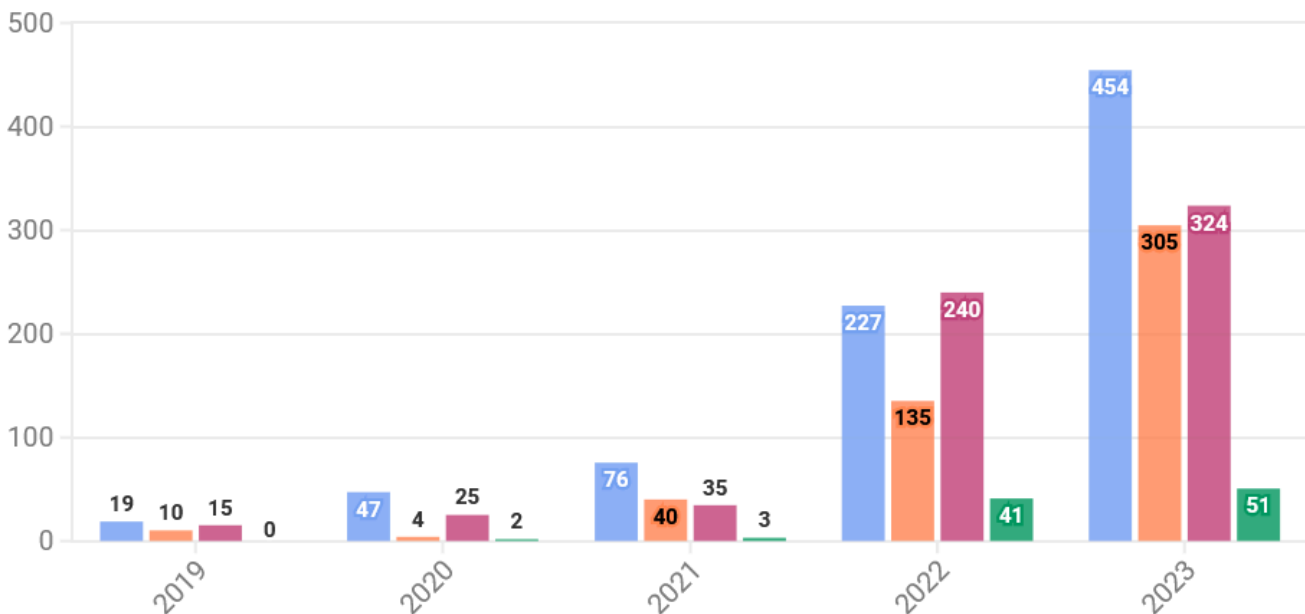
- **Agreements unknown:** We lack information about non-public offtake agreements.
 - Comparing airline groups' annual reporting with public offtake agreements, we found that a number of airline groups reported SAF consumption from 2019-2023 that could not be attributed to public offtake agreements.
- **Fuel suppliers and airports buying SAF:** We are likely to underestimate the SAF consumption driven by fuel suppliers and airports introducing SAF unilaterally (including because of SAF mandates).
 - We compared SAF consumption volumes reported by airlines with public offtake agreements and the mandated SAF volumes in Sweden, Norway and France. We found that airlines generally used more SAF than mandated but less than their offtake agreements indicated. This may in part be due to the ongoing ramp-up of SAF production. Still, public offtake agreements have been a good indicator of total SAF consumption in the past.

- **Production uncertainty:** There is uncertainty around offtake volumes for long-term offtake agreements with a single SAF producer as many of the largest SAF offtake agreements since many SAF production facilities are not operational yet. Bloomberg NEF believes that only around 75% of the nameplate SAF production capacity announced for 2030 will be online by 2030.
- **Timing:** There is uncertainty around offtake periods. When not available, we assume a start year based on when a renewable fuel plant is expected to be operational and an offtake duration based on the offtake volumes and the fuel plant's (expected) capacity.
- **Some agreements are better than others:** Different offtake agreements come with different legal obligations, and some are more binding than others. Without detailed information on every agreement, it is difficult to compare individual agreements. As a compromise, we decided to distinguish between memorandums of understanding, letter of intent, offtake agreements and investments with offtake commitment.

Airline SAF reporting roughly matches public offtake agreements

■ IATA SAF production estimate
 ■ Airline SAF reporting
 ■ SAF offtake in T&E SAF observatory
 ■ French, Norwegian and Swedish SAF mandates

SAF consumption in kt



Source: T&E (2024), based on data from ICAO (2024), BNEF (2024), Stratas (2024), press announcements



Uncertainty around sustainability of SAF

- **Feedstocks unknown:** There is uncertainty around the exact type of feedstock used by the different projects. The feedstock composition and therefore the sustainability of the resulting fuel may fluctuate and change over time.
- **CORSIA emission factors:** We believe that CORSIA underestimates the emissions of some waste feedstocks such as forestry residues depending on which residues are used and how they are collected. Hence, real emissions savings from these SAF offtake agreements may be lower than assumed here.
- **Risk of fraud:** There is a significant risk of fraud around many waste feedstocks that may lead to higher emissions. For instance, virgin vegetable oils could be fraudulently labelled as waste oil. SAF produced from virgin vegetable oils would have significantly higher emissions than assumed here.

Uncertainty around future jet fuel consumption

- **Fast airline growth:** Airlines that have not recovered from the Covid 19-pandemic in 2023 or fast-growing airlines are expected to have a higher fuel consumption growth in the years ahead. We believe that the 1.1% annual fuel consumption growth rate is a conservative estimate.
- **Every airline is different:** There is individual variation in air traffic growth that we do not consider in this study. For instance, cargo airlines or airlines with a significant share of cargo may have different growth projections than a low-cost passenger airline.

Annex 3: List of airline groups in ranking

Airlines/airline groups included in the ranking

- Aegean Airlines, Aeroflot, Aerolíneas Argentinas, Air Canada, Air China, Air Europa, Air France-KLM, Air Greenland, Air India, Air New Zealand, Air Transat, AirAsia, airBaltic, Alaska Air Group, Amazon Air, American Airlines Group, ANA Group, Asiana Airlines, Atlas Air Worldwide, Avianca Group, Binter Canarias, Cargolux, Cathay Pacific Airways, Cebu Air, China Airlines Group, China Eastern Airlines, China Southern Airlines, Copa Airlines, Croatia Airlines, Delta Air Lines, DHL Group, easyJet, Egyptair, Emirates Group, Ethiopian Airlines, Etihad Airways, Eva Air, FedEx Express, Finnair, Frontier Airlines, Garuda Indonesia, Grupo Aeroméxico, Hawaiian Airlines, IAG, Icelandair, IndiGo, ITA Airways, JAL Group, Jet2, JetBlue, Kenya Airways, Korean Air, LATAM Airlines Group, LOT Polish Airlines, Lufthansa Group, Malaysia Aviation Group, Norwegian, Oman Air, Qantas, Qatar Airways Group, Ryanair, SAS Group, Singapore Airlines Group, Smartwings, Southwest Airlines, SriLankan Airlines, TAP Air Portugal, Thai Airways International, Turkish Airlines, United Airlines, UPS Airlines, Virgin Atlantic, VivaAerobus, Volaris, Volotea, WestJet Airlines, Wizz Air

Selected airlines/airline groups not (yet) included in the ranking

- Spirit Airlines, Pegasus Airlines, Gol Transportes Aéreos, Azul Linhas Aéreas, VietJet Air, Allegiant Air, Air Arabia, S7 Airlines, Uzbekistan Airways, Philippine Airlines, flydubai, Air Astana, SunExpress, SpiceJet, Ural Airlines, SKY Airline, UTair Aviation, Sky Express, Air Serbia, Flybondi, Starlux Airlines, Widerøe, Luxair, SATA Group, Alliance Air (India), PLAY, NordStar, Loganair, Norse Atlantic Airways, Voepass, Andes Líneas Aéreas, TUI Airways, Condor, Nordwind Airlines, Azur Air, Smartavia, Red Wings Airlines, Belavia, TAROM, Azerbaijan Airlines, Enter Air, Azimuth, Pegas Fly, Air Malta, Yamal Airlines, SkyUp, I-Fly, Bulgaria Air, Windrose Airlines, Tunisair, Royal Air Maroc, FlySafair, Air Peace, Air Algérie, Air Mauritius, Libyan Airlines, Caribbean Airlines, Air Caraïbes, InterCaribbean Airways, Cubana de Aviación, Air Antilles, Cayman Airways, Bahamasair, Winair, Western Air, St Barth Commuter, Air Guyane Express, Aruba Airlines, Ukraine International Airlines, Hainan Airlines, Lion Air Group, Jeju Air, Royal Jordanian, Biman Bangladesh Airlines, Pakistan International Airlines, Air Incheon, T'way Air, Vietnam Airlines, Sunclass Airlines, Bangkok Airways, Fiji Airways, South African Airways

Annex 4: SAF agreements considered

- [Link to Google Sheets](#)