

Ynys Môn Hydrogen Island



Llywodraeth Cymru
Welsh Government

Hwb Hydrogen Caergybi
Astudiaeth Dichonoldeb (Crynodeb)

Holyhead Hydrogen Hub
Feasibility Study (Summary)



Mehefin / June
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ynni glân

elementenergy



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Contents

	p
1 Introduction and Executive Summary	1
2 Technology & Applications; Supply & Demand	3
3 Site, Infrastructure & Cost	4
4 Project Partners & International Interest	5
5 Environmental Benefits & Jobs	6
6 Business Case	7
7 Local Hydrogen SPV & Action Plan	9
8 Scale-up & Diversification	10
9 Wales, UK, Ireland & wider in Europe	11
10 Conclusion & Recommendations	12

Ynni Glân and Element Energy were commissioned by Menter Môn to prepare a study to look at the option of establishing a Hydrogen Hub at Holyhead and to develop a realistic business model that will support such a hub. The key stakeholders who provided valuable contributions to the study are shown above. This summary report presents the main findings of the study.

"Upon hearing about the Hydrogen Fuel station which has been proposed on Anglesey, we welcome the opportunity to show our support for this exciting initiative and look forward to seeing this development lead the way in reducing emissions."
Tony Parry, Chairman, Delivery Solutions Delsol Limited [HGV Haulage company]

"Connecting Europe for a sustainable future" - As a sustainable business we are constantly looking at ways we can reduce our carbon footprint and our impact on the environment whilst providing ferry services for passengers and freight. We await with interest the outcome of report on how Anglesey can capitalise on this emerging opportunity, bringing commercial-scale production capacity and applications to the Island."
Will Calderbank, Port Operations Manager, Stena Line [Port of Holyhead]

"Ynys Môn has an unfair advantage."
Dafydd Gruffydd, Managing Director, Menter Môn

The authors would like to thank all the stakeholders who have contributed their knowledge and generous time towards the preparation of this study, especially given the considerable demands which have been placed on their work during the COVID-19 crisis.

1 Introduction & Executive Summary

A study has been undertaken of the viability of setting up a hydrogen demonstration plant in Holyhead – namely a hydrogen production plant and fuelling/distribution hub - so as to enable the development of an embryonic hydrogen economy in Ynys Môn/Anglesey and North West Wales.

The study has identified an initial option to set up a plant capable of meeting the initial Hydrogen needs of local heavy transport firms and with the capability to be upgraded as further use is made of hydrogen to decarbonise the economy and supporting meeting the Government’s net zero carbon emissions target by 2050. The plant will have an initial capability of producing over 400kg/day of hydrogen and with the potential to expand its production. An indicative investment from Government / private sector of £200-250k would be required to develop the project and £4.8 – 7.3m to subsequently implement the hub.

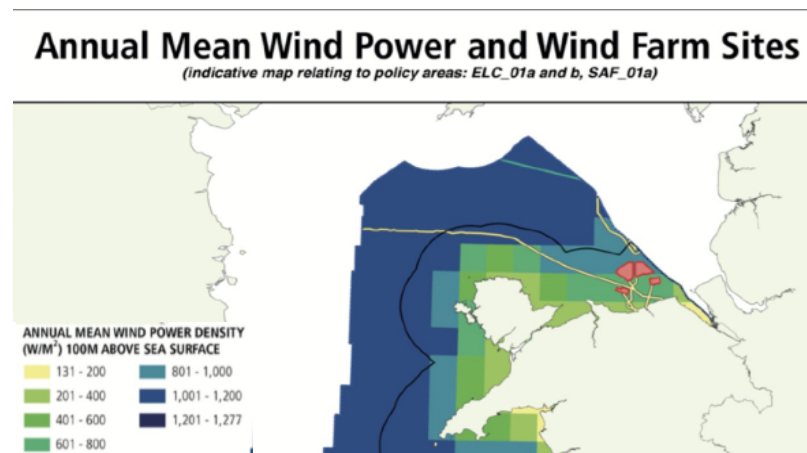
Holyhead is a port town on the west of Ynys Môn (Anglesey), Wales’ largest island. The Port of Holyhead is on the European TEN-T network and connects Wales and the UK with Dublin, Ireland. It is the second largest roll-on, roll-off port in the UK, with 500,000 annual HGV movements.

The Ynys Môn/Anglesey Energy Island Programme, established by Isle of Anglesey County Council, is a collective effort between several stakeholders within the public, private and third sectors putting Anglesey at the forefront of low carbon energy research and development, production and servicing, and bringing with it potentially huge economic rewards.

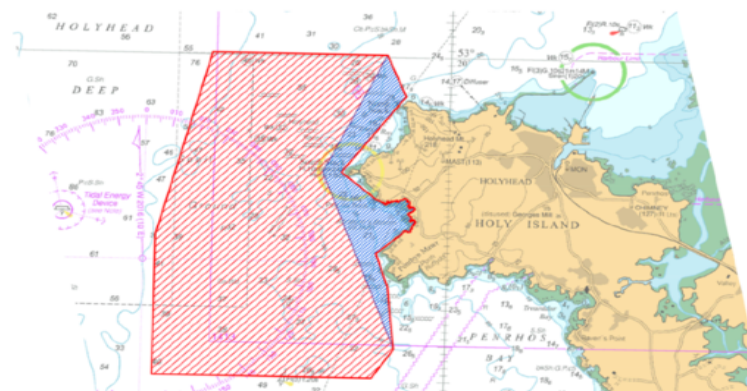
Menter Môn is a social enterprise that seeks opportunities to provide solutions to the socio-economic challenges faced by communities on Ynys Môn. Since it was established in 1995 the company has attracted more than £70 million of funding to deliver projects which have had a demonstrable impact on people’s lives. Menter Môn has expertise in energy and infrastructure, as developers of the 240MW Morlais tidal energy project¹.

As shown below, there are huge renewable resources offshore, both tidal and wind, which, together with the above factors present a compelling case to explore the establishment of a hydrogen supply-chain on Ynys Môn, kick-started with a Hub at Holyhead. Additionally, there is also the potential for the production of hydrogen from the Wylfa Newydd development.

The Welsh Government’s Wales National Marine Plan² illustrates the high offshore wind resource around Ynys Môn:



The Morlais tidal energy project is offshore from Holyhead:



Demand for hydrogen in heavy transport and at the port's operations has been identified which would require an initial supply rate of over 400kg/day at the Holyhead Hydrogen Hub. This could be established by 2022/23.

An initial pilot project has been defined involving the creation of a hydrogen generation plant at Parc Cybi (the Hydrogen Hub) involving an electrical supply of 1-2 MW initially and distributing that hydrogen to Holyhead Port and heavy transport users.

Trigeneration [Hydrogen + Power + Heat] fuel cell technology is assessed as the cheapest hydrogen production method for the Hub at £3.9/kg, which provides added revenue potential from e.g. EV (Electric Vehicle) charging through shared Hydrogen/EV infrastructure and heat. But there is also a strong case for the inclusion of an electrolysis plant for the initial Hub, because this is the technology which would be relevant for the scale-up opportunities.

A very positive outcome has been the appetite shown for the project from major local employers Stena Line and haulage companies, so as to future-proof them and make them more competitive in a decarbonised economy.

The initial commercial case is weak but the wider & longer-term business case is strong. Kick-starting a local, sustainable hydrogen supply-chain under the control and majority ownership of a local entity is key to enabling local benefit and longer term success, ensuring Holyhead (and Anglesey) does not get left behind regarding 21st century infrastructure. Such an ownership model will support the Welsh Government's aim of increasing benefit from new energy generation in Wales through local ownership³.

Parc Cybi has been identified as an ideal site for the Hub. It also provides the launchpad for larger, scaled-up green hydrogen production via electrolysis to release the full potential of the region's vast renewable energy resources. Parc Cybi and the surrounding area has extensive electricity and gas infrastructure which can support scale-up and allow for sector-coupling to balance networks and avoid costly upgrades.

Scale-up extends to trains, public transport and shipping and also diversification to other hydrogen markets, on Ynys Môn and further afield, in heat, industry, power & agriculture.

This is a First Of A Kind project which can connect with emerging hydrogen infrastructure in Wales, the UK and Ireland to create a connected network.

The estimated capital expenditure for the pilot project has a range £4.8m - £7.3m, based on a Hub and Spoke model and makes allowances for contingencies (such as the cost of equipment and the inclusion of both trigeneration and electrolysis technology). The design is pragmatic and the technology is modular. There is a strong R&D and innovation element.

The Hub will create 20-30 initial jobs, help support over 500 in local businesses and set the scene for large growth as part of a Green Recovery.

The project will decrease carbon emissions, air pollution and noise pollution.

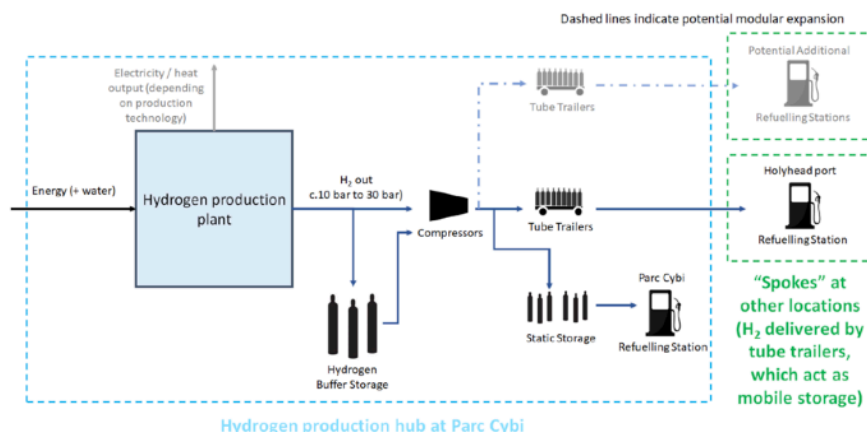
It supports Welsh Government and UK Government policy to achieve net zero carbon emissions by 2050^{4,5}. The Climate Change Commission's landmark Net Zero report⁶ and now, also, the EU's Green Recovery programme⁷ recognise that it is impossible to decarbonise the economy without green hydrogen.

This report acknowledges that hydrogen is fast-emerging into the mainstream and that there are other complementary studies, developments and aspirations occurring in North Wales, Wales and UK as a whole including the "Opportunities for Hydrogen in North Wales" study [by Advisian in Partnership with Jacobs]. Discussions with the North Wales Economic Ambitions Board, Welsh Government North Wales and Welsh Hydrogen Reference Group will help to facilitate a unified approach across the North Wales region, as well as for Wales, for current and emerging proposals, to ensure maximum investment and impact is achieved from hydrogen proposals.

The project is attracting major national and international private sector interest including Stena Line, Delivery Solutions, SP Energy Networks, Wales & West Utilities and Hyundai Motor Company.

2 Technology & Applications: Supply & Demand

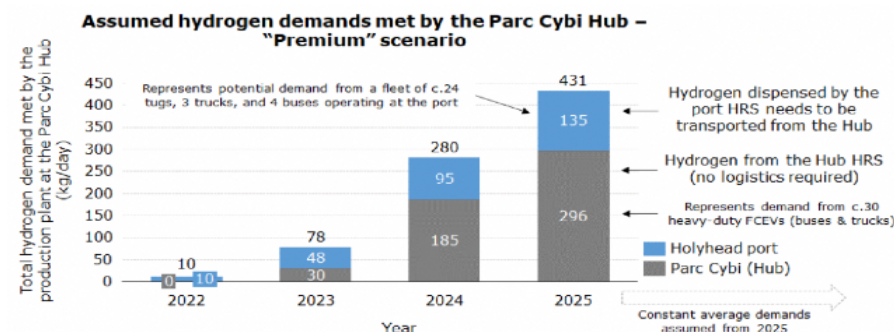
The preferred configuration for a hydrogen **supply** system at Holyhead is based on a “hub and spoke” model, whereby hydrogen is produced at a centralized hub and can be supplied to on-site refuelling stations or transported to those sited elsewhere to meet customers’ demands. The configuration is shown below, for a **Hub based at Parc Cybi and an initial Spoke at the Port**, see next section.



For the **demand-side**, the study has focused on heavy duty vehicles as the justification and platform for establishing the Hub. Following discussions with major local businesses including **Stena Group** (for Port of Holyhead vehicles) and HGV haulage companies **Delivery Solutions** and **Gwynedd Shipping** an appetite for the project has been identified. Between them, they employ over 500 people with many more jobs indirectly dependent on their trade. Buses are also seen as a suitable application, to support public transport decarbonisation.



The potential hydrogen demand identified amongst this initial user group amounts to over **400kg/day**, see below. Note that take-up within only ~10% of these haulage companies’ fleets is assumed. When also considering the **~500,000 HGV movements annually between Holyhead & Dublin**, the scale-up potential in this transport market alone is impressive. This can also be extended to more buses plus trains, ships, vans & cars. The initial Hub therefore provides the platform for this growth and its further diversification to supply and support the development of hydrogen for the power, heat, industrial and agricultural markets.



To meet this initial demand, suitable hydrogen production technologies have been assessed. It was concluded that **fuel cell trigeneration** technology provides the most cost-effective method, while also presenting additional revenue stream opportunities from electricity (via e.g. shared EV charging infrastructure) and heat as a community benefit.



However, **electrolysis is the scale-up option** – to be able to take full advantage of the offshore tidal and wind resource. Hence a hybrid trigeneration and electrolyser option is recommended for the Hub so as to maximise revenue streams and to embed local learning and skills for the scale-up and diversification opportunities.

3 Site, Infrastructure & Cost

Parc Cybi, Holyhead, has been identified as the most suitable site for locating the hydrogen production hub. It offers the following advantages:

- Location – very close to Holyhead Port (c.1km).
- Adjacent to the A55 on the Trans-European Transport Network (TEN-T) and the Roadking Truckstop & Café.
- Space – an initial survey indicates that there is ample available space for hydrogen infrastructure in this area.
- Availability of utilities – including extensive gas and electricity networks.

The proposed **Hub and Spoke** model comprises of:

- Hub: central hydrogen production facility & filling station; and
- Spoke: the subsequent distribution of hydrogen to a network of end-users, including satellite filling stations at specific locations.

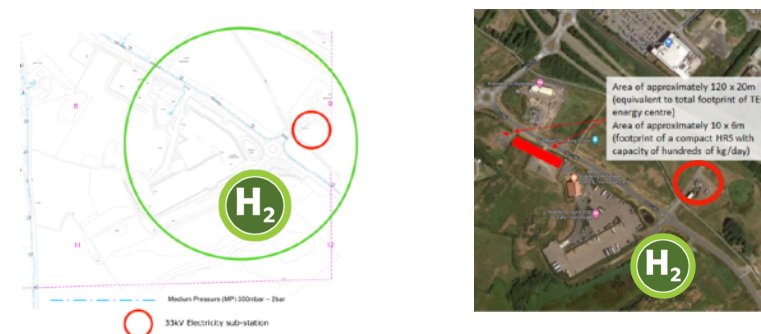
An overview of the geography of the Hub and Spoke model is shown below, identifying the Hub at Parc Cybi together the initial spoke to the Port of Holyhead and subsequent scale-up (and further spokes) to the rest of Ynys Môn and further afield.



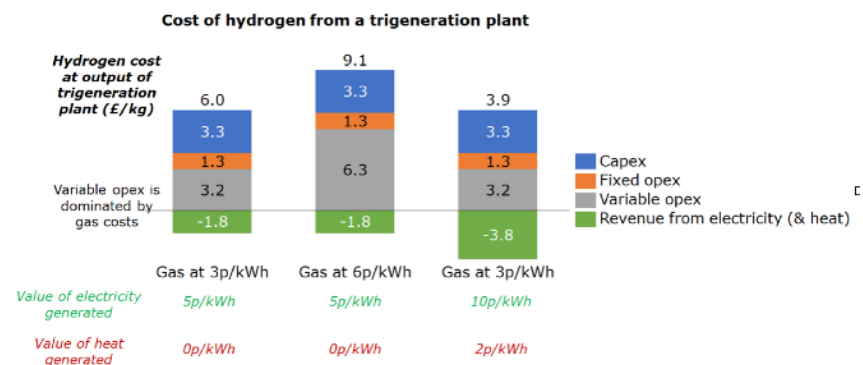
The area is served by an extensive electricity & gas network; connecting to the rest of Ynys Môn, Wales & the UK system.

A close-up of the proposed Hub area's **gas and electricity infrastructure** is shown below, with a 33kV sub-station located within the red circle and the blue medium pressure gas pipeline running through Parc Cybi and adjacent to the lorry park. A 132kV sub-station with potential connection to the National Grid Transmission system is nearby.

An indicative area for the Hub is also shown. Parc Cybi, shown by the H2 icon, may be the most favourable site for the Hub as it is directly adjacent to Roadking and the required gas and electricity infrastructure, with adequate water supply.



The capex cost range for the Hub has been assessed as £4.8m - 7.3m, which makes allowances for contingencies and the inclusion of both trigeneration and electrolysis technology. For trigeneration, assessed as the most cost-effective production method, a **hydrogen output cost as low as £3.9/kg** is modelled as below. But costs are subject to many variables.



4 Project Partners & International Interest

Local & Wales

Morlais is a **Menter Môn** project which aims to benefit local communities, the economy and environment through renewable & low carbon electricity generation. Morlais manages 35km² of seabed near Ynys Cybi, offshore from Holyhead. It has the potential to become one of the world's largest tidal stream energy sites with a generating capacity of up to 240MW.

Discussions with the Morlais team confirm the findings and recommendations of this report, in respect of complementary hydrogen production, the Hub's initial sizing, its scale-up potential and proposed project timescales. The Holyhead Hydrogen Hub can therefore be seen as supporting Morlais' tidal ambitions and this marine energy expertise also sets the scene for extending hydrogen production from the large offshore wind resource.

Also confirmed is interest from: **Cyngor Ynys Môn** on the prospects for decarbonising transport, reducing air pollution and supporting the local economy; **Coleg Menai** with respect to the training and skills opportunities; **Bangor University's** science & innovation hub **M-Sparc** on the R&D opportunities; **SP Energy Networks** on the flexibility which hydrogen production can provide to its operations via their Active Network Management programme; and **Wales & West Utilities** on the potential for sector-coupling with the gas network to decarbonise heat.

The project can, therefore, add considerable value to the **Energy Island** programme.

"Parc Cybi was originally developed with Welsh Government support as it is an ideal location for an industrial/commercial transport hub, connecting further generation and/or other low carbon opportunities. The Parc Cybi site is a key resource in our medium and long term plans for the island and we would like to be actively involved in helping to facilitate a wider long term strategy for net zero for Anglesey [Ynys Môn] that includes hydrogen."

SP Energy Networks

This local element is further strengthened by the appetite shown from businesses **Stena Group**, **Delivery Solutions** and **Gwynedd Shipping** for the introduction of hydrogen vehicles to their HGV fleets, port operations and scaling-up to potential shipping applications.

But expressions of interest and partnership opportunities extend beyond Ynys Môn to involve **AMRC Cymru's** advanced manufacturing expertise on Deeside, **Oil4Wales** and several SMEs in Wales.

"We are the only Welsh Oil distributor that covers the whole of Wales with its own tankers and drivers through our 8 depots. There are many regional but only us national and we believe strongly that Hydrogen has a great future in the truck market and we would gladly explore possibility of our depots being filling points." **Oil4Wales**

UK & International

Further expressions of interest in the project and its scale-up opportunities — extending to concrete partnership offerings in some cases - have been received from across the UK and internationally. These include:

Alstom , UK	Hydrogen Train
Hyundai Motor Company , Korea	Fuel Cell System/Vehicle Supplier
Protium , UK	Hydrogen Developer
Ryse Hydrogen , UK	Hydrogen Production & Buses
SAITEC , Basque Country	Floating Offshore Wind
Storengy , UK	Hydrogen Storage

There is also interest from investors, renewable energy companies & others. The list is neither exclusive nor exhaustive but serves to underline the project's appeal.

"HMC sees the Ynys Môn Hydrogen Island project as a very positive sign, and combined with (hopefully HMC's) downstream applications at proper time will ensure the region to achieve the "pioneer" title in the forthcoming hydrogen activity." **Hyundai Motor Company**

5 Environmental Benefits & Jobs

The project proposes a practical solution for transport and other applications which can **slash carbon emissions** and **air pollution**.

The initial Holyhead Hydrogen Hub has the potential to reduce carbon emissions by 1,700 tonnes per year. The carbon and air pollution reductions from scaling-up the project will be orders of magnitude greater.

Noise pollution is also significantly reduced from near-silent hydrogen fuel cells in vehicles.

The **economic benefits** are potentially large. The Hub can:

- establish Ynys Môn as the **pioneering region of Wales** in advancing a hydrogen value-chain built on its natural and infrastructure advantages;
- establish a local entity as the development vehicle which can maintain **local ownership** of assets and the hydrogen supply-chain by rapidly building-up local knowledge & expertise and by forging partnerships with external expertise and investment;
- **support major local businesses**, Stena Line at the Port of Holyhead and haulage companies Delivery Solutions & Gwynedd Shipping, in their transition towards decarbonisation and as an investment in their long-term viability to support local jobs and by future-proofing against tighter emissions controls;
- provide **a platform to scale-up green hydrogen** production to serve larger, local transport markets including the 500,000 annual HGV movements through Holyhead, hydrogen trains (with the notable interest of Alstom), public transport and shipping;
- spur **local business development** in the high-growth hydrogen sector and attract **assembly** and **manufacturing** opportunities and the associated **supply-chain development opportunities**;
- connect Ynys Môn with the **network** of emerging hydrogen hubs in Wales, the UK & Ireland including providing opportunities for “franchising” the development of such hubs in partnership with e.g. Oil4Wales;

- **diversify** to serve other developing hydrogen markets in **heat, power, industry** and **agriculture** in partnership with organisations such as **SP Energy Networks** and **Wales and West Utilities**;
- establish **partnerships** with companies who are at the global forefront of the hydrogen economy such as **Hyundai Motor Company**;
- develop **skills** training in the hydrogen supply-chain in partnership with **Coleg Menai Llandrillo** and others including the transfer of skills from the oil, gas and nuclear sectors;
- establish **R&D partnerships** between e.g. **M-Sparc, Bangor University** and **AMRC Cymru** in order to explore the development innovative hydrogen applications;
- complement other **circular & foundational economy** projects on Ynys Môn.

A **high-level socio-economic assessment** has been undertaken which identifies 3 levels of job opportunities and support. The results are:

1. **Directly at the Initial Hub: 20 FTEs** for the construction phase (c.11 highly-skilled direct jobs + 9 indirect) and the operation of the hub (maintenance, distribution, business development, administration etc.). Plus, for 20 heavy vehicles being maintained locally in workshops per year, a **further 10 additional jobs** would be created.
2. **Indirectly at local businesses**: The project will provide support to sustain and futureproof local businesses Stena Line at Holyhead, Delivery Solutions and Gwynedd Shipping who, between them, **employ over 500 people**.
3. **Scale-up**: Many other regions of the UK and Europe have large hydrogen ambitions including north west England and northern Netherlands. The draft EU hydrogen strategy forecasts the creation of 140,000 jobs by 2030⁸.

We recommend that a full socio-economic impact of the Holyhead Hydrogen Hub should be undertaken as part of the development phase.

6 Business Case

A straight commercial case for the initial Holyhead Hydrogen Hub as a stand-alone investment at this time is difficult to make because of the immature state of the market and developing Government policy. Pump-priming resource is, therefore, required.

The financial analysis indicates that developing a short-term, positive business case for a hydrogen production and delivery system on Ynys Môn (at a scale of low hundreds of kilograms per day) will be challenging when accounting for all costs involved and assuming that revenues from the sale of hydrogen to the mobility sector will be limited by the need to offer hydrogen prices that give fuel cost parity with incumbent solutions.

But the cost of producing green hydrogen is falling, policy support is being urged in the UK and the market will need to expand to meet the recommendations of the Climate Change Commission's NetZero report. This is likely to be reflected in an improvement in the commercial case between now and 2022/23, demanding flexibility in assessing the business case. Given its strong innovative aspects, the project is also well-placed to attract green recovery funding support.

Such a pre-commercial project development pathway is recognised in the nascent hydrogen industry and has been reflected in consultations with potential investors and partners. In other words, any investments may not be dependent on short term returns from the initial Hub but rather as a stake in the longer-term commercial prospects of scaling-up the Holyhead Hydrogen Hub.

At this stage, hydrogen supply technologies have been deliberately matched with specific, identified demands which can support the initial investment case rather than over-sizing any hydrogen production plant. But, as explained elsewhere in this report, the scope to expand the hydrogen supply-chain at Holyhead is considerable.

The business case rests on the need to:

- swiftly establish the Holyhead Hydrogen Hub as a quasi-commercial operation, while recognising that, in common with most hydrogen projects around the world at this stage that there are limited, short-term commercial returns to be made from green hydrogen;
- kick-start the local hydrogen supply-chain, to establish learning and skills on Ynys Môn in advance of expanding the supply-chain for medium and long-term economic development, R&D and commercial opportunities; through scale-up and diversification.

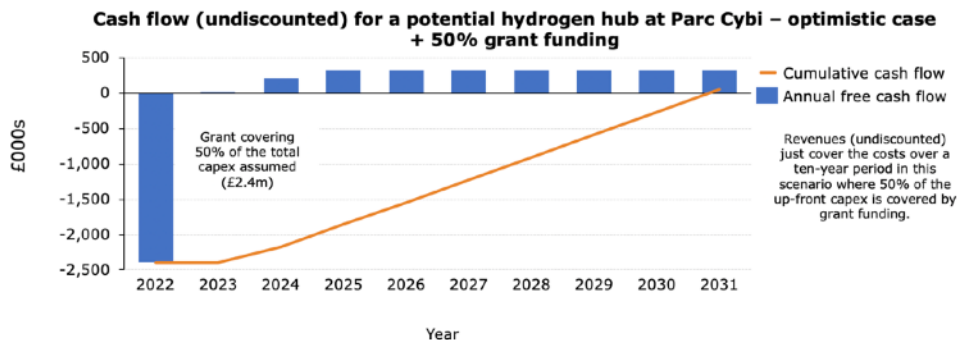
The project asks for patient capital in order to realise its full potential. Ynys Môn and Wales need to seize the opportunity to embrace and take a stake in the nascent hydrogen industry.

Several CAPEX cashflow forecasts have been prepared for the Hub. A selection of these results is provided on the following page (all apply to the trigeneration option except for an illustrative electrolysis option).

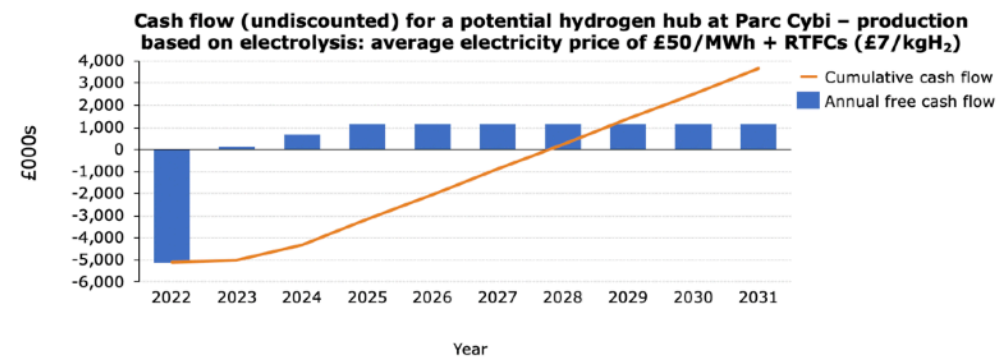
These forecasts underline the high sensitivity of the results to cost and revenue parameters. In all cases, substantial capital funding is required.

The main aim of the Holyhead Hydrogen Hub is to provide a platform from which to take advantage of the scale-up and diversification opportunities for the sustainable, long-term benefit of the local economy.

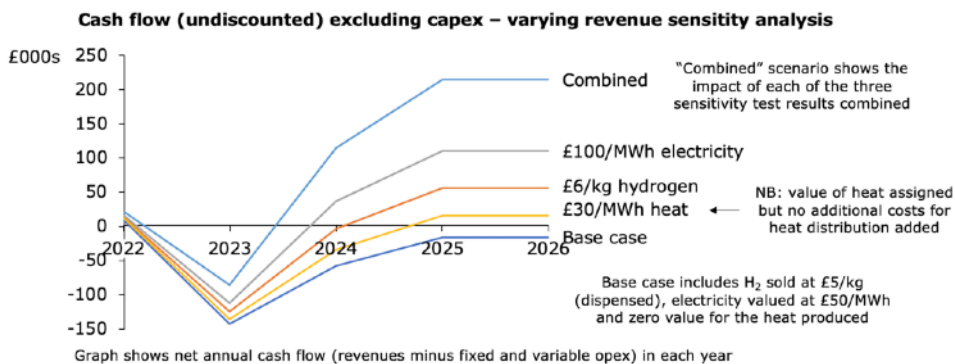
The following chart illustrates the cashflow from the trigeneration plant based on optimistic hydrogen demands and 50% grant funding.



The cashflow from electrolysis could be attractive if low input electricity prices and incentives can be secured.



The revenues from the trigeneration plant are very sensitive to the sale prices of hydrogen, electricity and heat as show in the following chart.



All scenarios for the initial Hub share the following common factors:

- High initial capital costs require funding support.
- Positive OPEX cashflows are achievable in the medium-term.
- The results are highly sensitivity to operational costs, revenue streams and policy support.

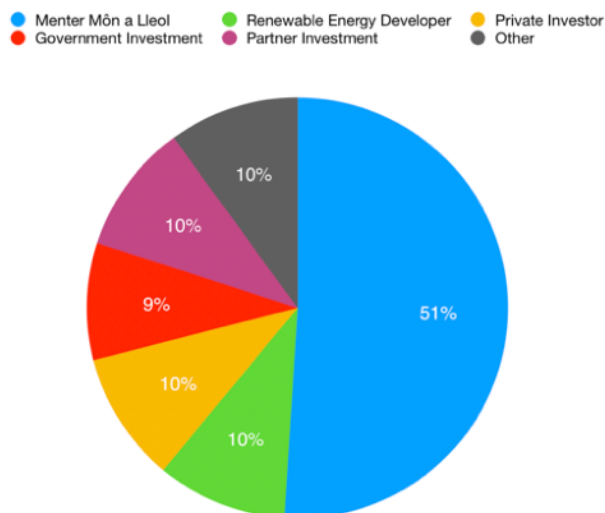
An investment in the initial Hub should be viewed in the context of establishing a platform for the much larger scale-up and diversification opportunities; and by embedding a locally-owned hydrogen supply-chain at Holyhead and more widely on Ynys Môn.

7 Local Hydrogen SPV & Action Plan

In order to keep benefits local the establishment of a SPV to advance the project, as the preferred delivery model is recommended.

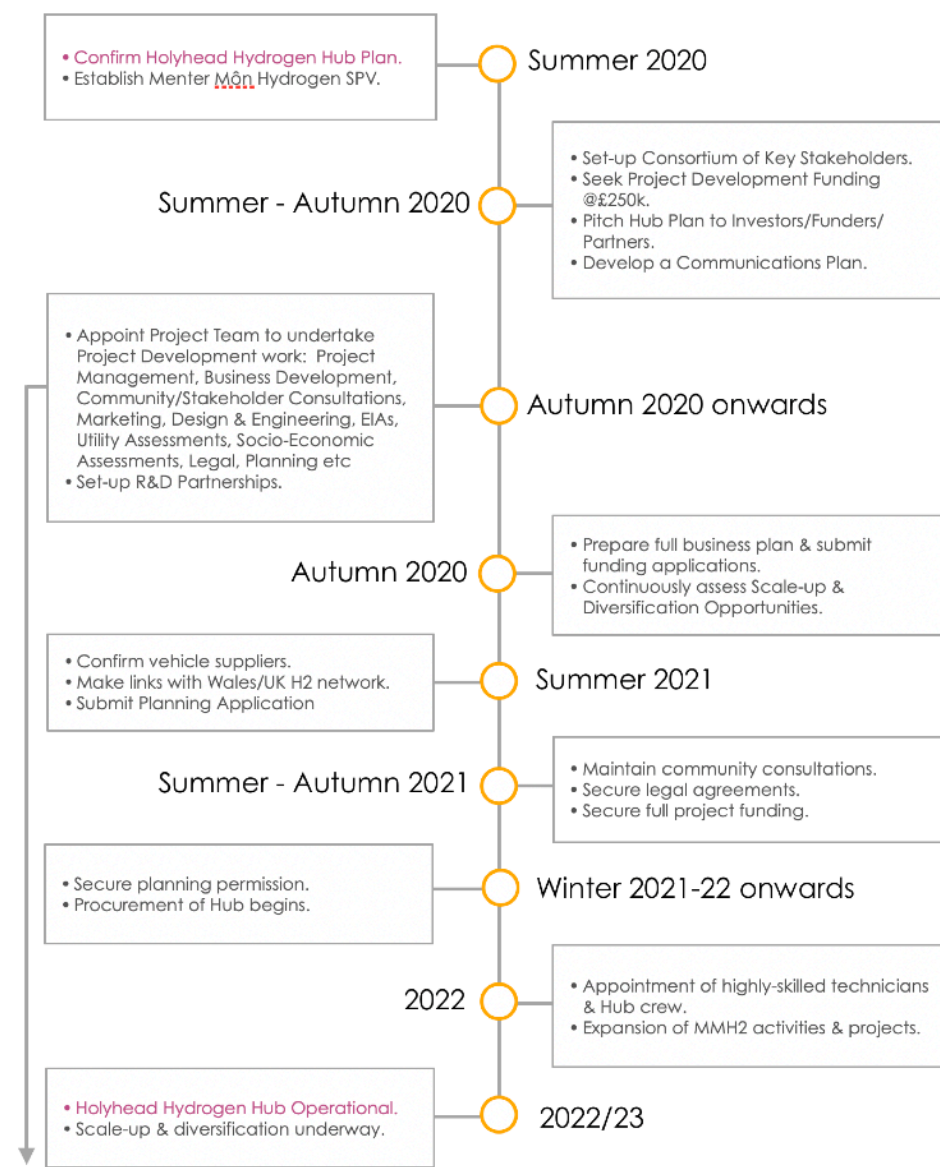
The SPV could be established by Menter Môn and called *Menter Môn Hydrogen*. A co-operative arrangement should be explored but community ownership and management would be guaranteed under Menter Môn's majority involvement.

An indicative ownership distribution for *Menter Môn Hydrogen* is shown below. All named parties are assumptions and values are for illustration purposes only. They do not represent any commitments at this stage. But majority ownership remains under local, community control (at a nominal 51% in the illustration below). Private investors could be in the form of a local community share offering.



The Action Plan, with indicative timeline, for the delivery of the Holyhead Hydrogen Hub by the *Menter Môn Hydrogen* SPV is shown opposite.

Menter Môn Hydrogen (MMH2) SPV - Action Plan



8 Scale-up & Diversification

Holyhead Hydrogen Hub can kick-start the local hydrogen supply-chain and develop local know-how and experience as a platform for scaled-up, commercial opportunities - extending to offshore renewables - through the 2020s and beyond. In doing so, it can help deliver the **Welsh Government's** decarbonisation and air pollution targets, as detailed in Prosperity for All: A Low Carbon Wales⁹.

The initial Hub can be the platform for supplying larger, local markets in Holyhead and Ynys Môn, including the 500,000 annual HGV movements, more buses, refuse trucks, hydrogen trains (with the notable interest of **Alstom**) and shipping via **Stena Line** and **Irish Ferries**.

Heavy transport vehicles can justify the Hub's initial investment case and its subsequent scale-up but small, personal vehicles stand to gain as well. Hydrogen fuel cell **cars** - including Wales' **Riversimple** - **vans**, **taxis**, **bikes** and novel, small **marine** applications are all in the frame; as are small hydrogen **planes** which could fly from **Valley or Caernarfon airports**.

Transport is the premium market for hydrogen, where values of £5-6/kg can compete with diesel and petrol but diversification of hydrogen to decarbonise **heat**, **agriculture**, the **power** sector & **industry** is also an opportunity for Ynys Môn Hydrogen Island. In early discussions, **Wales & West Utilities** has expressed an interest in the scope for injecting hydrogen into the gas network¹⁰; hydrogen could also be used in **off-gas grid** homes, accounting for >50% of Ynys Môn's properties; for agriculture in fertiliser production; and in power generation as a substitute for gas. All of this adds-up to energy sustainability and resilience built around a **local-supply-chain** and based on **circular economy** and **foundational economy** principles.

There is no large, heavy industry on Ynys Môn or Gwynedd but extending from Deeside to north west England sits one of the UK's largest industrial



clusters, including existing consumers of hydrogen at scale. The **HyNet** project proposes a **blue** hydrogen (natural gas + carbon capture & storage) solution for this cluster involving storage in gas fields off the coast of north east Wales. But, should **green** hydrogen (from renewables via electrolysis) follow expected cost curve reductions and given the gas infrastructure which connects Ynys Môn to this region 100km away, it may be feasible to ship green hydrogen from Ynys Môn to serve this large industrial market and without the complications of CCS.

Electrolysis is the long-term focus for the Hub, which provides the basis to produce hydrogen-derived synthetic fuels such as **ammonia** and **methanol**.

The project has also identified **added-value spin-offs** from the core hydrogen production including **zero emission power supply to the Port**, **community heating** applications, carbon dioxide and heat for **enhanced food production** and the supply of **medical-grade oxygen**.

Established technologies and companies have a major role to play but the Hub should also be the catalyst for **R&D** into innovative, new applications and for nurturing **new companies**, building on the area's research, skills and business development expertise; not only in hydrogen but also for complementary applications in the **digital** and **fintech** sectors. Ynys Môn's "*unfair advantages*" of resources, skills and infrastructure can provide fertile ground for the **green, post COVID-19 economy**.

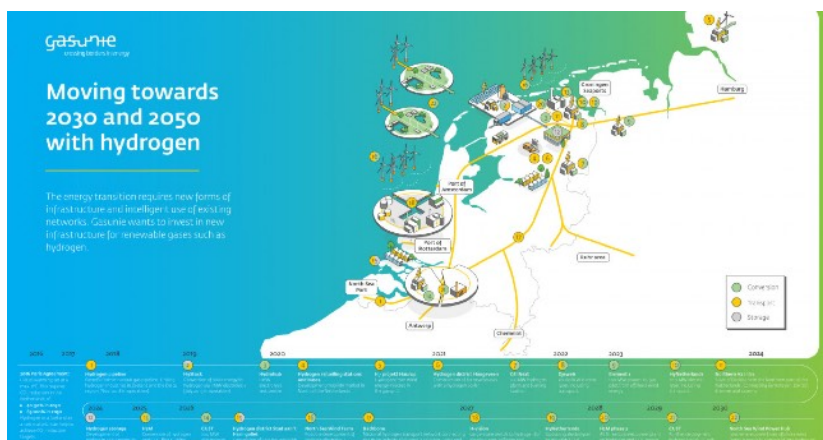
The proximity of the **Wylfa Newydd** site to Holyhead and the potential longer term opportunity to generate significant quantities of hydrogen from low carbon **nuclear** electricity¹¹ (as proposed, for example, by EDF at Heysham), provides grounds to also engage with **Horizon Nuclear**.

Additionally, the opportunity afforded by likely low carbon electricity developments at **Trawsfynydd** in the **Snowdonia Enterprise Zone** also needs to be explored, taking account of the lessons from this study around Holyhead (and its association with the **Anglesey Enterprise Zone**).

9 Wales, UK, Ireland & wider in Europe

Could the green hydrogen economy be adopted swiftly in Wales; and become a model and launchpad for the rest of the UK? Emerging projects include the South Wales Industrial Cluster¹² and Milford Haven Energy Kingdom¹³ and activities in north east Wales.

Other nations and regions of Europe have already developed clear 2020+ pathways for green hydrogen (notably The Netherlands, as shown below in this Gasunie chart¹⁴) which provide a ready-made template for Wales and Ynys Môn Hydrogen Island to emulate.



Many of the characteristics are common: natural resources; suitable ports; comprehensive gas, electricity and water infrastructure; ready-made markets and larger emerging markets; an excellent skills development record; strong R&D; a strong industrial and manufacturing base; and an increasingly supportive government.

Looking west, there are partnership opportunities in green hydrogen production and supply-chain development to be explored with Ireland - to fully exploit the Celtic Sea's abundant resources.

Looking east, there are large growing markets for hydrogen in north west England such as the HyNet project, as shown¹⁵.

The UK's power grid has reduced its carbon intensity substantially in recent years - although it should be noted that intensities of $\sim 300\text{g/kWh}$ are still commonplace, even on sunny days in summer due to the use of gas turbine plant to even out generation production from unpredictable renewable generators. Decarbonising heat, transport and industry remain hugely challenging. As the Climate Change Commission's landmark NetZero report finds hydrogen is essential to decarbonising the UK's economy.



There is already significant, multi-sector activity on hydrogen in the UK. For example, in heat (the utilities' Green Gas Advisory Group), industry (industrial clusters), transport (emerging hydrogen filling station network) as well as emerging manufacturing capability amongst electrolyser and fuel cell companies and their supply-chains; underpinned by a strong R&D base.

Renewable energy companies increasingly identify hydrogen as the next-step in their evolution, building on the UK's success in deploying offshore wind at scale. The Nuclear Industry Research Advisory Board has identified the importance of hydrogen to complement nuclear development as well¹⁶.

It should also be noted that hydrogen has long been established and well-regulated for use in industry. But this hydrogen is sourced from fossil fuels and has a large carbon footprint unless carbon capture can be applied. These existing markets do however provide the platform for the expansion of zero carbon green hydrogen into new, overall much larger markets of power, heat, transport and agriculture - and synthetic fuels.

As recognised by the June 2020 German National Hydrogen Strategy¹⁷ (which includes a €9bn support package) and also across the EU (where hydrogen could account for a forecast 5.4m jobs by 2050¹⁸), it will be impossible to decarbonise the economy without investing in hydrogen.

10 Conclusion & Recommendations

Whereas the project initially started as a hydrogen-supply opportunity, based around the large, local renewable resource which could be directed to producing green hydrogen on Ynys Môn, the work done has shown that this can justifiably be supported by the demand-led requirements of major, identified local businesses.

The project identifies a zero emission solution for transport and other applications which can slash carbon emissions and air pollution. Noise pollution is also significantly reduced from near-silent hydrogen fuel cells in vehicles.

The economic benefits are large. The proposed Holyhead Hydrogen Hub at Parc Cybi, Ynys Môn, would:

- create 20FTEs directly at the initial Hub plus a further 10 additional jobs in vehicle maintenance;
- indirectly support over 500 jobs at local businesses;
- provide the platform for scaled-up hydrogen production for transport and diversification to the heat, power, industry and agriculture markets; plus the development of synthetic fuels and synergies with the digital and fintech sectors. This would boost GVA and provide substantial, sustainable job opportunities which can be embedded in the local community.

This initial Hub can nurture partnerships with several, significant hydrogen-related companies who have expressed a strong interest in the project; and also provide the catalyst for R&D partnerships amongst identified parties.

This is a fast-evolving sector and higher hydrogen demands may emerge more quickly than those specifically identified at this stage. In this case, the Menter Môn team should be receptive to opportunities which can both complement and build-on the findings presented in this report.

The project is also well-placed to attract Green Recovery funding, especially under the narrative of kick-starting the local hydrogen supply-chain and as a platform for scale-up and diversification into heat, power, industry and agriculture markets; and in support of key north Wales businesses.

In conclusion, if the project is not swiftly pursued and appropriately funded, the opportunity to develop a locally-controlled hydrogen-supply chain may be lost.

Key Recommendations

- Establish *Menter Môn Hydrogen SPV* with legal advice
- Set-up a consortium of key stakeholders
- Seek £250k of development funding to appoint a team to undertake Project Development work to set up an initial Hydrogen Hub in Holyhead; this work consisting of:
 - Project Management, Business Development, Community/Stakeholder Consultations, Marketing, Design & Engineering, Environmental Impact Assessments, Utility Assessments, Socio-Economic Assessments, Legal aspects, Planning Obligations & Application.
- Pitch the Holyhead Hydrogen Hub project to potential investors & funders
- Develop a communications plan
- Set-up R&D partnerships

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