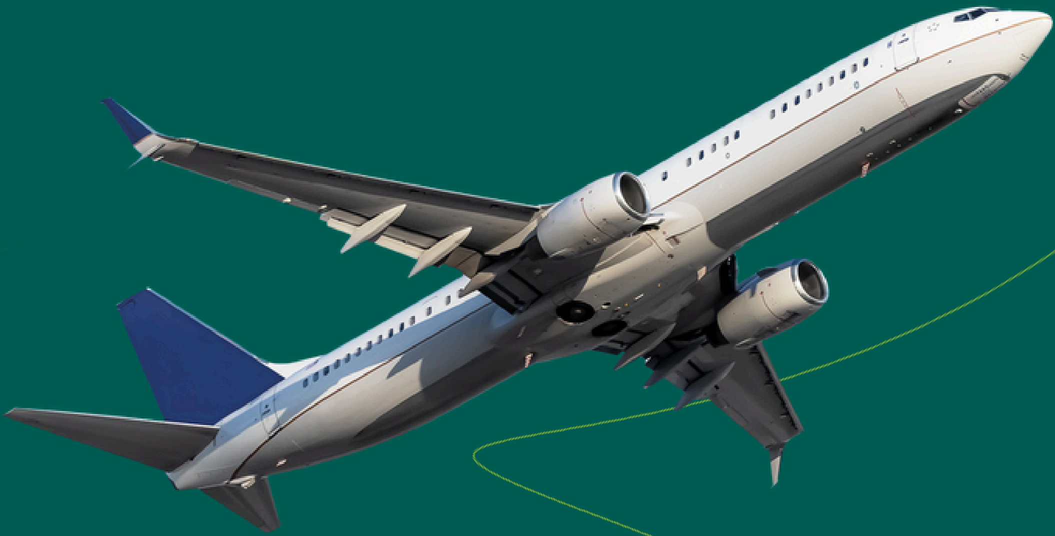

# A FALSE CHOICE BETWEEN CARBON REMOVALS AND E-SAF

## HOW DO WE ESCAPE THIS CARBON TUNNEL VISION?

SKYNRG

# INTRODUCTION

As European industry and policymakers work to de-risk electro-sustainable aviation fuel[1] (e-SAF) production to meet the 2030 ReFuelEU blending targets, the cost and energy needs of these novel fuels are becoming clearer. At the same time, fossil jet fuel coupled with carbon removals, particularly direct air capture and storage (DACS), are viewed by some as a cost-effective and less energy-intensive alternative for addressing aviation's climate impact. This narrative creates a false choice between two technologies that should be seen as complementary within a broader climate change mitigation strategy.

This article argues that framing carbon removals and e-SAF as competing options is not only flawed but also harmful, because it risks delaying European SAF projects that have capital ready to be deployed. Removals offer critical solutions for unavoidable emissions and support negative emissions, while e-SAF reduces the climate impact of aviation and drives systemic transformation in the energy sector. The increasing reliance on removals as a perceived "low-cost" alternative risks delaying the structural investments needed for a sustainable future for aviation. In this article, we call for a more balanced approach: one that recognizes the complementary roles, distinct benefits, and limitations of both pathways.

## But first: what is aviation's environmental challenge?

The world is currently on track for more than 2°C of warming, far exceeding the Paris Agreement goal. Aviation is a major driver of this challenge, responsible for about 2% of global $CO_2$ emissions, and demand for air travel continues to rise. According to IATA, if the sector takes no decarbonization measures, aviation's annual emissions could climb to around 1.9 billion tonnes of $CO_2$ by 2050.[2]

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[1] e-SAF, also known as electro-sustainable aviation fuel or power-to-liquid (PtL) fuel, is a synthetic aviation fuel produced using renewable electricity, water, and captured carbon dioxide (CO2).
[2] IATA (2025). Minimizing residual CO2 emissions in 2050.

This is not the only challenge. Aviation also warms the climate through non-$CO_2$ effects. When aircrafts burn fuel, they release water vapor, soot, and pollutants such as NOx and sulfur, which can under specific circumstances form contrail clouds that influence the climate. Although fewer than 3% of flights account for 80% of contrail-related warming, the total warming impact of contrails is estimated to be roughly as large as that of aviation's $CO_2$.[3]

IATA, the representative association for airlines, addresses the issue in their Net Zero Roadmaps and relies on four pillars to address aviation's climate impact:[4] 1) energy efficiency and infrastructure, 2) new propulsion technologies, 3) SAF and 4) carbon offsets and removals. SAF is the single biggest lever, expected to deliver 65% of total emission reductions by 2050. This includes bio-SAF and e-SAF.

So far, sustainable bio-resources are limited especially for the most commonly used technology for SAF production: Hydrotreated Esters and Fatty Acids (HEFA). Sustainable oily feedstocks are expected to bring us to max. 20% of jet fuel substitution.[5] A large gap must be covered with advanced, more costly, scalable technologies, such as e-SAF and advanced bio-based SAF. The aviation sector expects that carbon offsets and removals will contribute to the final 19% of residual emissions, showing the complimentary nature of offsets for emissions that cannot be mitigated within the supply chain.

[3] Teoh et al. (2023). Global aviation contrail climate effects from 2019 to 2021.
[4] IATA (2025). Net zero 2050: sustainable aviation fuels (SAF).
[5] SkyNRG and ICF (2025). SAF Market Outlook 2025.
[6] The point in time when greenhouse gas emissions reach their highest level before starting to decline.
[7] Harry B Smith et al. (2024) Residual emissions in long-term national climate strategies show limited climate ambition.

Carbon removals, through methods like biochar or DACS, have a crucial role to play in decarbonization strategies, but only to deal with the very last slice of residual emissions. Smith et al. (2024) argue that today, climate strategies assume that around 21% of peak emissions[6] in developed countries and 34% in developing countries will remain “hard-to-abate.” [7] That adds up to billions of tonnes of $CO_2$ that would already need to be removed to reach temperature goals. On top of this we need removals to clean up the excess of $CO_2$ in the atmosphere that has built up over time. The fundamental problem here is that the world simply does not have enough high-integrity removals to clean up our mess from the past and add billions of tonnes of additional emissions by 2050. Relying on them as a fallback is a dangerous illusion, as it takes away focus on avoidance and efficiency efforts. Instead of outsourcing responsibility to removals, we must double down on in-sector reductions, which in the aviation sector already exist today.

### Inset vs. offsets

At the core of the e-SAF vs. carbon removals debate is the distinction between insets and offsets. Insets are measures that directly reduce emissions within a company’s own value chain, such as switching to e-SAF in aviation. Offsets, by contrast, take place outside the value chain, like forestry projects or direct air capture, and are typically traded as certificates. According to the Science Based Targets initiative (SBTi), companies must first cut at least 90% of their emissions within their own operations and supply chain. Only the residual ~10% can be neutralized with removals. This means the question is not whether to choose e-SAF or removals. Both are necessary in a long-term climate strategy, but removals should never come at the expense of in-near term in-sector mitigation options.

At SkyNRG we want the aviation sector to take responsibility and mitigate its impact on the climate as quickly as possible, while safeguarding aviation access for all. We recognize that to reach this goal we need both insets and offsets. However, recent narratives have suggested that we should reconsider e-SAF mandates, and instead focus more on carbon removals, mostly on the basis of energy demand and cost per tonne of $CO_2$ avoided.[8] We argue that this would be detrimental to the energy transition for the following reasons: 1) industrial transition 2) energy independence, 3) legislative uncertainty and 4) climate change mitigation costs.

[8] Höglund (2024). Removals are better than some reductions — The case of electrofuels for aviation.

## 1. Industrial transition

Beneath the need to transition aviation fuel lies a broader recognition of the cascading benefits of investing in e-SAF. Next to its role in decarbonizing aviation, e-SAF serves as an important enabler of renewable energy deployment. European and UK legislation enforce electricity to be renewable and additional to ensure that the electricity is first used in sectors where it can make the most impact. As a major and predictable offtaker of green hydrogen, e-SAF production provides the long-term demand needed to unlock investment in wind and solar power, and electrolysis. In providing this firm demand, e-SAF production supports grid expansion and drives down hydrogen costs through economies of scale. At the same time, Europe's refining capacity for liquid fossil fuels is in decline, threatening both industrial resilience and energy security.[9] Investing in e-SAF production can counter this trend by sustaining and modernising Europe's advanced industrial base. Unlike carbon removal projects, which are often isolated and deliver limited spillover effects, e-SAF builds up an ecosystem of industrial capabilities that strengthens Europe's strategic autonomy. By treating carbon removals as a substitute for e-SAF, Europe risks losing its first-mover advantage in clean fuel technologies and missing a critical opportunity to reinforce its green industrial base.

## 2. Energy (in)dependence

Relying too heavily on carbon removals as a climate solution for aviation also poses significant risks to Europe's energy independence. The Ukraine war has shown how dependency on fossil fuel imports can lead to geopolitical challenges.

[9] EUISS (2025). The lifeblood of the military: The energy transition and operational capacity.

Unlike carbon removals, which keep us reliant on imported fossil fuels, e-SAF directly replaces fossil jet fuel with an 'in Europe'-produced alternative. This approach reduces Europe's exposure to geopolitical energy risks, price volatility, or supply chain disruptions. It accelerates the shift towards a clean, self-sufficient energy system, which is the type of energy system we urgently need in this age of heightened geopolitical tensions. A common argument against e-SAF is that it represents an inefficient use of 'limited' renewable energy and, by extension, of capital. This claim is a strawman and often incorrect. While it is correct that the decarbonization of heat and electricity must take priority, this principle is already embedded in e-SAF policy: the European Commission has established strict sustainability criteria on the additionality of renewable electricity to ensure that e-SAF deployment does not come at the expense of broader decarbonization goals.

## 3. Legislative uncertainty

So far, the European Union and the United Kingdom (UK) have implemented e-SAF blending mandates. Shifting focus in climate policy towards carbon removals risks undermining the broader industrial transition required to decarbonize aviation. With over 40 European SAF projects in the pipeline,[10] investors are ready to deploy capital. SkyNRG's shareholders alone manage over one trillion EUR in funds and are making their first investments in SAF.[11] If policy and market signals shift toward removals instead of fuel substitution, a lot of this project development and fundraising could be delayed or abandoned due to increased policy risk. This locks the market into existing fossil jet fuel infrastructure and may slow down the development of a renewable fuel production system, focused only on biofuel and fossil fuels. The legislative certainty created by blending mandates should not be underestimated, as demonstrated by other end-use sectors that are pursuing similarly effective policies. It is therefore important that emerging carbon removal narratives do not erode support for mandates like ReFuelEU, which, when combined with targeted de-risking measures, can play a central role in enabling a European.

[10] T&E (2025). Spotlight on e-SAF.
[11] SkyNRG (2025). APG, on behalf of ABP, makes strategic investment of up to €250 million in SkyNRG, a leader in Sustainable Aviation Fuel.

## 4. Climate change mitigation cost

Relying on carbon removals instead of investing in e-SAF also overlooks the full environmental impact of aviation. Aviation's warming is not just from $CO_2$ but also from non-$CO_2$ warming effects like contrail formation, which can double the climate footprint of fossil jet fuel. SAF, especially at high blend levels, can reduce both $CO_2$ and contrail-related effects by lowering soot emissions that drive contrail formation, and also emits less NOx, sulphur and other pollutants that harm local air quality and the health of ground personnel.[12] In this sense, e-SAF investments address more of aviation's real externalities than removals, which only compensate for $CO_2$. A 2022 Nature study[13] estimated the social cost of carbon at $185/t$CO_2$.[14] This suggests that burning a tonne of jet fuel could inflict several hundred dollars in damages even before accounting for non-$CO_2$ effects. While exact cost comparisons remain uncertain, prioritising e-SAF ensures that these broader externalities are mitigated directly, strengthening both the climate case and the credibility of the aviation sector's transition.

## Moving from dichotomies to synergies

Carbon capture and e-SAF are too often framed as a false dichotomy, when in reality they can be synergistic. By balancing $CO_2$ flows between storage providers and utilization pathways, industrial emitters can diversify revenues and reduce project risks. The real barrier for e-SAF and storage projects in this regard is not access to $CO_2$, but structuring projects that financial institutions consider bankable. That requires end-use sectors to work together to de-risk capture and unlock investment in large-scale climate solutions. At the same time, we must resist carbon tunnel vision. Corporates should keep carbon removals as a last resort for truly unavoidable emissions or to clean up emissions from the past and not as a license to pollute and continue using fossil fuels. Policies should therefore continue embracing the power of mandates that drive strategic in-sector solutions like e-SAF, rather than fixating narrowly on cost per tonne of $CO_2$ mitigated.

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[12] DLR (2024). Flying using 100 percent sustainable aviation fuel significantly reduces non-carbon-dioxide emissions.
[3] Rennert et al. (2022). Comprehensive evidence implies a higher social cost of CO2.
[14] The social cost of carbon monetizes the impact of climate change on aspects such as agriculture, mortality, energy consumption and sea-level rise.