Synkero: Futureproof Aviation

What is Synkero?

Synkero is a startup company that is developing a synthetic kerosene facility in the Port of Amsterdam. The facility will produce 50.000 ton of synthetic Sustainable Aviation Fuel (SAF) per year from 2027 onwards. Synkero is supported by its core partners: KLM, Royal Schiphol Group, Port of Amsterdam, SkyNRG and the city of Amsterdam.

It is our mission to reduce carbon emissions from flying by developing a network of facilities that produce carbon neutral[1] and clean synthetic SAF : starting in Amsterdam.

Why?

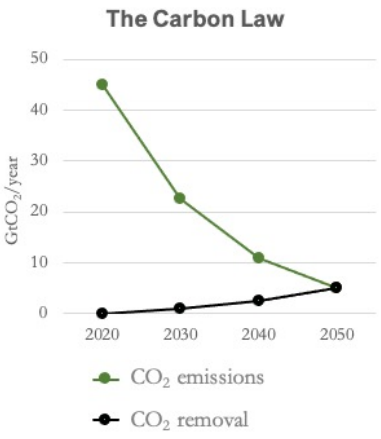

Figure 1: The global carbon law guiding pathways

In order to keep our planet livable, we need to halve our emissions every decade and reach net zero emissions by 2050.

The aviation sector, however, is hard to decarbonize. Ninety eight percent of its emissions come from kerosene combustion. Due to its need for high energy density[2] liquid fuel, kerosene will power the majority of flights in the coming decades. For long haul flights it is expected that SAF is the only option to decarbonize. To make flying more sustainable, kerosene must become more sustainable.

There are several feedstock and technology options to produce sustainable aviation fuels. All of those are needed to decarbonize the aviation industry. Currently SAF is mainly produced from waste oils such as used cooking oil. The availability of these feedstocks is limited, so it is essential to diversify resources (and thus technologies) to scale up SAF. In the near future, SAF produced from waste streams derived from agriculture and forestry will be added to the mix but eventually all biomass-based feedstocks are limited. Therefore, synthetic SAF is an essential part of a sustainable future for aviation.

Synkero focuses on the synthetic route of SAF production, where the feedstocks (energy, water and carbon dioxide (CO_2)) are widely available. When synthetic kerosene is made from CO_2 captured from the air or from biogenic source, burning the fuel will emit the same amount of CO_2 that was used to make it: Carbon Neutral.

[1] With green hydrogen and biogenic carbon dioxide our feedstock is carbon neutral. The facility itself will be built in the most eco-friendly matter as possible.
[2] Energy density of kerosene is 35 GJ/m^3: approximately 4x higher than liquefied hydrogen

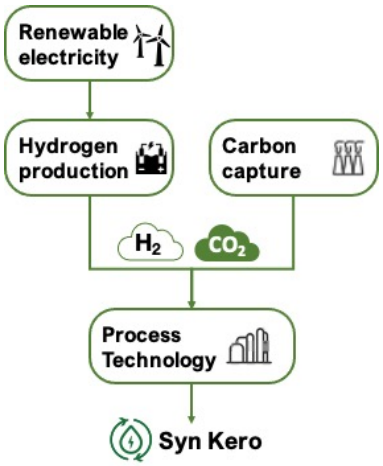

Figure 2 : The Syn Kero production process

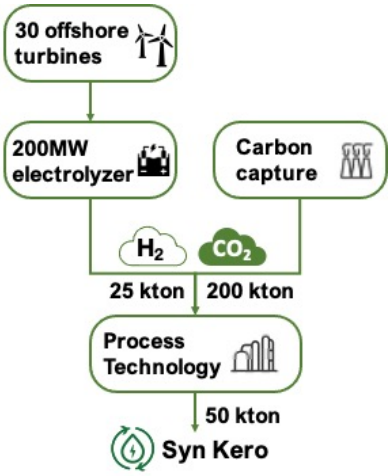

Figure 3 : Energy requirements for 50 kton of Synthetic SAF

How is synthetic kerosene produced?

There are several steps and technologies needed to produce synthetic kerosene which are also called e-fuels, Synthetic SAF, or Power to Liquid (PtL).

Without going into all the details, Synkero basically needs **green hydrogen** (H_2) and **carbon dioxide** that are fed into a chemical process. The CO_2 can be captured from a biogenic industrial process (point source) or in the future, from the air (Direct Air Capture, DAC).

Currently 99% of hydrogen is made from fossil fuels. Green hydrogen can be produced by electrolysis of water, for which a vast amount of renewable electricity is needed. Green hydrogen is not available in large quantities at the moment, and scaling of green hydrogen production (and the related renewable electricity capacity) is one of its key challenges.

What is needed?

Synkero will build a facility that produces 50.000 ton of SAF per year. This is comparable[3] to 1% of the annual fuel usage of Schiphol airport in 2019.

To reach this volume, Synkero needs approximately 25.000 ton of green hydrogen and 200.000 ton of CO_2 per year, volumes that require (dedicated) pipelines to continuously feed the facility.

The production of 25.000 ton of green hydrogen requires about 1.200 GWh of renewable energy and a 200MW electrolyzer capacity. To put this in perspective: roughly 30 offshore wind turbines are needed, which equals 2,5% of all offshore wind capacity currently planned in The Netherlands for 2030. Multiple electrolyzer projects have been announced: the first 100MW project should become operational in 2024 in the Netherlands.

This significant amount of renewable energy and technologies are needed to decarbonize 'only' 1% of the "pre-covid" kerosene demand. Based on this, you can imagine what it takes to decarbonize the Dutch, European or even the global aviation sector.

Why do we start in Amsterdam?

You don't have to be an engineer to understand that it is impossible to decarbonize the entire Dutch aviation sector with synthetic kerosene powered by Dutch energy. The Netherlands is a densely populated country with a large energy intensive industry. As with oil, the import of green hydrogen from sunny and windy locations will be required to satisfy our future energy needs.

However, Amsterdam is a perfect region to start this innovation. KLM and Schiphol are frontrunners in the aviation sector on sustainability. The Port of

[3] Before covid-19 Schiphol used 4 million tons kerosene per year.

Amsterdam has existing infrastructure to Schiphol and a lot of industry expertise in liquid fuels. Also, several carbon capture and hydrogen projects have been initiated in the region. Plus, there is active support from the city of Amsterdam and the province of Noord Holland.

How to scale?

We want to develop a network of synthetic kerosene facilities around the world, in countries with abundant solar and wind energy to produce SAF without a negative impact on the decarbonization of other sectors. Therefore, we aim to work with partners that share our mission and also want to create global impact.

Ten years ago, it was hard to imagine that solar energy would cost about 1 cent per kWh[4] and that the price of batteries would fall by 89%[5]. Due to scale and innovation we are close to the point where electrical vehicles become cheaper than petrol cars.

Figure 4 : Area requirement for renewable energy (illustrative)

We foresee the same development for the aviation sector. Synthetic kerosene is substantially more expensive than fossil kerosene. However, carbon emissions already have a price tag and expected EU blending mandates will increase SAF demand rapidly. In parallel, by scaling and learning the cost of electrolyzers will decrease, lowering the costs for green hydrogen and due to replication and further scaling the cost of technology to produce synthetic kerosene will fall as well.

Every hour our planet receives the same amount of energy from the sun as the entire world consumes in a year. The European "pre-covid" demand for kerosene (60 million tons/yr) could be produced by a solar energy park of 'only' 100 x 100 km in a sunny desert. Sunny and windy countries like Morocco, Spain, Chili, Oman, Saudi Arabia, and so many more, will therefore become the energy suppliers of the future.

Synkero is here to stay. With our partners and long-term commitments, we support the energy transition and accelerate the development of renewable energy and green hydrogen production.

And you?

We hope this clarifies where we are up to and how we want to get there. Flying less is obvious the quickest and most cost-effective way to reduce CO_2 emissions. If we, in parallel, scale-up production of synthetic kerosene worldwide, we can reduce the climate change impact of flying together.

Feel free to follow us on Linkedin and/or subscribe to our newsletter. We welcome your questions at info@synkero.com.

[4] https://reneweconomy.com.au/saudi-solar-plant-locks-in-new-record-low-price-for-power-1-04c-kwh/
[5] https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/