

15 July 2020

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Price (p)	4.0
Shares in issue (m)	2,078
Mkt Cap (£m)	83
Net debt (£m)	0
EV (£m)	83
BVPS (p)	0.1

Share price performance

1m	17.6%
3m	321.1%
12m	809.1%
12 m high/low	4.6/0.3
Ave daily vol (3m)	32,088,720

Shareholders

Hargreaves Lansd'n	28.7%
Interactive Investor	13.2%
Halifax Share	6.5%
A J Bell Securities	5.3%
Barclays Plc	5.2%
Renewme Limited	4.3%
Pershing & Co	4.0%
UBS	3.8%
Yady Worldwide	3.1%
White Ben	2.9%
Total for top 10	77.1%
Free float	96.2%

Next news Ints Q4

Business description

Waste to hydrogen technology



HYDROGEN HOTHOUSE

Powerhouse Energy offers competitively priced low carbon hydrogen while also providing a solution to plastic waste disposal. The modular units are ideal for local hydrogen charging and the company has a route to market through its development agreement with Peel Environmental. The immediate UK opportunity alone could be worth 6p per share in our view.

Waste to hydrogen competitive with electrolysis

Powerhouse Energy has developed a proprietary waste to hydrogen technology. This can produce hydrogen as a clean energy source from the plastic contained in municipal solid waste. The hydrogen is 99.999% pure which can be used in all fuel cell technologies as well as for direct heating or industrial processes. The Distributed Modular Generation (DMG) technology can produce hydrogen that is cost competitive with electrolyser technology today. A learning curve route map suggests that this competitive position can be retained as other technologies come down in price.

Route to market secured

The technology has been successfully demonstrated and as a modular system minimises scale up risks. The company is about to deploy its first commercial project at the Protos Energy Park in Cheshire in partnership with Peel Environmental. The agreement with Peel has been expanded into an 11 unit deal and Peel has identified a further 77 sites in the UK giving the company a strong route to market. Powerhouse is also following up interest in Thailand, Japan and Australia. The agreement with Peel sees Powerhouse provide the technology under a licencing agreement with additional supporting engineering sales. This approach minimises the capital requirements of the company.

International opportunities add value

Our base case valuation of the company based on UK opportunities alone is 6.0p per share. If the company can develop existing leads in Japan and Australia this rises to 9.0p and if the European market can be added we get 15.3p. The main risks to our valuation include residual technology risk ahead of the Protos site commissioning, feedstock security and wider support for the hydrogen economy.

£,000 Dec	2018a	2019a	2020e	2021e	2022e	2023e
Sales	0	0	1,049	3,900	4,902	7,717
EBITDA	-2,494	-1,704	-877	-156	1,095	2,341
PBT	-2,495	-1,706	-874	-113	1,106	2,376
EPS	-0.2	-0.1	0.0	0.0	0.1	0.1
CFPS	-0.1	0.0	-0.1	-0.1	0.0	0.1
DPS	0.0	0.0	0.0	0.0	0.0	0.0
Net Debt (Cash)	-841	-104	-1,441	-391	-1,168	-2,618
Debt/EBITDA	0.3	0.1	1.6	2.5	-1.1	-1.1
P/E	-26.2	-50.3	-99.3	-765.5	78.5	36.5
EV/EBITDA	-33.0	-48.7	-94.6	-530.8	75.8	35.5
EV/sales	#DIV/0!	#DIV/0!	79.1	21.3	16.9	10.8
FCF yield	-3.1%	-1.0%	-1.9%	-1.3%	0.9%	1.6%
Div yield	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

INVESTMENT SUMMARY

Powerhouse Energy has developed a proprietary waste to hydrogen technology. This can produce hydrogen as a clean energy source from the plastic contained in municipal solid waste. The hydrogen is 99.999% pure (five “nines”) which can be used in all fuel cell technologies as well as for direct heating or industrial processes.

Hydrogen is increasingly seen as an essential component in the energy transition to clean energy away from fossil fuels. It is the best available technology for heavy duty and long range transport, for decarbonising key industries including cement and steel production and potentially domestic heating.

Powerhouse can produce low carbon hydrogen that can be competitive with existing technologies such as electrolyzers and remain so even as higher volumes reduce their costs. The fact that it also deals with previously untreatable waste and generates power rather than consuming it makes it a complementary technology rather than a competing one. And unlike electrolyzers it does not consume water as a feedstock.

BULL POINTS

- Competitively priced hydrogen from waste
- Route to market through deal with Peel Environmental
- Global interest in technology
- Capital light licencing approach

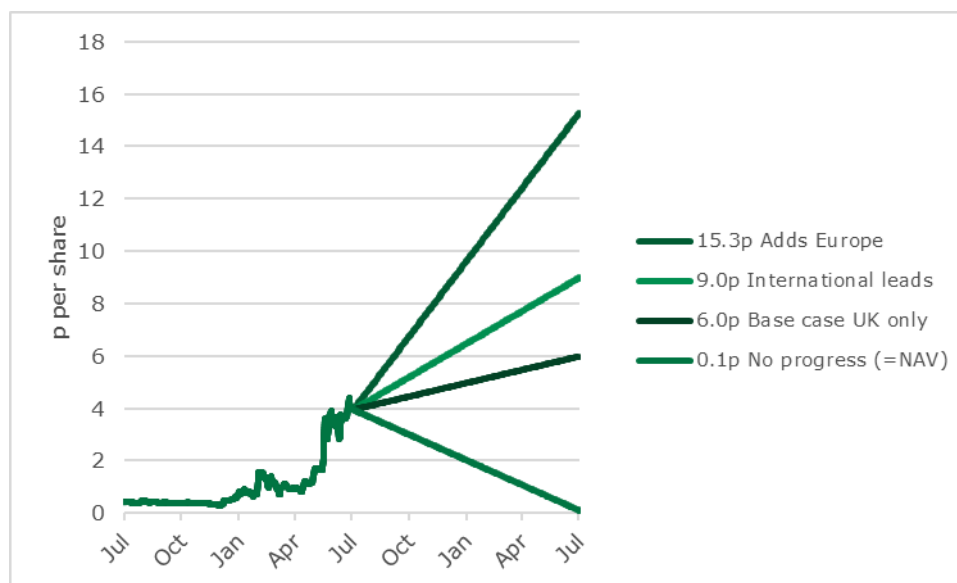
BEAR POINTS

- New technology needs to become established
- Feedstock needs to be secured
- Still early days for the hydrogen economy
- Not completely emissions free

CATALYSTS

- Protos unit commissioning
- Second and subsequent unit roll out
- International progress

Share Price and Valuation Points



Source: Bloomberg, Longspur Research

COMPANY HISTORY

Powerhouse was established on AIM in 2011 and has developed its own ultra high temperature gasification technology based on lessons learnt working with earlier technology from Pyromex AG. The company worked with its Australian engineering partner to develop its own improved technology that overcame issues with the Pyromex design and resulted in a lower manufacturing cost of the unit. Powerhouse subsequently combined the gasification technology with hydrogen purification technology to deliver 99.999% pure hydrogen.

MOVING TO COMMERCIALISATION

In April 2019 Powerhouse signed its first commercial contract with developer Waste2Tricity (W2T) to design a DMG unit at Peel Environmental's Protos Energy Park in Cheshire with W2T acting as an exclusive partner for UK project development. In August of that year Powerhouse expanded the collaboration agreement with Peel Environmental for the development of a minimum of 11 DMG projects in the UK. The agreement also signed up W2T to act as project developer. As the agreement proceeded it was decided to roll up W2T into Powerhouse in an all-share acquisition with Peel making it a condition that all rights were transferred. The agreement was approved at EGM on 14th July and will give Peel exclusivity on all UK waste to hydrogen projects to develop with Powerhouse technology. Peel has identified a long list of 77 potential sites.

HYDROGEN IS KEY TO THE ENERGY TRANSITION

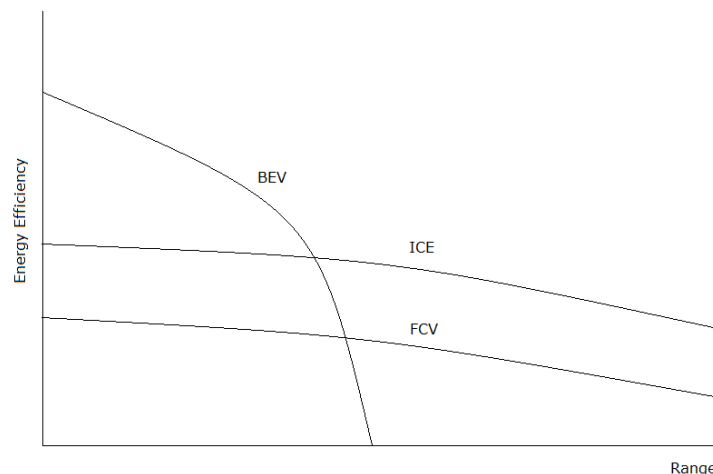
A key component of the energy transition

The UK's Committee on Climate Change (CCC) has said that developing low-carbon hydrogen is a necessity not an option. This message has been reinforced globally by the IEA, IRENA and IPCC. Hydrogen can be used to decarbonise a number of key sectors including transport, industry and heating. It also has potential as a storage medium for electricity in the power sector.

Hydrogen for transport

Batteries are already making inroads towards decarbonising transport but are limited by the way they scale with range. Physically the only way to get greater range with a battery is to add weight in a linear manner. As a result efficiency falls off by comparison with traditional fossil fueling or hydrogen fuel cell vehicles.

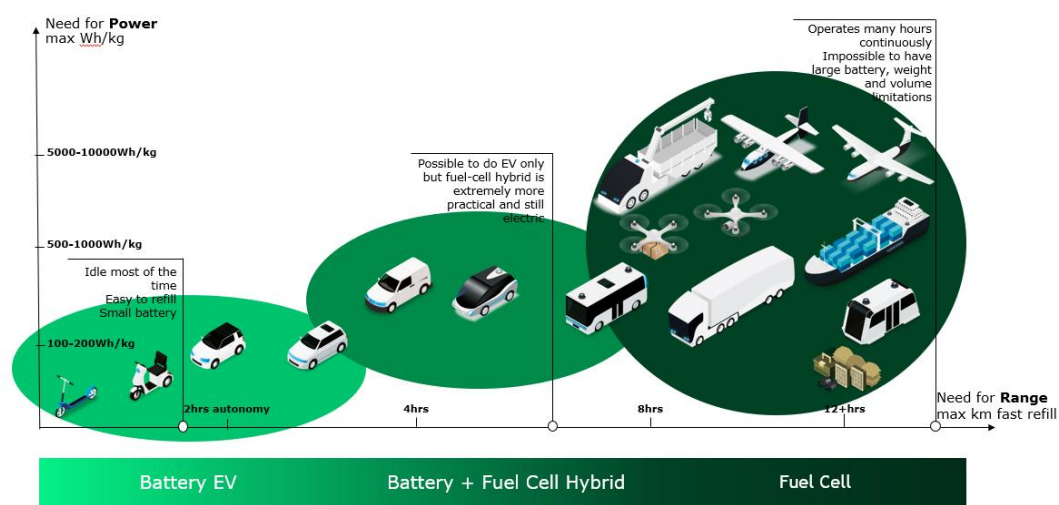
Engine efficiency against range



Source: ICCT

This is worsened for heavier, more powerful applications. We are already seeing a move by Chinese bus OEMs to make use of fuel cells notably for longer distance buses. There is also interest in trucking including mining and in areas such as fork lift trucks and logistics vehicles including airport or port service vehicles. All of these benefit from the fact that they can be fuelled at their depots without the need for a hydrogen infrastructure.

Low carbon vehicle market segments



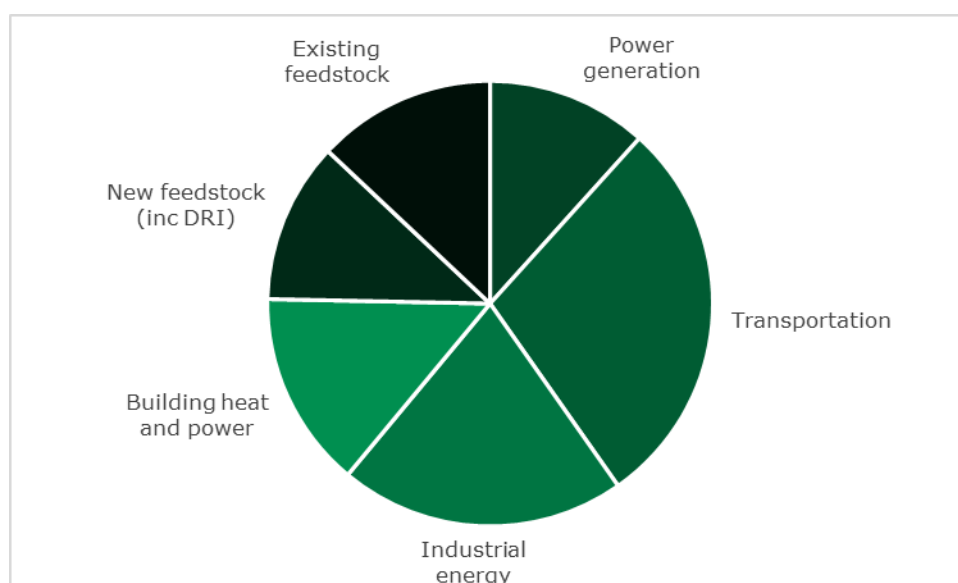
Source: Advent Technology

Increasingly hydrogen is seen as the go to solution for longer range and high power transport.

Hydrogen for Industry

Additionally, hydrogen may be the only realistic way to decarbonise key industries including steel making. Hydrogen is already used for the direct reduction of iron ore which currently accounts for 7% of all steel production. Clearly there is an opportunity to increase this percentage. As a fuel it can also help to decarbonise industries requiring high temperatures including cement manufacture and is also of use as a source of direct heat in distributed industries where scale makes carbon capture costly or impractical.

Forecast uses of hydrogen in 2050

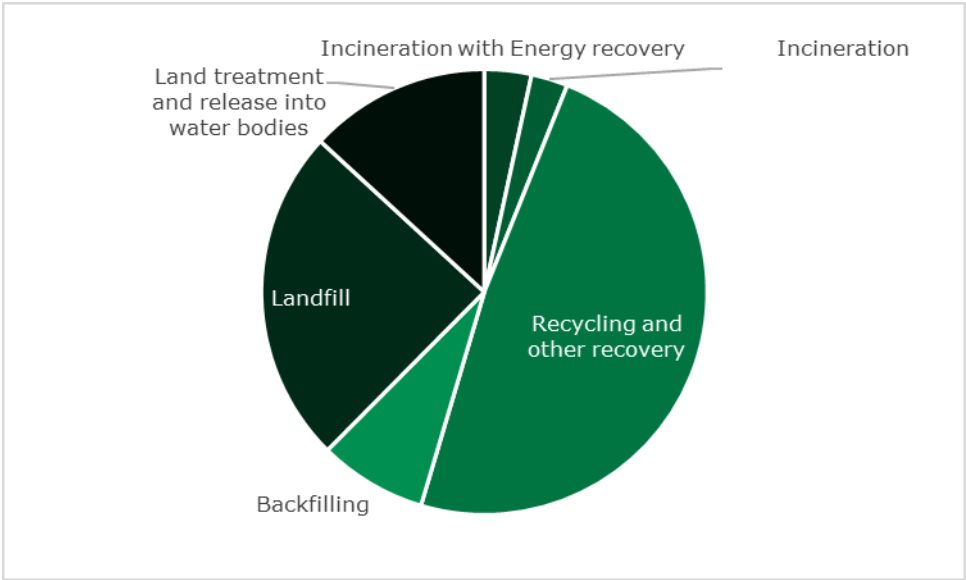


Source: The Hydrogen Council

WHY WE ALSO NEED A WASTE SOLUTION

There is also a major need to deal with non-recyclable waste including single use plastic. Left in landfill, this can decay to emit methane with a greenhouse gas potential of 22 times that of CO2. The UK is still landfilling almost a quarter of all waste with a further 8% backfilled.

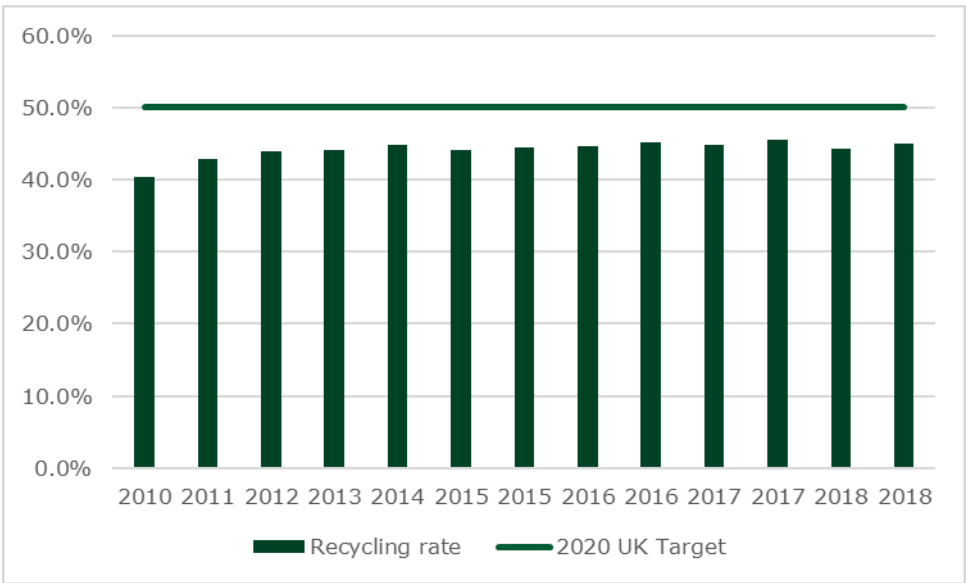
UK Waste Destinations (2016)



Source: DEFRA

Recycling rates have remained fairly static for most of the last decade and below the UK’s 2020 target of recycling 50% of our waste.

UK Recycling Rates



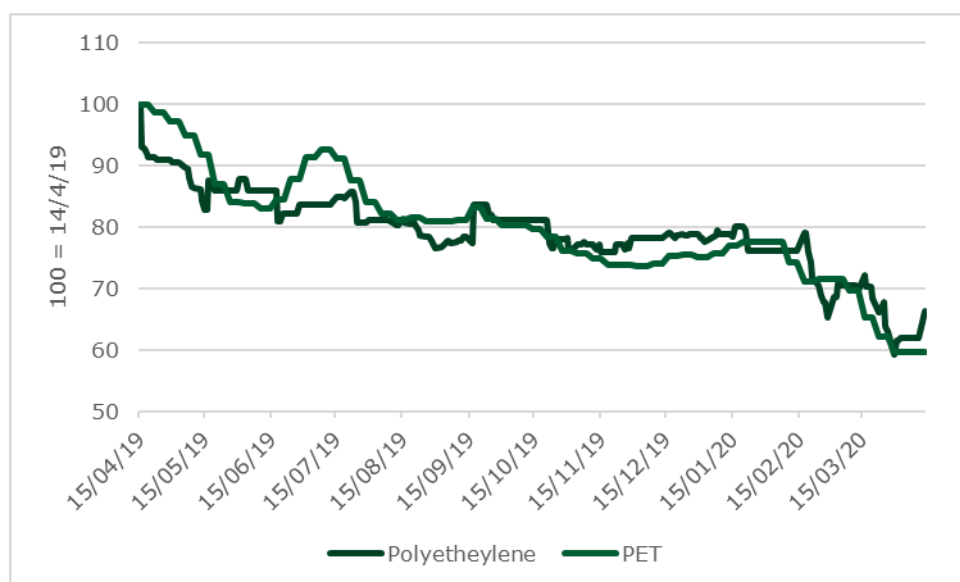
Source: ONS

WHY COVID-19 MAY INCREASE DEMAND FOR WASTE SOLUTIONS

Vincent Kneefel of WWF has identified three trends in waste resulting from COVID-19. We are seeing at least a temporary increase in the usage of single-use plastics. Obviously PPE is needed but we are also seeing the restaurant sector moving to more takeaway provision and bottled water sales are up. Starbucks, Dunkin Brands and Tim Hortons have all dropped reusable cup programmes. The US Plastics Industry Association has sent a letter to the Department of Health and Human Services asking them to publicly declare single use plastic bag bans as a health threat during the pandemic. Some effects will be temporary but a marginal increase in packaging, especially hard to recycle films, is likely to lead to more waste.

At the same time the low oil price has made virgin plastic more competitive with recycling. While plastic feedstock prices were already low, sustained weakness acts as a brake on recycling. As with the oil price this may reduce investment but the dynamics of production are different here with less reinvestment required to meet demand and we see a more sustained impact as a result.

Polyethylene and PET Prices



Source: Bloomberg

Finally the waste management industry is being impacted by COVID-19 directly and indirectly. This is a front line service with employees at risk. Waste workers at Biffa have already gone on strike in the Wirral over COVID-19 related concerns. While there has also been an ongoing dispute over pay, the union, Unite, says that this dispute is unconnected. South Africa is also seeing industrial action among waste sorters. We hope disruption here is temporary but some effects may linger.

Overall, we think there will be a persistent impact of COVID-19 that results in more plastic waste. As a result we think demand for waste to energy solutions including advanced thermal treatment will remain strong and feedstock sourcing should remain secure.

WHY WASTE TREATMENT REPRESENTS A CARBON REDUCTION

While the overall DMG technology releases CO2, it represents a potentially considerable reduction in CO2 compared to other options for waste treatment. As such it is a key contributor through avoided emissions.

The biogenic content of waste that goes to landfill will decompose and release methane with a greenhouse gas potential worth 28 times that of CO2 when assessed over a hundred year period. Simple incineration of this waste is the most common alternative to landfill and by converting the waste into heat and CO2 the GHG impact is reduced. However the DMG process goes further by also avoiding emissions from electricity and heat generation and perhaps most importantly transport generation when hydrogen is maximised.

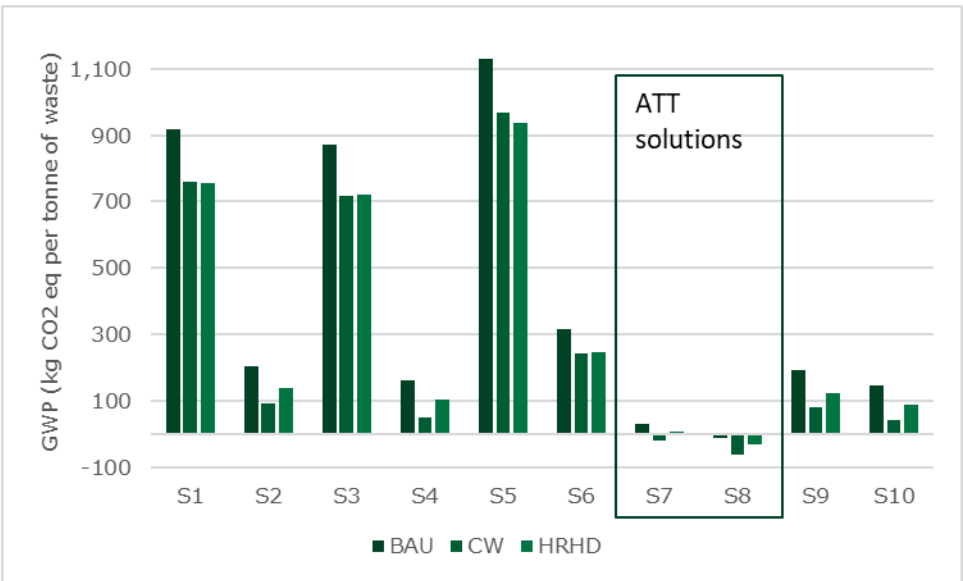
DMG Avoided Greenhouse Gas Emissions

tCO2e per day	Power maximised	H2 maximised
Emissions from DMG system	70.67	70.67
Emissions offset by electricity production	-33.75	-24.64
Emissions offset by heat production	-22.79	-22.79
Landfill offset	-15.8	-15.8
HGV offset	0	-36.08
Net daily emissions	-1.67	-28.64

Source: Engsolve for Powerhouse Energy

Research by University College London looked at a number of integrated waste management options for treating municipal solid waste arising from the 2012 London Olympics. The results showed that integrated processes that used advanced thermal treatment (ATT) as a significant part of the process had the lowest greenhouse gas emissions in every case they considered. Gasification is one of the leading ATT technologies.

Global warming potential of different integrated waste solutions



Source: UCL

To quote the UCL research:

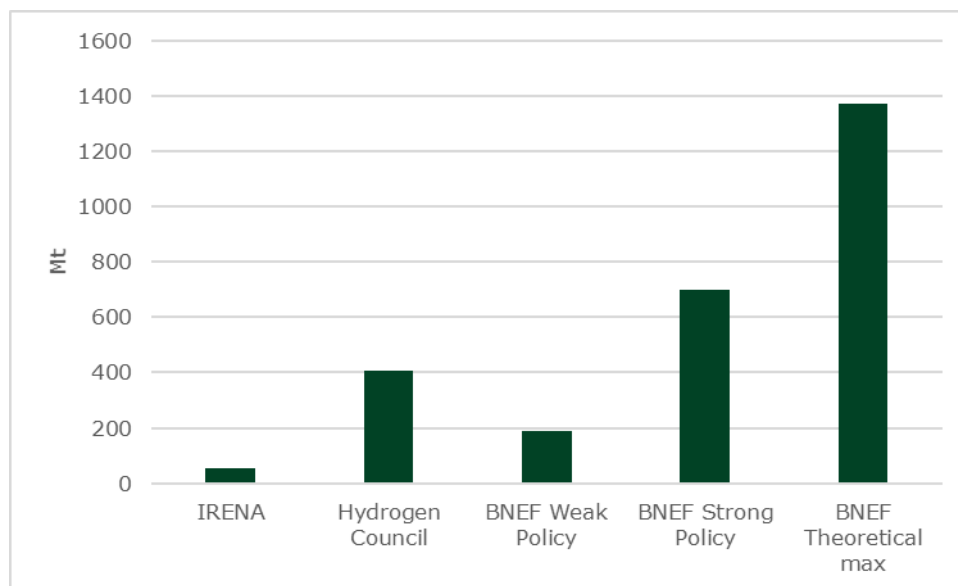
“it can be seen that [integrated waste management strategies] with landfill as the primary waste treatment technology have the highest direct and indirect burdens and the lowest avoided burdens. [Strategies] with Advanced Thermal Treatment as the primary technology have the lowest impacts regarding GWP. These results can be explained by the fact that the amount of electricity generated from landfill gas (0.369 MJ/tonne MSW) is significantly less than the amount of energy generated from the EfW or ATT plants (1.03 and 2.95 MJ/tonne MSW respectively). At the same time, the GHG emissions associated with landfill process are higher than those resulting from other waste treatment facilities.”

Notably ATT was a better option than landfill or incineration. While incineration has been a solution in the UK waste industry for over a hundred years, cleaner solutions are likely to be favoured going forward. Additionally further opportunity is likely to be created when existing incineration plants come to the end of their working lives.

HYDROGEN DEMAND POTENTIAL

The International Renewable Energy Agency, Bloomberg New Energy Finance, and the Hydrogen Council have all published 2050 forecasts of global demand for hydrogen with a considerable range of expectations. These go from 7.7 EJ to 195 EJ which is the equivalent of 54Mt to 1,373Mt of hydrogen

Hydrogen demand in 2050

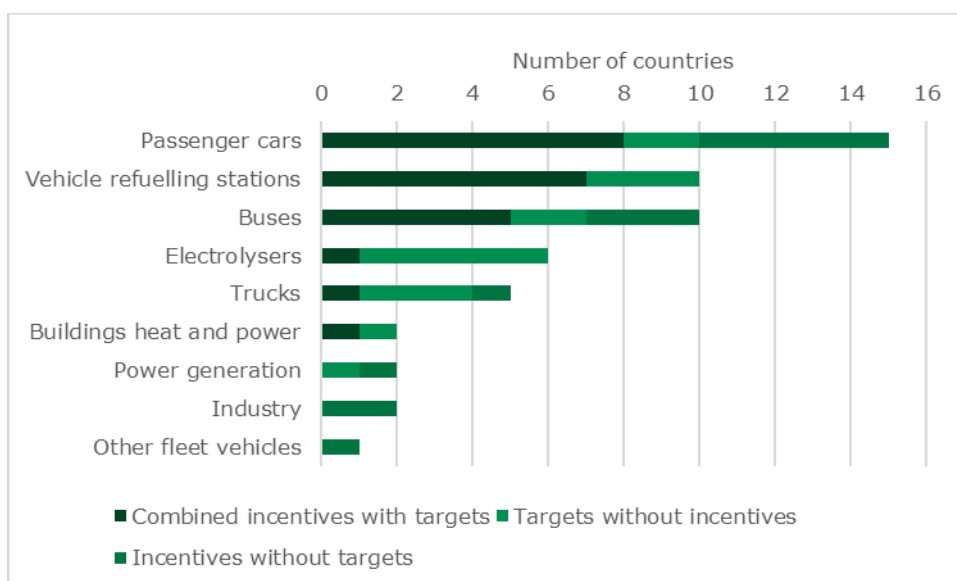


Source: IRENA, Hydrogen Council, BNEF

EQUATING THESE FORECASTS WITH A 1.5 DEGREE TARGET

The UK is committed to net zero greenhouse gas emissions by 2050. The European Union is following suit with its Green Deal initiative. So far 14 countries have committed to net zero and a significant number of countries are directly supporting hydrogen deployment.

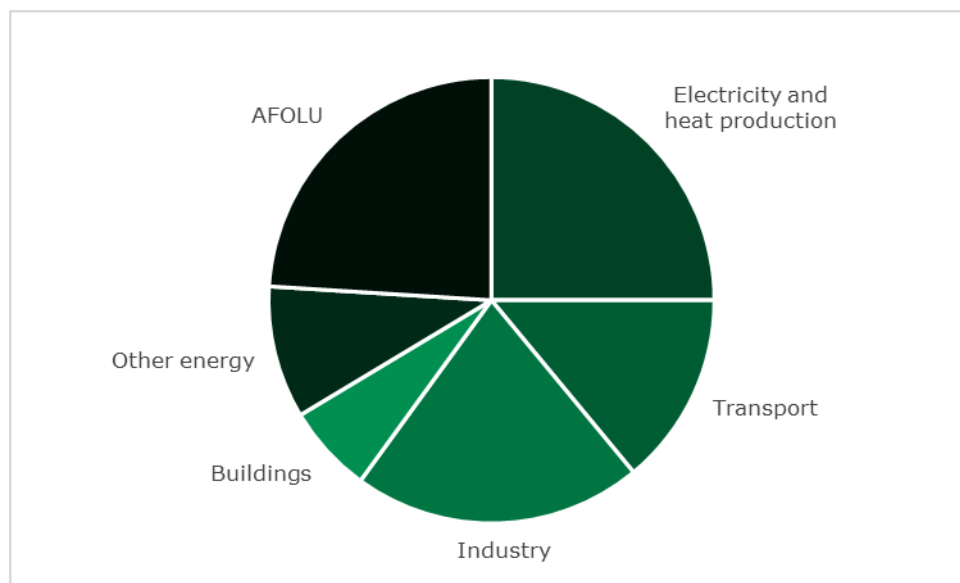
Hydrogen demand in 2050



Source: IEA

Global greenhouse gas emissions are distributed as follows.

Global Greenhouse Gas Emissions



Source: IPCC, AFOLU = agriculture, forestry and other land use

The solutions to these emission sources are varied. The IPCC's 1.5 degree report identified 85 pathways to net zero by 2050. The IPCC assumes that a considerable element of vehicle emissions will be met by biofuels. We think that this is unrealistic given the land required for this amount of biofuel.

We think that while biofuels might represent a transition fuel, in the long run we think batteries and hydrogen will be the solutions that win out and this is in fact recognised in the IPCC report.

The IPCC has given further details of how they see transport emission solutions breaking down.

Transport Emissions and Solutions

	Share of each mode (%)			Reduction from 2014 (%)	
	Energy	Biofuel	CO2	Energy	CO2
LDV	36	17	30	51	81
HDV	33	35	36	8	56
Rail	6	0	-1	-136	107
Aviation	12	28	14	14	56
Shipping	17	21	21	26	29

Source: IPCC

Because the biofuel component and energy components are not equal we have reallocated some of the biofuel to hydrogen in the mix as follows. This gives us 25% of transport energy fueled by hydrogen fuelled energy equal to 107EJ. This gives us a "solutions" picture as follows:

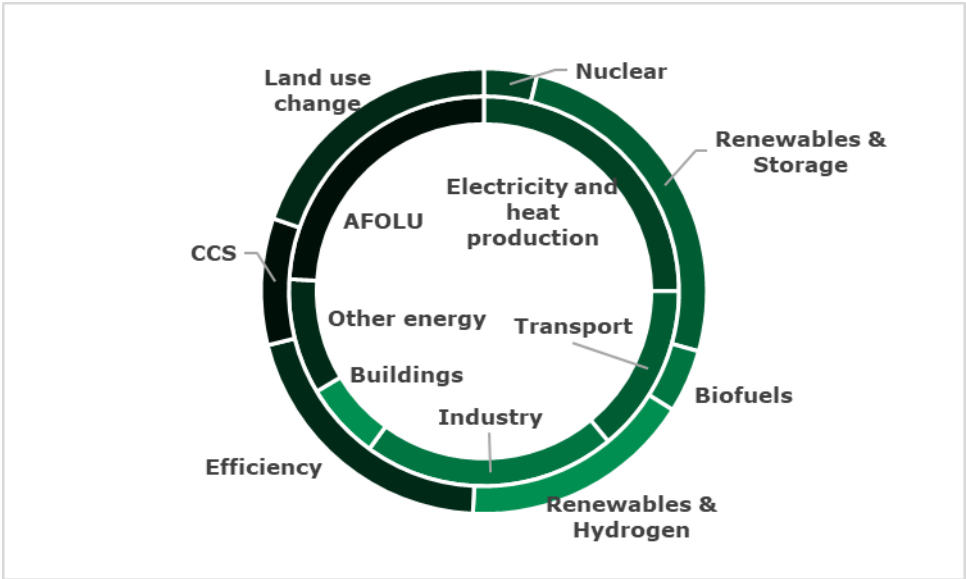
Revised Transport Solutions (%)

	Total	Biofuel	H2	EV
LDV	36	7	0	29
HDV	33	14	18	0
Rail	6	0	3	3
Aviation	12	12	0	0
Shipping	17	9	4	4

Source: IPCC

And this in turn presents the full solutions picture as follows.

Global Emissions and Solutions



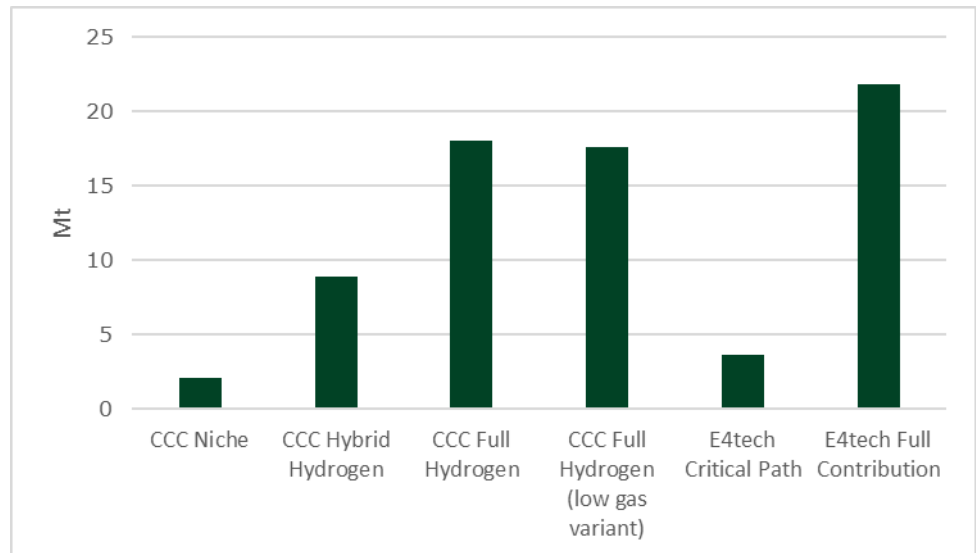
Source: IPCC, Longspur Research

This equates to 107EJ of hydrogen energy, equivalent to 750Mt of hydrogen. This is broadly consistent with the BNEF strong policy case. Given that “strong policy” equates to policies required to deliver the IPCC target this to be expected.

HYDROGEN DEMAND IN THE UK

In the UK forecasts by E4tech and the Committee for Climate Change range from 0.3 EJ to 3.1 EJ or 2Mt to 22Mt of hydrogen. The range depends on a number of things including whether hydrogen is used in domestic heating or not.

2050 UK Hydrogen Demand Forecasts

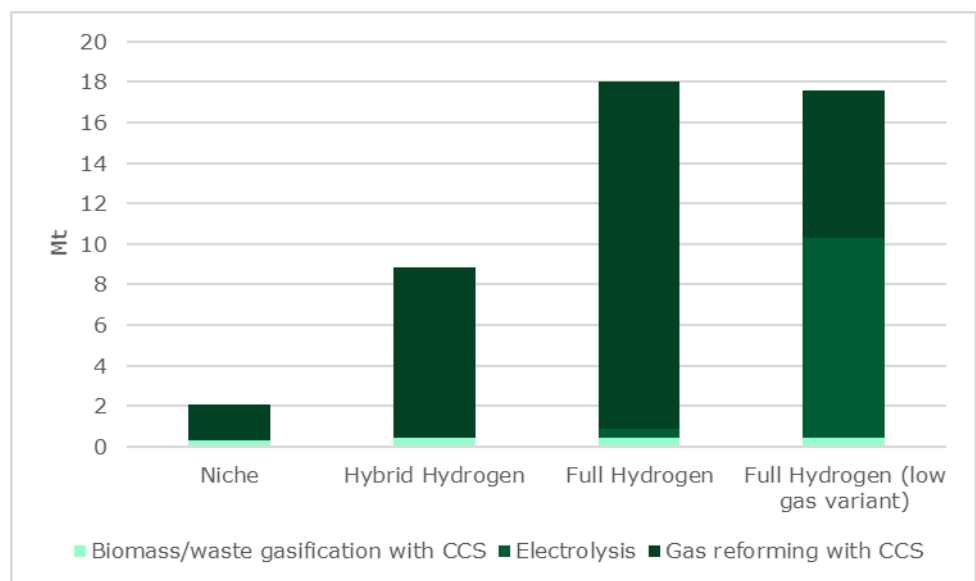


Source: E4tech, CCC

FORECAST FOR HYDROGEN FROM GASIFICATION

The UK's Committee for Climate Change has published forecasts for UK hydrogen production in 2050 under differing scenarios and including a forecast for gasification from biomass or waste. In all cases this remains a marginal technology yet even in the weakest scenario there is still a significant opportunity for Powerhouse.

2050 UK Hydrogen Demand Forecast by Production Options



Source: CCC

The niche scenario still assumes 0.32Mt of hydrogen produced per annum from gasification. This would equate to 435 Powerhouse Energy units. The CCC has also said that they expect the decarbonisation of heavy goods vehicles to require 800 refuelling stations to be built by 2050 if a hydrogen solution is followed which we see as confirming the order of magnitude of the potential demand.

“HGVs are harder to decarbonise. Our new research suggests that it is possible to get to very-low emissions by 2050 by switching most of these vehicles to hydrogen power or electrification. A hydrogen-based switchover would require 800 refuelling stations to be built by 2050 and electrification would need 90,000 depot-based chargers for overnight charging.”

Currently the UK has just 17 refuelling stations.

Hydrogen Refuelling Stations

Region	H2 Refuelling Stations
California	41
China	36
Europe	132
Germany	83
Japan	116
Korea	27
UK	17

Source: AFDC,H2Live, HyNet, JHyM, Sussex Express

Gobal opportunity for gasification

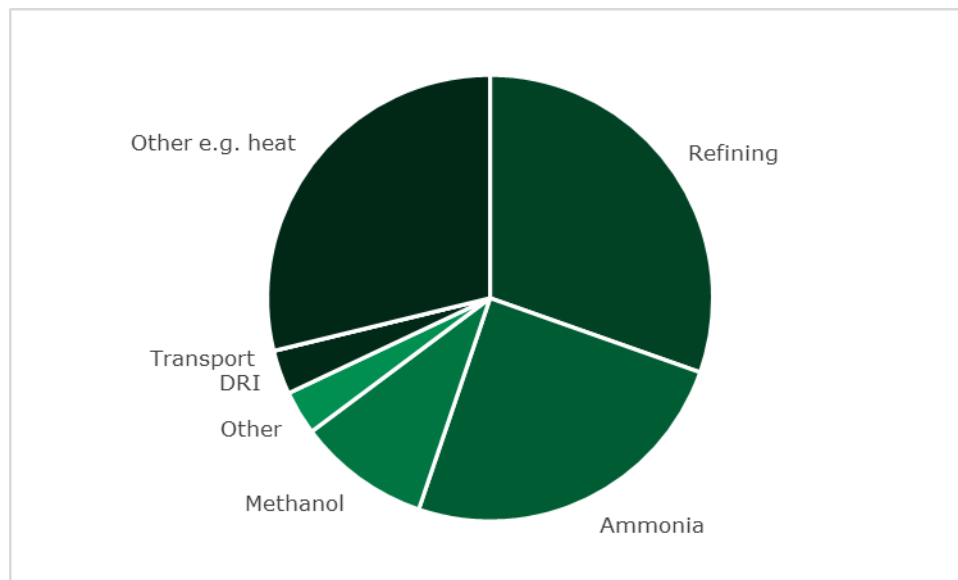
Under the CCC niche scenario, gasification accounts for 15% of total production. Applying that percentage to the BNEF low case forecast would give global demand of 28Mt per annum. That equals 38,600 Powerhouse Energy units.

We actually think the CCC forecasts for gasification could be low as we think the Powerhouse distributed solution has advantages that may see it being deployed where the CCC has assumed electrolyser technology.

HYDROGEN PRODUCTION

The world currently produces around 50Mt of hydrogen annually. This is primarily used in the refining industry and for the production of ammonia and methanol.

Current uses of hydrogen



Source: Hydrogen Council

Currently, hydrogen is mainly produced by steam reformation of natural gas. Steam methane reformation is energy intense and a major emitter of CO₂. While carbon capture and storage (CCS) is an option to reduce or eliminate the CO₂ emissions, creating “blue” hydrogen, this is not yet a fully developed technology and is likely to be expensive.

Low carbon, or green, hydrogen can be created from the electrolysis of water with renewable energy providing the electricity. There are two main types of electrolyser, proton exchange membrane (PEMs) or alkaline. PEMs are more responsive but higher cost thanks to the use of expensive catalysts. Alkaline electrolyzers are cheaper. While they are less responsive they are still viable for most applications even when matched with variable output renewable generation.

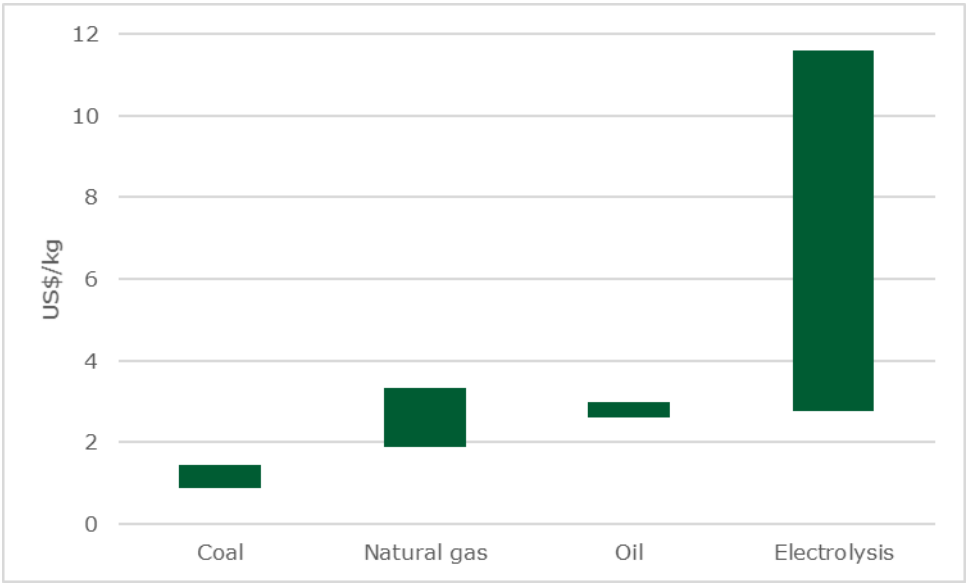
Alkaline electrolyser technology is well proven with large scale alkaline units being operated since the 1920's. Driven by demand for hydrogen for ammonia production, many projects were completed with output in the 2-3 ton per hour (50 –70tpd) range. However these were rendered uneconomic by steam methane reforming as plentiful natural gas became available.

The Levelised cost of hydrogen from electrolyser technology is clearly dependent on the cost of the electricity. There is a lot of interest in using otherwise wasted electricity from renewable generators at times of over supply or when the generators are otherwise curtailed. However, while this results in free electricity, utilisation of the electrolyser is limited to those times when the generator is being curtailed. This reduces the number of hours in a year over which the fixed costs of the electrolyser can be amortised. The alternative is to pay for the power which changes the economics.

“Surplus’ low-carbon power is limited. While there is some opportunity to utilise some ‘surplus’ electricity (e.g. from renewables generating at times of low demand) for hydrogen production, our modelling shows that the quantity is likely to be small in comparison to the potential scale of hydrogen demand. Producing hydrogen in bulk from electrolysis would be much more expensive and would entail extremely challenging build rates for zero-carbon electricity generation capacity” CCC

Bloomberg New Energy Finance has published calculations of Levelised costs of hydrogen for different electrolyser types and utilisations.

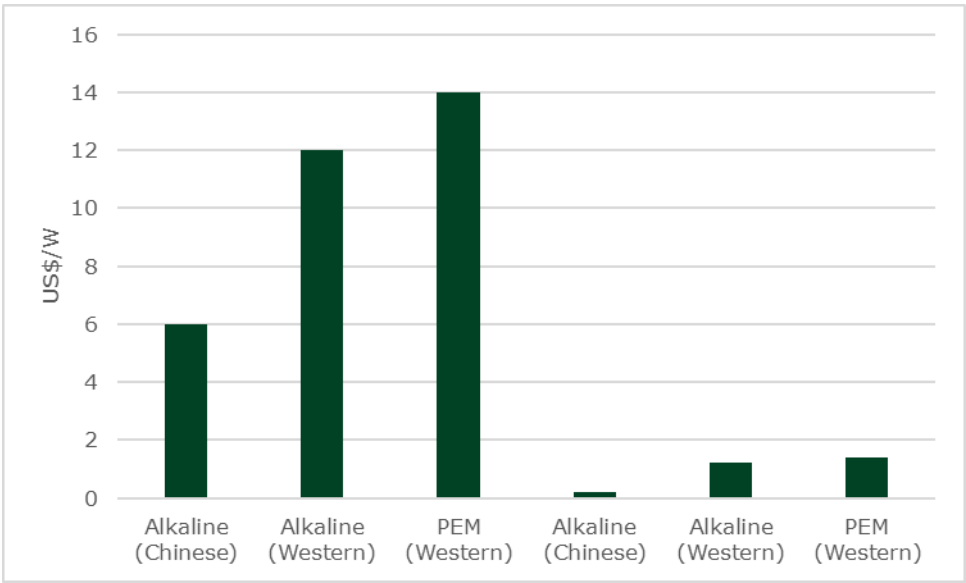
Levelised cost of hydrogen 2019



Source: BNEF

These estimates assume large scale project benefiting from economies of scale. BNEF also estimates the capital costs of smaller scale projects in the 50kW range and these are an order of magnitude larger.

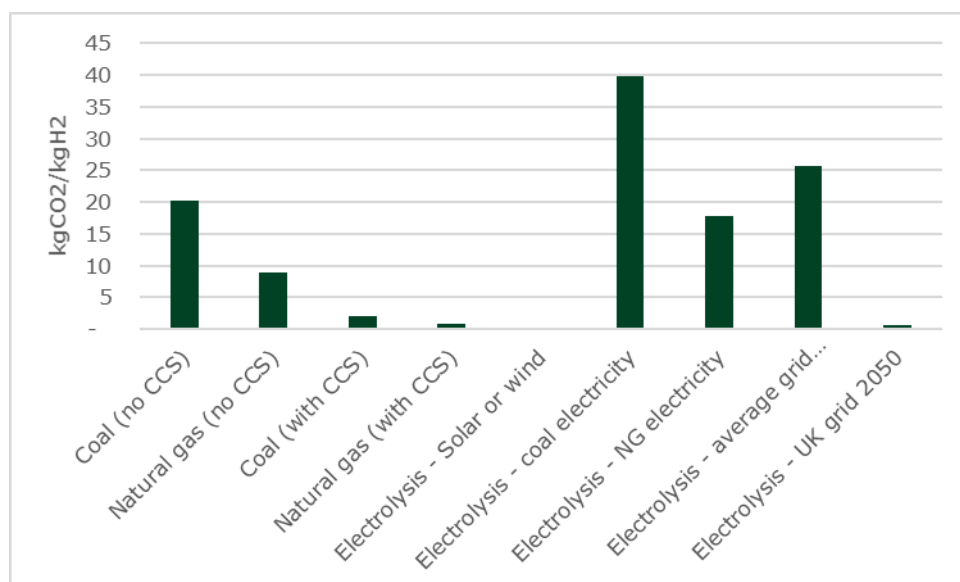
Capital cost of hydrogen – small scale units against large scale



Source: BNEF

SMR is clearly the most economic method of producing hydrogen. However, it is a major source of greenhouse gas emissions. Even electrolysis represents emissions if the electricity is from fossil fuel sources although as we move to net zero this will disappear. As a result the key pathway for low carbon hydrogen production is either electrolysis or SMR combined with carbon capture and storage to minimise the emissions problem. Adding the likely cost of CCS increases the cost of SMR.

CO2 emissions from hydrogen production

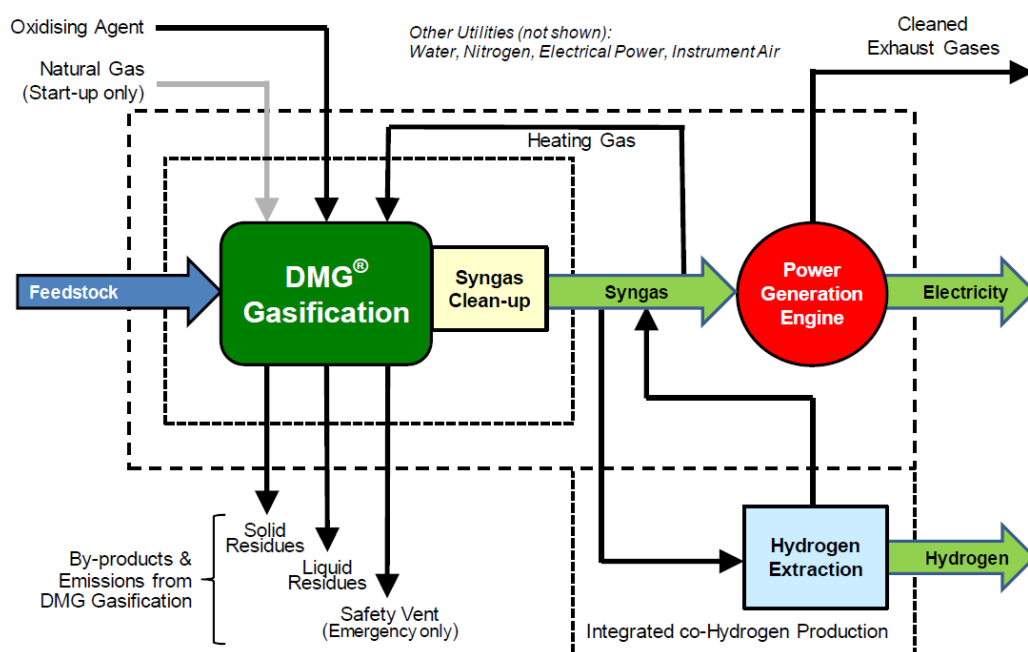


Source: BNEF

THE POWERHOUSE PROCESS IN DETAIL

Powerhouse uses high temperature gasification of plastic waste to produce syngas, a mixture primarily of carbon monoxide (CO) and hydrogen (H₂). After a gas clean up stage a proportion of the syngas is fed to an extraction unit using proven pressure swing adsorption technology to separate out the hydrogen. The remaining syngas is used for power generation in reciprocating gas engines.

DMG Process Outline



Source: Company Data

Inputs and outputs

Most waste streams will be pre-sorted into plastic waste with other waste removed for recycling or other disposal. The plastic waste will be sourced from municipal solid waste as well as waste collected from commercial and industrial properties.

Natural gas is used to start the process and an oxidising agent is added. There are some solid and liquid residues which go for disposal. The process produces syngas and hydrogen. The hydrogen is 99.999% pure and does not contain any trace materials that might poison a fuel cell.

The generic system is sized to process 35 tonnes of waste per day and if optimised for hydrogen will produce 2 tonnes of the gas per day and 4MW of power. The system is deliberately modular, with larger capacity provided simply by providing more units. Some balance of plant saving is possible with larger units.

Off the shelf components

Most of the process uses standard, proven technology. The critical element is the rotary kiln. This makes use of a specialist steel alloy that allows for the high temperature production. Additionally Powerhouse has developed control technology that is critical to making the process work.

The equipment will be manufactured and fabricated by standard equipment manufacturers and the company has a relationship with a UK fabricator who can deliver at least three units per annum sufficient to establish the initial roll out. Beyond this the company is investigating production in a number of lower cost geographies. Lead time to establish production with a new international supplier could be as short as four months thanks to the use of standard parts.

The DMG technology has been certified by quality assurer DNV GL under their Technology Qualification (TQ) methodology. Essentially DNV GL has given an assurance that the DMG technology is feasible for its designated use. While some further failure risk assessment may be undertaken, it shows that the technology is at a well developed stage which we would put at Technological Readiness Level (TRL) 8.

TRL AND CRI

Powerhouse has run its demonstration unit for two years. The modular nature of this means that it is effectively a full scale unit. As such we would put this at TRL 8 and moving to TRL 9 with the Protos deployment. We also look at the Commercial Readiness Index (CRI) created by the Australian Renewable Energy Agency (ARENA). This looks beyond TRLs to examine how developed a technology is commercially. It uses eight indicators to derive a rating from one to six which broadly represents the commercial lifecycle of a technology. We show how Powerhouse rates against these indicators below.

Commercial readiness level

	<i>1. Hypothetical commercial proposition</i>	<i>2. Commercial trial</i>	<i>3. Commercial scale up</i>	<i>4. Multiple commercial applications</i>	<i>5. Market competition driving widespread deployment</i>	<i>6. Bankable grade asset class</i>
Overall		*				
Regulatory Environment			*			
Stakeholder Acceptance		*				
Technical Performance		*				
Financial Proposition – Costs		*				
Financial Proposition – Revenue		*				
Industry Supply Chain and Skills			*			
Market Opportunities			*			
Company Maturity			*			

Source: Longspur Research based on ARENA

We see Powerhouse currently at stage 2 with a commercial trial but, as the deal with Peel Holdings evolves, it should move quite quickly to stage 3. In other words we think the move to a fully commercial offering is quite tangible for Powerhouse.

THE MIXED HISTORY OF GASIFICATION

A number of gasification technologies exist reflecting a degree of immaturity in the market although there is now a subset which have delivered reasonable operating lives under commercial conditions.

Gasification projects in the UK

Site	Size (MWe)	Gasifier	Status
Ince Bio-power	26.5	Outotec fluidised-bed	Operational
Birmingham Bio-power	10.3	Nexterra	Operational
Welland Bio-power	10.6	Nexterra	Operational
Dartmoor Bio-power	4.3	Nexterra	Operational
EMR Oldbury	10.0	Chinook Science RODECS	Uncertain
Glasgow RREC	10.0	Energos	Uncertain
AmeyCespa MK	7.0	Energos	Uncertain
Full Circle Energy Facility	15.0	Biomass power step-grate	Operational
Energy Works Hull	24.0	Outotec fluidised-bed	Operational
Swindon Energy	2.0 (x3)	Refgas fixed-bed	Under construction
Derby RRC	7.5	Energos	Under construction
Advanced Biofuels Solutions	3.5	Plasma gasification	Under construction
Charlton Lane Eco-park	ND	Outotec fluidised-bed	Under construction
Hooton Bio-power	24.0	Kobelco Fluidised Bed	Under construction
Hoddesdon ATT	10.0	Biomass Power Step-Grate	Commissioning
Levensat EfW	12.5	Outotec fluidised-bed	Commissioning
ETI/KEW Technologies	1.5	Frontline gasifier	Demonstration
Syngas Products Ltd	1.0	Pyrolysis	Demonstration
BAEF Riverside	80.0	Potentially Outotec	Under consultation
Altalto, Immington	-	APP gasifier with FT	Planning received
GoGreen Gas, Swindon	0.05	Plasma gasification	Pilot plant
Progressive Energy/Peel	35.0	Proprietary	Planning received

Source: Supergen Bioenergy

GASIFICATION ISSUES

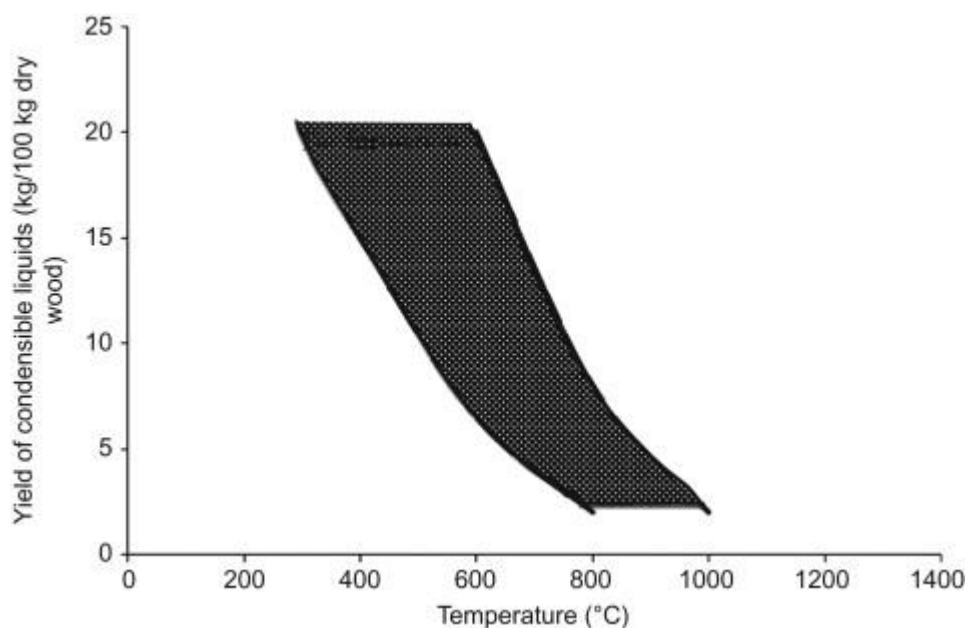
Gasification of carbon feedstock to produce syngas is not a new technology but has had a difficult history with many projects having failed or been cancelled. Quite a few of these failures were due to factors not connected with the technology itself, with failure to secure reliable volumes of feedstock being a common issue. However, two key issues have been identified as creating problems for gasification, tar and scale up.

Tar

Tar is a complex mixture of hydrocarbons containing a wide range of aromatic substances including benzene, toluene and xylene (BTX) as well as polyaromatic substances. Many of these substances are carcinogenic. Tars generated by gasifiers of waste feedstock with plastic content may be notably high. BTX and tars can be present in between 1% and 10% of gas exiting the gasifier. Tars cool to form a liquid or semisolid substance that fouls the system.

Tar has been one of the major issues leading to gasifier project failures although it can be managed and minimised by process design and generally the higher the temperature of gasification the less tar is an issue although this has to be balanced against slag formation at higher temperatures.

Tar Yield by Temperature



Source: Baker, Brown, Elliott, Mudge, AIChE 1988 Summer National Meeting, Denver, CO.

Scale up

Perhaps one of the most high profile gasification failures in the UK was the Air Products project in Tees Valley. While little is officially known about the reasons for the decision by Air Products to write off this £1bn project, there appears to have been a number of factors including erosion of the gasifier walls and failure of the mechanical handling systems. But more importantly the scale up of the system from a 10ktpa demonstrator to a 350kt project was well ahead of a normal experience recommendation of a 10x scale up factor. Other projects with less dramatic scale changes have still found this to be an issue.

WHY PHE HAS FIXED THE KEY ISSUES

The Powerhouse process operates at a higher temperature than most gasification processes and makes use of a rotary kiln rather than static vessel. These features mean that tar is not produced removing one of the key issues with gasification.

Because the system has been designed in a modular fashion there is no scale up to produce larger capacity systems. It is simply a case of adding more modules. This eliminates the other main issue in gasification.

MOVING DOWN THE LEARNING CURVE

Powerhouse has identified immediate cost savings available in its second generation systems. Beyond this there are other gains to be made. Aside from the obvious benefits of greater volume on order sizes and negotiating power, the company has identified savings potential in the materials used in the kiln. At present the high temperature and potentially corrosive nature of the waste means an expensive steel is used. Powerhouse has already identified lower cost materials that can safely be used resulting in a much lower overall project cost. This together with higher volumes should allow a 40% saving in capex and opex.

LICENCING MODEL REDUCES CAPITAL NEEDS

Powerhouse has developed its business model from its agreement with Peel into a model that can be replicated internationally.

The model is quite similar to the licencing model used successfully by a number of other clean tech players including Ceres Power, Ilika and Velocys.

The core business is licencing the DMG technology to developers. The agreement with Peel provides for an annual fee of £500,000 per DMG unit.

Powerhouse will also enter into exclusivity agreements similar to the one with Peel. Peel are to pay a one-off £500,000 fee to Powerhouse for exclusive use of the technology in the UK over and above the licence fee. Powerhouse expects to enter into similar agreements with developers internationally and is currently in discussions in Thailand, Japan and Australia.

The company will also deliver engineering services during the development and construction stages of projects and will charge a fee and make a margin on doing so. It will also offer ongoing operations and maintenance services again for a fee and margin.

A typical project should deliver revenues from engineering fees in the first year accounting to c.£300,000. Then a licence fee of £500,000 per annum should be payable over the life of the project.

As it grows, Powerhouse will see early revenues as projects are developed but will also benefit from annuity like income streams over the life of each project.

MARKETING AND ROUTES TO MARKET

THE PEEL RELATIONSHIP

Powerhouse has been working with Peel Environmental for some time, initially on the development of the first commercial site at Peel's Protos Energy Park in Cheshire. The relationship has expanded so that now Peel has an option to gain exclusive development rights in the UK for the DMG technology with waste feedstock. The option is subject to the successful acquisition by Powerhouse of developer Waste2tricity, current holder of UK development rights for the technology.

Peel Environmental is part of the privately owned Peel Group, one of the leading infrastructure, transport and real estate investors in the UK, with collective investments owned and under management of more than £5 billion.

Powerhouse and Peel originally agreed to develop the first commercial unit at Peel's Protos Energy park in Cheshire. This is planned as a full scale unit taking 35 tonnes of waste per day and generating 4MW of electricity and 2 tonnes per day of hydrogen.

Peel then signed a collaboration contract to develop ten further sites and has now followed this up with the full UK development rights. Essentially Powerhouse has found a partner to do the heavy lifting of development while allowing it to focus on and maximise the value of its technology.

Peel have identified an initial pipeline of 30 sites at various stages of development as part of a total of 77 potential sites in the UK. As a real estate developer it already has land and sites that can take Powerhouse projects.

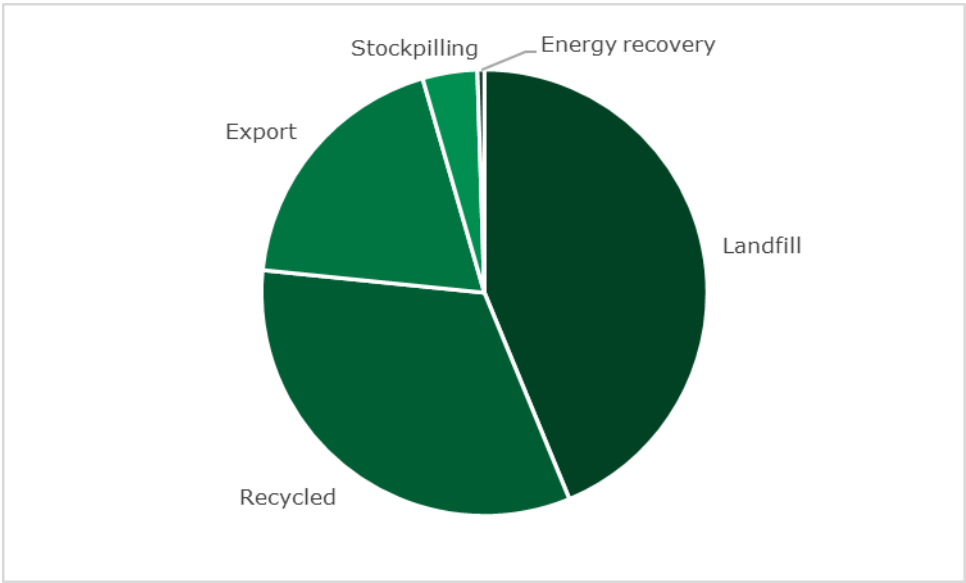
REPLICATING THE MODEL

Powerhouse has only given exclusive rights to Peel for the processing of municipal solid waste to hydrogen in the UK. Other opportunities abound both in other geographies but also with other feedstocks or outputs.

Powerhouse is already in discussions with counterparties in Thailand, Australia and Japan. The company has received a letter of support from the Japanese Ministry of Economy Trade and Industry (METI). METI’s letter states that it views the technology as a major competitor in the the low-cost production of hydrogen. In all these countries recycling is undertaken but other less environmentally sound solutions remain a major route for waste.

Australia recycles 33% of its waste with 44% going to landfill. As much as 15Mt could be available as a market for Powerhouse Energy.

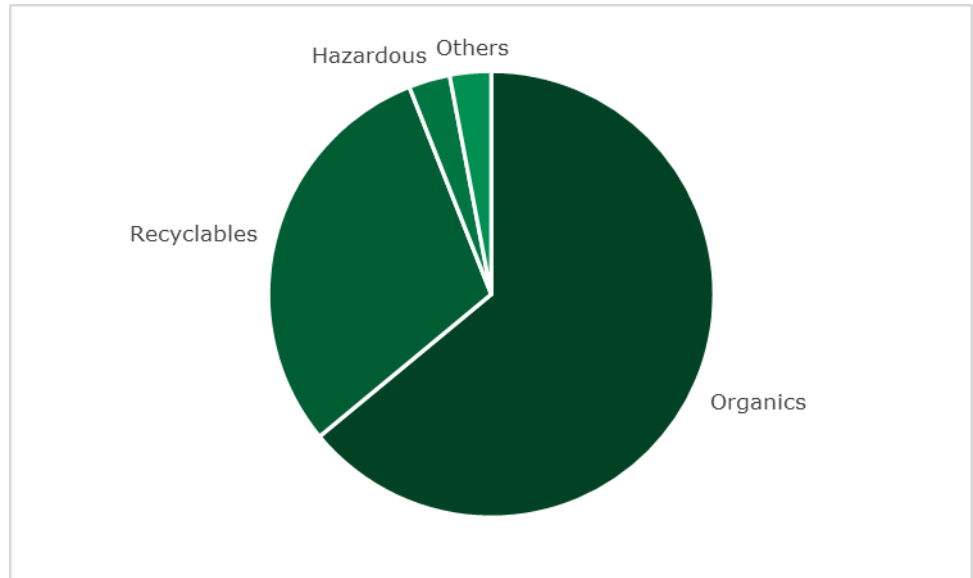
Australia Waste Composition



Source: University of Technology Sydney

Thailand recycles just 30% of its 4.3Mt of annual waste. We estimate that 2.3Mt of the remaining waste would be suitable for the DMG process.

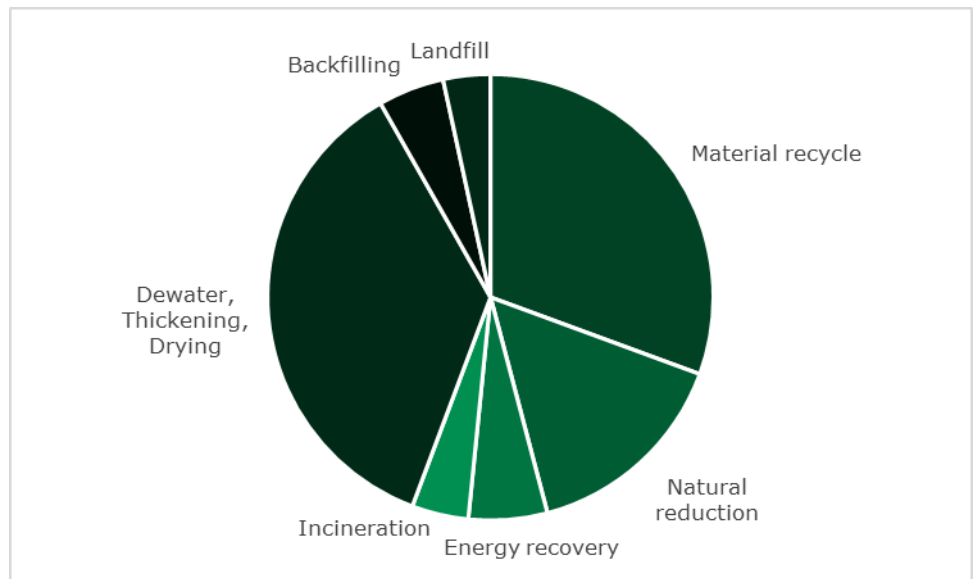
Thailand Waste Composition



Source: Ministry of Natural Resources and Environment, Thailand

Japan has a high recycling rate of 46% and landfill accounts for less than 4%. Energy recovery is already strong, taking 6% of all waste. However with a high level of overall waste at 437Mt per annum, we think Powerhouse could still find a market of c.3mt.

Japan Waste Composition



Source: Nippon Institute of Technology

THE CUSTOMER PROPOSITION

The appeal to a project developer is based on high potential returns from a combination of three revenue streams.

- Gate fee for accepting waste
- Power sales
- Hydrogen sales

GATE FEES

For waste to energy projects, a key element of revenue is received from fees for accepting waste for disposal, known as gate fees. For Powerhouse projects, the inputs are waste with an end-of-waste status and as such will attract a gate fee from waste providers looking to avoid paying landfill tax. In the UK the government has set landfill tax rates at £91.35/t for 2019/20 rising to £94.15/t in 2020/21. The landfill tax is avoided by paying gate fees and these will vary according to the eventual waste treatment. For Powerhouse projects we expect gate fees to follow those seen for other energy from waste (“EfW”) projects.

UK NGO Wrap publishes an annual survey of UK gate fees. This shows the median 2018/19 gate fee for EfW at £89/t, up from £86/t in 2017. Newer projects see higher fees with a median figure of £93/t and we think Powerhouse can achieve this.

EfW Gate Fees Reported by Local Authorities

Treatment	Materials / Type of Facility / Grade	Median	Mode	Range	No of gate fees reported
MRF	All contracts (all wastes)	£25	£5 to £10	-£41 to £97	91
	Contracts beginning in 2018	£35	£35 to £40	-£3 to £60	18
In-Vessel Composting (IVC)	Mixed food & green	£50	£50 to £55	£28 to £67	28
Mixed food & green	All feedstock types	£46	£55 to £60	£10 to £73	52
Anaerobic Digestion (AD)	All gate fees	£27	£15 to £20	-£5 to £68	62
All gate fees	UK (contracts started between 2016 - 2018)	£19	£0 to £5	-£5 to £50	18
Energy from Waste (EfW)	All	£89	£85 to £90	£44 to £125	68
	Pre-2000 facilities	£65	£65 to £70	£44 to £89	20
	Post-2000 facilities	£93	£85 to £90	£50 to £121	45
Landfill	Non-hazardous waste including landfill tax	£113	£114 to £119	£91 to £176	76
	Non-hazardous waste excluding landfill tax	£24	£25 to £30	£2 to £87	76

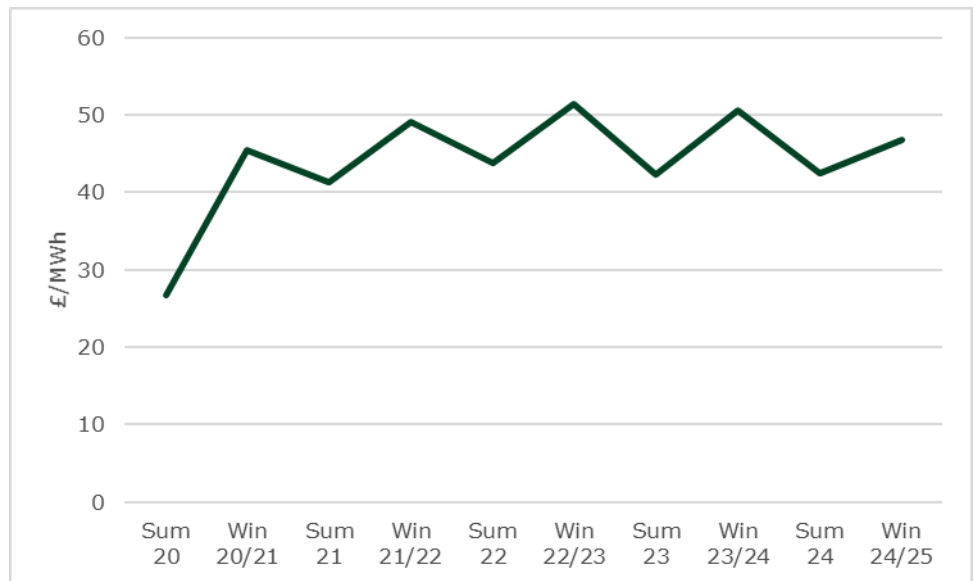
Source: WRAP Gate Fees 2018/19 Report

As a result, we expect Powerhouse projects to receive gate fees in line with the median for post 2000 projects of £93/t.

POWER PRICES

UK baseload prices are extremely low as a result of the impact of the coronavirus lockdown on demand. This is temporary and the forward curve suggests at least one view of recovery with season ahead prices averaging over £40/MWh. We think this is a reasonable number to use in assessing the economics of projects.

UK Power Price Forward Curve (3 July 2020)



Source: Bloomberg

In the longer run some forecasts show lower baseload prices as a result of price cannibalisation of low marginal cost renewable energy. However, peakload prices are likely to firm. The flexibility of the gas engines used by Powerhouse Energy means that the company should be able to take advantage of these prices. It may also be able to participate in the capacity market as well as the wholesale market and we think this will keep average prices at least in line with the current forward curve.

HYDROGEN SALES

Current hydrogen refuelling stations charge between US\$6/kg and US\$11/kg with an average of US\$10.4/kg.

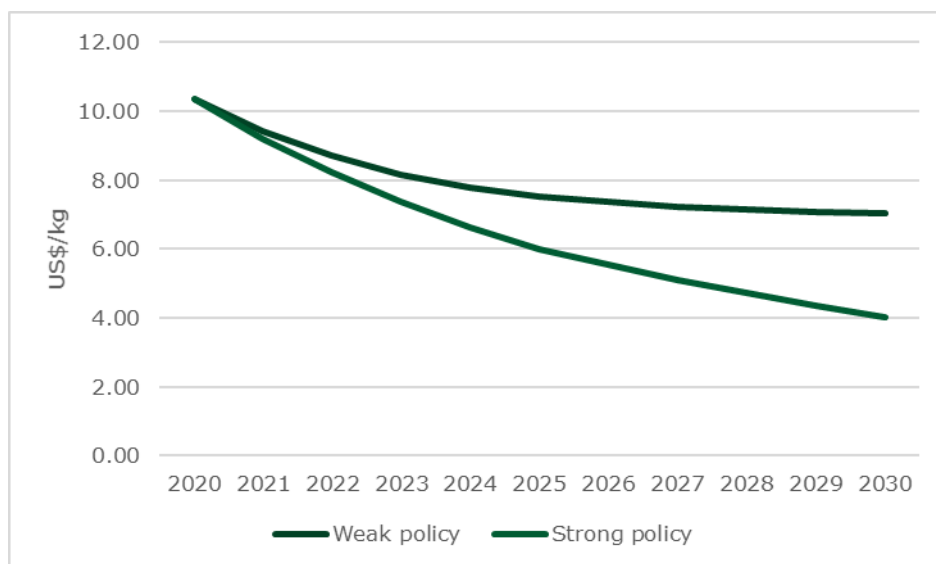
Hydrogen refuelling pump prices

Region	Average pump price (\$/kg)
California	14
China	6
Germany	15
Japan	10
Korea	7
Average	10.4

Source: BNEF

The range is dependent on a number of factors including the sources of the hydrogen and transportation costs. BNEF forecasts that average prices will fall from US\$10.4/kg to US\$4.0/kg by 2030 assuming strong policies in favour of hydrogen. For evaluation purposes a current price of US\$8/kg is conservative in our view when looking at early stage projects reflecting current pricing and immaturity of the market.

Average Hydrogen Pump Price



Source: BNEF

PUTTING IT TOGETHER

We have created a simple single period model to evaluate the proposition from the customers point of view. Using a gate fee of £65/t, electricity price of £40/MWh and a hydrogen price of £8/t we can deliver a simple 12% IRR on a first of a kind (FOAK) project. Powerhouse has already mapped out cost savings as it moves from the first deployment to multiple sites and should reduce both capital costs and opex by 40%. This gives an even better outcome from the customers point of view shown as NOAK long term below.

Single period model of a DMG

	FOAK	NOAK	NOAK Long Term
Rated power capacity (MW)	4	4	4
Hydrogen capacity (tpd)	2	2	2
Feedstock required (tpd)	35	35	35
Efficiency	35%	35%	35%
Parasitic load	32%	32%	32%
H2 energy loss (MW)	0.97	0.97	0.97
H2 calorific value	120	120	120
H2 output (tpa)	667	667	667
Power output (MWh)	13,870	13,870	13,870
Waste input (tpa)	11,667	11,667	11,667
Plant life	25	25	25
Tax	19%	19%	19%
Availability	91.3%	91.3%	91.3%
Capital cost	22,389,610	16,826,000	10,095,600
Power (£/MWh)	40.00	40.00	40.00
Gate fee (£/t)	65.00	65.00	65.00
Hydrogen (£/t)	8.00	8.00	5.00
Power	554,809	554,809	554,809
Gate fee	758,333	758,333	758,333
Hydrogen	5,333,333	5,333,333	3,333,333
Total revenue	6,646,476	6,646,476	4,646,476
Depreciation pa	895,584	673,040	403,824
Opex	2,020,451	2,020,451	1,212,270
Licence fee	500,000	500,000	500,000
Total cost	3,416,035	3,193,491	2,116,094
P&L (£)			
Revenue	6,646,476	6,646,476	4,646,476
EBITDA	4,126,025	4,126,025	2,934,205
EBIT	3,230,441	3,452,985	2,530,381
Interest	0	0	0
PBT	3,230,441	3,452,985	2,530,381
Tax	613,784	656,067	480,772
Cashflow to equity	3,512,241	3,469,958	2,453,433
IRR	12%	15%	17%

Source: Longpur Research

POWERHOUSE AGAINST THE COMPETITION

With the cost of hydrogen relative to that produced by rival electrolysis a key consideration, we have also configured our model to produce a Levelised cost of hydrogen assuming a 10% project hurdle return. This gives £6.1/kg (US\$7.7/kg) for the first of a kind (FOAK) project and £5.0/kg (US\$6.3/kg) for the nth of a kind (NOAK). Both are well below the current average price of hydrogen. The NOAK is a near term figure for a commercial unit and beyond this we would expect further cost reductions with volume and also as a result of potential material substitution in the kiln. We estimate that the price could be brought down as low as £2.5/kg (US\$3.2/kg) over time.

Levelised cost of hydrogen calculation (£/kg)

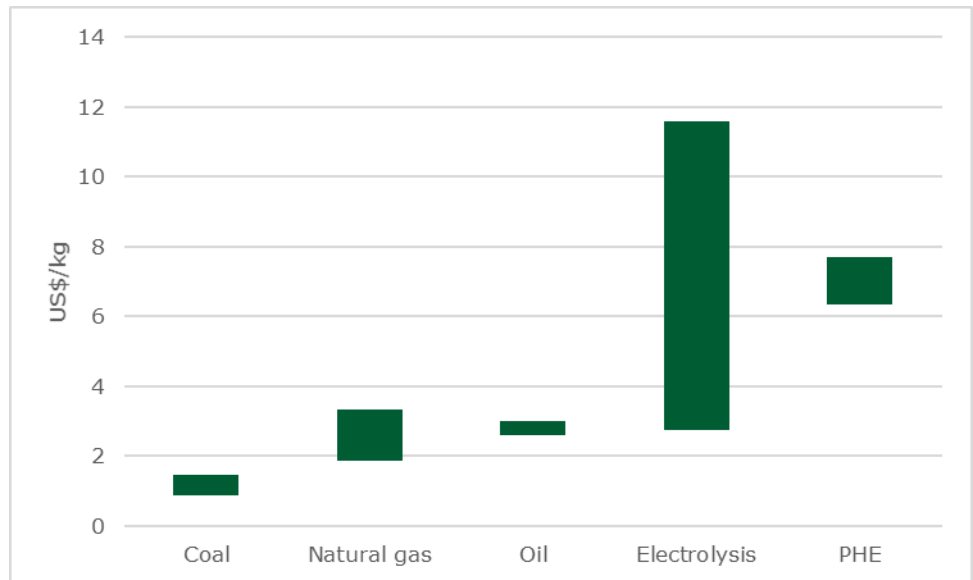
	FOAK	NOAK	NOAK Long Term
Life (years)	25	25	25
Availability	91.3%	91.3%	91.3%
CoE	10.0%	10.0%	10.0%
CoD	7.0%	7.0%	7.0%
Gearing	0.0%	0.0%	0.0%
Effective tax rate	19.0%	19.0%	19.0%
WACC	10.0%	10.0%	10.0%
Capital Recovery Factor	0.1102	0.1102	0.1102
Capacity (tpd)	2.0	2.0	2.0
Output (tonnes)	666.7	666.7	666.7
Capital cost (£)	22,389,610	16,826,000	10,095,600
Costs per kg of H2			
Capital cost	3.70	2.78	1.67
Operating cost	3.03	3.03	1.82
Licence fee	0.75	0.75	0.75
Tax	0.55	0.42	0.25
Power income	-0.83	-0.83	-0.83
Gate fee	-1.14	-1.14	-1.14
Levelised cost of H2 per kg	6.06	5.01	2.52
LCoH US\$/kg	7.68	6.34	3.19

Source: Longspur Research

COMPARISON WITH OTHER TECHNOLOGIES

We have already shown the BNEF estimates for the current cost of comparable scale hydrogen electrolysis. The Powerhouse solution is already competitive with low carbon electrolysis.

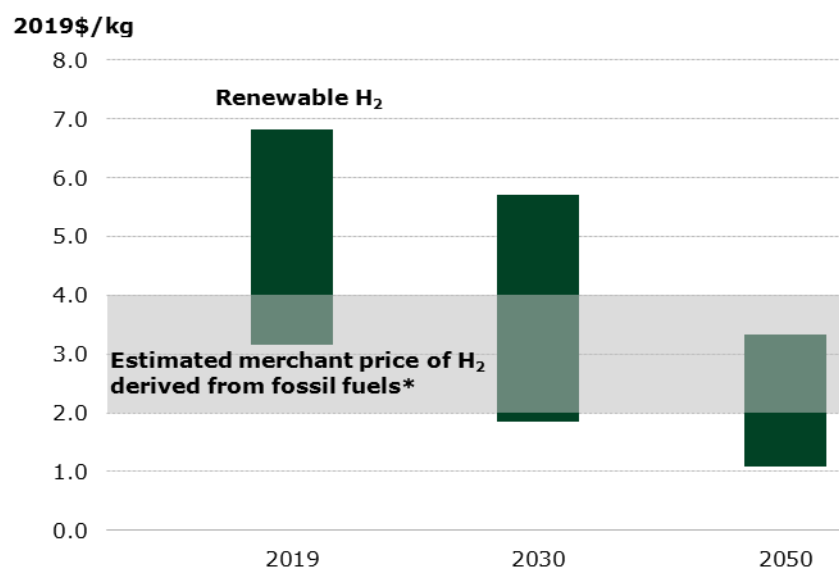
Levelised cost of hydrogen today



Source: BNEF

Looking forward BNEF forecasts costs to fall so that by 2030 electrolyzers can deliver hydrogen in the range \$1.9/kg to \$5.7/kg. At US\$3.2/kg, Powerhouse sits comfortably within this range. Further out BNEF thinks that volume gains can bring costs down to \$1.1/kg to \$3.3/kg by 2050. There is no reason for thinking that Powerhouse cannot see similar volume gains and remain competitive across this period.

Small scale levelised cost of Hydrogen



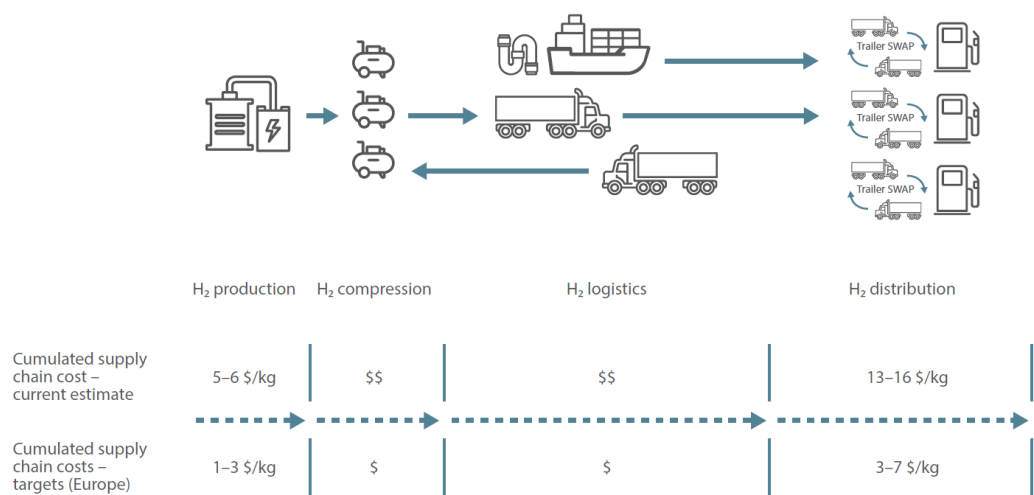
Source: BNEF

THE DISTRIBUTED ADVANTAGE

The DMG product is a modular system which allows deployment at sources of demand. The work with Peel is targeting sites which are convenient for both the delivery of waste and are good locations for charging. This eliminates the cost of bringing hydrogen to the charging point. While some electrolyser solutions also offer this advantage, it does give the Powerhouse solution an advantage over the bulk of hydrogen production.

The cost of delivering hydrogen is \$18/kg to \$22/kg in total including compression, transport and storage. Hydrogen systems at the point of use will still require some compression and storage but we estimate an overall cost benefit of at least \$1/kg.

Hydrogen delivery costs



Source: IRENA

In summary Powerhouse can produce low carbon hydrogen competitively and continue to do so even as other technology becomes more competitive.

IS THERE ENOUGH WASTE?

For the Protos project and any subsequent projects the model is reliant on there being enough waste to process. A number of recent reports into the UK waste market show that there should be little risk in sourcing sufficient waste to fuel the project.

The Environmental Services Association commissioned an independent review of third party reports and analysed these. They concluded that by 2030 there would be a residual waste tonnage (the excess of waste over waste treatment) in every scenario bar one. The only case in which there is no residual waste available assumes a very high rate of recycling, well ahead of the UK government's circular economy target.

The review was conducted by Tolvik Consulting and analysed six reports dated May 2017 to September 2017. It also considered work from five earlier reports. Tolvik used a tonnage model to develop five scenarios based on different assumptions about the level of recycling achieved in the UK.

2030 Recycling Rates and Residual Waste

Treatment	Materials / Type of Facility / Grade	Median	Mode	Range	No of gate fees reported
MRF	All contracts (all wastes)	£25	£5 to £10	-£41 to £97	91
	Contracts beginning in 2018	£35	£35 to £40	-£3 to £60	18
In-Vessel Composting (IVC)	Mixed food & green	£50	£50 to £55	£28 to £67	28
Mixed food & green	All feedstock types	£46	£55 to £60	£10 to £73	52
Anaerobic Digestion (AD)	All gate fees	£27	£15 to £20	-£5 to £68	62
All gate fees	UK (contracts started between 2016 - 2018)	£19	£0 to £5	-£5 to £50	18
Energy from Waste (EfW)	All	£89	£85 to £90	£44 to £125	68
	Pre-2000 facilities	£65	£65 to £70	£44 to £89	20
	Post-2000 facilities	£93	£85 to £90	£50 to £121	45
Landfill	Non-hazardous waste including landfill tax	£113	£114 to £119	£91 to £176	76
	Non-hazardous waste excluding landfill tax	£24	£25 to £30	£2 to £87	76

Source: WRAP Gate Fees 2018/19 Report

They then analysed the likely waste treatment capacity covering energy from waste ("EfW"), micro biological treatment ("MBT"), industrial emissions directive ("IED") biomass incineration and co-incineration. This gives a total of 16.6Mt currently operational or in construction and a further 2.2Mt likely before 2022. Export routes for waste have been limited by China's move in January 2018 to enforce a ban on the import of 24 specific grades of waste including mixed paper and plastics. However some RDF export is likely to continue notably to Europe. The review assumes 2.5mt.

2030 Residual Waste Capacity Gap

Treatment	Materials / Type of Facility / Grade	Median	Mode	Range	No of gate fees reported
MRF	All contracts (all wastes)	£25	£5 to £10	-£41 to £97	91
	Contracts beginning in 2018	£35	£35 to £40	-£3 to £60	18
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	Non-hazardous waste excluding landfill tax	£24	£25 to £30	£2 to £87	76

Source: WRAP Gate Fees 2018/19 Report

The difference between the residual waste figure and the residual waste treatment capacity is untreated waste which would be available for Powerhouse projects. This ranges from - 3.8Mt to 8.5Mt with a mean of 2.8Mt and a median of 3.5Mt. The low case is an extreme one and more recent work from E4Tech suggests that the high end of the range may be more likely with a figure of 7.3Mt after removing competing uses. In Europe, CEWEP analysis based on the latest Eurostat figures estimates that 88Mt are available overall.

A single Powerhouse project is expected to consume just under 12,000t per annum. This suggests a capacity in the UK for between 240 and 730 projects and 7,500 projects in Europe as a whole. As existing incinerators reach the end of their lives, gasification may become a preferred route for waste, increasing the size of this opportunity.

These conclusions are backed up by a study the company has undertaken for the initial site at Protos. This shows 1.4Mt of plastic waste available in the catchment area of the Protos project today.

FINANCIALS

EARNINGS ESTIMATES

We have forecast earnings using a number of scenarios with a base case that assumes the 77 wider list of Peel sites are developed over time. We are not necessarily assuming that these will all be Peel sites but we think this gives a reasonable view of the scope of development potential.

We assume the first project sale for the Protos Energy Park is completed in 2020 with a second project sold in 2021. Growth thereafter follows a logistic function and we use the Bass Diffusion model to drive this. This sees unit sales grow from a single unit in 2020 to 13 units a year by 2030 at which point a total of 77 units will have been sold in line with the Peel target above.

On the base case the sales are sufficient to move the company into profitability by 2022. The capital light model means a gross margin approaching 50% so that an operating margin of 25% is possible in that year. Accumulated tax losses should mean that the company will not pay any meaningful tax until 2025. Earnings growth out to 2030 should be strong with a CAGR of over 50%.

Earnings Estimates to 2025 in base case

£'000	2020e	2021e	2022e	2023e	2024e	2025e
Projects ordered	1	2	2	3	5	6
Engineering revenue	89	1,075	1,031	1,489	2,117	2,941
Build stage sales	260	2,530	2,426	3,504	4,980	6,921
Licence revenue	0	145	1,445	2,724	4,588	7,255
Total revenue	1,049	3,900	4,902	7,717	11,685	17,118
Gross profit	722	1,543	2,425	4,031	6,323	9,517
Gross margin	69%	40%	49%	52%	54%	56%
Overheads	700	1,000	1,300	1,690	2,197	2,527
Exceptionals	900	700	30	0	0	0
Operating profit	-878	-157	1,095	2,341	4,126	6,991

Source: Longspur Research

BALANCE SHEET

The company has husbanded its resources well and remained solvent by slimming down its operations and paying external fees in shares. It is now at a point when it can begin to expand. We forecast that the company will need to raise additional capital and we have included a £3m fund raising a 3p per share in our forecasts. On our growth assumptions, combined with reasonable working capital needs, this should be sufficient to get the company to cash breakeven thanks to the capital lite model. Personnel can grow organically with only a small additional resource. Growth thereafter is capable of being self financing although rapid overseas development or product development beyond that planned could see additional spend.

VALUATION

There is a healthy comparator group of companies in the hydrogen space including a number of electrolyser companies. Hydrogen remains a new technology and most of these companies are loss making 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 and merely use multiples as a sense check.

We use a nominal risk free rate of 3.5% and an equity market premium of 7.5%, based on recent UK Competition and Markets Authority and UK Regulated Industry cost of capital considerations. We have used a beta of 1.0. With minimum existing debt, this gives us an overall WACC of 11%.

Weighted Average Cost of Capital Assumptions

Risk free rate	3.5%
Market premium	7.5%
Loan margin	6.8%
Marginal tax rate	19.0%
After tax cost of debt	4.3%
Debt/total capital	-40.5%
Beta	1.0
Cost of equity	11.0%
Weighted cost of capital	11.0%

Source: Longspur Research

We have forecast cashflows to 2030 based on our discussion under earnings outlook above. We then calculate a terminal value in 2030 based on Gordon's growth model and assuming that long term cashflows are flat (deteriorate by 2.5% in real terms) to reflect long term margin erosion with market maturity. The terminal EV/EBITDA on this basis is 7.4x which we do not see as onerous.

Discounted Cashflow Valuation

£'000	2020e	2021e	2022e	2023e	2024e	2025e
Operating cash inflow	-1,861	-1,093	765	1,416	2,822	4,701
Cash from associates	0	0	0	0	0	0
Tax paid	196	0	0	0	0	0
Interest tax shield	0	0	0	0	0	0
Capex & investments	0	0	0	0	0	0
Free cashflow	-1,666	-1,093	765	1,416	2,822	4,701
Terminal growth	1.5%					
Terminal valuation	328,272					
Terminal EV/EBITDA	8.6					
Implied enterprise value	127,052					
Implied market cap.	130,892					
Implied share price	6.0					

Source: Longspur Research, Valuation based on projections to 2030e

This gives a base case valuation of 6.0p per share.

SCENARIOS

We have also considered scenarios that assumed greater international traction is gained. Our mid case scenario assumes the growth as the base scenario and adds a 5% market share gain based on available waste in Australia, Japan and Thailand but with a two year lag before these additional sales commence. We then add a further scenario that assumes the same market share of waste in Europe with a further two year lag. These three scenarios are summarised below.

Table of Unit Sales

Market	Waste (mt)	Market share	Units	Cum. valuation (p)
UK waste	7.3	19%	116	6.0
Australia and Japan	20	5%	87	9.0
European waste	88	5%	377	15.3

Source: Longspur Research

These would increase the DCF to 9.0p and 15.3p respectively.

Of course the company may find it cannot gain traction, and despite the positive announcements, the Peel deal stalls for some reason. In such a situation we think the company has sufficient re-saleable assets including IP to see the NAV as a low point. At 0.1p this does not offer much comfort but there has been so much recent progress that we see this as a less likely outcome.

The comparator group is shown below.

Powerhouse Comparator Group

	EV/sales historic	EV/sales prospective
<i>Fuel Cell Companies</i>		
Ceres Power Holdings Plc	45.0	36.5
AFC Energy Plc	na	na
Ballard Power Systems Inc	33.6	25.7
Fuelcell Energy Inc	11.4	9.1
Bloom Energy Corp- A	2.4	1.8
Powercell Sweden Ab	149.0	72.5
Plug Power Inc	11.7	8.9
<i>Electrolyser Companies</i>		
ITM Power Plc	328.1	81.5
McPhy Energy Sa	19.4	10.7
NEL ASA	38.4	24.7
Mean	71.0	30.1
Median	33.6	24.7
Max	328.1	81.5
Min	2.4	1.8

Source: Longspur Research

Prospective EV/sales for this group ranges from 1.8x to 81.5x with a median of 24.7x. There have also been some corporate stake building transactions including Linde for ITM, EdF for McPhy, Waichia for Ballard and Ceres, and Bosche for Ceres. However, these have all been undertaken and referenced to prevailing share prices rather than target valuations so do not inform significantly in our view. However, the all out acquisition of Hydrogenics by Cummins is more instructive. That delivered an EV/sales multiple of 8x, well below the current median of the group but within the range.

Based on our forecasts and target price, Powerhouse would show an EV/Sales figure of 14.7x in FY 23 when it moves beyond the initial unit sales. This drops to 9.7x in FY 24. Both are well below the median prospective multiple and we feel our base case valuation sits comfortably in line with the group on this basis.

RISKS

RESIDUAL TECHNOLOGY ISSUES

While the DMG unit has been successfully run there may be some residual technology issues. In particular, long term running may identify issues not seen in the demonstration phase. That said, the project has run successfully for some time now without any issues that cannot be rectified or overcome through engineering solutions.

FEEDSTOCK SECURITY

Feedstock security is always a key issue with any waste to energy project. Powerhouse is not itself directly exposed to this as the risk will fall on individual project developers. Our analysis of waste volumes suggests that there is more than sufficient to back our forecasts and the impact of COVID 19 may actually increase waste volumes.

MANAGEMENT BANDWIDTH

Powerhouse Energy remains a small company active in several geographically distant markets. The low capital model helps to make this possible but there remains a management challenge to fully exploit all the opportunities. As the company grows we expect this issue to resolve itself.

POLICY DEVELOPMENT

There is strongly vocalised support for a hydrogen economy in the UK and elsewhere. However, actual policy still needs to be developed and there are risks that politicians may favour certain solutions over other. There is also a risk that the environment moves off the political agenda. Given an apparent rise in grass roots support we think this unlikely and if anything, the exposure to the existential crisis of COVID 19 may make the general public more not less concerned about other potential existential crises.

MANAGEMENT AND GOVERNANCE

The board is well balanced in our view with only the CEO representing company management at board level. A representative of Peel Environmental sits on the board and following the W2T transaction the chairman of that company will also join the board.

BOARD OF DIRECTORS

David Ryan – Chief Executive Officer

David was the former CEO and Managing Director of Thyssenkrupp Industrial Solutions' Oil & Gas Business Unit for the UK. Prior to his employment with Thyssenkrupp, he founded and built a successful engineering consulting organisation, Energy & Power Limited, which was acquired by Thyssenkrupp in 2012. He has over 30 years of increasingly complex engineering, business development, and project management experience. An expert in sophisticated design engineering, David will bring a breadth of project delivery, international business management, and general engineering acumen to the Board.

Cameron Davies – Non-Executive Chairman

Dr Davies is a capable business leader who has successfully grown revenues and profits in a quoted alternative energy company. As founder, CEO, and Executive Director of AIM-quoted Alkane Energy plc (now Alkane Energy Limited), he led that company through each phase of its development. He built Alkane from its initial concept to the point of providing over 160MW of connected power generation, and a successful exit for his shareholders – a c. £60 million sale to Balfour Beatty Infrastructure Partners in October 2015. Prior to Alkane Dr Davies led a number of other start-up companies and is currently a Non-executive Director of AIM-quoted Ascent Resources plc.

Dr Davies was awarded a PhD in Applied Geochemistry from Imperial College London. Over the course of the past 20 years Dr Davies has evaluated numerous gasification technologies and projects. He is also a Fellow of the Geological Society of London a member of the European Petroleum Negotiators Group, and the Petroleum Exploration Society of Great Britain.

Brent Fitzpatrick – Non-Executive Director

Mr. Fitzpatrick has over 20 years experience as a corporate finance consultant. In the last 15 years he has been instrumental in advising a number of companies on their acquisitions and subsequent flotations. Mr. Fitzpatrick was Non-Executive Chairman of Global Marine Energy plc- an AIM listed oil services company and Non-Executive Chairman of Risk Alliance plc, an insurance broker consolidator. Mr. Fitzpatrick is also an adviser to ECO Capital, a global clean tech fund and is a member of the Audit Committee Institute.

James Greenstreet – Non-Executive Director

Mr. Greenstreet has over 20 years of corporate and structured finance experience. Having started his career at Arthur Andersen, Mr. Greenstreet joined BAE Systems in 1994 to work in the corporate finance team. After leaving BAE, Mr. Greenstreet held corporate finance positions at IBM and XL Capital, once more focussing on asset and lease finance. In 2001 he co-founded Orbis Capital a successful corporate and structured finance business. Over the past 10 years Mr. Greenstreet has been instrumental in sourcing, structuring, packaging and managing transactions for a number of high profile clients across a wide range of sectors.

Myles Kitcher – Non-Executive Director

With over 20 years' experience in the energy and waste industries, Myles has a career spanning local government, public sector and private enterprise. As Managing Director of Peel L&P Environmental, a developer of real estate and infrastructure in the energy, waste and mineral sectors, he is the leading force behind Protos – Peel's flagship destination for energy, innovation and industry near Ellesmere Port, north west England. He is also Executive Director of Natural Resources & Energy, Peel L&P and he works with investors, technology providers and private and public sector partners to deliver innovation and investible project opportunities.

Tim Yeo – Non-Executive Director

On completion of this transaction, it is also proposed that Tim Yeo, (former UK government Minister), Non exec chairman of W2T, will also join the PHE board as a NED. Mr Yeo has an extensive record in UK Government and opposition, having served in the Home Office, Health and Environment and State for Trade and Industry. He sat on many parliamentary committees, including Environment and Climate Change. He is currently an honorary Ambassador of Korean Investment Promotion, Chairman of New Nuclear Watch Europe, and Chairman of the University of Sheffield Energy 2050 Industrial Advisory Board. He is a NED for Geolink SE, operator of the Eurotunnel.

FINANCIAL MODEL

Profit and Loss Account

£ '000, DEC	2018a	2019a	2020e	2021e	2022e	2023e
Turnover						
WTE	0	0	1,049	3,900	4,902	7,717
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Total	0	0	1,049	3,900	4,902	7,717
Operating profit						
WTE	-2,495	-1,705	-878	-157	1,095	2,341
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Operating profit	-2,495	-1,705	-878	-157	1,095	2,341
P&L Account	2018a	2019a	2020e	2021e	2022e	2023e
Turnover	0	0	1,049	3,900	4,902	7,717
Operating Profit	-2,495	-1,705	-878	-157	1,095	2,341
Investment income	0	0	0	0	0	0
Net Interest	0	-1	3	43	12	35
Pre Tax Profit (UKSIP)	-2,495	-1,706	-874	-113	1,106	2,376
Goodwill amortisation	0	0	0	0	0	0
Exceptional Items	0	0	0	0	0	0
Pre Tax Profit (FRS3)	-2,495	-1,706	-874	-113	1,106	2,376
Tax	145	196	0	0	0	0
Post tax exceptionals	0	0	0	0	0	0
Minorities	0	0	0	0	0	0
Net Profit	-2,351	-1,510	-874	-113	1,106	2,376
Dividend	0	0	0	0	0	0
Retained	-2,351	-1,510	-874	-113	1,106	2,376
EBITDA	-2,494	-1,704	-877	-156	1,095	2,341
EPS (c) (UKSIP)	-0.15	-0.08	-0.04	-0.01	0.05	0.11
EPS (c) (FRS3)	-0.15	-0.08	-0.04	-0.01	0.05	0.11
FCFPS (c)	-0.12	-0.04	-0.08	-0.05	0.04	0.07
Dividend (c)	0.00	0.00	0.00	0.00	0.00	0.00

Source: Company data, Longspur Research estimates

KEY POINTS

- Protos deployment creates first revenue in FY 20
- Two units sold each in FY 21 and FY 22
- Growth in recurrent licence fees raises revenue between these years
- Profit by FY 22
- Meaningful profit by FY 23

Balance Sheet

£ '000, DEC	2018a	2019a	2020e	2021e	2022e	2023e
Fixed Asset Cost	7	7	7	7	7	7
Fixed Asset Depreciation	-5	-7	-7	-7	-7	-8
Net Fixed Assets	2	0	0	0	-1	-1
Goodwill	0	0	0	0	0	0
Other intangibles	0	17	17	17	17	17
Investments	0	0	0	0	0	0
Stock	0	0	345	1,282	1,612	2,537
Trade Debtors	64	46	173	641	806	1,269
Other Debtors	145	310	310	310	310	310
Trade Creditors	-247	-490	-173	-641	-806	-1,269
Other Creditors <1yr	0	0	0	0	0	0
Creditors >1yr	0	0	0	0	0	0
Provisions	0	0	0	0	0	0
Pension	0	0	0	0	0	0
Capital Employed	-37	-117	672	1,608	1,938	2,863
Cash etc	841	104	1,441	391	1,168	2,618
Borrowing <1yr	0	0	0	0	0	0
Borrowing >1yr	0	0	0	0	0	0
Net Borrowing	-841	-104	-1,441	-391	-1,168	-2,618
Share Capital	12,396	12,923	12,927	12,927	12,927	12,927
Share Premium	48,774	48,779	51,775	51,775	51,775	51,775
Retained Earnings	-60,365	-61,714	-62,589	-62,702	-61,596	-59,220
Other	0	0	0	0	0	0
Minority interest	0	0	0	0	0	0
Capital Employed	-37	-117	672	1,608	1,938	2,863
Net Assets	804	-13	2,113	1,999	3,105	5,481
Total Equity	804	-13	2,113	1,999	3,105	5,481

Source: Company data, Longspur Research estimates

KEY POINTS

- Licencing model limits need for fixed assets
- Working capital needs grow as company develops
- Cash runs low in FY19 but funding provides cushion in FY 20

Cashflow

£ '000, DEC	2018a	2019a	2020e	2021e	2022e	2023e
Operating profit	-2,495	-1,705	-878	-157	1,095	2,341
Depreciation	1	1	0	0	0	0
Provisions	0	0	0	0	0	0
Other	554	693	0	0	0	0
Working capital	31	146	-984	-937	-330	-926
Operating cash flow	-1,909	-865	-1,861	-1,093	765	1,416
Tax paid	0	145	196	0	0	0
Capex (less disposals)	0	0	0	0	0	0
Investments	0	-17	0	0	0	0
Net interest	0	-1	3	43	12	35
Net dividends	0	0	0	0	0	0
Residual cash flow	-1,910	-737	-1,663	-1,050	777	1,451
Equity issued	3,402	0	3,000	0	0	0
Change in net borrowing	-1,493	737	-1,337	1,050	-777	-1,451
Adjustments	0	0	0	0	0	0
Total financing	1,910	737	1,663	1,050	-777	-1,451

Source: Company data, Longspur Research estimates

KEY POINTS

- Flat unit sales between FY 21 and FY 22 reduces working capital outflow in FY 22
- Working capital outflow picks up with higher units sales in FY 23
- New equity funding in FY 20
- Cash positive from FY 22

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