STAY GROUNDED
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Greenwashing Fact Sheet Series

"Greenwashing" is misinformation intended to mislead others about the environmental impact of activities.

Globally, the aviation sector plans to triple in size by 2050 which would see aviation fuel consumption and therefore greenhouse gas (GHG) emissions, double. Governments, lobbied by the sector, use unrealistic and distracting promises of technological solutions and offsets to greenwash this growth. They also use economic growth and job arguments to justify subsidies and tax breaks for airports, airlines, manufacturers and fossil fuel companies. In our series of Fact Sheets, we examine these claims and debunk common myths and misconceptions.

5 - Synthetic Electro-fuels

Synthetic electro-fuels or "e-fuels" (also known as "Synfuels" or Power-to-Liquid (PtL) fuels) are liquid hydrocarbon fuels that can be produced by combining hydrogen with carbon and that can be used in existing aircraft blended with fossil kerosene. Together with biofuels (see Fact Sheet #4), the sector calls them "Sustainable Aviation Fuels" (SAF) which, like biofuels, they are not, as we demonstrate in this Fact Sheet.

WHAT THE AVIATION SECTOR TELLS YOU

E-fuels will gradually take over from biofuels
which are limited by insufficient biomass availability and raise sustainability issues.

Happening soon
E-fuels could start to be blended with kerosene in 2030.

Zero emissions
Neither their production or their combustion would *add* CO_2 to the atmosphere.

Government support required
Due to the significant extra cost, public money is needed for e-fuels to keep travel costs low, so that aviation growth is not affected.

WHAT THEY ***DON'T*** TELL YOU

E-fuels also suffer from resource limitations
Primarily from the limited availability of renewable electricity which is required in huge quantities for producing e-fuels. This conflicts with other more essential sectors that need to decarbonise. Biogenic CO_2 (i.e. from organic sources) is another restricted resource, with sustainability issues.

Too late
E-fuels do not address the climate emergency. Although the technology has been demonstrated, it is still at the pilot stage and several decades of heavy investment would be needed to scale up production.

Not zero before long, if ever
The full decarbonisation of the energy and the CO_2 needed is difficult to achieve and e-fuel can only eliminate a small part of the predominant non-CO_2 climate effects of aviation.

Governments should not subsidise e-fuels
Subsidising a highly inefficient and expensive fuel would divert money needed in other sectors where the transition would be cheaper, faster and provides more social benefit.

For many, e-fuels seem to be the ultimate solution for decarbonising aviation, because they could be used directly in all types of current aircraft, whatever their range; and unlike biofuels they – superficially – do not seem to suffer from raw material limitations, as they can be made from water, air (for CO_2 extraction) and electricity, which can be produced sustainably.

So why are there no aircraft powered by e-fuels yet (in 2026) and very few likely for another ten years or so? Mainly because the production of e-fuels is extremely wasteful of energy and therefore very costly. Also because this is a new industry starting almost from scratch that still needs to complete process development and make heavy investments.
Also, why does ATAG (Air Transport Action Group, a global association that represents all sectors of aviation) project that so-called SAF would contribute only 58% toward achieving net-zero by 2050, with carbon offsetting and carbon capture still required to cover 21%? Why does ATAG have a fallback scenario with only 38–51% of "SAFs" and up to 32% offsetting and carbon capture?[1] This is because the sector's most ambitious scenario is under severe strain, due to the limited availability of resources and the difficulty in producing fuels that reduce emissions by more than 80%.

WHICH RAW MATERIALS AND PROCESSES MAKE E-FUEL?

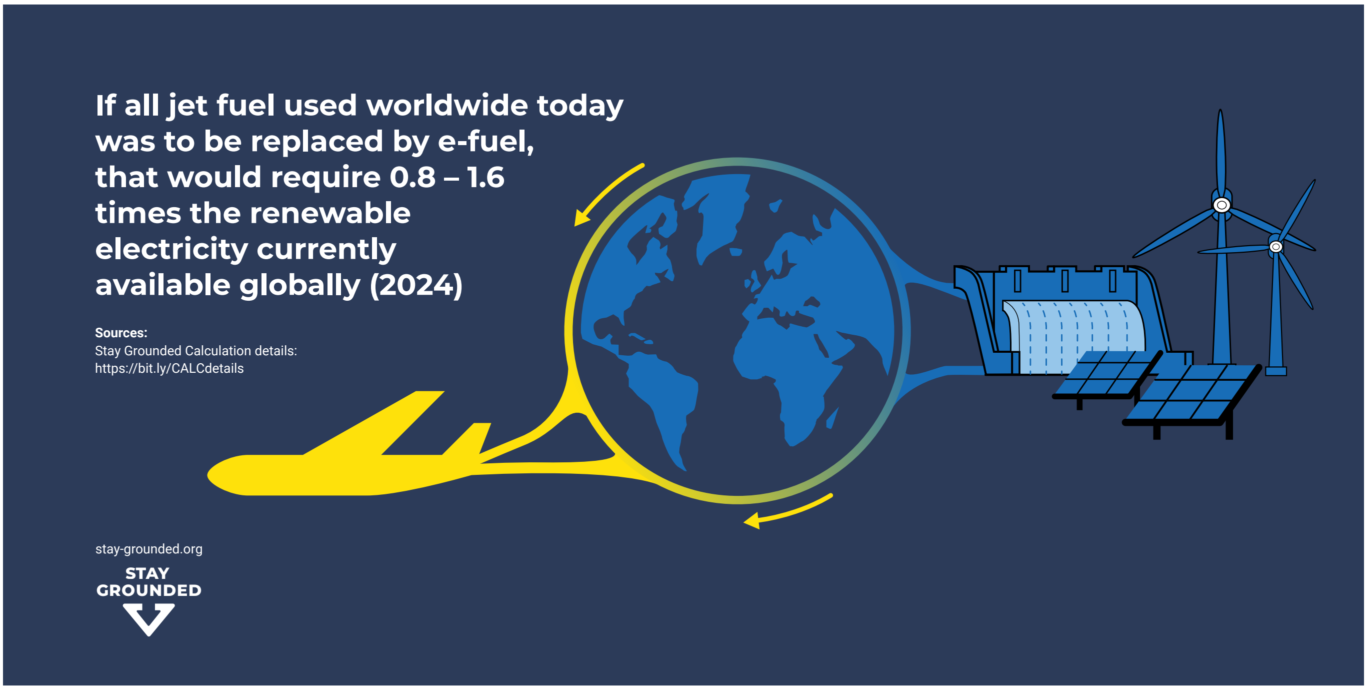
Synthetic electro-fuel or "e-fuel" can be produced by **combining hydrogen with carbon dioxide (CO_2) to create a liquid hydrocarbon. In 2026, two pathways are being contemplated, Fischer-Tropsch and Methanol to Jet.** Both produce a mix of hydrocarbons that subsequently needs to be refined to separate out molecules that are suitable for jet-fuel.

The **Fischer-Tropsch** process[2] is relatively old. It has been used to convert coal or fossil gas into liquid fuel but has so far never been successfully used with biomass as a raw material, nor has it been used to synthesise jet-fuel from hydrogen and CO_2. In this case a preliminary step still under development is needed to make syngas.[3]

A newer pathway that would produce a higher proportion of jet-fuel than the Fischer-Tropsch process (90% vs 60%), **Methanol to Jet**, is being given preference by about half of current projects, although it is still under development and is not yet certified for use in aircraft.[4] It involves the synthesis of e-methanol from hydrogen and CO_2, followed by several steps to transform methanol into hydrocarbons suitable for jet-fuel.

Whatever the process, unless recently discovered reserves of natural **hydrogen** can be sustainably exploited,[5] hydrogen has to be produced by **electrolysing water with low-carbon electricity**.

In the longer term, **CO_2 could be extracted from the atmosphere** (where it is present in 2026 at a concentration of 430 ppm (0.04%)) by Direct Air Capture (DAC) **but for now, it would be mostly captured from the exhausts of biomass combustion or fermentation** ("biogenic" CO_2), where it is present at much higher concentrations and could be extracted more efficiently[6] at a comparatively lower cost. This is nevertheless still hypothetical since none of these processes have ever been proven at scale.[7,8] CO_2 could also be captured from fossil fuel combustion fumes or cement plants, as temporarily allowed by the EU[9], but this would be at the expense of carbon neutrality.



E-FUELS, LIKE BIOFUELS, RELY ON HIGHLY CONSTRAINED RESOURCES, ESPECIALLY RENEWABLE ELECTRICITY

PRODUCING E-FUELS WOULD REQUIRE HUGE QUANTITIES OF RENEWABLE ELECTRICITY THAT WOULD DEPRIVE ALL OTHER SECTORS THAT NEED TO DECARBONISE

If all the jet fuel used worldwide today was to be replaced with e-fuels, that would require 0.8–1.6 times the renewable electricity currently available globally (2024).[10]

Electricity is not only massively needed to produce hydrogen, but also for CO_2 capture and for the successive stages of the synthesis process (see infobox), with very low overall energy efficiency. In total, **not more than about 10% of the electricity spent would be converted ultimately into thrust to move an aircraft.**[11]

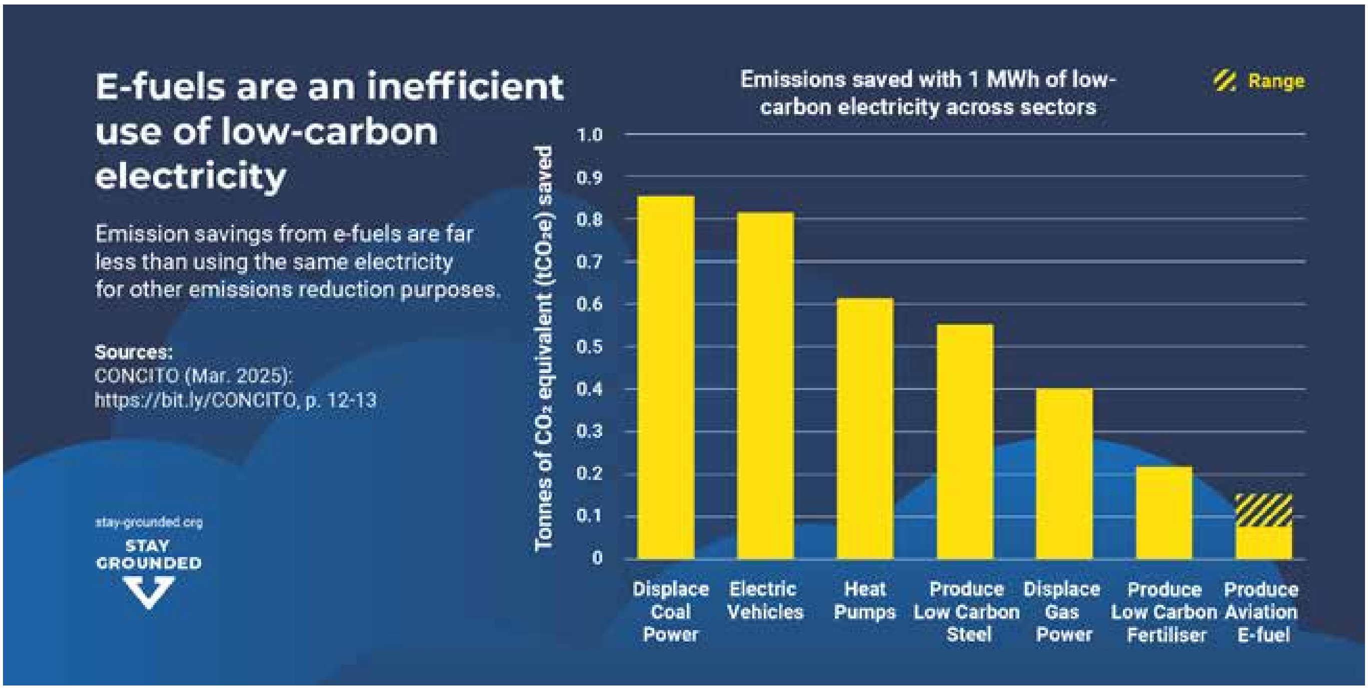
For decades to come, the production capacity of renewable electricity will still not be enough to decarbonise the global economy, irrespective of aviation. It should therefore be used primarily by sectors that make best use of it and that provide our most essential needs.[12] In regions of abundant renewable energy far away from an electricity grid, green hydrogen would be more efficiently used to produce low-carbon steel and fertiliser rather than e-fuels. If the e-fuel deployment plan were to be rolled out nonetheless, the huge electricity needs create the risk of further expansion of dangerous and eyewateringly expensive nuclear power at a massive scale, which would take decades to build and therefore arrive far too late[13].

BIOGENIC CO2, ANOTHER BOTTLENECK

Achieving the highest climate impact reduction with e-fuels would mean banning the use of CO_2 resulting from the combustion of fossil fuel and instead using CO_2 removed from the atmosphere. This could be done by DAC but, as the energy requirement is very high,[14] and with the process still in its infancy, companies aiming to produce e-fuel predominantly plan to use so called biogenic CO_2, i.e. CO_2 resulting from the combustion or fermentation of biomass. Verso Energy, for example, with four e-fuel projects in France has secured exclusive contracts with biomass-burning paper mills to capture CO_2 from their chimneys.[15] However, none of the potential sources are truly sustainable and they can entail significant environmental risks.[16,17] One risk has been clearly identified: CO_2 capture is energy-intensive and could lead operators to burn more biomass for this purpose. If the demand for biogenic CO_2 exploded, the increased pressure on biomass would further threaten forests and their essential role as carbon sinks and biodiversity protection. It would also increase competition with other sectors like forestry.[18,19]

SIGNIFICANT WATER REQUIREMENTS WOULD ENDANGER MORE ESSENTIAL USES

A large amount of water is required to make e-fuels, mostly for hydrogen production. Total gross requirements could reach about 20 tonnes of water for each tonne of e-fuel produced. For example, the quantity needed for EU aviation in 2050 would be equivalent to the domestic consumption of 9 million inhabitants.[20] This freshwater consumption may often be in areas that are suffering from severe drought and water and food insecurity.



E-FUELS CANNOT BE SCALED UP RAPIDLY ENOUGH TO MEET CLIMATE TARGETS

The deployment of e-fuels is likely to be slow and take several decades. Very few countries have concrete plans for implementation. Currently only the EU prescribes that e-fuels are incorporated into fossil jet-fuel, but this will only start in 2030 with a quite small - but still challenging - rate of 1.2% (600 kt) to reach 5% in 2035.[21] Airlines for Europe, the largest EU airline association, expects that the EU's e-fuel production in 2030 will not exceed 1% of the mandated 600 kt (0.01% of total jet fuel)![22]

Combined with all the issues related to biofuels (see Fact sheet #4), this is far behind the emissions reduction pace that must be achieved in order to not exceed the globally agreed 1.5°C heating target (or even 2°C): according to the United Nations Environment Programme (UNEP), worldwide greenhouse gas (GHG) emissions must be reduced by 58% by 2030 versus 2025 (see also Fact Sheet #6).[23] Furthermore, although there are a lot of production projects around the world, almost none have reached FID (a Final investment Decision) in 2026, so there is no chance that the 2030 EU requirements will be met. In particular, despite numerous attempts, the process of capturing CO_2 from biomass combustion flue gases has never been proven at scale.

E-FUELS WILL PROBABLY NEVER LEAD TO ZERO EMISSIONS

CO_2 emissions from e-fuels could theoretically be cut down to zero, but this is unlikely to ever happen. The key point is the source(s) of the CO_2 needed for the fuel synthesis.

A few projects would use **fossil CO_2**, that is CO_2 resulting from the combustion of fossil fuel, which is allowed by the EU until 2040, but this would just be like using fossil fuel a second time and still result in additional emissions ending up in the atmosphere. Achieving the highest climate impact reduction with e-fuels would mean banning the use of fossil CO_2 and instead using **CO_2 removed from the atmosphere**. There are two ways to do that: either via DAC, or using so-called biogenic CO_2. **DAC** is not contemplated by any known e-fuel project. **Biogenic CO_2** from burning wood is not carbon-neutral, because the CO_2 emitted is not fully reabsorbed by new plantations before 50 to 100 years, assuming they survive.

Another issue is that the **electricity** required in massive quantities for the process won't be carbon-neutral anytime soon if it comes from the grid, since it will be a long time before the grid is decarbonised. The alternatives are either to produce renewable electricity specifically or to buy renewable electricity through PPAs (Power Purchase Agreement)[24], but relying on PPAs means that in practice other users will be deprived of access to clean power.

It must also be emphasised that aviation should not only reduce CO_2 emissions but also non-CO_2 emissions which, when included, triple the climate impact.[25] Although both biofuels and e-fuels are expected to reduce contrail cirrus and their climate impact, recent flight tests and associated modelling have indicated that the reduction versus kerosene would only be 26%.[26] Even then this would only be achieved when fossil fuel is fully replaced by e-fuel, which would not happen for several decades. There are other ways to reduce contrails that could be fully effective much earlier, i.e. contrail avoidance[27] and fossil fuel hydrotreatment.[28] Furthermore e-fuels would still emit harmful nitrogen oxides (NOx), the derivatives of which also have a significant climate impact. **Non-CO2 benefits cannot therefore be used to advocate for e-fuels**.

GOVERNMENTS SHOULD NOT SUBSIDISE AVIATION E-FUEL

The complex processes and the huge energy requirements for producing e-fuel will result in extraordinarily high costs: **the production cost ranges between 9 and 13 times the 2024 market price of kerosene**.[29] Although the production cost of e-fuel may decrease,[30] it would still cost significantly more than kerosene in the future. To make the product affordable, governments are therefore pressured for subsidies, which are paid by taxpayers, most of whom never or rarely fly.[31] This may enable a new sector without any benefits for the planet and, worse, hinder the transition of other more essential sectors. Subsidies would also keep the price of flying artificially cheap, resulting in more air traffic and emissions.

CONCLUSION

The truth of the matter is that e-fuel will long remain a rare and expensive fantasy. It is hardly a commodity fit to replace kerosene in the future even in today's quantities, let alone the larger volumes required by aviation's growth aspirations. The only true solution is to reduce air traffic now.

While the development of new technologies and fuels may be helpful, it cannot be an excuse to delay regulation to reduce air traffic NOW to prevent further climate collapse.

In our Red Line manifesto and our Just Transition paper, we outline different reduction measures and how transitioning the sector can guarantee the livelihood of workers.

FURTHER INFORMATION

The 8 Fact Sheets and a two page Summary Fact Sheet can be found here: stay-grounded.org/greenwashing

1. Efficiency Improvements
2. Electric Flight
3. Hydrogen Flight
4. Biofuels
5. Synthetic Electro-fuels
6. Net Zero & Carbon Neutrality
7. Carbon Offsets
8. Negative Emissions Technologies (NETs)

Red Line manifesto:
https://bit.ly/RLAmanifesto

Policies to degrow aviation:
stay-grounded.org/policies-to-degrow-aviation/

Just Transition Paper:
https://stay-grounded.org/just-transition/

END NOTES & LITERATURE

[1] ATAG (2026): https://bit.ly/ATAGwaypoint2050
[2] Wikipedia: https://bit.ly/WP-FT
[3] Observatoire français des e-fuels (Sept. 2024): https://bit.ly/e-fuels-FR p. 19
[4] Observatoire international des e-fuels (April 2025): https://bit.ly/e-fuels-INT p. 14-15
[5] Euronews (2024): https://bit.ly/whiteH
France 3 (2026): https://bit.ly/Hnat
[6] Recharge (Sept. 2021): DAC requires almost as much energy as that contained in the fossil fuels that produced the carbon dioxide in the first place. https://bit.ly/Recharge_DAC
[7] Biofuelwatch (2022): https://bit.ly/BECCShype
[8] Allied offsets (2025): https://bit.ly/stateDAC
[9] EUR-lex: https://bit.ly/refuelEU
[10] Stay Grounded: Calculation details https://bit.ly/CALCdetails
[11] Stay Grounded: Calculation details https://bit.ly/CALCdetails
[12] CONCITO (Mar. 2025): https://bit.ly/CONCITO, p. 12-13
[13] Rising Tide UK (2021): https://bit.ly/risingT
[14] Recharge (Sept. 2021): DAC requires almost as much energy as that contained in the fossil fuels that produced the carbon dioxide in the first place. https://bit.ly/Recharge_DAC
[15] Verso Energy: https://bit.ly/verso-vosges, https://bit.ly/verso-saillat
[16] T&E (2025): https://bit.ly/biogenicCO2, Briefing p. 8-9
[17] Biomass Action Network (2026): https://bit.ly/false-promise
[18] CONCITO (Mar. 2025): https://bit.ly/CONCITO, p. 23
[19] T&E (2025): https://bit.ly/biogenicCO2, Briefing p. 8-9
[20] Stay Grounded: Calculation details https://bit.ly/CALCdetails
[21] T&E (2023): https://bit.ly/TE-ReFuelEU
[22] Airlines for Europe (2026): https://bit.ly/A4E-CLIMATE
[23] UNEP (2025): https://bit.ly/UNEPgap2025
[24] Wikipedia: https://bit.ly/WP-PPA
[25] Stay Grounded (2020): https://bit.ly/factsheetClimateImpact
[26] Märkl et al (2024-03): https://bit.ly/SAFcontrails
[27] Stay Grounded (2026): https://bit.ly/contrail-avoidance
[28] Stay Grounded (2023): https://bit.ly/jetfuelHT
[29] EASA (2025): https://bit.ly/SAFprice
[30] Allied Market Research (2024): https://bit.ly/SAFtrend
[31] Stay Grounded (2023): https://bit.ly/3KmlhAb

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