

20 May 2025

Current Price (p)	6.25
Shares in issue (m)	354
Mkt Cap (£m)	22
Net debt (£m)	0
EV (£m)	23
BVPS (£)	7.8

Share price performance

1m	8.7%
3m	-13.2%
12m	-53.7%
12 m high/low	13.5/5.3
Ave daily vol (30D)	363,413

Shareholders

Joe Scott Mouldings	10.6%
Kenera Energy	6.0%
Aurelius Invest's	5.9%
Hargreaves Lansd'n	4.8%
Price Henry	3.7%
Ig Markets Ltd	3.6%
Julius Baer Group Lt	3.5%
Dangoor Elie Basil V	3.5%
Williamson Nigel	2.9%
Brook Clive	2.8%
Total for top 10	47.3%
Free float	62.3%
Source: Bloomberg	19 May 25

Next news H2s Q3

Business description

Developer of membrane free hydrogen electrolyzers



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HYDROGEN DISRUPTOR

Clean Power Hydrogen's membrane free electrolyser has the potential to disrupt the hydrogen market in our view. It is low cost, can operate flexibly and does not contain forever chemicals. With a potentially oversupplied electrolyser market in sight, the ability to offer the lowest cost option could see the technology dominating the market. We initiate coverage with a central case valuation of 78p per share.

Can Deliver the Lowest Cost Hydrogen

Clean Power Hydrogen's (CPH2) membrane free electrolyser (MFE) has no membrane to degrade and does not use platinum group metals as a catalyst. As a result, it is on track to have a lower capital cost than rival PEM electrolyzers. While alkaline electrolyzers have a lower capital cost, they cannot operate flexibly so cannot take advantage of the price structure of the electricity market. This means they cannot beat CPH2 in delivering the lowest levelised cost of hydrogen where cheap off-peak electricity prices are available. This factor is even greater where the electrolyser can take advantage of curtailed electricity.

Technology Deployed and Company Taking Orders

Clean Power Hydrogen has installed its first MFE110 500kW demonstrator electrolyser with Northern Ireland Water in Belfast which will deliver both hydrogen and oxygen with the latter used in water treatment. This has now passed all its site acceptance tests and is fully operational. The company already has orders for 4MW of capacity of its larger MFE220 electrolyser and licencing agreements for over 4GW with major partners around the globe.

Hydrogen Market

The hydrogen market has seen setbacks in recent years but demand has been boosted by regulatory moves notably with low carbon fuel mandates for decarbonising shipping and aviation. Along with industrial demand we are seeing a more realistic picture of demand emerging that allows us to produce conservative growth assumptions for the company. Our central case value comes out at 78p per share.

£,000 Dec	2023a	2024e	2025e	2026e	2027e	2028e
Sales	0	0	0	5,668	16,237	22,578
EBITDA	-5,010	-4,838	-5,730	-6,848	-2,951	-131
PBT	-5,127	-5,283	-6,523	-7,823	-4,155	-1,557
EPS	-1.5	-1.8	-1.2	-1.4	-0.7	-0.3
CFPS	0.2	-3.0	-1.3	-1.4	0.4	0.2
DPS	0.0	0.0	0.0	0.0	0.0	0.0
Net Debt (Cash)	-1,731	497	-7,801	-240	-2,207	-3,323
Debt/EBITDA	0.3	-0.1	1.4	0.0	0.7	25.3
P/E	-4.1	-3.5	-5.3	-4.4	-8.3	-22.2
EV/EBITDA	-5.6	-6.2	-3.8	-4.3	-9.3	-200.0
EV/sales	na	na	na	na	na	-0.1
FCF yield	0.0%	-0.5%	-0.2%	-0.2%	0.1%	0.0%

INVESTMENT SUMMARY

Next generation electrolyser

Clean Power Hydrogen's (CPH2) membrane free electrolyser (MFE) is a major departure from existing designs although builds on the successful proton exchange membrane (PEM) electrolyser. However, it has no catalyst coated membrane. This means no membrane to degrade and no use of expensive platinum group metals as a catalyst. As a result, it has all the benefits of a PEM electrolyser with flexible operation and high pressure, high purity output but at a much lower cost. It also not reliant on PFAS, the forever chemicals that could face a ban in Europe.

Line of sight to lower costs

The company's commercially sized MFE110 demonstrator unit has been produced at a cost broadly consistent with the capital cost of a PEM electrolyser. As the company moves from this first of a kind unit to the commercially oriented MFE220 there are some immediate cost savings that can remove £0.45m from the unit cost and this could double in the near term. That puts the unit below the cost of PEM and in a flexible deployment it would also beat even low cost Chinese alkaline electrolysers. Cost leadership is key to winning market share and this is why we see CPH2 as a disruptor in the hydrogen industry.

Technology now deployed and taking orders

The MFE110 demonstrator unit is now fully operational at a Northern Ireland Water site in Belfast having passed its final site acceptance test on 5 May. It is delivering both hydrogen and oxygen at the site both at high purity levels with hydrogen at 99.999mol% and oxygen at 99.7wt%. The oxygen is being used for water treatment which could see further orders in the water sector. CPH2 has contracts for the sale of four MFE220 units from Northern Ireland Water and from licence partners Hidrigin and Fabrum with the latter taking two units.

Licence model limits capital needs

Hidrigin has a licence agreement to manufacture up to 2GW of capacity and manufacturing for these volumes has been outsourced to Jones Engineering Manufacturing although CPH2 will provide stacks and other critical components at a guaranteed margin. Hidrigin is targeting projects across Europe and has already been successful in the Irish RESS4 auction for 76MW for a solar farm with hydrogen co-location. Fabrum has an unlimited licence covering Australia and New Zealand. A third agreement with Kenera who have also taken a strategic equity stake in the company is focused on Europe and the Middle East.

Hydrogen market getting a boost from regulation

While there is debate about the extent of hydrogen's role in the energy transition, even some of the most hostile commentators agree that there is a role with some important applications. Key here are solutions for the decarbonisation of shipping and aviation. Hard mandates are emerging for the blending of low carbon fuels including those produced using low carbon hydrogen. Increasingly biomass derived solutions including biomethane and biomethanol are looking to hydrogen to upgrade their processes and improve yield.

Intermittent and curtailed renewables can drive down cost of hydrogen

Because CPH2 can offer flexibility in the operation of the MFE units it is ideal for pairing with intermittent renewables, taking power when it cannot find demand or cannot access grids due to curtailment. With grid capacity around the world under growing pressure this adds to the opportunity for CPH2.

BULL POINTS

- Potentially the electrolyser delivering the lowest cost hydrogen
- Already taking orders
- Ideal for co-location with intermittent and curtailed renewables

BEAR POINTS

- Policy uncertainty on hydrogen in some markets including the US
- Early-stage company only starting to take orders
- Company will require additional capital to secure growth

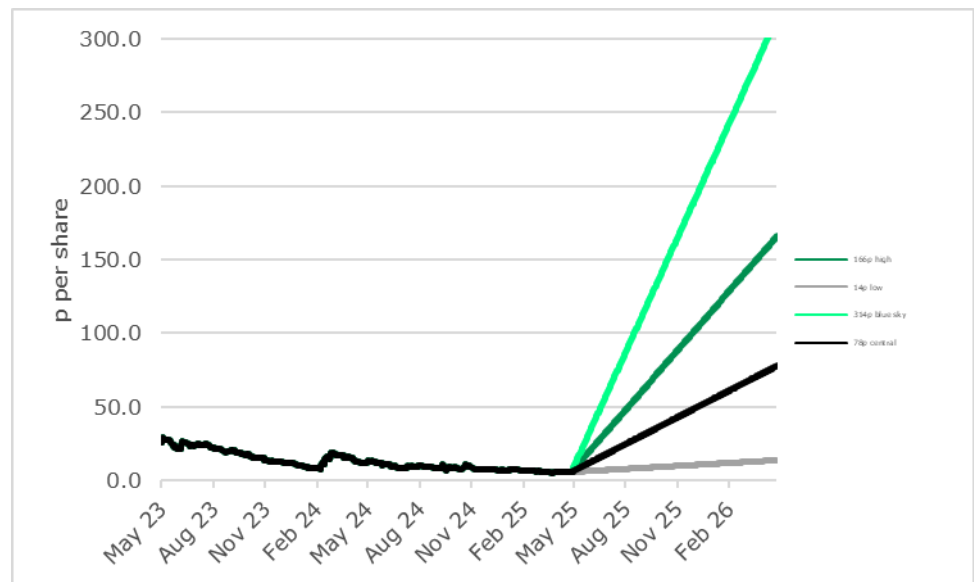
CATALYSTS

- Delivery against existing orders
- Near term costs gains secured

VALUATION

We have valued the company using a DCF approach with a discount rate of 14.2%. Using this approach we have derived sales and cashflows based on demand forecasts for the company’s initial geographic focus and only focused on market statistics for deliverable offtakes. This gives us a central case valuation of 78p per share. Narrowing the market to binding offtakes gives a low case of 14p and increasing to all offtake deals gives 166p. Finally widening to all geographies except China gives 314p.

Share price performance and valuation outlook



Source: Longspur Research, Bloomberg

RISK

The key risks to our valuations are technology redundancy, competition, and any stalling of the hydrogen economy.

Financing for growth

The company's full year results statement showed that the company will need additional funding to remain a going concern but that it has a reasonable expectation of doing so. With orders in place we expect that the de-risking represented by the final site acceptance of the demonstrator unit will allow the company to source the funding required to drive growth.

Technology redundancy

There is still some debate between alkaline and PEM electrolysis before introducing MFE. We see the flexibility of MFE combined with the potential to beat alkaline on costs by mid-decade as making it the likely dominant solution for green hydrogen. But if alkaline can maintain a cost advantage it could hold substantial market share. However, we think MFE will always have a role, even at a niche level, so we continue to see CPH2 develop even under a worst-case scenario. Less mature technologies such as AEMs and SOECs do not have the performance characteristics of MFE.

Competition

There are a number of strong players producing PEM electrolyzers including Siemens and Hydrogenics. However, we think CPH2 has a product with real competitive advantage. We think our market share assumption fits with this. New entrants could emerge, but we think they will be at a disadvantage to the existing players. For the existing players the market is potentially very large meaning there is room for all participants to grow.

Hydrogen economy development

The development of a hydrogen economy is driven by policy needs on climate change. All policy can be unpredictable and can face setbacks depending on the politics of the day. That said we do see support building for hydrogen and acceptance in key applications or geographies is likely to create its own momentum. Additionally, CPH2's global offering diversifies it against this threat.

CLEAN POWER HYDROGEN

CPH2 has developed a hydrogen electrolyser that has similar performance characteristics to a proton exchange membrane (PEM) electrolyser but importantly does not have a membrane. This membrane free electrolyser (MFE) means it does not require platinum grade metals which reduces its costs. Also it does not suffer from degradation of the membrane by dint of not having one to degrade.

The downside of the design is that there is no separation of the hydrogen and oxygen gases created by the electrolysis of water. However CPH2 has used a standard cryogenic process to separate these and thus produced both hydrogen and oxygen gas as saleable products.

Company history

CPH2 can trace its history back to 2012 when Dr Nigel Williamson and Joe Scott created CPH2 Ireland. Their aim was to establish a technology which would deliver a modular solution to the hydrogen production market in a cost-effective, scalable, reliable and long-lasting way. The technology has been developed and the company has received orders directly and through its partners. The company's MFE110 demonstrator electrolyser has now passed all its site acceptance tests and is operational and functioning at a customer's site. This places the technology firmly at Technological Readiness Level 9 (TRL) in our view and ready for commercialisation.

Key Events in Company History

Date	Event
05-Dec-17	Completed first external investment round (£450k).
30-Jan-20	Won <i>Hydrogen & Fuel Cells</i> category at Rushlight Awards.
06-Jul-20	Received first non-grant funded order for MFE30 electrolyser.
01-Sep-20	Jon Duffy started as CEO.
25-Nov-20	Delivered Ireland's first demonstration electrolyser secured, £3m private investment.
01-May-21	First 1MW MFE220 electrolyser order from AFCryo (now Fabrum).
15-Jun-21	1MW MFE220 electrolyser order from Northern Ireland Water.
21-Jul-21	Signed lease for new 29,000 sq ft manufacturing facility in Doncaster.
07-Feb-22	Shortlisted for Made in Yorkshire Award (Manufacturing Innovation).
16-Feb-22	Admitted to London AIM; received Green Economy Mark.
04-Apr-22	Second 1MW electrolyser order from Fabrum.
04-Apr-22	Second 1MW MFE220 electrolyser order from AFCryo (now Fabrum).
05-Sep-22	Technology cooperation agreement signed with Kenera, part of KCA Deutag.
22-Dec-22	Signed development and updated supply agreement with Fabrum.
31-Jan-23	Signed 10-year manufacturing agreement with Fabrum (NZ/Australia).
27-Mar-23	Fabrum receives first customer order (Obayashi) for MFE220 under licensing deal.
10-Apr-24	CPH2 granted <i>Fit for Hydrogen</i> status by Nuclear AMRC.
19-Apr-24	Published 2023 year-end results: key testing milestones, £21m net assets, 3 ISO certifications.
26-Sep-24	MFE110 passes factory acceptance test.
15-Oct-24	Renewed MFE220 contracts with NI Water and Fabrum for 2025 deliveries.
04-Nov-24	Signed 2GW licence agreement and 1MW sales contract with Hidrigin (Ireland).
07-May-25	MFE110 passes site acceptance test.

Source: Company Data

Technology in detail

The CPH2 MFE electrolyser separates water into hydrogen and oxygen. Unlike other electrolyser designs the hydrogen and oxygen remain mixed on separation. The resulting gas mix then undergoes a cryogenic separation to split it into two streams, one of hydrogen and one of oxygen. CPH2 have developed IP in this area building on well understood technology from the cryogenic industry.

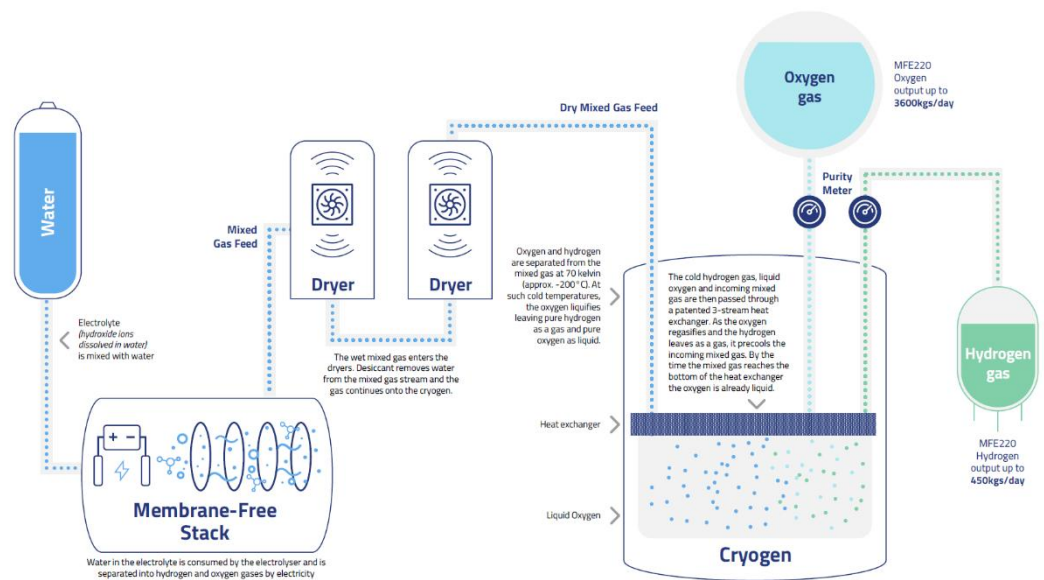
The electrolyser is designed to be simple, robust and to have a 25-year lifespan. This allows it to match the project lives of wind turbines and solar PV projects making the unit attractive for co-location and the generation of hydrogen from curtailed electricity. With a modular design it can be scaled to projects from sub 1 MW to multi-GW installations.

While competing with proton exchange membrane (PEM) electrolysers, the lack of a membrane removes a key area of degradation and failure for CPH2. The membranes in a PEM electrolyser are coated with platinum group metals which are costly. The MFE does not use any PGMs which gives it a significant cost advantage.

The more simple design of the cell stack does not need a sterile environment for assembly and avoids any need for membrane sealing. This means it is an easier process to be undertaken by robotic assembly and also allows new manufacturing sites to be commissioned rapidly. The simplicity also means that any R&D improvements can be implemented without complex refitting of manufacturing facilities. Manufacturing of the units can be seen as mainly an assembly operation with limited need for manufacturing capex. This makes the process ideal for licencing and reduces the investment required by licensees.

A simpler design also reduces lifetime maintenance costs and the electrolyser does not rely on complex upstream manufacture in its supply chain.

MFE Process Diagram



Source: Company Data

MFE Key Specifications (MFE 220)

Hydrogen Production (kg/day)	450
Hydrogen Purity (vol%)	Up to 99.999% (to ISO 14687 for fuel cells)
Oxygen Production (kg/day)	3,600
Oxygen Purity (vol%)	Up to 99.8%
Hydrogen Pressure (bar)	20
Efficiency (kWh/kg AC Input)	59

Source: Company Data

Intellectual Property

CPH2 have a number of patents awarded and pending, with no ongoing claims for or against them. The patents listed below are for various elements of the CPH2 electrolyser and the company continues to spend on R&D to progress their technology, as such we would expect the company’s body of IP to continue to grow over time. In particular the company may change and expand the geographic filings in future.

For context, the Patent Cooperation Treaty, administered by the World Intellectual Property Organization (WIPO), allows inventors and companies to file a single “international” patent application that can eventually lead to protection in over 150 countries. The Patent Cooperation Treaty (PCT) application process has two main phases: the International Phase and the National Phase. The International Phase allows for a single application to be filed, which serves as a temporary application in multiple countries. The National Phase begins when the international application is transitioned into individual national or regional applications in the countries where patent protection is sought.

Patent Summary

Name	Description	Status
DK2986759T3; EP2986759A1; EP2986759B1; US10443137B2; US2016090657A1; WO2014170337A1	A hydrogen gas generator system (This patents claims a particular arrangement of electrolyser stack but does not claim cryogenic separation)	Patent Cooperation Treaty (PCT) phase ended registered: GB,NL,IE,DE,DK,AT,FR,IT,NO,BE,SE World: Granted US
EP3011077A1; EP3011077B1; GB2515292A; US2016145749A1; WO2014202429A1	A hydrogen gas generation system, and process for the electrocatalytic production of hydrogen gas. (This is the core patent which claims membrane free stack and cryogenic separation)	The European patent has been granted with the designated state as Ireland. PCT Phase ended registered: IT,GB,DE,NL,FR,NO. World: None.
AU2020466174A1; AU2020466174A9; BR112023003975A2; CA3189968A1; CN115997098A; ECSP23024343A; EP4208682A1; IL301067A; JP2023540552A; KR20230062604A; MX2023002565A; PE20230976A1; US2023375276A1; WO2022049359A1	Heat exchanger (This is the 3 stream plate heat exchanger)	PCT Phase ended, registered Europe: GB, NL,IE,DE,DK, AT,FR,IT,NO,BE,SE. World: US, CN, JP, AU,BR,CA,EC,IL,KR,MX,PE,
(WO2022/112732)	Field-distributed electrolyser system this claims directly linking electrolyser to Solar Panel and Solar Panel Array	Application: EP and Australia. PCT phase is just ending.
WO2023/021075	Electrolyser with metal hydride storage (This is a way to separate hydrogen and oxygen using an absorbent to absorb H2).	Application: Currently in PCT phase. Application in US, China and Europe.

Source: Company Data

CPH2 BUSINESS MODEL

CHP2 has made initial sales of MFEs but is also pursuing a licence model where others can manufacture electrolyzers for sale in their own markets. While sales are normally made by licence holders, for two of the three existing deals, CHP2 can also place orders for sales made directly.

Existing Licence Agreements

	Hidrigin	Kenera	Fabrum
Potential	Up to 2GW	Up to 2GW	No max.
Royalty fees	Yes	Yes	Yes
Component sales	Yes	Yes	Yes
CPH2 can place orders?	No	Yes	Yes

Source: Company Data

Even where the company undertakes licence sales it will still supply the stack on which it will make a margin as well as retaining control of the key intellectual property. Manufacturing of the stacks will take place at the 29,000 sq ft facility in Doncaster which can produce up to 200MW of stacks.

As we have already discussed the simple design of the technology means that manufacturing is largely an assembly process requiring minimal capex and for manufacturing facilities to be commissioned rapidly. This makes the process ideal for licencing and reduces the investment required by licensees. It also reduces the capital required by CPH2, allowing the company to cover more regions and capture the benefits of its leading position in the market.

Hidrigin

Hidrigin is an Irish based development company targeting €500m of renewable energy projects across Europe with initial success winning 76MW of solar PV capacity in the Irish 4th Onshore Renewable Energy Support Scheme Auction (RESS4). It aims to combine solar PV with MFE220 hydrogen electrolyzers. A further three PV projects are in the pipeline in Ireland.

Kenera

Kenera Energy Solutions is part of oil services company H&P Inc and was formed to consolidate and apply oil services skills into the energy transition including a focus on clean fuels. Based in the UK the company is truly global with operations in Norway, Denmark, Germany, Oman, Saudi Arabia, UAE, Qatar, Kuwait and Iraq.

Fabrum

New Zealand based Fabrum is an engineering company focused on cryogenics, green hydrogen, advanced engineering and integrated manufacturing. It is active in New Zealand and Australia. In the hydrogen space it is active in hydrogen liquefaction, storage and refuelling stations.

WHY THIS IS TRULY DISRUPTIVE TECHNOLOGY

We see CPH2’s MFE as standing out for three reasons:

- Low cost
- Flexible operation
- No PFAS

The CPH2 electrolyser is low cost. While the capital cost is higher than a Chinese alkaline electrolyser it is cheaper than most others and unlike alkaline electrolysers can operate flexibly which we think is key to working with intermittent renewables and reducing the overall costs of hydrogen. While PEM electrolysers can also operate flexibly, CPH2 does not suffer the same efficiency issues that PEM can face at low loads. Also, like PEM, the unit has a high natural pressure operating and outputting hydrogen at up to 20 bar. This reduces the cost of any additional compression stages. Unlike PEM there are no PFAS in the electrolyser stack. With the EU considering a ban on these, PEM electrolysers face a potential risk or at least higher end of life costs for safe disposal. Finally, installations are designed to be containerised with minimal footprint making them ideal for co-locating with renewable energy or at locations of hydrogen usage.

With better operating characteristics and a low cost we think CPH2’s electrolyser is a next generation unit capable of disrupting the market for flexible electrolysis.

Apart from MFE, there are two main types of electrolyser, proton exchange membrane (PEMEC) or alkaline (AEC). Solid oxide electrolysers (SOEC) and anion exchange membrane electrolysers (AEMEC) also exist but are at an earlier stage of development with solid oxide not responsive to intermittent renewable power. PEMECs are more responsive but higher cost thanks to the use of expensive catalysts. Alkaline electrolysers are cheaper but less responsive, taking longer to start up when needed. Electrolyser manufacturer NEL (NEL NO) manufactures both types and expects the capital cost of these to converge by 2030.

Several factors come into play when choosing between electrolysers. A key difference is flexibility with only MFE and PEM electrolysers offering rapid response times and flexible operation. This makes them a better choice for pairing with intermittent renewable energy especially if operators are targeting electricity response markets for some of their income. Purity of the hydrogen produced, and a higher output pressure are additional benefits of the MFE technology.

Electrolyser technologies compared

	MFE	AEC	PEMEC	SOEC
Voltage efficiency (%HHV)	67-82	62-82	67-82	<110
Operating Temp. (C)	50-80	60-80	50-80	650-1,000
Operating Pressure (bar)	20	<30	30	<25
Gas purity (%)	99.999	>99.5	99.99	99.9
System Response	Seconds	Minutes	Seconds	Seconds
Cold-start time (min.)	<20	<60	<20	<60
Works with renewables	Y	N	Y	N
Stack Lifetime (h)	200,000	60,000-90,000	20,000-60,000	<10,000
Maturity	Demonstration	Mature	Commercial	Demonstration
Capital Cost (€/kWe)	1,185-2,320	1,000-1,200	1,860-2,320	>2,000

Source: Imperial College, Company Data, Longspur Research

LEVELISED COSTS OF HYDROGEN (LCOH)

The MFE delivered to Northern Ireland Water had a material capital cost of £1.98m/MWe. While this does not include labour, overhead or commissioning costs or any profit it is also a first of a kind (FOAK) unit so is not representative of the cost levels that can be achieved.

Already identified are savings that could remove £0.9m per MWe from the commercial MFE220 with early wins delivering half of this in the next two years. The identified savings come from known design improvement opportunities, development of the supply chain strategy and lower pricing from procurement in volume.

The MFE should also be able to improve on its efficiency and we believe it can get to a figure of 49kWh/kg. As a result of these savings, we think we can look at cost comparisons with other technologies at an all-in capital cost of US\$1,339 per kW with potential for lower costs in time. Using this figure, we can compare the levelised cost of hydrogen (LCOH) against other electrolyzers. For MFE and PEM we have factored in the potential to sell oxygen as a by-product which reduces the overall LCOH.

Levelised Cost of Hydrogen

	Alkaline	PEM	PEM+O2	MFE	MFE+O2
Life (years)	10	10	10	25	25
CoE	10.0%	10.0%	10.0%	10.0%	10.0%
CoD	6.0%	6.0%	6.0%	6.0%	6.0%
Gearing	60.0%	60.0%	60.0%	60.0%	60.0%
Effective tax rate	25.0%	25.0%	25.0%	25.0%	25.0%
WACC	6.7%	6.7%	6.7%	6.7%	6.7%
Capital Recovery Factor	0.1404	0.1404	0.1404	0.0835	0.0835
Electrolyser H2 Output (tonnes)	150	150	150	150	150
Electrolyser O2 Output (tonnes/t H2)			8		8
Electrolyser O2 Output (tonnes)	0	0	1,200	0	1,200
Utilisation	90.0%	90.0%	90.0%	90.0%	90.0%
Electrolysis efficiency (kWh/kg)	50	49	49	49	49
Electrolyser capacity (MW)	1	1	1	1	1
Electrolyser electricity (GWh)	8	7	7	7	7
Water consumption (l/kg)	11.12	11.12	11.12	10.94	10.94
Water consumption (m3)	2	2	2	2	2
Electricity unit cost (\$/MWh)	113	113	113	113	113
O2 price (\$/t)	100	100	100	100	100
Water unit cost (\$/m3)	2.21	2.21	2.21	2.21	2.21
Fixed O&M (\$/MW/year)	5,700	5,700	5,700	5,700	5,700
Variable O&M (\$/MWh)	6.00	6.00	6.00	6.00	6.00
Electrolyser Unit Capex (\$k/MW)	339	1383	1383	1339	1339
Electricity	850	833	833	833	833
Water	0.004	0.004	0.004	0.004	0.004
Maintenance	50	49	49	49	49
O2 sales	0	0	-120	0	-120
Total opex	900	882	762	882	762
Electrolyser capex	0.3	1.3	1.3	1.2	1.2
Costs per kg of H2					
Operating cost	6.00	5.88	5.08	5.88	5.08
Capital cost	0.30	1.21	1.21	0.69	0.69
Total LCOH	6.30	7.09	6.29	6.58	5.78

Source: Longspur Research

REDUCING COSTS FURTHER

The hydrogen industry needs to bring costs down for electrolysers in order to compete with fossil fuel hydrogen produced using steam methane reformation (SMR). There is an expectation that this will happen with volume increases leading to cost reductions in a similar fashion to Moore’s Law in semiconductors or Swanson’s Law in PV solar.

IRENA has identified that electrolysers have similar learning rates to solar PV and could experience similar cost decreases with large-scale deployment. In our view, this gives a lot of comfort to the view that electrolysis can overtake fossil fuel produced hydrogen in cost terms. IRENA cites many studies which show good learning rates of up to 18% for hydrogen technology.

Learning Rate Estimates for Electrolysers and Fuel Cells

Learning rate (%)		Notes	Reference
9	Electrolysis	Alkaline for 2020-2030	Hydrogen Council, 2020
13	Electrolysis	PEM for 2020-2030	Hydrogen Council, 2020
18 +/- 6	Electrolysis	1956-2014 data (alkaline)	Schmidt et al., 2017
18 +/- 13	Electrolysis	1972-2004 data	Schoots et al., 2008
8	Electrolysis	Floor cost of USD 350/kW (alkaline)	Gül et al., 2009
18 +/- 2	PEM fuel cell	1989-2012 data	Schmidt et al., 2017
18	PEM fuel cell	Initial capacity of 1.1 GW	McDowall, 2012
15	PEM fuel cell	Based on proprietary data	McKinsey, 2010
21 +/- 3	PEM fuel cell	1996-2006 data	Schoots, Kramer and van der Zwaan, 2010
15	PEM fuel cell	Floor cost of USD 50/kW	Gül et al., 2009
0%	Solid oxide fuel cell	California self-generation incentive programme	Wei, Sarah Josephine Smith and Sohn, 2017
16 +/- 3	µCHP	Based on EneFarm, Korean demonstration and PEMFC manufacturer	Staffell and Green, 2013
18 +/- 2	µCHP	Based on EneFarm	Wei, Sarah J. Smith and Sohn, 2017

Source: IRENA

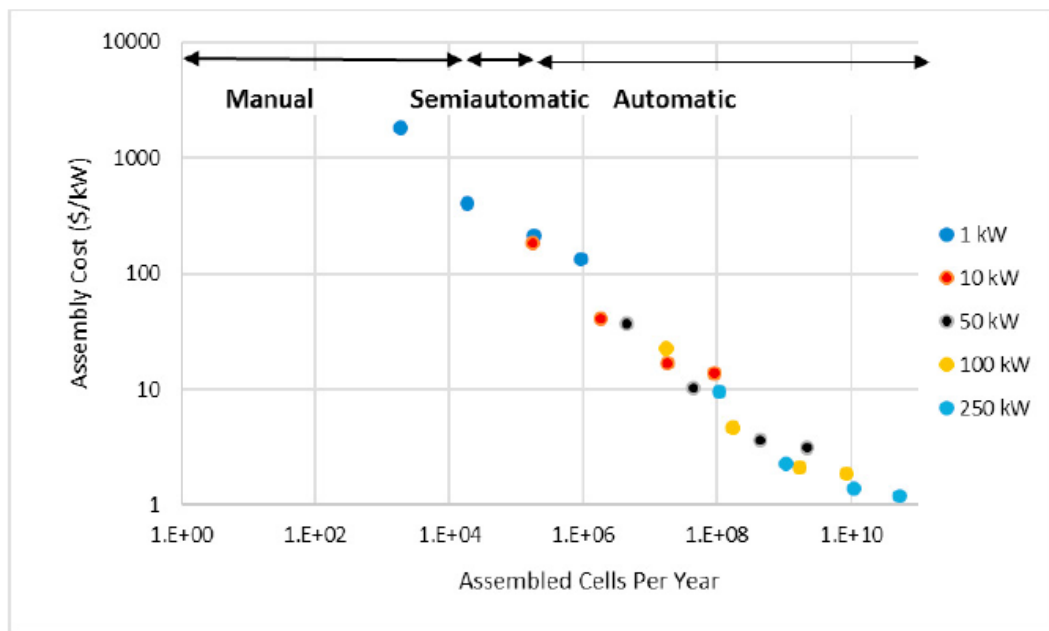
However, these cost reductions are not axiomatic. The classic work on learning curves is Abernathy and Wayne, Limits of the Learning Curve, Harvard Business Review 1974:

“The frequency with which this cost reduction/ volume increase pattern is found in practice sometimes leads to the incorrect impression that the learning-curve effect just happens. On the contrary, product design, marketing, purchasing, engineering, and manufacturing must be carefully coordinated and managed.”

It requires work to bring costs down, volume alone will not do this. In manufacturing, companies can drive faster throughput with a number of initiatives. We especially note the opportunity for adopting robotic stack assembly at CPH2.

Stack assembly is still often undertaken as a manual process. Higher volume battery and fuel cell manufacturers have already moved to robotic stack assembly. This can reduce stack assembly time and cost dramatically.

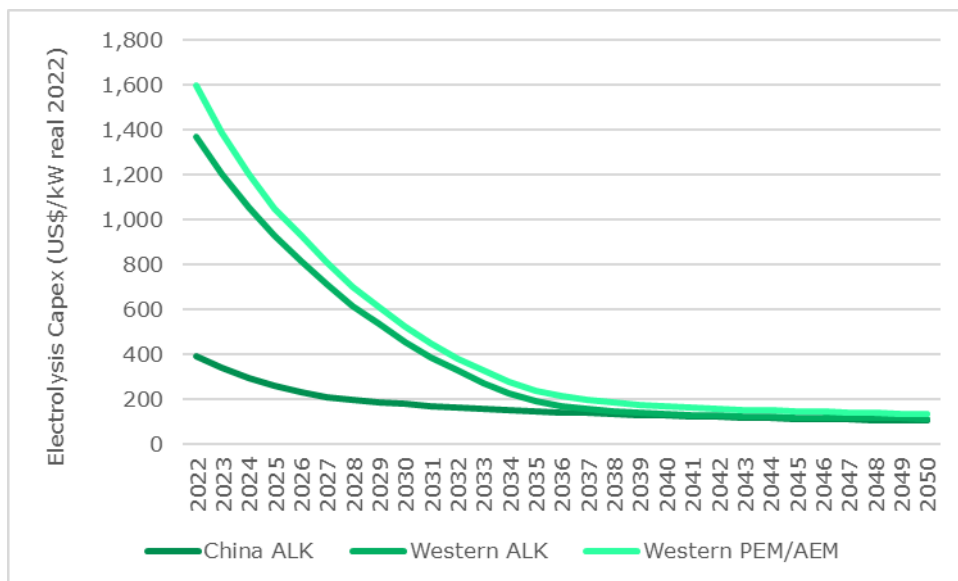
Automation Impact on Stack Assembly Costs



Source: National Renewable Engineering Laboratory

With manufacturers such as NEL happy to forecast a convergence of PEM costs with alkaline we think CPH2 can do at least as well. Note that other forecasts from BNEF confirm the NEL view and also show convergence with the very low cost of Chinese alkaline electrolyzers. We expect CHP2 to be able to do as well if not better.

Electrolysis Capex at the System Level



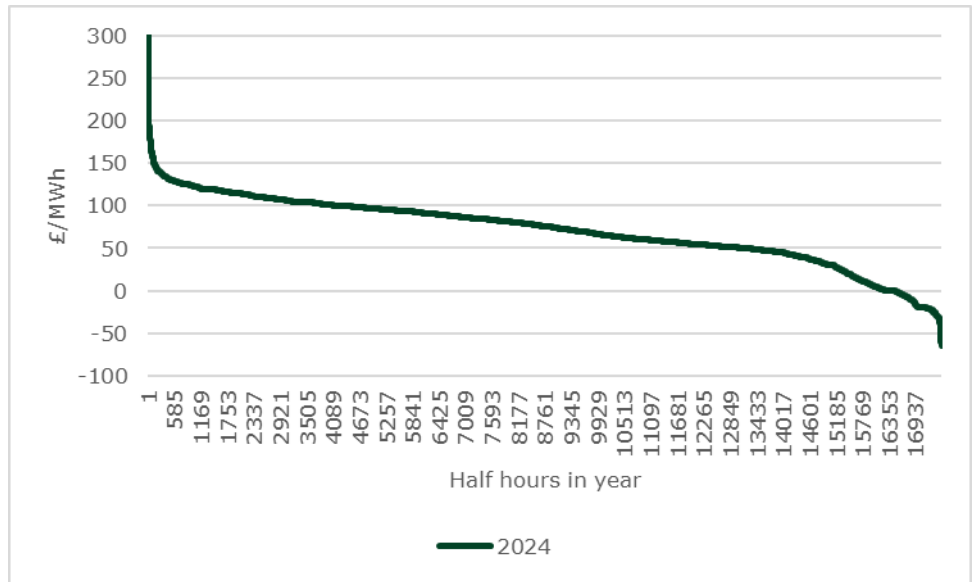
Source: BNEF

FLEXIBILITY

Why flexibility matters

The electricity industry typically represents prices across a year in a price duration curve which displays all prices in order starting with the highest prices and ending with the lowest. As more renewables operate on a system we expect more lower prices.

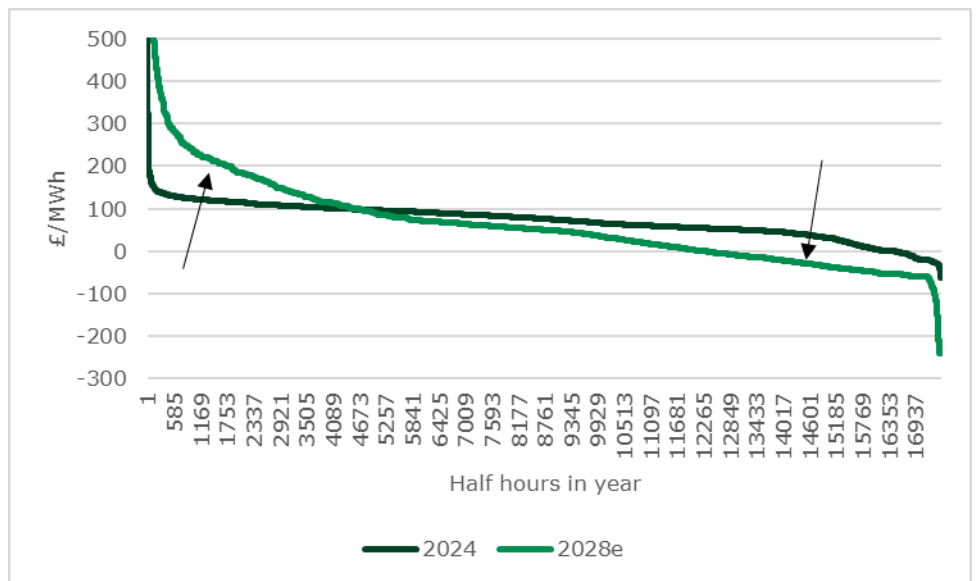
UK Price Duration Curve



Source: Longspur Research

The likely longer term outcome is that a gradually more extended low price regime will apply at the right hand end of the curve. High prices stay at current levels or even rise as CCGTs try to recover income from fewer hours of operation.

Price Duration Curve Development



Source: Longspur Research

The price curves shown here are for the UK (GB) power market. EU markets generally show a similar price distribution. Even if storage and hydrogen electrolysis adds demand at the lower end of the price curve a basic supply/demand analysis suggests that considerable demand could be added without having a major effect on these low prices.

Because a MFE can operate flexibly it can be operated to run only at times of low cost power. As we will see this improves the overall economics.

Using the actual GB price duration curve for 2024 we can examine the levelized cost of hydrogen (LCoH) for a baseload operation, a MFE plant at 33.3% utilisation. For baseload operation we have taken the average prices across the year which comes out at US\$113/MWh. We have assumed that the baseload electrolyser is a Chinese alkaline unit with a cost of US\$339/MW based on BNEF reported capital costs. At 33.3% we have taken the average of the lowest third of electricity prices which gives us US\$40/MWh. In this case we have assumed that a CPH2 electrolyser is required for the flexibility to work with an intermittent power source despite it being more expensive than the Chinese option. Membrane free technologies can respond to demand changes very rapidly whereas alkaline are slower to react.

We have assumed a capital cost of US\$1,339/MW for a CPH2 electrolyser based on expected near term cost predictions. This shows that the low utilisation intermittent operations give a lower levelised cost of hydrogen than the baseload option even where a cheap alkaline electrolyser is used for the baseload option.

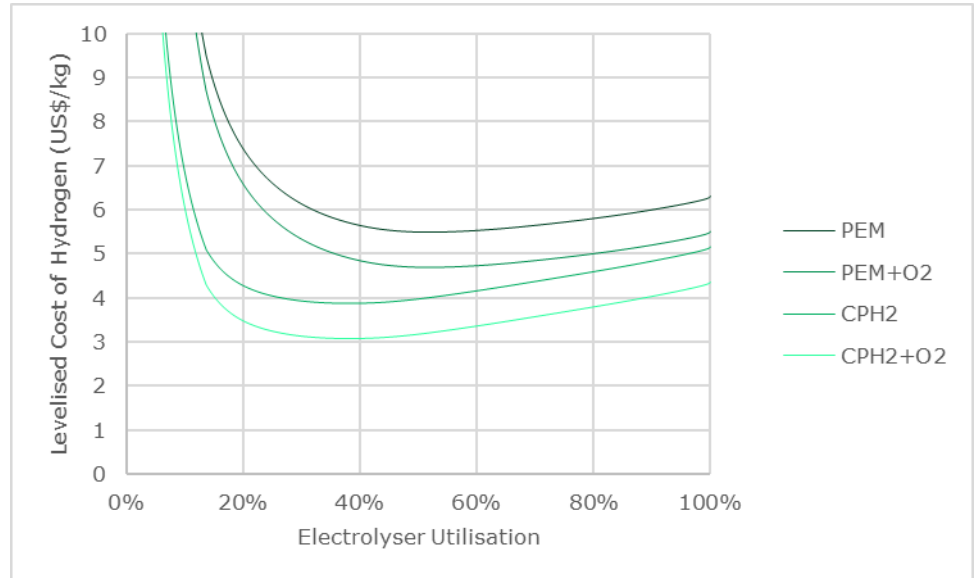
Levelised Cost of Hydrogen at Different Utilisation Levels

	Baseload	Off-peak	Off-peak + O2
Life (years)	10	25	25
CoE	10.0%	10.0%	10.0%
CoD	6.0%	6.0%	6.0%
Gearing	60.0%	60.0%	60.0%
Effective tax rate	25.0%	25.0%	25.0%
WACC	6.7%	6.7%	6.7%
Capital Recovery Factor	0.1404	0.0835	0.0835
Electrolyser H2 Output (t)	150	150	150
Electrolyser O2 Output (t/t H2)			8
Electrolyser O2 Output (t)	0	0	1,200
Utilisation	90.0%	33.0%	33.0%
Electrolysis efficiency (kWh/kg)	50	49	49
Electrolyser capacity (MW)	1	3	3
Electrolyser electricity (GWh)	8	7	7
Water consumption (l/kg)	11.12	10.94	10.94
Water consumption (m3)	2	2	2
Electricity unit cost (\$/MWh)	113	40	40
O2 price (\$/t)	100	100	100
Water unit cost (\$/m3)	2.21	2.21	2.21
Fixed O&M (\$/MW/year)	5,700	5,700	5,700
Variable O&M (\$/MWh)	6.00	6.00	6.00
Electrolyser Unit Capex (\$k/MW)	339	1339	1339
Electricity	850	294	294
Water	0.004	0.004	0.004
Maintenance	50	59	59
O2 sales	0	0	-120
Total opex	900	353	233
Electrolyser capex	0.3	3.4	3.4
Costs per kg of H2			
Operating cost	6.00	2.35	1.55
Capital cost	0.30	1.90	1.90
Total LCoH	6.30	4.25	3.45

Source: Longspur Research

Of course we have chosen the representative utilisation rates in this example. We can rearrange the LCoH formula to use utilisation as the independent variable and then plot a LCoH curve against utilisation. We have done this with PEM and CPH2 electrolyzers both with and without O2 sales taken into account. This again shows CPH2 offering a lower LCoH than PEM with a cost minimising utilisation of 38%.

Levelised Cost of Hydrogen Against Utilisation



Source: Longspur Research

Levelised Cost of Hydrogen at Different Utilisation Levels

	PEM	PEM+O2	MFE	MFE+O2
Min LCoH	5.49	4.69	3.87	3.07
Utilisation	52%	52%	38%	38%

Source: BNEF

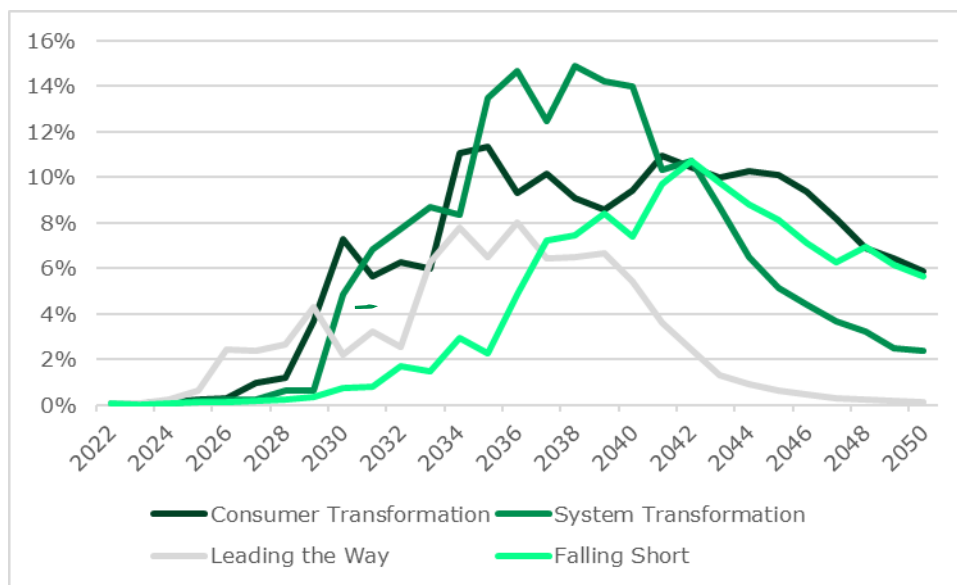
Curtailement

Curtailement is where electricity can be generated but is not generated, resulting in a deliberate reduction in what could have been produced. There is no single agreed definition of curtailement but we broadly split it into two groups, economic and technical. Economic curtailement occurs where there is oversupply in the market relative to demand. Technical curtailement occurs where grid capacity is unavailable often for reasons connected to voltage or frequency. Curtailed energy can be made use of at the point of generation where there are alternatives to grid offtake and this could include co-located hydrogen electrolysis.

Our utilisation graphs above assume that no curtailed energy is available to the electrolyser. However we can add an assumption of 15% curtailed electricity being used to power the electrolyser. While this is on the high side we are already seeing higher levels of curtailement in the Australian market as high deployment of distributed PV has created system stability (voltage) problems limiting how much generation can be exported. This is consistent with the academic work which suggests 22% curtailement where renewable penetration reaches 90%, in line with decarbonisation targets. In the iSEM market covering all of Ireland and impacting CPH2’s deployment in Belfast has seen curtailement at 38% due to a high penetration of wind generation although system design is also partly responsible for this high figure.

The UK's National Grid in its Future Energy Scenarios (FES) under the customer transformation scenario forecasts peak curtailment at 15%. This is the highest scenario figure but we feel happy using it given the experience in Australia and Ireland. While the FES curtailment forecasts drop beyond 2040 this is only because the forecasts assume that curtailed energy will be used to manufacture hydrogen and this is not included in these longer term curtailment figures.

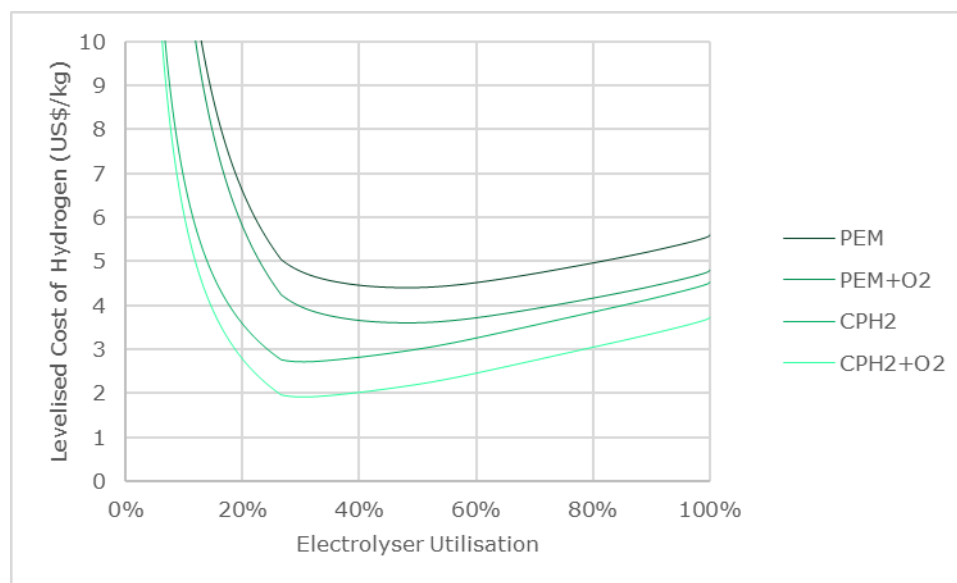
Curtailment Under UK Future Energy Scenarios



Source: National Grid FES

Curtailment can occur at any time but is more likely when demand on the network is high and lots of generation is trying to get access. As a result, it is more likely to take place when prices are high. So curtailed supply available to an electrolyser would be in addition to the electrolyser being able to source low price power from the grid. If we model this assumption, we get a set of utilisation graphs with even lower LCoH values.

Levelised Cost of Hydrogen Against Utilisation With 15% Curtailment



Source: Longspur Research

Levelised Cost of Hydrogen at Different Utilisation Levels

	PEM	PEM+O2	MFE	MFE+O2
Min LCoH	4.40	3.60	2.71	1.91
Utilisation	48%	48%	31%	31%

Source: BNEF

PFAS – A COST ADDITION FOR PEM

Per- and polyfluoroalkyl substances (PFAS) are the “forever chemicals” whose status as persistent organic pollutants is raising health and environmental concerns worldwide. While some PFAS are already restricted under EU law, tougher restrictions have been proposed by a number of member states with discussion slated for June.

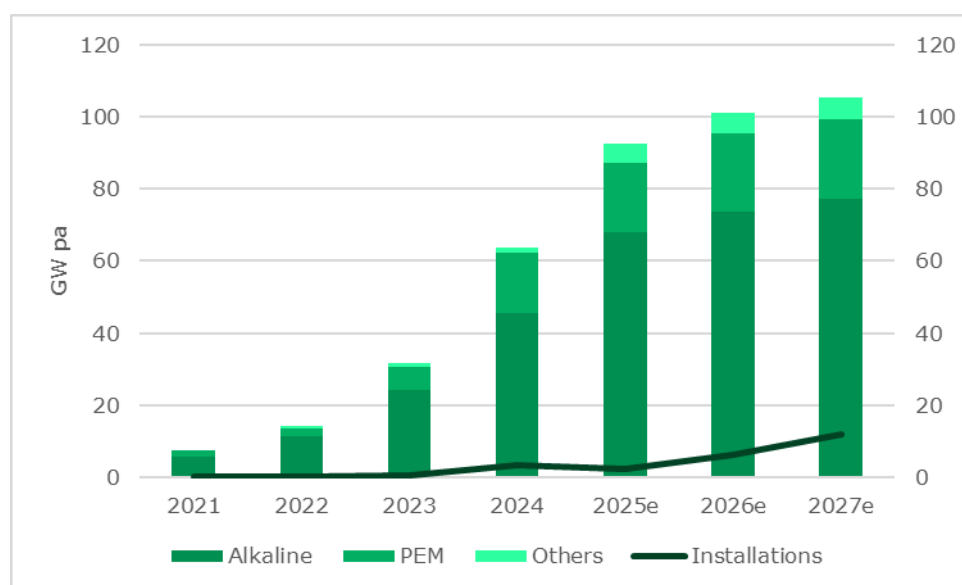
A possible restriction of the use of PFAS would be damaging for PEM electrolyzers and Hydrogen Europe has lobbied in an attempt to avoid an outright ban. However their assertion that there is no alternative to the use of specifically fluoropolymers for the production of hydrogen is clearly wrong given CPH2’s product. We think that there is at the very least a risk of greater compliance costs with risk management strategies around these materials for manufacturers of PEM electrolyzers leading to an increase in costs.

Note relevant aspects of EU law will also apply in Northern Ireland under the terms of the Northern Ireland Protocol. With initial deployment in Northern Ireland and possible further commercial interest there, this is clearly important and potentially beneficial for CHP2.

WHY LOW COST IS ESSENTIAL

Global electrolyser assembly capacity now exceeds current demand by a significant margin. This makes a low cost proposition essential. As CPH2 can both beat PEM and, if used flexibly, alkaline, it should be the go to option for developers and be able to return a gross margin even when others are struggling.

Global Electrolyser Capacity and Installations



Source: BNEF

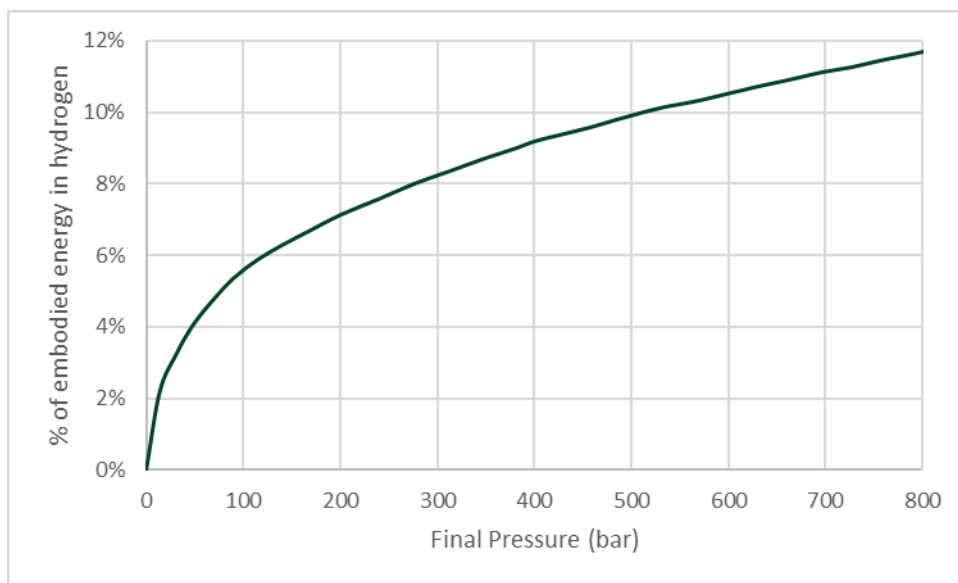
OTHER BENEFITS OF MFES

The pressure issue

CPH₂ electrolyzers can offer hydrogen at a pressure of 20 bar and they hope to increase this to 34 bar without additional compression. For many applications, further compression will be required but having an initially high-pressure output limits the amount of additional compression. Tube trailers for the transport of hydrogen are often operating at up to 500 bar.

By contrast alkaline electrolyzers run naturally at 1 bar and require more compression to raise pressure to that required by most applications. The output pressure is important given the need for high pressure in many applications. Pressure is raised by using a compressor which is usually the second most expensive component in a hydrogen refuelling station after the electrolyser. The size of the compressor will depend on how much pressure has to be raised. This will also consume power impacting the overall operating efficiency of the fuelling solution. Energy required to raise pressure is not linear and the first 100 bar of compression uses the most energy. For CPH₂ to be able to deliver 20 bar natively puts it ahead of many competitors in this regard reducing the need for more expensive compression.

Energy required for hydrogen compression



Source: BNEF

Gas purity

All electrolyzers can produce hydrogen of 99.999% purity. This is normally done through the use of a de-oxo dryer. These typically operate at a minimum pressure of 20 bar. For CPH₂ this is straightforward. While alkaline electrolyzers can be offered at 20 bar they are normally low pressure at 1 bar and therefore require additional compression to work with a de-oxo dryer and reach high purity levels. Without this they typically deliver at 99.5%. While this can be acceptable for some applications, current European hydrogen refuelling standards for mobility applications (Directive 2014-94-EU) are based on ISO 14687-2 which specifies an overall purity of 99.97%. PEM electrolyzers also work at a suitable pressure but can show impurities as a result of degradation products of their membranes which can affect purity.

NOT JUST HYDROGEN

Oxygen as a by-product

We have estimated demand for electrolysers based on demand for green hydrogen. However, hydrogen is not the only valuable product from an electrolyser. A number of industries require oxygen and while oxygen on its own does not always demand a high price, using an electrolyser to provide both oxygen and energy in the form of hydrogen can make strong economic sense.

This is already seeing demand emerging in the water treatment industry. Using injected oxygen in the wastewater treatment process allows bacteria to regenerate quickly and breakdown sewage more effectively. It also avoids the creation of hydrogen sulphide and methane. The normal aeration process is costly and accounts for around 50% of the carbon emissions and energy consumption in municipal treatment works.

CPH2's MFE is ideally suited to providing oxygen for the water industry. The pilot project in Belfast is sited at a Northern Ireland Water facility and is supplying 16kg/h of oxygen to a trial wastewater unit. PEM electrolysers can also be used to deliver oxygen as a by-product and Anglian Water is deploying a PEM electrolyser from Element 2 at its Cambridge Sewage Recycling Plant.

Northern Ireland Water as an early adopter

Northern Ireland Water, the state-owned water utility for Northern Ireland, has been an early adopter of the MFE technology, deploying a MFE110 at a wastewater treatment site in Belfast and ordering a MFE220. In addition to the benefits of the provision of oxygen for use as an energy saving wastewater treatment solution, the company is also exploring the decarbonisation of its operations using hydrogen with a focus on hydrogen vehicle refuelling for large heavy vehicles including sludge tankers, longer-distance buses, tractors and HGVs.

The existing setup in Belfast could be repeated at other wastewater treatment sites in Northern Ireland and beyond. Northern Ireland Water has 1,027 wastewater treatment sites. England has 1,470 and 144 of these are sized at over 100,000m³/pa. This would imply that 10% of sites are larger sites and if we use that as a guide for Northern Ireland then just over 100 sites might install CHP2 electrolysers. This level of demand would support our early forecasts with 97MW forecast for FY 28 in our base case. Further expansion to England or Ireland would back up longer term growth expansion beyond could support higher demand cases.

HYDROGEN DEMAND TODAY

Hydrogen demand remains strong despite market sentiment

An important recent paper in Nature (Realistic Roles for Hydrogen in the Future Energy Transition, Johnson et al, Nature Reviews Clean Technology 2025) reviewed the case for low carbon hydrogen in the energy transition and concluded that there is a continuing role to play. Our own thematic note on hydrogen (Hydrogen and Stupidity, Longspur Research, 7 November 2023) similarly concluded that hydrogen is not the solution to everything but has a key role to play in some key areas.

We have assessed demand from hydrogen for the following use cases:

Transport:

- Shipping using green methanol from power to X (PtX) and from biogenic sources with hydrogen upgrading
- Heavy trucking using biomethane with hydrogen upgrading
- Aviation using sustainable aviation fuel from PtX and biomass gasification/FT with hydrogen upgrading

Industry:

- Ammonia using green hydrogen via the Haber Bosch process
- Methanol using biogenic gasification and hydrogen upgrading
- Refining using green or blue hydrogen
- Specific high temperature and off grid heating using hydrogen or DME
- Steel using hydrogen direct reduction (H DRI)

Power:

- Power balancing using green hydrogen

We can estimate the total demand from these market segments assuming full decarbonisation is achieved in line with the Paris Agreement targets for 2050.

Hydrogen Demand Forecasts Breakdown

Use case	Mt	Solution
Shipping	35	Upgraded biomethanol
Heavy trucks	78	Upgraded biomethane
Aviation	63	Upgraded SAF
Transport subtotal	176	
Ammonia	32	Hydrogen/Haber Bosch
Methanol	16	Hydrogen
Refining	10	Hydrogen
Heating	7	Hydrogen/rDME
Steel	29	H-DRI
Industry subtotal	94	
Power balancing	177	LDES
Total	447	

Source: Longspur Research

We have also estimated the demand for green hydrogen production from the above demand assumption combined with an assumption that green hydrogen production will be 60% of the total with SMR plus carbon capture and storage (blue hydrogen) making up the rest.

Hydrogen Electrolysis Forecast

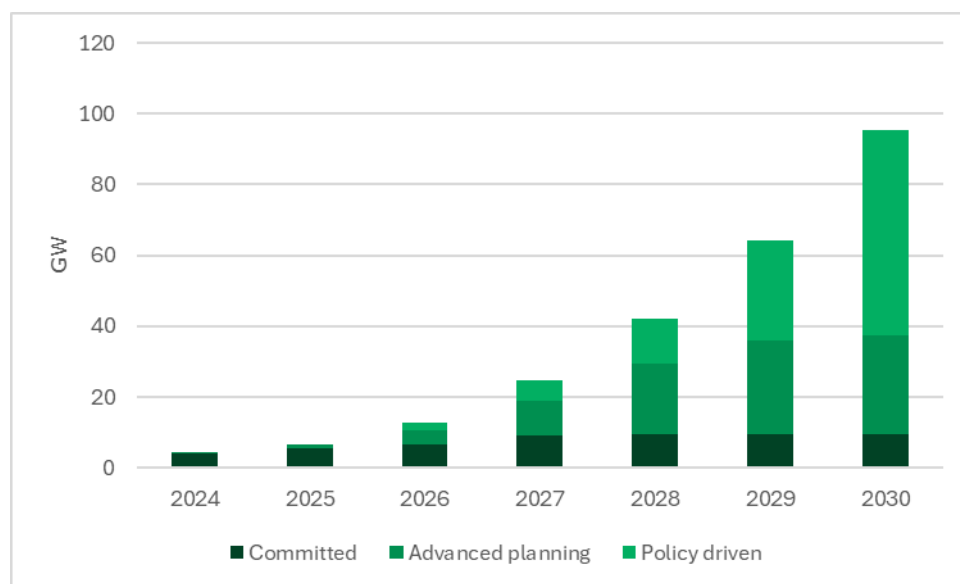
Total hydrogen (Mt)	447
Green hydrogen supply (Mt)	268
Electrolysis efficiency (kWh/kg)	50
Total electrolysis required (TWh)	13,410
Utilisation (%)	32%
Capacity (GW)	4,784

Source: Longspur Research

This high level of demand is the level that could deliver green hydrogen to meet the needs of fully decarbonised the world by 2050. Unfortunately, this feels uncertain especially since the USA withdrew from the Paris Agreement and sentiment here may slow movement towards these targets although we expect this will change in time as the impacts of slow action start to show in terms of climate tipping points.

A useful outlook is the near term forecast from Bloomberg New Energy Finance (BNEF) in their most recent hydrogen outlook report.

Forecast Electrolyser Capacity (Cumulative)



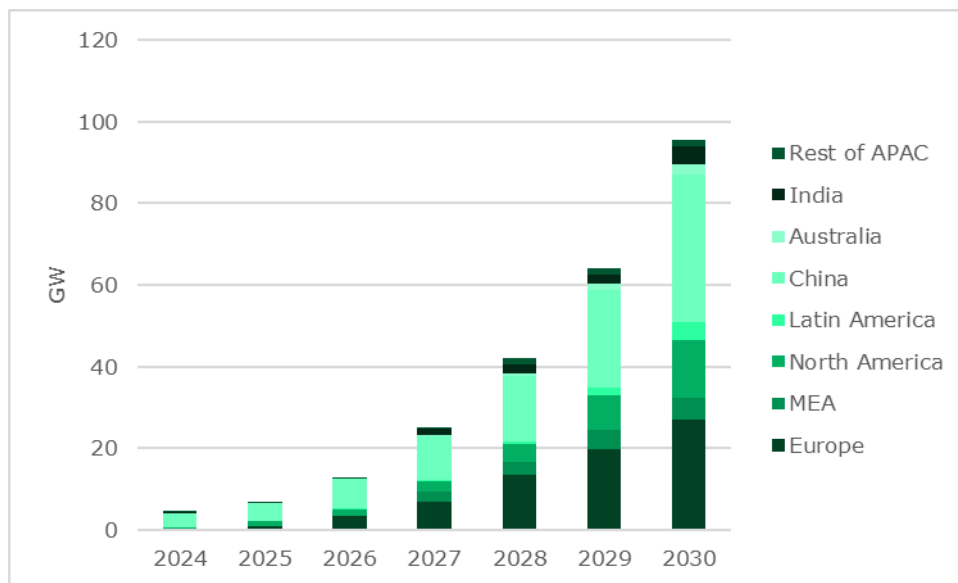
Source: BNEF

We expect that those projects that are committed and those in advanced planning have already decided on their electrolyser supplier so only the policy driven capacity is likely to be available to CPH2. Note that the forecast has been presented as cumulative capacity so new orders will be the difference between the totals. However, this still gives us a useful start point for demand.

Interestingly if we use a Bass Diffusion model to estimate how hydrogen capacity will diffuse into an energy market with a total capacity of 2,834GW, and the years 2025 to 2030 will show a similar pattern to those in the BNEF near term forecast provided we use a reasonably high coefficient of imitation. This reflects additional policy drivers for diffusion that we expect in the market and review later in this note.

Over half of this forecast capacity is either in China or North America and we do not see either as immediate markets for CPH2.

Forecast Electrolyser Capacity (Cumulative)



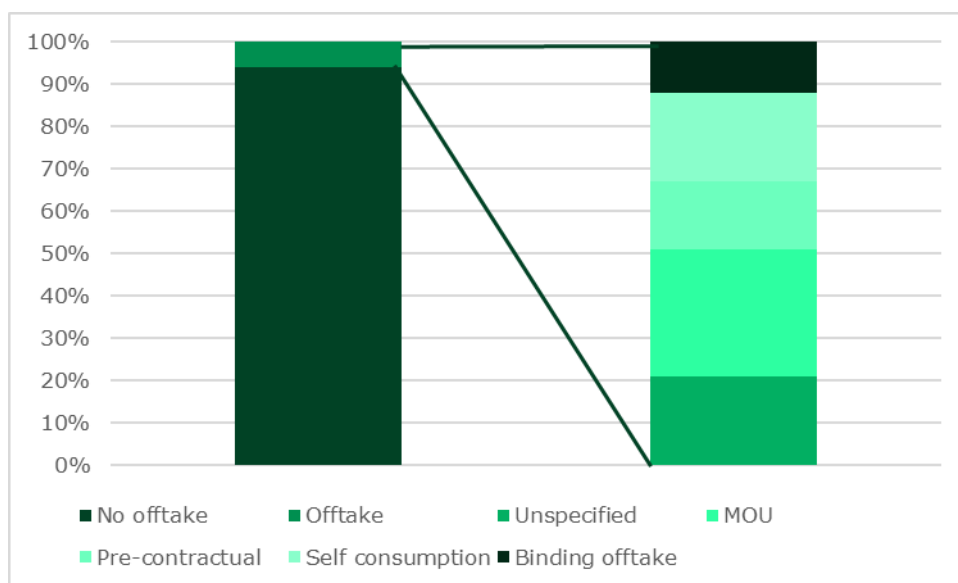
Source: BNEF

With 28% of the market in the current year in CPH2’s target areas of Europe, the Middle East and Africa and Australasia, we scale back our global market target of 7,784GW to 1,340GW.

A dose of reality

Behind these positive capacity growth figures lies the fact that only 6% of announced hydrogen production capacity has identified offtakers. Only 12% of that 6% is in binding offtake agreements although a further 21% is self consumption and 16% are pre-contractual agreements which we would consider to be likely to be delivered. The remaining are in memoranda of understanding, or unspecified. While these may materialise, in the current market environment we would not include them in our base case valuation. Adjusting for the reliable demand we get a total figure of 39GW.

Electrolyser Capacity Forecast by Offtake



Source: BNEF

If we use a Bass Diffusion model with the same coefficients which drive a matching forecast to the BNEF near term numbers then we can project a near term volume forecast. While we think CPH2 MFEs can beat the competition market on cost and therefore eventually dominate the market, we recognise that the market can be illogical and have scaled back to give the company a market share of 20% which result in the following progression.

Hydrogen Demand Forecasts Breakdown

MW	2027	2028	2029	2030	2031	2032	2033	2034	2035
Market demand	49	97	193	384	757	1,471	2,773	4,926	7,783
Market share	20%	20%	20%	20%	20%	20%	20%	20%	20%
Projects closed	9	19	38	76	151	294	554	985	1,556

Source: Longspur Research

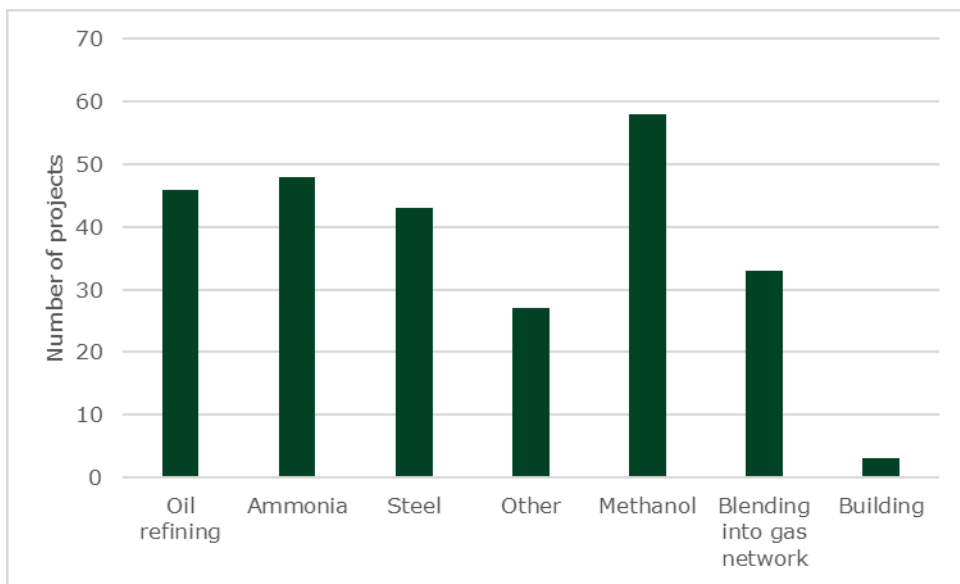
DEMAND IN DETAIL

Demand Developing in Industry and Derived Fuels

There is strong existing demand for hydrogen today with c.95Mt being supplied in 2022 with the vast majority produced by steam methane reformation (SMR) of natural gas, reforming of oil and gasification of coal. These resulted in 2% of all global greenhouse gas emissions. Decarbonising this hydrogen demand should be a priority and we see near term investment opportunities accelerating, driven by the EU policy move which will mandate that 42% of industrial hydrogen must come from green sources by 2030 rising to 60% by 2035.

Projects are already coming forward in oil refining, steel and methanol. Green ammonia production has been slowed by weaker product pricing but remains a strong opportunity in key geographies where cheap and abundant renewable energy is available. The efficiency losses in domestic heating make electric heat pumps and even direct electric heating more viable in most locations, but certain industries and certain locations can benefit from hydrogen or hydrogen derivatives for heat. We are starting to see the use of hydrogen derived DME emerging as heating solution for some specific applications and locations.

Announced Pipeline of Industrial and Heating Projects



Source: BNEF

Shipping and Aviation Driving Demand for Hydrogen Derived Fuels

Changes in regulation from the IMO and EU are pushing ship owners to move on lower carbon solutions. While hydrogen could be a solution, the high cost of delivery and bunkering make hydrogen-derived methanol or ammonia better solutions. Methanol is seeing strong momentum with over 403 methanol fuelled vessels on the water or on order. Demand is growing for green methanol production either from biomethanol or e-methanol. However, combining biomethanol from gasification of woody biomass with additional hydrogen from electrolysis can result in twice as much methanol produced from every kilo of biomass and we see growing demand for hydrogen from this biofuel upgrading route.

Shipping gets a boost from IMO

This April, the International Maritime Organization’s (IMO) Marine Environmental Protection Committee (MEPC) approved measures for a new low carbon fuel standard and a global pricing mechanism for emissions. While this still needs to be formally adopted, if this happens from 2027 large ocean-going ships of 5,000 gross tonnage or greater will be required to comply with a global fuel standard and global economic measures. The fuel standard means that over time, ships must reduce their annual greenhouse gas fuel intensity (GFI) on a well to wake basis.

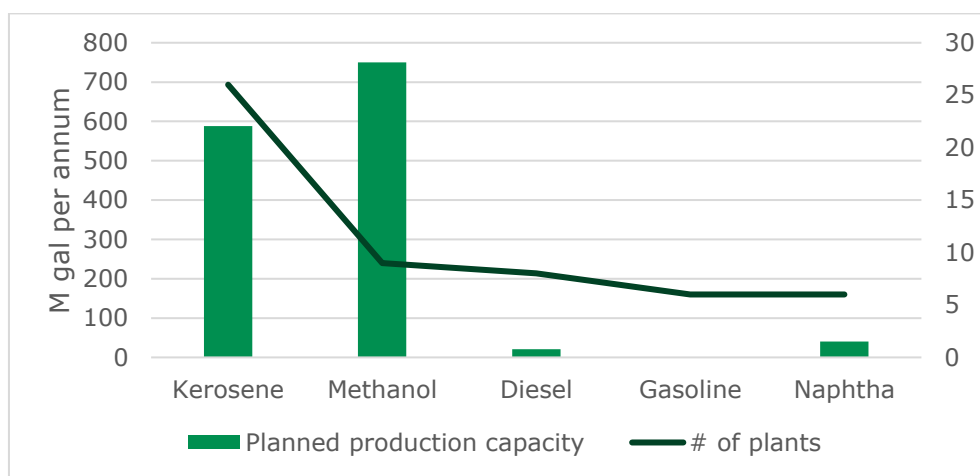
We see this as combining with the strong EU decarbonisation mandates for shipping and leading to increased demand for e-fuel solutions including methanol and ammonia with related demand for hydrogen as the key e-fuel feedstock. Methanol in particular appears to have real momentum with 403 methanol-fuelled vessels on the water or on order.

Sustainable Aviation Fuel

BNEF estimates that by 2050 sustainable aviation fuel (SAF) will need 47mt of clean hydrogen, roughly in line with our figure of 63mt. More immediately, if all currently operating or announced SAF plants come online they would consume 5.7mt hydrogen.

As a result of blending mandates for clean shipping and sustainable aviation fuel we are seeing a growth in power to liquids facilities.

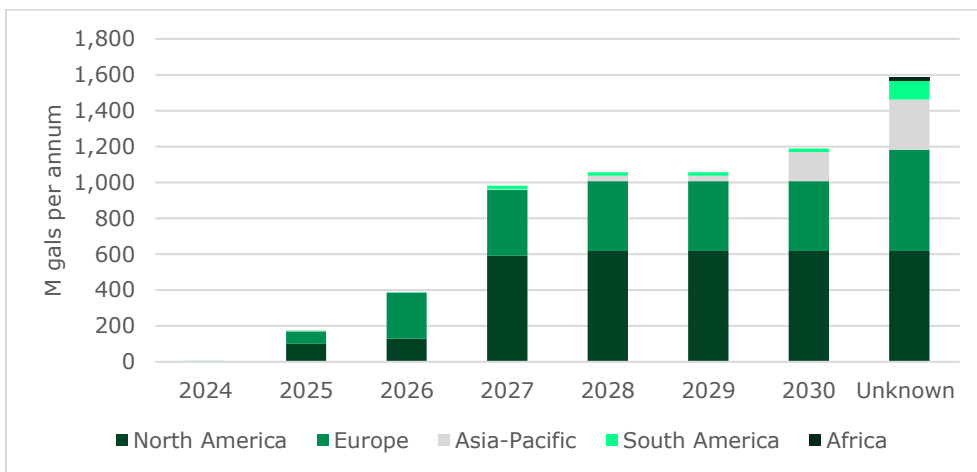
Power to Liquids Planned Capacity by Product



Source: BNEF

The bulk of this planned capacity is in North America and Europe with the latter playing to CPH2’s positioning.

Power to Liquids Planned Capacity by Region

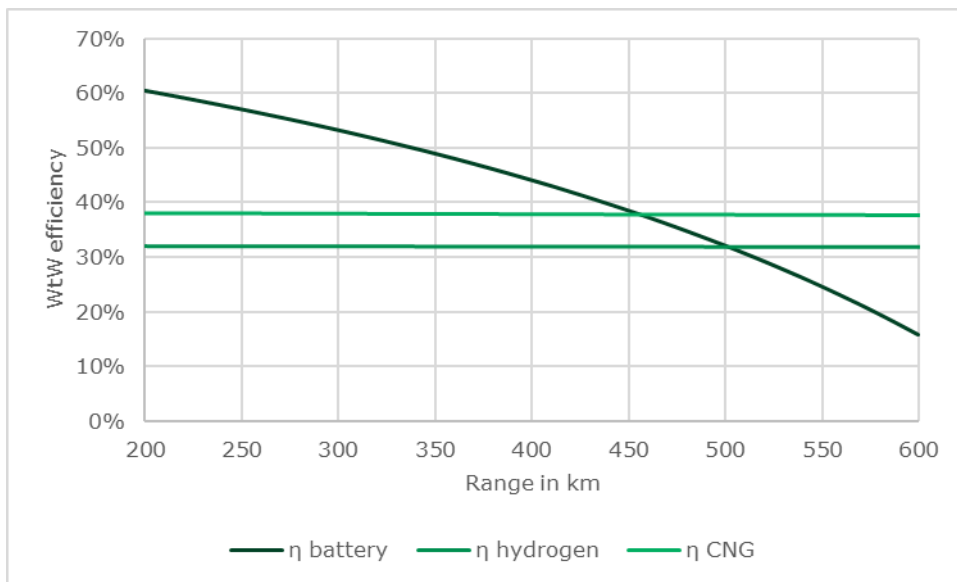


Source: BNEF

Forget Cars, But Trucking Could Use Hydrogen or Biomethane

Battery vehicles (BEVs) have been seen as the key solution for road transportation with hydrogen ruled out because of poor efficiency. However, as range and weight increase, efficiency drops much faster for BEVs than for hydrogen vehicles. Hydrogen cars still do not make sense, being less efficient than BEVs even out to 1,200 km. Our analysis shows that heavy hydrogen trucks could make sense at ranges over about 300 miles and that biomethane solutions can be better at even shorter ranges. This is for the largest long-range trucks. Short range local distribution makes most sense as BEVs.

Heavy Trucking Efficiency Against Range



Source: Longspur Research

Biomethanol and Biomethane Supercharged by Hydrogen

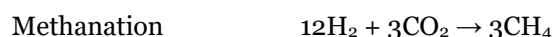
While biomethane is the winner from this analysis of trucking decarbonisation, biogas production from anaerobic digestion can be combined with green hydrogen to double the amount of biomethane produced from the same amount of feedstock and we see this growing as a source of demand for hydrogen production. This is also true of the production

of biomethanol and Canada's largest electrolyser deployment at 88MW is in support of a biomethanol gasification project, again doubling the methanol output for every unit of biomass used.

GREEN HYDROGEN CAN MAKE BIOGENIC FEEDSTOCK GO FURTHER

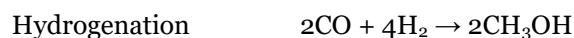
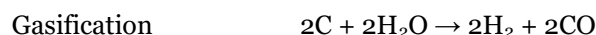
Anaerobic digestion for biomethane

A normal anaerobic digestion facility turns carbohydrate into biomethane and CO₂. If the CO₂ then undergoes methanation with hydrogen from a green electrolyser this can result in the creation of an equal amount of methane.



Gasification for methanol

Gasification of carbohydrate normally results in a syngas with roughly equal amounts of hydrogen and carbon monoxide. Methanol requires twice as much hydrogen as carbon monoxide so the output from normal gasification does not have enough hydrogen when run efficiently. Taking the additional hydrogen from an electrolyser gets round this and avoids less efficient gasifier operations. Gasification is slightly more complex than outlined below and more hydrogen can be created at the gasification stage. But the addition of electrolysis results in an efficient process that maximises fuel production per unit of biomass.



Note that in both cases the amount of resulting fuel is maximised for the biomass input and, unlike pure e-fuels, no carbon capture is required other than the initial biomass photosynthesis.

The mixing of biogenic processes with green hydrogen is now known as biofuels upgrading. We are already seeing developments in both methanol and methane.

Norwegian Hydrogen AS has formed a JV with energy entrepreneur Jens Peter Lunden to develop anaerobic digestion biogas projects co-located with wind and electrolysis with an initial project in Denmark.

Canada's largest electrolyser project is a 88MW unit integrated in the Varennes Carbon Recycling project with will produce 125ml of biomethanol annually using biogenic waste as feedstock along with green hydrogen from the electrolyser.

KBR (formerly Kellogg Brown & Root) have launched an advanced green methanol technology, PureM, combining green hydrogen with carbon from biogenic sources or from carbon capture.

POLICY SUPPORT GROWING

EU

Policy support is evolving rapidly, and we are beginning to see meaningful support for hydrogen applications. In the EU the Delegated Acts are expected to see a ten-year fixed support mechanism at €4/kg.

But perhaps more helpful are the low carbon mandates in industry, shipping and aviation and these are already starting to drive demand.

The EU Green Deal and the updated Fit for 55 programmes have brought in significantly meaningful controls for greenhouse gas emissions affecting all shipping travelling within, as well as to and from, EU ports. The overall aim of the Fit for 55 programme is to deliver a 55% reduction in carbon emissions by 2030. There are four separate initiatives that will affect shipping.

- EU ETS
- FuelEU Maritime Initiative
- Energy Taxation Directive
- Alternative Fuels Infrastructure Directive

While the range here creates some complexity but perhaps most simplistically the FuelEU requirement is for a 2% greenhouse gas cut in 2025, rising to 6% in 2030 and to 80% by 2050.

The ReFuelEU Aviation law requires that SAF has a 2% blend in all EU airports as of this year and this will increase to 70% by 2050. Of this 1.2% must be synthetic fuels now and 35% in 2050.

Ireland

While following EU policy, the Republic of Ireland has its own supportive National Hydrogen Strategy which aims to developing business models to support the development of renewable hydrogen and targeting surplus renewable grid electricity pre-2030 and an initial 2GW of offshore wind beyond 2030. With a high level of curtailed power in the all Ireland Integrated Single Electricity Market (iSEM), the Irish government is looking to hydrogen to provide net zero dispatchable power solutions as well as supporting an alternative fuels infrastructure including hydrogen powered heavy duty vehicles.

Potential operating models under evaluation include a curtailment model where electrolyzers run during times of high wind, a marginal pricing model where electrolyzers run in times of low pricing and a system services model where electrolyzers run at c.50% of full availability but ramp up and down to help balance the electricity system. While other models including a baseload model are also considered these first three add most in terms of system benefits and work very well with the MPE electrolyser.

In Northern Ireland, the Department of the Economy provided £5m to support the project which included the MFE electrolyser purchase by Northern Ireland Water. Support has also come from the UK government towards the manufacture of hydrogen buses at Ballymena by Wrightbus.

USA

In the USA the Inflation Reduction Act sees up to US\$3/kg in tax credits and the Bipartisan Infrastructure Law sees US\$114bn of support including the recently announced US\$7bn for seven clean hydrogen hubs. However the Republican administration is now threatening

these including removing support from projects, but only those in Democrat voting states. Clearly there is uncertainty about any support in the current political environment in the US.

UK

The UK Government has introduced support for low carbon hydrogen through the Hydrogen Allocation Round (HAR) process. This follows success in support for low carbon technologies through price support rather than direct subsidy. The scheme falls under the Hydrogen Production Business Model and provides funding for a 15 year period based on a set strike price. If, as is likely in early years, the actual price of hydrogen sold is below this level, the scheme tops up revenue so the average price is equal to the strike price. The scheme also pays additional cash to encourage producers to seek higher market prices and to top up to cover any volume risk.

The first Hydrogen Allocation Round has negotiated 262MW of capacity in 17 projects although pricing may be modest and offtake requirements may limit the balancing opportunity that hydrogen can bring. The second allocation round has now awarded funding to a further 21 projects.

ACTUAL ORDERS

CPH2 has been active in business development and has secured sales and licence agreements for over 4GW of capacity. The bulk of this is represented by two licencing agreements for 2GW each, one with Hidrigin and one with Kenera. However smaller early sales are also important and we see the 4MW of sales for delivery in 2026 as a key milestone for the company, putting operating units in the market which we think will help to build momentum.

Sales and Licence Agreements

Date	Counterparty	Capacity (MW)	Type	Location	Delivery	Term (years)
01/05/21	Fabrum Northern Ireland	1	Sale		2026	
15/06/21	Water	1	Sale		2026	
04/04/22	Fabrum	1	Sale		2026	
05/09/22	Kenera	30	Manufacture Licence to sell and	Germany		
05/09/22	Kenera	150	manufacture Licence to sell and	Europe		10
05/09/22	Kenera	2000	manufacture	Middle East Zealand and		10
31/01/23	Fabrum	na	Manufacture Licence to sell and	Australia New Zealand and		
31/01/23	Fabrum	na	manufacture	Australia		
28/11/23	Molecular Energies	na	Non binding framework	Mercosur countries		
04/11/24	Hidrigin	1	Sale Licence to sell and		2026	
04/11/24	Hidrigin	2000	manufacture	Global		20
Total		4184				

Source: Company Data

FINANCIALS

EARNINGS OUTLOOK

We have taken a reasonably cautious view of demand growth as a start point with the assumption that the company can build from the existing 4MW of orders in 2026 to over 1.5GW by 2035 based on the agreements the company has in place. We have also assumed that the company can reduce the cost of its unit with the near term wins mentioned earlier and generate a gross margin from FY 27. As a result, we see sales build from FY 26 (helped by the recent appointment of a Chief Commercial Officer) and the company moving into profit in FY 29. Beyond this we see strong growth with the potential to see sales of over £100m by 2031.

We have assumed that there is a split between full sales from CPH2 and licence sales of 100% sales initially falling to 25% by 2028 as the company makes more use of its licencing agreements. We assume a 5% learning rate on the average unit sales price from 2025 and that the company can achieve a 20% gross margin once volumes have picked up and the initial targeted cost savings are delivered. For licence sales we assume a 10 year licence life.

BALANCE SHEET

We estimate cash in January at £6m thanks to the fund raise completed that month. Operational cash burn in FY 24 was £6m and we expect this to be similar in FY 25 before initial sales in FY 26 start to improve cashflow. As a result, we would expect the company to seek additional funding to allow it to develop its opportunity set to the full and we have factored in a second equity raise in FY 25.

VALUATION

Hydrogen remains an evolving technology and most of companies in the sector will be loss making for some time as the market evolves. This makes PE and EV/EBITDA multiples unusable leaving EV/Sales as the main metric on which to make comparisons. These vary widely. As a result, we think a valuation approach should concentrate on a well-constructed DCF valuation.

We have used a weighted average cost of capital of 14.2%. This is based on the high end of the most recent UK's Competition and Markets Authority assessment on cost of capital. We see this as one of the best contemporary estimates based on thorough work that if required must be able to stand the scrutiny of a judicial review. This gives a risk-free rate of -1.0% which with a 2.5% inflation assumption gives 1.5%. The market premium is 8.5% based on historical ex-post market returns going back to 1900. We have used a beta of 1.5 based on the high beta from the comparator group. With no debt this gives us a WACC of 14.2%.

Weighted average cost of capital

Risk free rate	1.5%
Market premium	8.5%
Loan margin	4.5%
Marginal tax rate	25.0%
After tax cost of debt	4.5%
Debt/total capital	0.0%
Beta	1.5
Cost of equity	14.2%
Weighted cost of capital	14.2%

Source: Longspur Research, CMA

We have forecast cashflows to 2035 based on our discussion under earnings outlook above. We then calculate a terminal value in 2035 based on Gordon's growth model and assuming that long-term cashflows are flat in nominal terms. The terminal EV/EBITDA on this basis is 5.0x which we do not see as onerous.

DCF Valuation – central case

£'000	2025e	2026e	2027e	2028e	2029e	2030e
Operating cash inflow	-6,283	-5,971	3,562	2,710	6,651	8,205
Cash from associates	0	0	0	0	0	0
Tax paid	508	0	0	0	0	-1,093
Interest tax shield	0	0	0	0	0	0
Capex & investments	-1,595	-1,595	-1,595	-1,595	-5,595	-1,595
Free cashflow	-7,370	-7,566	1,967	1,115	1,056	5,516
Terminal growth	0.0%					
Terminal valuation	1,479,591					
Terminal EV/EBITDA	5.0					
Implied enterprise value	424,846					
Implied market cap.	434,349					
Implied share price	78					

Source: Longspur Research, (explicit forecasts go to 2035)

This gives a base case valuation of 78p per share.

SCENARIOS

We see the key driver of valuation as being the level to which volume sales build. Our central case assumption is narrowed to the immediate market geographies and to the level of deliverable orders driving those market volume figures. If we further tighten the level of orders in the market to just signed agreements, we get a valuation of 14p per share which we think is a viable low case. If we loosen the market figures to include all notified levels we can get a high case of 166p. Finally if we open up to more geographies but still leaving China out of the mix we can get a “blue sky” valuation of 314p.

DCF Scenarios

	Geographic Markets	Market Offtake Status	Valuation (p/share)
Low	Near targets only	Signed only	14
Base	Near targets only	Pre-contractual only	78
High	Near targets only	All notified	166
Blue sky	All ex China	All notified	314

Source: Longspur Research

COMPARATIVE MULTIPLES

Comparative multiples are fairly meaningless at this stage of the industry with companies still developing business models and jostling for market share. We believe CPH2 is extremely well placed against the competition both in terms of its offering and also the advantages of building capacity early.

EV/Sales

	Market Cap (£m)	EV (£m)	EV/Sales current	EV/Sales prospective
Clean Power Hydrogen	22	23	na	5.3
Ceres Power Holdings	140	40	0.7	0.7
Enapter	72	100	14.1	8.0
Fusion Fuel Green	5	14	0.3	0.5
Haffner Energy	14	14	6.8	0.3
Hydrogen Utopia	4	4	na	na
Hydrogenpro	22	10	0.1	0.5
ITM Power	282	92	4.0	1.7
John Cockerill India	123	118	na	na
NEL	324	193	2.7	1.8
Plug Power	639	965	1.8	1.4
Mean	150	143	3.8	2.3
Median	72	40	2.2	1.4
Max	639	965	14.1	8.0
Min	4	4	0.1	0.3

Source: Bloomberg, Longspur Research

MANAGEMENT

BOARD & KEY MANAGEMENT

Christopher Train OBE – Independent Non-Executive Chair

Former CEO of Cadent Gas and National Grid Gas Distribution, Chris has extensive leadership experience in the energy and utilities sectors. He has chaired multiple high-profile organisations including the Nuclear Decommissioning Authority and currently serves as Chair of South East Water and Sellafield Ltd, and Executive Director at CT Energy.

Jonathan Duffy – Chief Executive Officer

Jonathan led CPH2 through its IPO and AIM listing in just nine months. With a background in agriculture, food and drink, and FTSE 100 performance improvement, he brings strong commercialisation and growth experience. He also serves as a Non-Executive Director at Unibio International.

James Hobson – Chief Financial Officer

James is a seasoned finance professional in the energy sector, skilled in investor relations, corporate governance, and fundraising. He has led finance teams across M&A, strategy, and AIM compliance, delivering continuous improvement and financial clarity.

Natalie Fortescue – Independent Non-Executive Director

A chartered accountant with 20 years in capital markets, Natalie has held roles at Premier Oil, Genel Energy, and investment firms including Investec. She specialises in corporate finance, restructurings, and stakeholder relations, and is a NED at Serinus Energy and Trustee of GB Wheelchair Rugby.

Rick Smith – Independent Non-Executive Director

An experienced MD and accountant with a manufacturing and turnaround background. He has advised private equity firms and held senior roles at Chesapeake Ltd and Multi Packaging Solutions, focused on M&A and operations in the US, Europe, and Asia.

Joe Scott – Managing Director, CPH2 Ireland

A veteran engineer and manufacturing entrepreneur, known for pioneering CAD/CAM-based tool-making in Ireland. He founded two successful businesses in tool-making and injection moulding and brings decades of design and development expertise to CPH2.

Arash Selahi – Chief Operating Officer

Arash has over 20 years' experience in regulated industries including Automotive and Aerospace. He specialises in lean manufacturing, Six Sigma, and Kaizen, and is focused on building high-efficiency teams and scaling production processes at CPH2.

Paul Cassidy – Chief Technical Officer

Appointed in 2023, Paul has deep expertise in hydrogen and methanol-based technologies. With a Master's from Cambridge and multiple IChemE awards, he has a strong record of scaling innovations to commercial level. He leads the production delivery of CPH2's MFE220 system.

Richard Scott – Chief Commercial Officer

Appointment effective July 2025, Richard has over 30 year's energy sector experience most recently as Executive Vice President at ACME Greentech Group India. Before that he was at World Kinect (WKC US) and has held senior roles at Siemens, E.ON and Applied Energy.

FINANCIAL MODEL

Profit and Loss Account

£,000, Dec	2024a	2025e	2026e	2027e	2028e	2029e
Turnover						
Electrolysers	0	0	0	5,668	16,237	22,578
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Total	0	0	0	5,668	16,237	22,578
Operating profit						
Electrolysers	-5,423	-5,370	-6,486	-7,828	-4,155	-1,559
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Operating profit	-5,423	-5,370	-6,486	-7,828	-4,155	-1,559
P&L Account						
2023a	2024a	2025e	2026e	2027e	2028e	
Turnover	0	0	0	5,668	16,237	22,578
Operating Profit	-5,423	-5,370	-6,486	-7,828	-4,155	-1,559
Investment income	0	0	0	0	0	0
Net Interest	296	87	-37	5	0	1
Pre Tax Profit (UKSIP)	-5,127	-5,283	-6,523	-7,823	-4,155	-1,557
Goodwill amortisation	0	0	0	0	0	0
Exceptional Items	0	-9,662	0	0	0	0
Pre Tax Profit (IFRS)	-5,127	-14,945	-6,523	-7,823	-4,155	-1,557
Tax	1,012	508	0	0	0	0
Post tax exceptionals	0	0	0	0	0	0
Minorities	0	0	0	0	0	0
Net Profit	-4,115	-14,437	-6,523	-7,823	-4,155	-1,557
Dividend	0	0	0	0	0	0
Retained	-4,115	-14,437	-6,523	-7,823	-4,155	-1,557
EBITDA	-5,010	-4,838	-5,730	-6,848	-2,951	-131
EPS (p) (UKSIP)	-1.54	-1.77	-1.18	-1.41	-0.75	-0.28
EPS (p) (IFRS)	-1.54	-5.37	-1.18	-1.41	-0.75	-0.28
FCFPS (p)	0.15	-3.03	-1.33	-1.36	0.35	0.20
Dividend (p)	0.00	0.00	0.00	0.00	0.00	0.00

Source: Company data, Longspur Research estimates, *Project monetisation recognised as a gain on investment and not as turnover

KEY POINTS

- Initial sales delivered and revenue recognised in FY 26
- Further growth in FY 27 and more significant beyond
- Costs and operating loss begins to reduce with breakeven in FY 29
- No interest as no material debt ex leases and no tax in early years

Balance Sheet

£,000, Dec	2024a	2025e	2026e	2027e	2028e	2029e
Fixed Asset Cost	3,370	3,791	5,386	6,981	8,576	10,171
Fixed Asset Depreciation	-728	-2,256	-3,012	-3,991	-5,195	-6,622
Net Fixed Assets	2,642	1,535	2,374	2,990	3,381	3,549
Goodwill	0	0	0	0	0	0
Other intangibles	7,614	4,608	4,608	4,608	4,608	4,608
Investments	7,059	0	0	0	0	0
Stock	3,155	1,614	1,654	1,696	4,004	5,567
Trade Debtors	1,449	1,476	1,513	1,551	4,004	5,567
Other Debtors	120	120	120	120	120	120
Trade Creditors	-1,037	-1,275	-1,307	-1,864	-5,338	-7,423
Other Creditors <1yr	0	0	0	0	0	0
Creditors >1yr	-1,780	-1,166	-1,166	-1,566	-9,366	-13,249
Provisions	0	0	0	0	0	0
Pension	0	0	0	0	0	0
Capital Employed	19,222	6,912	7,797	7,534	1,412	-1,261
Cash etc	2,468	327	8,427	240	2,207	3,323
Borrowing <1yr	128	198	0	0	0	0
Borrowing >1yr	609	626	626	0	0	0
Net Borrowing	-1,731	497	-7,801	-240	-2,207	-3,323
Share Capital	2,682	2,697	2,700	2,700	2,700	2,700
Share Premium	27,707	27,745	43,447	43,447	43,447	43,447
Retained Earnings	-13,132	-27,742	-34,265	-42,088	-46,243	-47,800
Other	3,696	3,715	3,715	3,715	3,715	3,715
Minority interest	0	0	0	0	0	0
Capital Employed	19,222	6,912	7,797	7,534	1,412	-1,261
Net Assets	20,953	6,415	15,597	7,774	3,619	2,062
Total Equity	20,953	6,415	15,597	7,774	3,619	2,062

Source: Company data, Longspur Research estimates

KEY POINTS

- Asset light model means limited fixed assets
- Working capital controlled but will expand with sales from FY 27
- New equity assumed to deliver further growth

Cashflow

£,000, Dec	2024a	2025e	2026e	2027e	2028e	2029e
Operating profit	-5,423	-5,370	-6,486	-7,828	-4,155	-1,559
Depreciation	413	532	756	980	1,203	1,427
Provisions	0	0	0	0	0	0
Other	240	203	0	0	0	0
Working capital	1,435	-1,865	-553	878	6,514	2,841
Operating cash flow	-3,335	-6,500	-6,283	-5,971	3,562	2,710
Tax paid	686	608	508	0	0	0
Capex (less disposals)	-1,595	-219	-1,595	-1,595	-1,595	-1,595
Investments	4,650	-2,048	0	0	0	0
Net interest	296	87	-37	5	0	1
Net dividends	0	0	0	0	0	0
Residual cash flow	702	-8,072	-7,407	-7,561	1,968	1,116
Equity issued	97	53	15,705	0	0	0
Change in net borrowing	-799	2,228	-8,298	7,561	-1,968	-1,116
Adjustments	0	5,791	0	0	0	0
Total financing	-702	8,072	7,407	7,561	-1,968	-1,116

Source: Company data, Longspur Research estimates

KEY POINTS

- Cash outflow drive by operating cost but begins to drop with sales in FY 26
- Maintenance capex assumed
- Additional equity raise assumed to deliver further growth

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