

*Hydrogen on uncertain
ground going into 2024,
but contracts deliver
injection of capital and
confidence*

January 2024



Foreword

The last two years have seen unprecedented disruption in global energy markets. Volatile gas prices, rising supply chain costs for offshore wind, and politics that whilst not slowing down the global importance of the climate crisis, has at least made some countries look closer to home for their own energy security. Hydrogen, whilst not insulated from these trends, has at least weathered the storm pretty well and the interest, investment, and importance of this technology is looking up.

Hydrogen is still finding its place in the future energy system. Perhaps the versatility of hydrogen helped to keep it on the priority list for policy makers and industry, as well as the fact that it likely to be crucial in decarbonising the most challenging sectors of our global economy.

Last year saw important milestones reached, but if the last couple of years has taught us anything, it's to expect big global political events and shocks to occur more often than ever.

We should try and remember that one of hydrogen's biggest strengths is its role in protecting our energy security, which has, recently, been demonstrably shown to be more important than ever.

As the sector seeks to consolidate last year's gains, we take a close look at the five key areas to focus attention on in 2024.

Brendan Murphy – Head of Hydrogen

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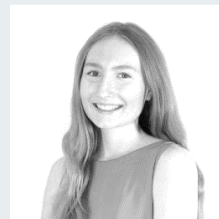
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2023: Foundations established for the European hydrogen sector

Despite the challenges, 2023 proved to be a foundational year for the development of the hydrogen economy. Some doubts still exist around the deliverability of hydrogen at scale as an energy transition solution, and real leadership from government's and from industry will be crucial to overcome this.

“2023 concluded with key decisions and announcements including finalised definitions for renewable hydrogen, solid targets for hydrogen infrastructure, and a broad range of mandates for hydrogen consumption in industry, transport, marine and aviation sectors”

Last year started against a backdrop of energy market volatility and robust responses by European governments to protect energy security. The market shock brought significant inflationary pressures, which in turn had a knock-on impact on global commodity prices and the wider supply chains. Hydrogen project developers felt the pain, with many projects' economics being hit by the additional cost pressures, resulting in delayed final investment decision (FID) horizons. As a result, seeing its strategic value, Europe invested heavily in formulating new policy and regulation aimed at regaining momentum in the new hydrogen economy.

So... What does the future hold? Some of the big flagship support schemes for hydrogen projects hit some major milestones in 2023, with several awarding the first tranche of public funding to the early projects. Notable examples included Denmark's first Power-to-X tender³ and the UK's Hydrogen Allocation Round 1 for production projects⁴. We expect to see more awards of funding for hydrogen projects in 2024, with the caveat that market is still in recovery and may take some time to reestablish some of the lost momentum, as demonstrated by the UK HAR1 allocation total installed capacity figure being half of what the government had originally targeted. This all came down to the projects' costs being driven up, straining the government's willingness to support. However, with the publication of the average HAR1 strike price, support levels have effectively been benchmarked, which now provides some clarity on the size and scale of the support available for future projects.

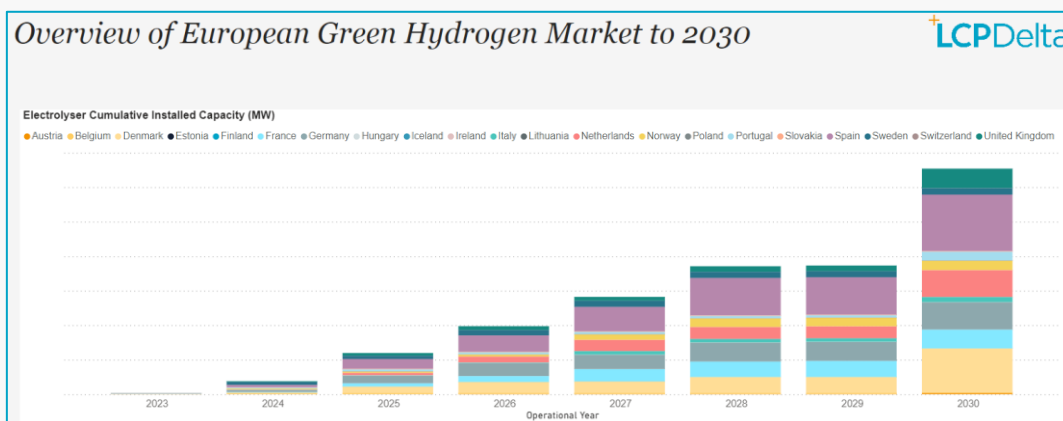


Figure 1 shows significant upturn in the installed capacity of green hydrogen projects going out to 2030 across Europe, and we expect to see more awards of funding for hydrogen projects in 2024 to support this growth.

Data extracted from LCP Delta's HYbase as of January 2024.

Fig.1 – European hydrogen production

¹ EU Net Zero Industry Act, https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en
² EU Carbon Adjustment Border Mechanism, https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en
³ PtX tender in Denmark, <https://ens.dk/en/press/first-ptx-tender-denmark-has-been-determined-six-projects-will-establish-electrolysis-capacity>
⁴ UK HAR 1 results, <https://www.gov.uk/government/publications/hydrogen-production-business-model-net-zero-hydrogen-fund-shortlisted-projects/hydrogen-production-business-model-net-zero-hydrogen-fund-har1-successful-projects>



Another much needed development in 2023 was the heightened focus on hydrogen distribution and storage, both critically enabling infrastructure for scaling up the hydrogen market. Europe finalised its Hydrogen and Gas Decarbonisation Package,⁵ setting the groundwork for hydrogen infrastructure, while the UK opened the process for designing its Storage & Transport Business Model. The European Commission also adopted the 6th list of Projects of Common Interest, where 40% of the infrastructure projects selected involved hydrogen.

It has also never been more important to get those first-of-a-kind (FOAK) projects off the ground and share the crucial learnings from them. It seems that we are no longer talking about another false dawn – hydrogen seems to have moved on from a promising option to a solution that will help deliver Net Zero.

The key question now is how quickly can hydrogen deliver a big impact, and who will capitalise on this injection of capital and confidence.

For more hydrogen market intelligence please contact the team for a demonstration of our research products including [HYbase](#), LCP Delta's clean hydrogen project data tool



⁵ EU Hydrogen and Gas Decarbonisation Package, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_6085



2024: Contracts deliver injection of capital and confidence

1 Hydrogen price benchmarking emerges

Reaching the point at which hydrogen is traded in a transparent, deep and liquid market remains many years away. In fact, the idea of hydrogen market fundamentals being similar to the current natural gas market may in fact be unhelpful, given that hydrogen is likely to be produced and traded much more locally or nationally for the foreseeable future, and the numerous forms it will take to be transported and utilised (all at differing price points).

Existing hydrogen price indexes currently offer limited transparency. However, with projects breaking ground and subsidy contracts being awarded, the market is getting a glimpse of a certain degree of clarity on the market prices at which clean hydrogen will be commercialised.

Interestingly, there are big disparities between different public support schemes, with the UK's Hydrogen Production Business Model HAR1 agreeing an average strike price of £9/kg (€11/kg), whereas Denmark's PtX tender resulted in subsidies under €1/kg. With a cap of €4.5/kg, the results from first European Hydrogen Bank auction will provide another temperature read to establish a European benchmark for hydrogen prices. Successful import projects from H2Global will also provide a first indication of the cost competitiveness of imports versus domestic production. These differences reflect the local and national conditions,

and the sectoral aspects and are not necessarily a bad thing – transparency of costs and supports levels will help the efficient deployment of capital. This benchmarking process also reflects the willingness of offtakers to pay a green premium, a measure of the end consumer market readiness to swap fuels. External factors like carbon taxation and subsidies will also shape the market equilibrium and influence the final market price.

A secondary outcome of price benchmarking is likely to be the reconfiguration, consolidation, or cancellation of some projects with higher costs struggling to secure public funding and attract offtakers. Project bankability will undergo greater scrutiny from both public and private investors and lenders. We have already seen anecdotal evidence of hydrogen projects being cancelled or delayed; a case-in-point is the Westküste 100 project in Germany, which was scrapped despite being awarded €30m in state funding and securing an offtaker in the oil refinery Raffinerie Heide. The project, which appeared to have overcome the early development hurdles, was pulled, citing high construction costs.⁶

Finally, as internationally produced hydrogen begins to be traded across Europe, domestic production projects will face additional competitive pressures with securing offtakers. This may prove challenging particularly in regions with elevated electricity and green hydrogen prices, such as Germany.

⁶ Westküste 100 press release, <https://www.westkueste100.de/en/joint-venture-decision-westkueste100-electrolyser-will-not-be-built/>



2

Global supply chain competition arrives in Europe

The globalisation of hydrogen is increasingly visible in Europe, with numerous Memorandum of Understanding agreements (MOUs) being signed between countries for research and commercial purposes. By the end of 2022, the US announced the Inflation Reduction Act and sent a shock across the international hydrogen markets. However, despite maintaining a lucrative support scheme, the US encountered its own obstacles in implementing the hydrogen Production Tax Credit. Debate centred around the introduction of the three pillars: additionality, geographical, and temporal correlation, which align with Europe's criteria.

While the momentum from the US has slowed, attention has shifted to another key player: China. According to the International Energy Agency (IEA) projects database, China reached a significant milestone, achieving 50% of the global electrolyser installed capacity at 1.2 GW by the end of 2023.⁷ With reported manufacturing costs falling to potentially a third of those of Western electrolyser manufacturers, Chinese industry is now looking west to Europe as the next big marketplace to capture.

The gradual opening of the Chinese market to European businesses has commenced, as seen by the collaboration between leading Chinese electrolyser manufacturer PERIC and Swedish hydrogen technology producer Metacon. Metacon has not only sourced PERIC's electrolyser and hydrogen refuelling station (HRS) technology for projects in the EU and the USA but has also signed a Memorandum of Understanding (MOU) to

manufacture Metacon's hydrogen generators (from non-electric sources) in China.⁸ This strategic move positions Metacon to swiftly access the growing market and leverage PERIC's large-scale production facilities.

The move towards price-based subsidies is also driving a race to the bottom in terms of costs, but without additional ESG criteria in place. The results from the Hydrogen Bank auction will provide an early indicator on the opportunities for lower cost technology, as the scheme will rank bids solely based on price.

3

Hydrogen key to integrated energy system planning

A pivotal shift is underway as hydrogen evolves into an integral element of system planning, driven by initiatives both in the UK and Europe. In 2024, the UK is set to establish the Future System Operator (FSO) role, tasked with strategically planning gas and electricity networks, including hydrogen.⁹ This move aims to address network constraint issues, laying the foundation for integrated system planning of hydrogen networks. The FSO will play a crucial role in maximizing the potential benefits that hydrogen projects can offer to the electricity grid. These benefits include reducing renewable energy curtailment, providing flexibility, and contributing to long-term energy storage.

Concurrently, in Europe the Hydrogen and Gas Decarbonisation Package has paved the way for the creation of the European Network of Network Operators of Hydrogen (ENNOH). This independent entity is tasked with coordinating the planning, development, and operation of the EU hydrogen infrastructure. However,

⁷ IEA Global Hydrogen Review 2023, <https://www.iea.org/reports/global-hydrogen-review-2023>

⁸ Metacon press release, <https://metacon.se/metacon-has-entered-into-a-memorandum-of-understanding-with-peric-regarding-a-strategic-partnership-for-the-production-and-sale-of-metacons-hydrogen-generators-on-the-chinese-market/>

⁹ UK Future System Operator, <https://www.nationalgrideso.com/what-we-do/becoming-future-system-operator-fso>



its full establishment is not expected until 2026, with independent operations commencing in 2028.

In the UK, the government is publishing its second consultation on the Review of Electricity Market Arrangements (REMA) early this year,¹⁰ which is wide-ranging and potentially significant for hydrogen projects. A key component, with the biggest impact on hydrogen, is the possible move to Locational Marginal Pricing (LMP) for power generation assets. This option is being explored as a potential solution to electricity transmission constraints through new locational investment signals.

If LMP is adopted, it will likely also send strong locational signals for where to develop electrolyser projects. REMA is also exploring arrangements for how to utilise electrolysers as flexibility assets in the future energy system, a potential new revenue stream for projects.

4

Increased competition for green electrons

With demand for green electricity increasing across sectors globally, green hydrogen projects will be competing with other industries to secure their renewable electricity power purchase agreements (PPA). The data centre industry is an example of a fast-growing sector with significant power requirements, and with decarbonisation targets being set, these companies are increasingly demanding renewable electricity via PPAs. This intensifies competition for developers of green hydrogen projects, who face the challenge of contending with established players who are willing to pay more and present a lower-risk profile for renewable developers. While larger developers may have in-house capabilities to commission renewable electricity plants, the prevailing

tight competition is expected to exert upward pressure on PPA prices.

Given the significant contribution of electricity to the levelised cost of hydrogen, low-cost electricity is essential for projects to be bankable. Within Europe, the Renewable Fuels of Non-Biological Origin (RFNBO) criteria allows for hydrogen production to be supplied from grid electricity in regions with a high penetration of renewables. This has accelerated the development of projects such as H2 Green Steel in Sweden, which signed a PPA with Fortum in March.¹¹

Navigating this landscape will require strategic positioning and effective negotiation for hydrogen developers to secure reliable and affordable renewable electricity sources. The outcome of this competition will significantly influence the feasibility and success of green hydrogen projects in the evolving broader energy market.

5

Hydrogen markets get injection of capital and confidence

2024 brings a more optimistic and focussed energy, thanks to the good foundations laid last year, even given the political and market shocks experienced. The early stages of market openness and cost transparency are important next steps on the path to building a functioning hydrogen sector. With contracts for support signed, industry has received a much-needed injection of capital and confidence.

However, it is important to note that the hydrogen sector is still recovering from the wider market volatility of 2023, and that 2024 will be a reality check for the industry and have the effect of setting apart the leaders of the pack from the also-rans.

¹⁰ UK REMA, <https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements>

¹¹ H2 Green Steel press release, <https://www.h2greensteel.com/latestnews/h2-green-steel-has-entered-into-a-long-term-frame-agreement-with-fortum-for-electricity-supply-1>



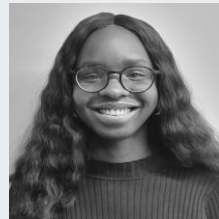
Coupled with the fact that 2024 is the biggest election year in history, with the US, UK and EU having national or parliamentary elections, all with the potential to transform the political landscape and set a new agenda and political direction for hydrogen. For example, the Labour Party in the UK has announced it will double the green hydrogen production target for 2030 to 10 GW should they enter office. However, the flipside is that we are in somewhat of a political vacuum that comes with being in election cycles, with the associated slowdown in decision-making due to the political uncertainty.

The focus for industry and governments now should be close collaboration all the way along the hydrogen value chain, as well as integrating offtakers, electricity suppliers, and investors early into projects, all backed by with joined up policy, to break down the big challenges of project bankability and deliverability.

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