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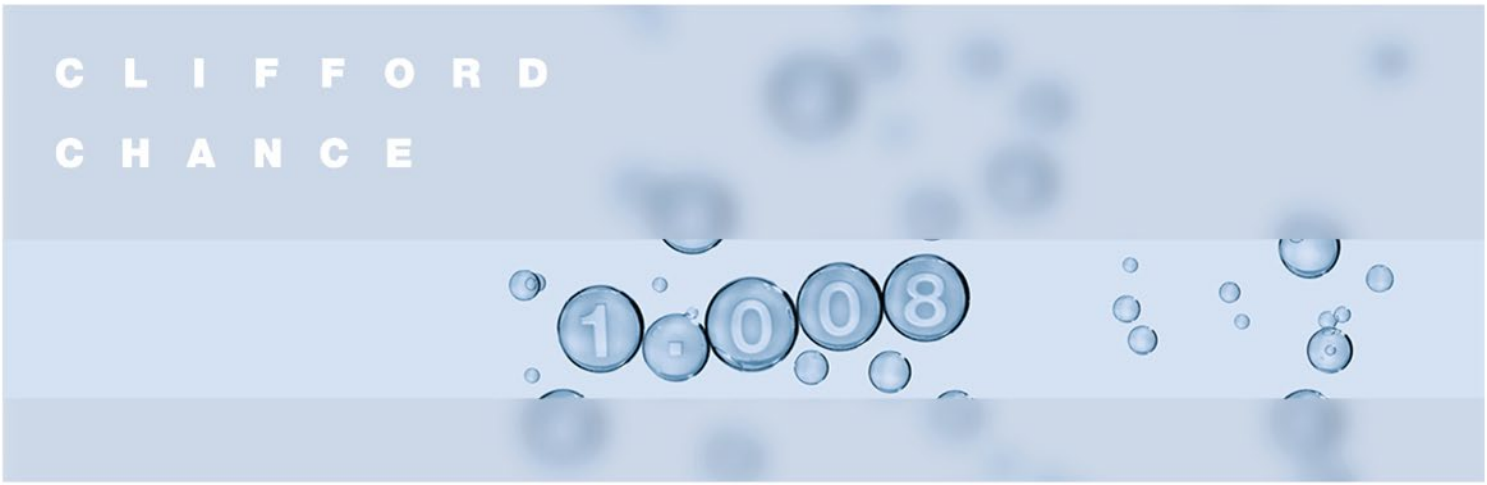

FOCUS ON HYDROGEN: UK ANNOUNCES HYDROGEN STRATEGY AS PART OF ENERGY TRANSITION PLAN

The UK Government has launched its long-awaited Hydrogen Strategy, which outlines key investment pledges and a vision for hydrogen's role in the economy, but the Strategy's 'twin-track' approach faces a number of issues. This briefing provides an outline of the Strategy and some of its implications.

Key issues

- 'Twin-track' approach to encourage investment in 'blue' and 'green' hydrogen
- By 2030, forecasted £900m hydrogen economy in the UK, attracting £4bn of private investment
- By 2025, ambition for 1GW of low carbon hydrogen capacity, rising to 5GW by 2030
- By 2050, hydrogen could cover 20-35% of the UK's energy consumption
- £240m Net Zero Hydrogen Fund announced to support deployment of low carbon hydrogen production
- £105m package via the £1bn Net Zero Innovation Fund
- £60m Low Carbon Hydrogen Supply 2 competition announced
- Consultations on low carbon hydrogen business models, the design of the Net-Zero Hydrogen Fund and a UK low carbon hydrogen standard also published with the strategy.

THE UK HYDROGEN STRATEGY

The UK's Hydrogen Strategy was released on 17 August 2021 and expands upon the Prime Minister's pledge of 5GW of low carbon hydrogen capacity by 2030 in his Ten Point Plan for a Green Industrial Revolution. The Strategy provides an ambitious roadmap outlining hydrogen's role in fulfilling the UK's commitment to net zero by 2050 and seeks to transform the UK into a global hydrogen leader. The Strategy takes a 'whole-system approach', covering the entire value chain, from generation, to storage, to end use.

The Strategy uses low carbon hydrogen as a term which encompasses both blue and green hydrogen. Blue hydrogen is produced via a process of steam methane reforming (SMR) of natural gas and sequestering or utilising any carbon emitted in the process via carbon capture, utilisation and storage (CCUS). Conversely, green hydrogen is produced via electrolysis, using electricity produced from a renewable source and is therefore considered fully carbon neutral. It is unclear as to the eventual proportion to be supplied through these different methods. However, the current high cost of green hydrogen suggests that, at least in the short term, blue hydrogen will play a key role in scaling-up any hydrogen economy. That said, the Strategy predicts that by 2025, green hydrogen should become cost competitive with blue, pointing in the longer term to a more balanced proportion.

Scaling up: uses

A broad range of end-uses for hydrogen are envisioned in the Government's plan. **Heavy industry** is earmarked to lead the way in early adoption of low carbon hydrogen, given its carbon intensiveness and compatibility to use hydrogen as a replacement fuel. In the Industrial Decarbonisation Strategy, BEIS set out their expectation of a minimum of 20TWh of fossil fuel per year being replaced with low carbon alternatives. This offers hydrogen the opportunity to step in to offer a low carbon substitute, with an estimated carbon saving of approximately 3MtCO_2e per year by 2030, roughly equivalent to the emissions of 1.4 million cars.

The Strategy also discusses hydrogen's role in the decarbonisation of the **power sector** via the use of hydrogen as a generating fuel in itself (Gas to Power) and the flexibility offered by electrolytic production and hydrogen storage (Power to Gas). The Government has already identified technological, market-based and practical issues with the roll out of hydrogen in the power sector. To address these issues, it announced a number of Calls for Evidence between December 2020 and July 2021, with the first of these, the Decarbonisation Readiness for New Power Generation Report, expected to be published soon.

Alongside electrification, the other key uses for hydrogen outlined in the Strategy are to provide an alternative to the UK's gas-based **domestic heating sector**, and as a fuel for **transport**. The Government shed more light on the first-of-a-kind heating trials outlined in the Ten Point Plan, with hydrogen-based neighbourhood domestic heating trials taking place by 2023, scaled up to a village by 2025 and with a view to planning a hydrogen heated town before the end of the decade. For transport, the Strategy forecasts up to 6TWh per year of demand for low carbon hydrogen from the sector by 2030, across public transport, heavy goods vehicles, shipping, and aviation.

Scaling up: creating a market

The Strategy notes that the nurturing of the low carbon hydrogen market will be considered within a 'holistic approach' to the wider reform of the UK energy system. Further plans for this will be set out in the forthcoming Net Zero Strategy, but the implication is that whatever policy framework eventually emerges to guide the UK to its target of net-zero by 2050, it will be all-encompassing.

The Government recognises, in developing a market framework for hydrogen, the tension between certainty for investors and building in flexibility to adapt to developments in energy. On the supply side, the Government's Net Zero Hydrogen Fund is designed to provide initial investment for new low carbon hydrogen production – reducing the risk for early investors. In terms of demand-side interventions, the Strategy proposes carbon pricing, the introduction of a Low Carbon Hydrogen Standard (a consultation on which was published with the Strategy) and introducing and developing sector-specific policies such as the Renewable Transport Fuel Obligation and the Capacity Market.

A consultation on the Low Carbon Hydrogen Business Model was also published with the strategy. The consultation outlines a number of market barriers that are impeding the development of a low carbon hydrogen market in the UK. The consultation's aim is to gather responses to proposals on a business model, with the eventual goal of creating a framework which incentivises the production and use of low carbon hydrogen through ongoing revenue support. This, the Government hopes, will have the effect of bringing the cost of low carbon hydrogen down to the cost of 'counterfactual' (non-low carbon hydrogen) fuels. The proposal to use a Contract for Difference (CfD) style variable price mechanism indicates that, as the market matures and the price of low carbon hydrogen decreases, the level of support would also decrease – as has been the case with offshore wind.

IMPLICATIONS OF THE STRATEGY AND ITS 'TWIN-TRACK' APPROACH

Other low carbon strategies in the UK

As mentioned, using a variable price mechanism as the basis for revenue support for hydrogen follows similar approaches by the Government to other low carbon technologies. Namely, business models for the CCUS value chain

published in December 2020, and before then the Offshore Wind Industrial Strategy from 2013. Both utilise variable price mechanisms with initially high levels of government revenue support, which decrease proportionally to the price of energy as the market matures.

For low carbon hydrogen, this poses a problem. Unlike CfDs, where the Intermittent Market Reference Price provides a benchmark price for units of electricity, low carbon hydrogen suffers from a lack of an observable market benchmark price. Variable price mechanisms, at their core, depend on reliable and accurate reference prices in order to determine premiums vis-à-vis an agreed strike price. Without a pricing benchmark in which investors have confidence, the Government may struggle to attract early-stage investment. In part, this binds the success of the entire strategy on the ability of the Government to formulate a reliable reference price for low carbon hydrogen.

The proposal in the Low Carbon Hydrogen Business Model consultation is that in the near term, the closest proxy to a market benchmark would be an achieved sales price, whereby the size of the subsidy will depend on each plant's average sales price. A drawback of this approach is its potential to distort market prices, as it could discourage producers from seeking higher prices as there is no reward for price discovery. In the long run, this would inhibit the level of subsidy reducing over time, which is a key part of the Government's approach. Eventually, it is proposed that a 'market benchmark price' will emerge that will best represent low carbon hydrogen's market value. However, the current illiquidity of the market is preventing the formulation of such a price. It will take a far more mature market for such a benchmark to be reliably measured and reported on and until this happens, investors will be cautious of a market benchmark approach. Whatever path the Government decides on to create a reference price for low carbon hydrogen, it will be a crucial component in the success of the overall strategy.

In context: European approaches to hydrogen

As well as comparing the Strategy against other domestic low carbon plans, it is helpful to place it in context of the other European states that have announced hydrogen strategies:

- **The Netherlands** has adopted a 'clean hydrogen' approach, under which, as in the UK, both blue and green hydrogen fall. The Dutch Government has pledged €35m per year to scale up hydrogen specifically, as well as funding under the €5bn SDE++ subsidy scheme for projects in its Strategy on Hydrogen. The policy agenda revolves around four key pillars which are all present in the UK Strategy: development of legislation and regulation, cost reduction and scale up of green hydrogen, sustainability of final consumption, and 'supporting policies' which include international strategy. The Dutch programme is detail-light, but a further National Hydrogen Programme is forthcoming, outlined in the National Climate Agreement.
- In **France**, the Ordonnance Hydrogène commits the country to investing €2bn before 2022, increasing to €7.2bn by 2030 in low carbon (blue) and green hydrogen. This dwarfs the UK's Net Zero Hydrogen fund, which has a headline figure of £240m. The Ordonnance estimates that investment in low carbon and green hydrogen could reduce French CO_2 emissions by six million tons by 2030, equivalent to the annual emissions of Paris. Like the UK strategy, the French taxonomy governing the definition of low carbon hydrogen is yet to be finalised, however the Ordonnance's distinction

between 'low carbon' and 'green' acknowledges that SMR with CCUS is to be separated due to its inability to sequester all carbon produced in the process of hydrogen manufacturing. The French approach also stresses the need to invest in green hydrogen in particular, with the aim of reaching 6.5GW of electrolyser installed capacity by 2030.

- As with the UK, **Germany's** strategy urges investment in hydrogen across the value chain. It notes the role hydrogen will play in sector coupling and its potential to open paths to decarbonisation in industries where electricity cannot be used from renewable energy. The first difference in approach to note is the level of investment in Germany compared to the UK. Germany's headline investment of up to €9bn, the first €2.1bn of which will be spent between 2020 and 2023, as well as a further €2bn to be spent on overseas hydrogen projects, makes the UK's £240m look paltry by comparison. Responses to the UK's consultation on the design of the Net-Zero Hydrogen Fund may do well to point this out. More fundamentally, however, the German strategy takes the view that "only hydrogen produced on the basis of renewable energies is sustainable in the long term". This approach stands in stark contrast to the UK's 'twin-track' commitment to blue and green hydrogen. Whilst the German model does not discount the use of blue hydrogen altogether, suggesting that it "will be used on a transitional basis", this variation in long term vision is one that should be taken note of. In the nearer term, Germany's strategy has faced criticism for presenting a false dichotomy between green and blue hydrogen, given the infancy of the green hydrogen market. Members of Germany's hydrogen council have urged greater focus on the transitional benefits of blue hydrogen, given the lack of attention to it in the strategy.

Blue hydrogen – how green is it? Problems with a 'twin track' approach

The German approach begs the question of whether blue hydrogen is suitable to be defined alongside green hydrogen as 'low carbon'. Answering this has implications for the usefulness of the UK's 'twin-track' approach for achieving its net-zero target by 2050.

The Government is planning to use the low carbon hydrogen standards consultation to define a taxonomy on what the term 'low carbon hydrogen' should encompass. A key point of contention is not only the inclusion of blue hydrogen in the definition, but at what point in the supply greenhouse gas (GHG) emissions are measured – i.e., the 'system boundary'. Three options are suggested for measuring the extent of the system boundary:

- measurement of GHG emissions at the exit of the production plant (**the point of production**);
- measurement of delivered hydrogen's GHG emissions including production emissions and downstream distribution to the end user, but excluding end use emissions (**the point of use**); and
- measuring GHG emissions using the methodology of the point of use, but also including emissions during use, which includes any 'slip' from 'fugitive' emissions such as methane (**the point of use + in use emissions**).

The point of use + in use emissions method offers the most complete assessment of the GHG emissions of any hydrogen produced. It not only measures emissions from downstream distribution to end users, but any fugitive emissions during the use phase. The Government's suggested

position, however, is to set the system boundary at the point of production – at the risk of omitting potentially significant downstream emissions.

A recent paper published by academics from Cornell and Stanford Universities asserted that blue hydrogen is 'worse than gas' for the climate given its reliance on fossil fuels to drive the process and the leakage of fugitive methane from downstream usage. The paper went so far to say that blue hydrogen has 'no role in a carbon-free future', noting that its GHG footprint is 20% greater than burning natural gas or coal for heat. Notably, the methodology used measures GHG emissions from a point equivalent on the Government's system boundary scale to point of use + in use emissions. If shown to be accurate, these findings ought to be taken into account in determining the system boundary to properly reflect GHGs emitted. That said, the paper is a first-of-a-kind study: academics and industry experts will be furiously dissecting the assumptions and methodology behind the paper's findings to determine its veracity. It has already met with a strong response from blue hydrogen proponents, with Equinor's Al Cook using evidence from Zero Carbon Humber to refute some assumptions in a letter to The Times newspaper. At the very least, however, the paper casts a critical light on the Strategy and the centrality of blue hydrogen within it.

Applying the low carbon hydrogen standard at the point of production, and thereby not accounting fully for the GHG emissions of blue hydrogen in the downstream transportation and use risks undermining confidence in the label 'low carbon hydrogen'. The 'twin-track' commitment of the Government and the implied equivalence of green and blue hydrogen in terms of emissions may come under greater scrutiny if further research validates the Stanford/Cornell article's findings. The Government should provide clear targets on a blue/green hydrogen combination under the twin-track approach over the coming decades to mitigate the worst of these criticisms and provide greater certainty for investors.

OUTLOOK

The publishing of the Strategy is a big step for the UK insofar as pledges are concerned; it being filled with commitments across the low carbon hydrogen value chain. However, it is light on hard policy and there remains a long journey ahead to achieve the goals of establishing the UK as a global hydrogen leader, let alone reaching net-zero by 2050. Adopting a market benchmark for the price of hydrogen will be a start, yet the questions raised around the 'greenness' of blue hydrogen and its importance in the Strategy (differing from some European neighbours) puts pressure on the Government to show that both can coexist under the banner of low carbon hydrogen – and, if not, to design a model similar to Germany whereby blue hydrogen acts in a transitional capacity before giving way to green. Moreover, the commitments of France and Germany to multi-billion-euro investments indicate to investors a greater willingness by the government to deliver on hydrogen by these countries compared to the UK. If the Government is serious in its ambitions to be a leading global hydrogen player, it will likely need to increase its financial support to attract early investment at scale.

These early stages of low carbon hydrogen's journey in the UK makes industry responses to the consultations particularly important, for the reasons outlined in this briefing. Each consultation closes on 25 October 2021 at 23:45.

ABOUT

Focus on Hydrogen is a Clifford Chance briefing series covering hydrogen-related developments globally. 1.008 is the standard atomic weight of hydrogen.

For other hydrogen publications, please see our thought leadership page here.

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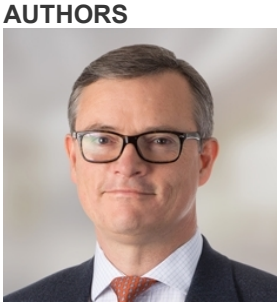

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