When will alternative fuels take off?

Biofuels, hydrogen, and sustainable aviation fuel have been mooted as potential low-carbon alternatives to fossil fuels. However, although they increasingly feature in company transition plans and government policies as an attractive opportunity, there are drawbacks that must be addressed. By Will Farrell and Michael Yamoah.

Setting the scene

Low-carbon fuels, often referred to as renewable or alternative fuels, should provide energy with lower net greenhouse gas emissions than fossil fuels over their lifecycles.[1] Alternative fuels such as hydrogen and sustainable aviation fuel (SAF) are likely to play a pivotal role in delivering net-zero emissions in the harder-to-abate segments of surface transport, aviation, heating, manufacturing and construction, agriculture, and industrials.[2]

The International Energy Agency (IEA) expects an expansion of low-carbon fuels from a 1% weight in global final energy consumption in 2022 to almost 5% in 2030 under its Net Zero Emissions by 2050 (NZE) scenario.[3] However, most low-emissions fuels are likely to remain more expensive than their fossil counterparts. For example, SAF is currently twice as expensive as conventional jet fuel.[4] This means that any discussion of the role of low-carbon fuels should focus on credible emissions savings, particularly for those emissions-intensive segments of the economy where the technological and commercial feasibility of electrification remains unlikely or impossible.

Companies are increasingly exploring the potential of low-carbon fuels, seeing them as an attractive 'plug in' solution to some of the challenges associated with the energy transition.

On the surface, alternative fuels appear to help companies continue with business as usual, sometimes without the need to wait for the build out of costly new supporting infrastructure. For example, biomethane can be injected directly into gas grids. However, a push into low-carbon fuels, even as an interim solution, is not without risk, such as competition for supply, or regulatory reversals.

For investors, there are also unintended consequences to consider. The expansion of biofuel crops, such as palm oil and sugarcane, has been associated with land grabbing, forced

For further information, please contact:

Will Farrell
Theme co-lead: Climate Change

Michael Yamoah
Theme lead: Wider Societal Impacts

[1] Low-carbon Fuels and Energy Sources Basics | Department of Energy.
[2] Sixth Carbon Budget – Climate Change Committee (theccc.org.uk).
[3] Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach – Analysis – IEA.
[4] Bergero, C. et al. 2023. *Pathways to net-zero emissions from aviation.* Nature Sustainability. Pathways to net-zero emissions from aviation | Nature Sustainability.

displacement, and labour exploitation in developing countries.[5] These human rights violations raise ethical concerns, disrupt supply chains, and create reputational risks for companies. Land use change can also have severe environmental and social consequences, including biodiversity loss, increased greenhouse gas emissions from forest and soil carbon release, and the erosion of food security.[6]

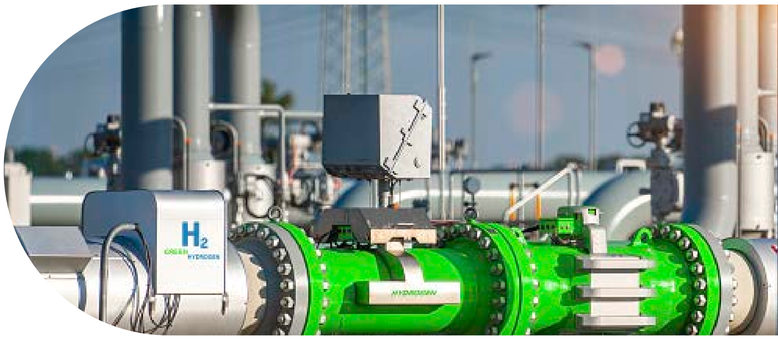
The production of advanced low-carbon fuels, such as green hydrogen, also faces technological constraints. Competition for biomass resources between biofuel production, food, feed, and other bio-based industries can lead to price volatility and supply shortages.[7] The lack of adequate infrastructure for the production, distribution, and use of low-carbon fuels presents another supply constraint.

On the demand side, there is uncertainty surrounding long-term policy support for low-carbon fuels, which can dampen investor confidence and limit demand growth. For example, the EU's Renewable Energy Directive II (RED II) has set sustainability criteria for biofuels, including minimum greenhouse gas savings thresholds.[8] These thresholds can limit the demand for certain types of biofuels that fail to meet the required emissions reductions.

> **Competition for biomass resources between biofuel production, food, feed, and other bio-based industries can lead to price volatility and supply shortages.**

Demand for alternative fuels

In the aviation sector, the use of sustainable aviation fuel (SAF) in the near-term is expected to drive emissions reduction, as a fully commercially-viable electrification option is not yet well developed. However, in a business-as-usual demand scenario, 50% biofuel penetration by 2050 would require almost 20% of global cropland to be dedicated to aviation biofuels.[9] Land use, food security, and price concerns associated with such a significant displacement of agricultural markets strengthen the economic case for exploring alternative technologies over the longer term, rather than relying on SAF.



Gas distribution infrastructure also represents a hard-to-abate segment, and the blending of low-carbon gases, such as biomethane, has been mooted as an intermediate solution.[10] We have engaged Engie, the French utility, on the viability of its plans for its biomethane sales to reach 30TWh by 2030. This has included challenging business leaders over the risks of relying on scarce waste feedstocks at a meeting at its headquarters in 2024. We continue to engage on the delivery of this strategy and its consistency with the company's longer-term vision for a hydrogen grid.

In some easier-to-abate sectors, such as power generation, low-carbon fuels can support a lowest-cost energy transition. The co-firing of biomass in coal-fired plants would support near-term emissions reduction in countries where the existing coal fleet is unlikely to be phased out in the near-term. In India, Adani Power – which we have engaged on the transition-related financial risks faced by its fleet of coal-fired power plants – is piloting green ammonia and biomass co-firing. It expects these solutions to reduce coal use by up to 30% over time. However, we do not expect co-firing to be a long-term solution given supply constraints and the cost competitiveness of renewable solutions.[11]

Green hydrogen may also play a role in connecting locations with abundant renewables to centres of high energy demand. This could improve the efficiency and reliability of a net-zero energy system without the significant transmission losses.[12,13] In the UK, National Gas's Project Union is pioneering this approach to build a hydrogen 'backbone' for the country. It is proposing to repurpose 2,000km of gas transmission pipelines to carry hydrogen to connect large-scale offshore wind assets in Scotland to industrial clusters in England.[14]

5 Food versus fuel? Going beyond biofuels – ScienceDirect.
6 Bioenergy and the forest industry in Finland after the adoption of the Kyoto protocol – ScienceDirect.
7 The effect of bioenergy expansion: Food, energy, and environment – ScienceDirect.
8 Review of technologies for biomethane production and assessment of Eu transport share in 2030 – ScienceDirect.
9 How much biofuel would we need to decarbonise aviation? (sustainabilitybynumbers.com).
10 Future policy framework for biomethane production: call for evidence.
11 Coal 2023 – Analysis and forecast to 2026 (iea.blob.core.windows.net).
12 The Future of Hydrogen (iea.blob.core.windows.net).
13 Final-NIA-2-Full-Document.pdf (nic.org.uk).
14 Project Union _ Overview 27.8 (nationalgas.com).

Low-carbon fuels, their use cases, and competitiveness

Fuel	Production	Application	Strengths	Weaknesses
Hydrogen	Hydrogen can be a zero-carbon fuel when produced via electrolysis powered by renewable energy.	Petroleum refining, steel production (coke substitution), renewable energy storage, heavy transport, peaking for critical-load facilities like data centres.	✓ Renewable energy source for green hydrogen ✓ More efficient fuel than its fossil fuel counterparts ✓ Hydrogen is extremely energy dense ✓ Hydrogen boilers can operate on similar infrastructure to gas boilers, although some retrofitting required	× More flammable × Expensive to produce given inefficiencies × Production of hydrogen can result in CO_2 emissions if derived from non-renewable sources × Operational issues experienced at refuelling stations in European pilot programmes[15]
Synthetic ammonia	An e-fuel that can be produced in gas and liquid form. Its transportation is likely more feasible than that of hydrogen.	Mainly used for fertilisers; remainder is used for various industries such as plastics, explosives, and synthetic fibres. Could be adopted as an energy vehicle for industries transitioning to hydrogen.	✓ Of all chemicals manufacturing, ammonia is the least technologically difficult to decarbonise ✓ Relatively high energy density ✓ Existing infrastructure for distribution given agricultural footprint	× Expensive as requires green hydrogen × Toxic gas – requires careful control
e-methanol	A synthetic hydrocarbon. The production processes require CO_2 and green hydrogen.	Marine, aviation, and road transport fuels with existing infrastructure.	✓ Completely compatible with existing car and truck engines as well as fuel storage and distribution infrastructure ✓ Favoured low-carbon fuel of shipping company Maersk	× Lower energy density × Can be corrosive and toxic × Expensive to produce as requires both green hydrogen and nascent carbon capture and storage (CCS)
e-kerosene	A synthetic hydrocarbon. The production processes require CO_2 and green hydrogen.	Mainly for the aviation industry as an alternative to fossil fuel or biomass-derived SAF.	✓ e-kerosene provides a more scalable source of clean aviation energy ✓ e-kerosene can also contribute to improving local air quality, especially around airports, because of its significantly lower particulate matter	× Expensive: seven to 10 times the average price of Jet-A aviation fuel given requirement of CCS and green hydrogen[16]
e-methane	A synthetic hydrocarbon. The production processes require CO_2 and green hydrogen.	Shipping industry and alternative fuel for transport sector.	✓ Compatible with existing natural gas distribution infrastructure with no adjustments, unlike hydrogen	× Methane leakage is a key risk – a potent greenhouse gas × Expensive as requires both green hydrogen and nascent CCS

Source: EOS

[15] Klevstrand, A. 2023. Hydrogen Insight. 'Hydrogen refuelling is an industry-wide challenge' \| Problems with our 'immature' H2 pumps are not specific to us, says Nel \| Hydrogen Insight.
[16] Zhou, Y et al. 2022. *Current and future cost of e-kerosene in the United States and Europe*. International Council on Clean Transportation. fuels-us-europe-current-future-cost-ekerosene-us-europe-mar22.pdf (theicct.org).

Although the examples in the table are not exhaustive, they indicate the complex system impacts associated with low-carbon fuels and the difficulty in assessing their competitiveness. It is reasonable to expect different low-carbon fuels to play a role through the energy transition. Arguably, this has propelled policies to promote the penetration of low-carbon fuels. The US Inflation Reduction Act has stimulated green hydrogen investment through targeted tax credits, contributing to the US$50bn of announced low-carbon hydrogen projects in the US. The EU's Hydrogen Strategy has delivered the European Hydrogen Bank, an Innovation Fund mechanism and €3bn subsidy scheme.[17, 18, 19]

Implications for engagement

There are several economic and social consequences associated with low-carbon fuels that need to be considered and addressed. These include:

- Justification of why a low-carbon fuel is a significant and competitive emissions reduction lever for the particular intended application, timeframe, and systemic context.
- Feedstock risk management, including:
  - Minimising any negative impacts on biodiversity and water
  - Upholding high human rights standards, including respecting indigenous group and community engagement, and fair labour practices throughout the company's supply chain
  - Addressing potential food security issues, particularly when sourcing food crops for biofuel production.
- Proper board oversight of the strategy on low-carbon fuels and how companies are evolving financial and strategic risk management systems to identify and manage such risks, plus the effectiveness of supplier selection and monitoring processes.
- Addressing technological and infrastructure limitations associated with some low-carbon fuels (where these are reasonably expected to be competitive for the intended application), including through commercial partnerships and public policy.

EOS generally adopts a technology-agnostic approach but routinely inspects transition plans for their robustness and credibility. Where low-carbon fuels are referenced, EOS probes the assumptions being made. We encourage companies to develop capabilities to deliver decision-based climate scenario analysis, and to address their alignment with a transition scenario, capturing system effects. This improves investors' understanding and enables them to play a role in influencing the policy environment. EOS also encourages companies to outline their advocacy efforts for relevant policies supporting low-carbon fuel adoption.

Our engagement approach

EOS currently engages over 160 companies where their activities are closely related to low-carbon fuels. We engage on fuel and feedstock selection, and the associated climate, biodiversity, and human rights risks and opportunities. These companies include Shell, Valero Energy, and Repsol in the oil and gas sector, where diversification into low-carbon fuels is commonly cited as a strategic aim to manage transition risks.

We also engage with chemicals and industrials companies such as BASF, LyondellBasell, and Covestro; in this sector low-carbon fuels are often mooted as alternative feedstocks. Other relevant sectors include utilities, where there are opportunities to co-fire fossil fuels with low-carbon fuels as an interim transition activity ahead of greater renewables penetration, and transportation, including aviation, maritime, and land transport.

COMPANY ENGAGEMENTS

Since 2020, we have engaged with US-based Valero Energy on its emissions reduction strategy and its alignment with the Paris Agreement. The company has diversified its activities through its carbon reduction strategy with greater capital allocation to lower carbon fuel production, such as biofuels.

As it pursues these attractive opportunities, we have questioned some of its assumptions related to the comparable carbon performance of electric vehicles versus the adoption of its renewable diesel and ethanol fuels and encouraged it to be transparent in its methodology and assumptions. In 2024, the company laid out how these low carbon solutions would be imperative for a 1.5°C aligned future. We will continue to engage with the company on the resiliency of its assets and its contributions to the low carbon landscape.

In Denmark, we have engaged the container shipping company AP Moller-Maersk on its management of climate-related financial opportunities and risks since 2016. We suggested that the company should proactively manage the just transition and biodiversity concerns associated with its plans to source low-carbon marine and aviation fuels.

The company has subsequently published a set of policies to ensure the sustainability of green fuels, including biomethanol. The policies include the key safeguard that biofuels will only be derived from waste residues and not rely on any food feedstock, reducing the risk of land use change and biodiversity loss, as well as managing health and safety concerns for workers. We are now engaging the Canadian National Railway Company on similar concerns.

[17] New investments give renewables a big break (deloitte.com).
[18] Go big or go green? The EU's massively expanding hydrogen bet – POLITICO.
[19] European Commission. 2023. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions on the European Hydrogen Bank.* EUR-Lex – 52023DC0156 – EN – EUR-Lex (europa.eu).

Federated Hermes
EOS

Federated Hermes

Federated Hermes is a global leader in active, responsible investing.

Guided by our conviction that responsible investing is the best way to create long-term wealth, we provide specialised capabilities across equity, fixed income and private markets, multi-asset and liquidity management strategies, and world-leading stewardship.

Our goals are to help people invest and retire better, to help clients achieve better risk-adjusted returns and, where possible, to contribute to positive outcomes that benefit the wider world.

Our investment and stewardship capabilities:

- **Active equities:** global and regional
- **Fixed income:** across regions, sectors and the yield curve
- **Liquidity:** solutions driven by five decades of experience
- **Private markets:** private equity, private credit, real estate, infrastructure and natural capital
- **Stewardship:** corporate engagement, proxy voting, policy advocacy

Why EOS?

EOS enables institutional shareholders around the world to meet their fiduciary responsibilities and become active owners of their assets. EOS is based on the premise that companies with informed and involved investors are more likely to achieve superior long-term performance than those without.

For more information, visit **www.hermes-investment.com** or connect with us on social media: