Solutions for H2 feedstock and offtakes

07 Feb 18:59 | PFI 738 - 08 Feb - 21 Feb (/issue/8305/pfi-738-08-feb-2023-21-feb-2023) | 17 min read | Americas, EMEA, Asia

Clean hydrogen was the number one topic on the energy conference circuit in 2022. It has a massive contribution to make to the energy transition. Clean hydrogen producers will need a clear route to market, with adequate control over feedstock availability and cost, and certainty in respect of offtake volumes, pricing and revenue, in order to commit to developing new or expanded production facilities. By Alex Harrison, partner, Akin Gump Strauss Hauer & Feld.

While there is a growing abundance of viable clean hydrogen use cases, the offtake market remains immature at scale, with an uncertain growth curve, creating significant demand and price risk for producers. Government support for the sector has focused on production not use, but this "Field of Dreams: 'build it, they will come'" model risks leaving producers without a stable offtake solution, making investment decisions difficult and slowing the pace of the transition. Clean hydrogen production relies heavily on the availability of large quantities of cheap electricity, creating a clear feedstock cost risk for producers.

This article considers the most likely use cases for clean hydrogen and how producers should think about managing their exposure to both feedstock supply and cost risk and offtake demand and price risk to create cost and revenue certainty within their business model.

Market overview

Clean hydrogen is set to play a critical role in the decarbonisation of our power and gas networks, transportation system, agricultural economy and energy and carbon-intensive heavy industries. It is a particularly versatile solution for decarbonising "hard to abate" sectors that are otherwise difficult to electrify and that continue to rely on energy produced from fossil fuels.

A hydrogen rainbow has emerged to reflect the terminology used to describe the different sources of renewable or low carbon electricity needed to produce clean hydrogen via electrolysis, with green hydrogen, produced from renewables; blue hydrogen, produced from natural gas with carbon capture and storage; and pink hydrogen, produced from nuclear power, expected to be dominant in replacing current grey hydrogen – an umbrella term often used to describe conventional hydrogen produced from fossil fuels.

Clean hydrogen can be used, in the first instance, to displace existing grey hydrogen applications such as refining petroleum, treating metals, producing fertiliser or processing foods. But, clean hydrogen can also play a much broader role as a fuel for energy generation via internal combustion or fuel cells, for energy storage and as a feedstock in the production of green ammonia or synthetic or liquid fuels such as sustainable aviation fuel (SAF).

Green ammonia produced from clean hydrogen can, in turn, be used to produce green fertiliser, or to power maritime and other low carbon mobility solutions, or as a sustainable fuel for industrial energy generation and energy storage. SAF produced from clean hydrogen that is synthesised with carbon – otherwise known as power to liquid, PtL or e-fuel – is set to dominate the decarbonisation of aviation with SAF forecast to be capable of delivering about 65% of the required carbon emissions savings for the sector and the market for SAF PtL fuels forecast by KPMG to grow to six times the size of SAF produced from biofuels.

Feedstock supply and cost risk

Clean hydrogen production relies heavily on the availability of large quantities of cheap electricity, creating a clear feedstock cost risk for producers.

Long-term wholesale electricity pricing is inevitably uncertain, but the increasingly large proportion of renewables in the energy mix had led to expectations of periods of low or negative wholesale power prices, when aggregate available generating capacity exceeds demand, allowing surplus renewable generation to be used for hydrogen electrolysis rather than being constrained.

Russia's invasion of Ukraine and the resulting market volatility and unprecedented high energy prices have complicated analysis of those forward price dynamics. The Ukraine invasion has also led to calls to de-link the role of gas prices in setting the marginal price of electricity, which would require fundamental structural reform to current wholesale power markets.

Electricity markets also face broader continued reforms in response to the energy transition, for example to create more effective locational price signals (that incentivise generation assets to be located where power is needed and thereby reduce the need for system operator interventions to balance the grid) and to incentivise low carbon flexibility to play a more significant role in the system.

In addition, the costs of government support for renewables, managing grid constraints and reinforcement and other energy transition investments are often embedded in the tariffs paid by consumers for their energy. These costs may grow unpredictably moving forwards, increasing retail costs and risk.

The combination of current high wholesale prices and market volatility, change in law and change in regulation risk and the uncertain future costs of socialising the green transition makes it very difficult for a clean hydrogen producer to have confidence that it will be able to secure a medium to long-term firm renewable electricity supply commitment for an attractive low tariff.

Depending on the ultimate use case, producers may also be exposed to other feedstock availability and price risks such as for nitrogen (if the clean hydrogen is intended to be used to produce green ammonia) or carbon (if the clean hydrogen is intended to be synthesised into SAF). Equivalent considerations to those above will therefore also apply to a producer's ability secure other required feedstocks in the medium to long term.

Offtake demand and cost risk

The clean hydrogen offtake market is nascent. Clean hydrogen use cases that seek to replace existing uses and volumes of grey hydrogen have a clear existing market to sell into, but the addition of new clean hydrogen volumes alongside existing grey hydrogen volumes may lead to oversupply in the global or local markets, reducing prices and potentially resulting in a loss of demand and route to market.

The market for new clean hydrogen *use* cases, such as for energy generation and storage or as a feedstock in the production of green ammonia (for use as a fuel or to produce fertiliser) or synthetic or liquid fuels such as SAF for use in decarbonising transport and mobility is inherently less certain. Clean hydrogen producers may be confident that there will be significant future demand for clean hydrogen (at some point), but they may not know when, where, for what use cases or at what price that clean hydrogen will be needed.

Price parity between clean and grey hydrogen also presents another challenge – that hydrogen consumers may continue to prefer cheaper grey hydrogen (for existing or new use cases) until such time as mandatory regulation (requiring the use of clean hydrogen or increasing the cost of grey hydrogen), the power of social media and the crowd, activist investor hostility or litigation or a hydrogen producer's own internal commitments to environmental, social and governance (ESG) outcomes and decarbonisation push them to pay a premium for green hydrogen.

The cost differential between clean and grey hydrogen will play a key role in driving demand and the cost reduction pathway for clean hydrogen is therefore key to the market growing quickly at scale.

Potential solutions

There are a number of potential solutions for addressing feedstock and offtake risk.

In some markets, government support may be available. In the UK, for example, the government is proposing to provide support in respect of offtake market price risk, where the offtake tariff is lower than the cost of production, and offtake volume risk, where sales volume fall below a threshold at which producers can recover their fixed costs. Price support will take the form of a variable premium under a 15-year contract for difference, using a bilaterally agreed and indexed strike price with the natural gas price operating as a price floor.

A price discovery incentive will also apply to ensure producers continue to seek the highest sale prices. Volume risk will be based on a sliding scale with greater support paid on early volumes, providing a level of fixed cost protection for producers and with price support tapering away as volumes increase. Under the UK model, no protection is provided if offtake volumes fall to zero. A hydrogen producer benefiting from the UK support model will still be expected to bear offtake price risk below the natural gas floor, offtake volume risk where offtake volumes fall to zero, input fuel cost risk where applicable (and not offset by strike price indexation) and input fuel supply disruption or unavailability risk.

In jurisdictions where government support is not available or offtake and feedstock risks remain, the obvious answer is for a clean hydrogen producer to seek to enter into long-term supply and offtake contracts with creditworthy counterparties, supported by appropriate credit support as necessary, pursuant to which the producer locks in both long-term electricity and other feedstock supplies and clean hydrogen offtake in defined take-or-pay volumes for a fixed price or a cost plus tariff on the offtake side. Those agreements would need to cater for the risk of delivery or construction delay or failure and contract early termination in the usual way.

This solution, however, relies on there being feedstock suppliers and clean hydrogen offtakers willing to enter into contracts on the terms needed to backstop the clean hydrogen production base case. On the offtake side, this could be more likely if the offtaker is co-located or itself has the means to store the clean hydrogen purchased or to transport it to and re-sell it in other markets in the event that its own use case is interrupted. Given current electricity price volatility and the immaturity of the current clean hydrogen offtake markets, however, this options feels unrealistic for most clean hydrogen producers in the immediate future.

If securing firm feedstock and offtaker tariffs is unachievable, a variation on the same theme is to seek to secure pricing certainty within a cap and collar structure providing some level of pricing variability and upside/downside risk for the parties, but cost and revenue certainty at greater pricing extremes. This may become an attractive solution as the market develops.

A clean hydrogen producer may also be able to stack multiple smaller feedstock and/or offtake solutions to replicate the firm commitment of a larger single solution. This may be a viable option if there is a liquid market for the required supply or demand in aggregate, but not through any single counterparty. A multi-source solution may also diversify credit and single point of failure risks, but may not address price or price volatility risks.

In a similar vein, a clean hydrogen producer may be able to reduce its offtake risk by building and locating its facility so that it is best placed to market to multiple alternative use cases, eg energy generation/storage, transport and mobility, industrial decarbonisation, green fertiliser production, in order to diversify the range of potential firm, or merchant, offtakers it is able to access if one or more of its primary routes to market fail. Locating clean hydrogen production in an industrial cluster may be attractive for these reasons.

An alternative approach would be to develop a full chain vertically integrated solution delivering the required clean electricity feedstocks and any required green ammonia or sustainable aviation fuel production facilities alongside clean hydrogen production. This may be superficially attractive, but adds significant complexity in terms of “project on project risk” and doesn’t address exposure to ultimate offtake demand and price risk.

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A tolling structure, pursuant to which the tolling counterparty provides the feedstock and commits to purchase the offtake, may be more attractive. This structure provides a natural hedge for the tolling counterparty and removes supply and demand risk for the facility owner provided the tolling counterparty is of adequate counterparty strength or supported by appropriate credit support. A tolling structure mirrors the benefits of a fully integrated project without the facility owner needing to directly take "project on project" risk.

Where firm pricing is available, but contract tenor is the issue, it may be helpful to consider front-ending an element of merchant risk if it is easier to forecast demand in the immediate time horizon than over the longer term. This structural solution has been used successfully in the offshore wind markets.

If adequate demand/supply and price commitments are not achievable, it may be possible to de-risk the project through a soft demand underpin. This may be achievable if the project has some form of de facto exclusive or quasi-exclusive position in the market that makes it more attractive to buyers. This could arise, for example, as a result of some form of licensing, regulatory or government support advantage that gives a particular clean hydrogen producer a competitive edge over other clean hydrogen producers.

This type of soft underpin has been used previously to support the bankability case in other sectors, such as electrical vehicle charging where the exclusive nature of a commercial bus licensee has been used to determine likely charging demand without the need for a formal contractual demand commitment. A soft underpin may provide some protection in respect of offtake demand but is unlikely to offer a total solution to offtake price or price volatility risk.

A clean hydrogen producer may also be able to hedge its exposure to feedstock or offtake volume or price volatility with a commercial or financial counterparty or to manage that risk through a commodity trading strategy. A producer could also seek to put in place committed supply of last resort arrangements (at a market premium) or offtake of last resort contracts (at a market discount), as a backstop in its commercial structure, if it is able to find a willing creditworthy counterparty to do so.

Over time, as hydrogen becomes a critical part of our energy and mobility economy, more formal regulatory offtaker of last resort or special administration regimes may be introduced into the hydrogen value chain to protect consumers and ensure continuity of service. These regimes have been already applied elsewhere in the electricity and gas market (and in other critical sectors) but generally they apply to monopolistic networks and consumer suppliers rather than energy generation or production.

Conclusion

Clean hydrogen feedstock and offtake volume and price risks are likely to be significant for early producers seeking to invest in anticipation of investor demand. They will need to be carefully addressed to ensure project success. Early projects will also face other major risks that they will need to successfully navigate including construction risk, particularly if a multi-contract supply chain solution is deployed, technology risk in relation to the performance and reliability of the electrolyser and change in law and change in regulation risk as existing energy regulatory models are adapted and applied to hydrogen. The optimal solution to all of these issues will depend on the risk appetite of a project's developers and its funders. Project financing is expected to play a key role on the debt side in scaling the market, but there will also be opportunities for the private credit funds seeking higher returns and a corresponding risk profile.

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