fathom
Independent Thinking

Electricity will be the new jet fuel

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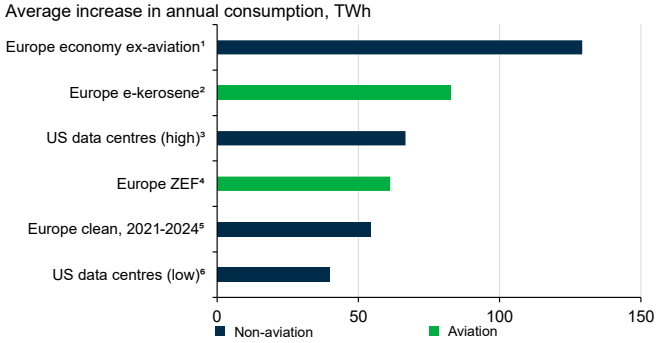
- Decarbonising aviation will require much higher production of clean electricity and hydrogen, as each of the two truly scalable low-carbon ways to fly — e-kerosene[1] and hydrogen-powered zero-emission flight (ZEF) — require a huge amount of both
- Europe's strategy for net-zero flight has until now relied heavily on a switch to sustainable aviation fuels (SAFs) produced from waste; but it has become clear that shortages of feedstocks such as used cooking oil, agricultural waste and municipal waste mean that less than a fifth of aviation can realistically be decarbonised in this way by 2050 and beyond,[2] leaving e-kerosene and hydrogen the only viable long-term options
- Europe currently produces 2,140 Terawatt hours (TWh) of clean electricity per year, including wind, solar, nuclear and other renewables; by 2050, excluding aviation, we project that it will need to produce nearly 5,500 TWh of clean electricity, and possibly more, depending on its success at building up its AI capabilities — decarbonising aviation would in addition require between 1,593 TWh (if done fully with ZEF) and 2,148 TWh (if done fully with e-kerosene) per year
- Thus to decarbonise its economy by 2050, starting from now clean electricity production in Europe will need to rise by approximately 129 TWh each year (excluding aviation), 191 TWh (with ZEF), or 212 TWh (with e-kerosene), assuming all aviation fuels are produced in Europe

Electricity demand forecasts

Average increase in annual consumption, TWh



1. European economy-wide clean electricity demand excluding aviation to 2050
2. Clean electricity needed to decarbonise all European aviation by 2050 using e -kerosene (Fathom central)
3. Electricity demand from US data centres, higher -end forecast to 2030 (McKinsey)
4. Clean electricity needed to decarbonise 100% of European aviation by 2050 using ZEF (Fathom central)
5. European clean electricity demand increase, average 2021 –2024
6. Electricity demand from US data centres, lower -end forecast to 2030 (IEA)

Source: McKinsey / IEA / Fathom Consulting

1. A synthetic aviation fuel, considered a SAF under European and UK policy, which is synthesised into a fuel using green hydrogen and captured carbon.
2. See Fathom's latest report, *Europe's flightpath to economic competitiveness* — other countries may be slightly better placed but feedstock shortages are set to be a global problem for SAFs. See also this working paper from the International Council for Clean Transportation *Estimating sustainable aviation fuel feedstock availability to meet growing European Union demand*

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- For context, clean electricity production increased by an average of 54 TWh per year between 2021 and 2024 in Europe, while analysts expect the much-talked-about expansion in US electricity demand from data centres to add between 40 and 67 TWh of demand each year out to 2030 – in other words, cleaning up aviation in Europe could use more electricity than US data centres[3] and require more new clean electricity each year than Europe currently adds for its entire economy

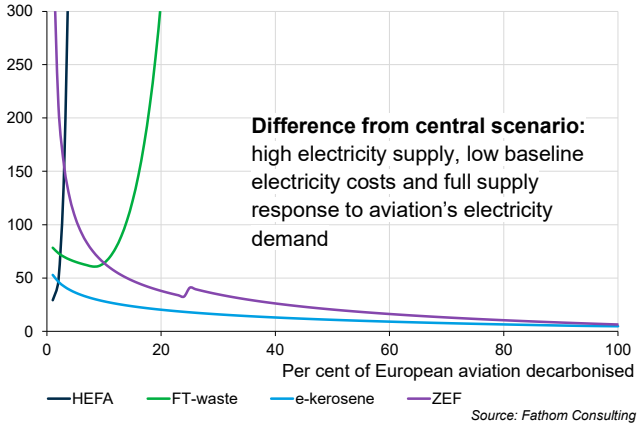
- Of course, Europe can import hydrogen and electricity from other countries; indeed, Fathom's Energy Transition Scores show that it would be cheaper to produce clean electricity and hydrogen in places like North Africa and the Middle East, which have more space, cheaper land and more reliable sunshine — but this would come at the expense of energy security and European clean energy jobs

- The cost of clean electricity will be key to the cost of low-carbon aviation; Fathom's central scenario uses the IEA's forecasts of clean electricity capacity and prices, which imply a weighted-average LCOE of 47 euros per MWh in 2050, around half of what it is today

- E-kerosene and ZEF would still be more expensive than fossil kerosene in this scenario, although a larger-than-expected decline in clean electricity prices would lower the cost of these technologies further, especially e-kerosene; the reverse would be true if electricity prices do not fall as fast as expected, and it would be a double whammy for the economy if demand from aviation caused non-aviation electricity prices to rise[4]

Levelised cost of flying in 2050, average

Without externalities, relative to fossil kerosene jet fuel, € per MWh



Source: Fathom Consulting

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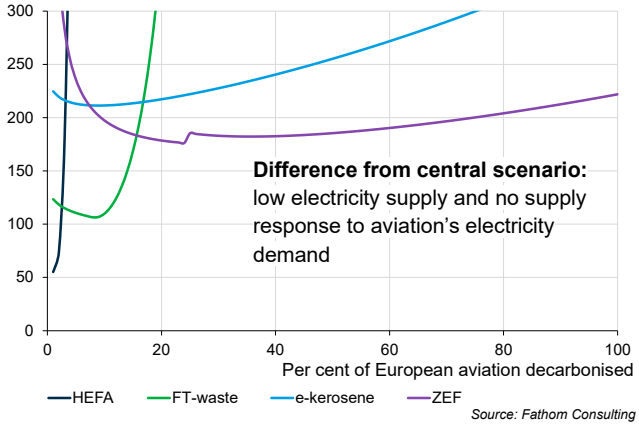

Source: Fathom Consulting

- This example shows how Fathom's Aviation Decarbonisation Model (FADM), can be used to explore a range of electricity supply, demand and price scenarios, letting users understand the relative attractiveness of different decarbonisation options under certain conditions, and the key drivers of price

- The bottom line is that decarbonising aviation will result in a huge increase in demand for clean electricity and hydrogen production, creating opportunities and risks for airlines, investors and the economy; some might question whether this will, or can, happen in a realistic time frame

- The alternative is that aviation is not decarbonised, which itself would carry big implications; neither scenario seems to be very well understood, or priced into asset markets

3. For more see: https://iea.blob.core.windows.net/assets/601eaec9-ba91-4623-819b-4ded331ec9e8/EnergyandAI.pdf or https://www.mckinsey.com/industries/private-capital/our-insights/how-data-centers-and-the-energy-sector-can-sate-ais-hunger-for-power
4. Which is why the EU's Additionality rule is key.

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Europe's flightpath to economic competitiveness

Considering the costs and benefits of different aviation decarbonisation options, in the context of Europe's economic and strategic objectives

This note is the second in a series drawing on findings in *Europe's flightpath to economic competitiveness*, Fathom's recent report on the economics of decarbonising European aviation. The views expressed in this note reflect those of Fathom alone.

View the project page

Read the report in full

To learn more about our work, the model underpinning it and how we can help your organisation, book a free 20-minute FADM demo.

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Chinese statecraft through new energy FDI

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