Hydrogen Innovation Initiative

Debt financing low carbon hydrogen projects in the UK

For Energy Systems Catapult
On behalf of the Hydrogen Innovation Initiative

Final Report
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Study undertaken by:
EigenVentures

CATAPULT Energy Systems

About Hydrogen Innovation Initiative

This survey was funded by the Hydrogen Innovation Initiative, which was set-up with support from Innovate UK and the Industrial Advisory Board to drive forward a hydrogen supported economy for the UK. HII has a mission to support UK industry by accelerating the development of critical hydrogen technology and supply chains for the fast-growing hydrogen economy. With industry-wide input, we have published a Hydrogen Technology Strategy for UK industry and working with funding bodies and investors to secure funding for hydrogen innovation and supply chain programmes. HII's partners include the Catapult Network, the Advanced Propulsion Centre, the Aerospace Technology Institute, the Net Zero Technology Centre and the National Physical Laboratory.

About Energy Systems Catapult

The report was organised by Daniela Montaño, Mona Khalili, Frank Bridge, Paul Jordan, Liam Lidstone and Richard Halsey from the Energy Systems Catapult (ESC), an independent research and technology organisation launched by Innovate UK in 2015 with a mission to accelerate Net Zero energy innovation.

About Eigen Ventures

The survey, interpretation of findings and reporting were carried out by Eigen Ventures Ltd, which provides business support services to low-carbon and clean tech innovators and funding agencies. The survey interviewers and report authors were John Pexton, Giles Dixon and Mark Bornhoft.

Executive Summary

There is significant interest and intent by banks and private funds globally to finance the commercial-scale production of low carbon hydrogen and hydrogen derivatives such as ammonia. However, to date only a few such projects have been funded by third party debt, and none in the UK. This will gradually change as the perceived technology risks diminish and government subsidy schemes are implemented. The world's first such scheme is the UK Government's Hydrogen Production Business Model (HPBM) under which the first production subsidies were agreed in late 2023; and other countries intend to finalise subsidy schemes in 2024. The HPBM structure was widely praised by industry stakeholders in our survey, not only for being the first to market, but also for its focus on revenue support and project due diligence.

Projects in energy markets often use debt financing because it is cheaper than equity and it enables rapid scaling. Debt funding for hydrogen projects will follow the same track as seen in the LNG, offshore wind and energy storage sectors over the last few decades: the initial projects will be primarily equity funded, but project finance debt will be increasingly used as more hydrogen projects start up and lenders become more comfortable with the risks they are being asked to take on. There is, however, an urgency to implement hydrogen projects in order to meet Net Zero goals, and we need to expedite new funding structures – with similar solutions being required in other First Of A Kind technology areas such as Sustainable Aviation Fuel (SAF).

Hydrogen will be one of the cornerstones of a Net Zero economy, particularly in 'hard to abate' sectors where electrification and batteries are not so practical or efficient. This will include substituting natural gas or coal in industrial processes such as cement and steel manufacturing; substituting fossil fuels for high-load transportation such as in trains and planes; use as a feedstock to make 'green' chemicals and fuels such as ammonia, methanol and SAF; and helping to balance the power grid through long duration storage.

We are needing to rapidly develop a low carbon hydrogen industry from a zero base. Subsidies are required at the early stage of market development so as to encourage the production and supply of low carbon hydrogen (in the absence of a high carbon tax), as happened in the offshore wind industry. But we also need to build up demand, which was not a challenge for offshore wind. Most hydrogen projects starting up in the early years will be small (5 to 20 MW production rate) as it takes time for industries to become familiar with hydrogen; and it is these smaller electrolytic projects that will help create the initial liquidity while the bigger projects (such as for CCS – carbon capture and sequestration) will take longer to implement. It is the small early projects that are needed to sustain the UK supply chain and innovation base into the 2030s.

For this survey we interviewed over 40 stakeholders in the hydrogen and project finance communities in the UK, including banks, funds, law firms, financial advisers, insurance providers, brokers, Government entities, SME technology innovators and project developers. Most of the project finance lenders we talked to had been approached by hydrogen project developers although the interactions were generally limited to date; and some banks in London were not familiar with the HPBM and associated hydrogen allocation rounds (HAR).

Most of the banks and SMEs were also not familiar with the new products that have been developed recently by insurance companies to address energy technology risks, for example in back-stopping electrolyser warranties. Insurance and assurance processes will be key in future to help both equity and debt providers to price such performance risks, but they are currently at an early stage of implementation. For example the insurance company AXA XL has already underwritten US$1 billion of technology risk insurance for new types of energy projects, primarily in USA, while Munich Re and Ariel Green also provide similar products – but we are not aware that this type of insurance has been used yet for energy projects in the UK. One key finding from this study was the need for more cross-industry discussion and sharing of learnings, which is a primary aim of this report.

An ultimate objective in scaling the hydrogen industry will be for debt providers to take on most of the project risk from shareholders i.e. debt finance with 'limited recourse' to these shareholders. This has already happened in mature energy sectors such as gas-fired power, LNG liquefaction, utility solar and offshore wind, where there is generally low technology risk and a liquid economic market for the end-product. This limited recourse debt is long term (more than 10 years in tenor) and can be put in place before plant construction starts.

However, from our interviews, it is apparent that it would be difficult for many of the current hydrogen projects in the UK to procure limited recourse debt prior to construction of the plant. The first issue is minimum loan size: many of the early hydrogen projects will cost less than £30 million, with a loan requirement of £10-20 million (although some will be much larger, such as the CCS projects). But the minimum loan size for the UK Infrastructure Bank (UKIB) is £25 million, and this cut-off is even higher for many international project finance banks. Only a few banks in the UK may go as low as £10-15 million, and just for one-off energy transition deals, although Scottish National Investment Bank can provide smaller loans for projects in Scotland.

Secondly, in order for lenders to take on the project risks from shareholders, even under many of the global subsidy programmes, banks would require a set of guarantees and standby funding facilities that many SME-led projects would find difficult to provide. A limited recourse financing adds significant cash costs, time and uncertainty to the funding of a project because of these lenders' requirements: project finance lenders, unlike equity providers, have no upside and need contingency planning through risk allocation for when projects go wrong.

For most hydrogen projects it would be advisable for SMEs to partner with larger corporates or funds who can help mobilise shareholder funding for construction risk and then refinance in the project finance markets after start-up. We also see a growing number of banks and boutique lenders who can provide venture debt to SMEs, providing that there is some revenue history and an intellectual property portfolio over which lenders could take security. The tenor of venture debt can be up to 5 years, potentially long enough to bridge an SME's share of costs of a hydrogen plant before refinancing after start-up. We have even seen the development of debt crowdfunding in France and Belgium for clean energy projects, whereby 5 year loans of up to €10 million have been provided.

There is a window in which we see limited recourse debt being possible now in the UK if an HAR-type project has most of the following characteristics:

- a project size above £40 million;
- construction guarantees from a credit-worthy contractor;
- the production plant being co-located with the anchor offtaker and (if electrolytic) having a sleeved low carbon power purchase agreement at a fixed price, maybe through a private wire;
- credit-worthy warranties for the plant performance from the operator or equipment manufacturer, backed up by independent engineering assurance (and maybe by a technology risk insurance policy if not yet a commercialised technology);
- offtake contracts with investment grade users of hydrogen on a long term take-or-pay basis who have invested in facilities for hydrogen use and maybe even invested in the production facility;
- sponsors have factored in returns that allow for the extra cash costs of project financing (interest during construction and fees can add 10-15% to the capex even before any technology risk insurance); and
- a low gearing (e.g. 50%) with debt service reserve and standby facilities in the event of reduced revenues.

This window will widen as the low carbon hydrogen market garners liquidity, for example through the start-up of pipeline networks in the 2030s. However, in the near term most hydrogen production projects in the UK will be funded by equity because of the immaturity of the hydrogen markets and the costs and potential delays if using project finance debt. Feedback from lenders indicates that there are some HAR1 projects that meet enough of these criteria to be potentially financeable using limited recourse debt, and these would be critical in helping move the industry forward. Project sponsors will need to ensure that they have included financing costs such as upfront fees, insurance and interest during construction when calculating the level of subsidy required.

The key risk identified by all the lenders we spoke to is offtake. It is apparent that large corporate users of hydrogen need to step up more to support the HPBM projects, for example by committing to long term take-or-pay contracts, maybe also taking a minority investment in the production facility so as to align interests, and committing to larger decarbonisation projects. Offtakers in the UK are motivated financially to switch their fuel use to hydrogen to avoid emissions trading scheme (ETS) payments; the financial returns for doing this may only be marginal for some companies, but we would like to see more companies accelerating capex cycles so as to achieve 100% switching to low carbon fuels.

We note that the world's first project financing of a large low carbon hydrogen project (NEOM in Saudi Arabia in 2023) was successful mainly because a major corporate (Air Products) provided a long term offtake commitment plus significant construction guarantees. H2 Green Steel, another major debt-funded project, has steel purchasers as minority investors, although it also has significant guarantees from government entities, including the Swedish government and the German export credit agency. We also note that these first successful projects consume hydrogen internally and sell a commodity (ammonia or steel) into a tradable market, which helps the financing (as opposed to selling just hydrogen into a market which is not yet traded).

Government subsidy support is critical to ensuing the economic viability of hydrogen value chains globally, including the UK. Inevitably, as HPBM is an untested scheme, banks will have concerns over some of the risks that they will be asked to take on as part of the scheme – the biggest issue being how to ensure debt service if the intended offtaker is unable to pay for the hydrogen. The UK Government (DESNZ) has told us that they will review the effectiveness of the HPBM in delivering the broader hydrogen ambition, with the progress of projects from the various allocation rounds forming part of that consideration, and thereafter determine whether revision or supplementary interventions are necessary. One area of debate is whether to allow injection of hydrogen into the gas grid, particularly as a fallback 'last resort' option, for which the safety case is still being evaluated. The first DESNZ Transport and Storage business model support will not be determined until late 2025, so it will be some years until there will be hydrogen pipeline networks operating that can facilitate liquid markets.

Going forward, we also expect to see more developments in the use of insurance and engineering assurance standards to address performance risk in hydrogen and other First Of A Kind technologies. We also expect to see participation by UKIB in providing debt facilities for the larger projects, including maybe mezzanine debt for first loss risk.

However, there will continue to be challenges for SMEs in procuring debt for smaller projects, including those that are using innovative technologies developed in the UK (such as biomass-based or new electrolyser designs). We expect that many such hydrogen projects will have a capex of less than £30 million, too small for most banks to lend to; but these projects are needed, both to create a liquid hydrogen market, particularly outside the hydrogen clusters, and to sustain a UK hydrogen supply chain and innovation base. One possible solution is the creation of a Hydrogen Debt Fund, seeded by a Government entity such as UKIB or a DESNZ programme, but funded primarily by private capital with a mandate to offer loans in the £7-25 million range.

In summary, the faster that lenders can become involved in financing hydrogen projects, both large and small, the faster we can grow a liquid hydrogen market and a hydrogen economy:

Offtaker commitments are key

- Both DESNZ and industry need to expedite the creation of a liquid market, DESNZ through liberalising the offtake constraints as far as possible (so lenders can see alternative offtake options) and the large corporates in the UK through providing greater commitment to offtake. We would like to see the users of hydrogen in the HAR schemes provide bankable long term take or pay contracts and maybe take a minority stake in the hydrogen plants to align their interests;

Assurance and insurance solutions need further development

- Further progress is required in developing insurance and assurance products that can price and therefore cover technology operating risk, especially for manufacturers of hydrogen plants (whether electrolytic or biomass-based) that cannot provide bankable warranties. Some of these products already exist and have been used to enable projects outside the UK to procure debt finance, there needs to be more awareness and industry discussion of these new tools; and

A Hydrogen Debt Fund would help finance small projects

- Further discussions are needed to identify possible means of debt-funding small hydrogen projects and similar First Of A Kind energy projects; these are needed to kick-start a liquid hydrogen market and sustain a hydrogen innovation and supply chain in the UK. The larger projects such as for CCS will take a longer time to build out, we need to push the smaller projects to help build and diversify hydrogen demand and develop industry capabilities – we note that this was not needed in the offshore wind and LNG markets, where large companies drove the development. We have suggested a Hydrogen Debt Fund as a possible solution; this idea was supported by a number of participants in the survey and more research with potential fund investors is required to develop this concept.

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