

PILOT ENERGY (ASX: PGY)

ALL THE RIGHT INGREDIENTS TO LEAD THE CLEAN ENERGY SOLUTION

Meet Pilot Energy. A company that is transitioning to face the new industry standard – renewable energy and carbon capture storage (CCS). By leveraging its **existing oil production assets and infrastructure**, Pilot is capitalising on a significant **first mover advantage** in pursuing an integrated wind and solar power generation opportunity with **clean hydrogen manufacture and carbon capture storage**. The opportunity is being explored through its Mid West and South West projects that collectively provide exposure to **multiple commercialisation pathways** and **diversified revenue streams**, with potential to deliver **world-class competitive clean energy** at the required scale.

COMPANY SNAPSHOT	
Name	Pilot Energy
Ticker	ASX: PGY
Price (22/11/21)	A\$0.069
30-day VWAP	A\$0.067
CAPITAL STRUCTURE	
Shares on Issue	501.6M
Options on Issue	64.6M
Market Cap	A\$35.6
Cash (30 Sep 21)	A\$5.4M
Debt	Nil
Enterprise Value	A\$30.2M

Existing oil & gas infrastructure & exploration permits

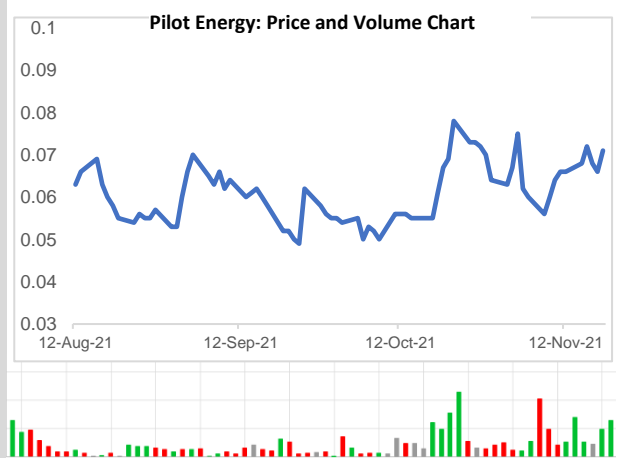
- Significantly reduced capex requirements and shorter development timeline, providing a strong first-mover advantage
- Foundation assets for a suite of competitive and scalable clean energy projects with multiple revenue streams (e.g. carbon credits - currently \$37/tonne and forecast to increase to ~\$45/tonne by 2030)
- Access to critical pipeline infrastructure and natural gas supply to meet existing domestic demand
- Commonwealth regulations allow for immediate CCS at Cliff Head
- Opportunity to attract cornerstone investment (e.g. Mitsui & other large gas producers located in close proximity to Pilot's operations with a pressing need for a carbon capture solution).

Clear hydrogen development pathway with support from Government and industry leading companies

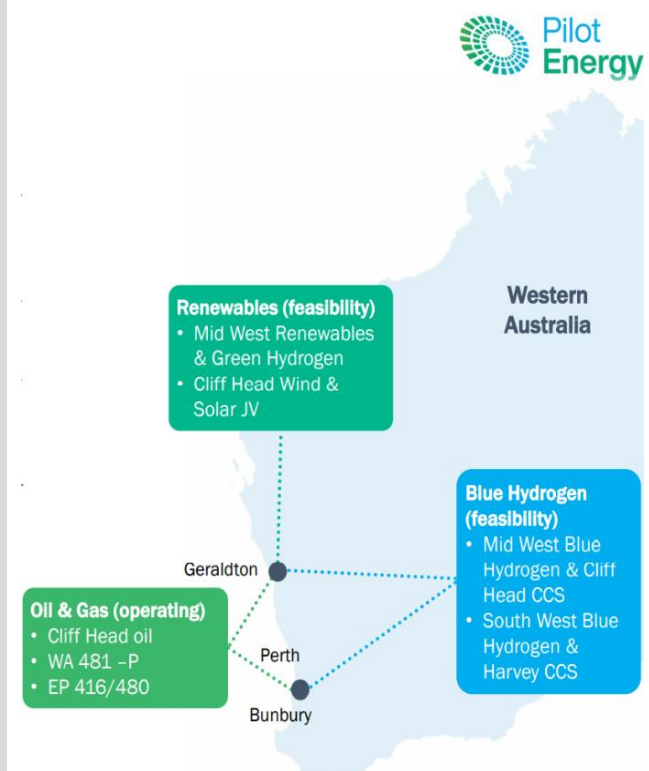
- Consortium with APA and Warrego to jointly fund Blue Hydrogen and CCS Feasibility Study to investigate delivery of low-cost hydrogen
- Partnership with world leading group, 8 Rivers Capital, which has had investment from Toshiba, Exelon and Occidental Petroleum
- [8 Rivers' blue hydrogen technology](#) that can provide more efficient hydrogen production, supplemental base load power and fully integrated carbon capture, all at lower cost than existing technology
- Existing Cliff Head offshore oil platform can be easily repurposed for CCS, allowing for carbon neutral hydrogen production.

World class wind and solar resources provide ability to deliver lowest cost clean energy at scale

- Best strategic location in the Southern Hemisphere for wind conditions, alongside world-class DA approved solar project
- Commonwealth legislation progressing through parliament with potential to develop within WA State waters under existing legislation, facilitating pathway to market
- Cliff Head demonstrator wind project to provide proof of concept following feasibility studies
- Combined renewables to deliver lowest cost clean energy and provide clear path to transition from blue to green hydrogen production at a commercially viable price.



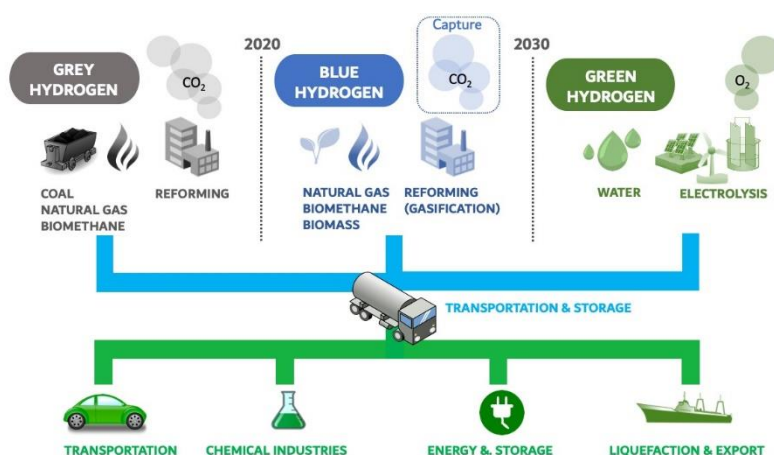
Source: Australian Stock Exchange



HYDROGEN – THE LANDSCAPE

Supplying hydrogen to industrial users is a major global business with current demand for pure hydrogen being ~70 million tonnes per annum (tpa). The recent surge in demand is largely due to the potential for hydrogen to be used in a wide range of new applications as an alternative to current fuels and inputs. Today's global H₂ industry is dominated by fossil-fuel based production, with 6% of global natural gas and 2% of global coal going to its production. Consequently, hydrogen production emits around 830 million tonnes of carbon dioxide (CO₂) per annum (pa). This hydrogen produced with gas and coal-based methods is known as grey and brown/black hydrogen respectively. The current cost of grey hydrogen is c.USD\$1/tonne.

Recent attention has been on the development of green hydrogen, in which hydrogen is formed via electrolysis of water using 100% renewable power, having no process-related carbon emissions. While favourable to the environment, the production of green hydrogen is typically expensive (current cost is c.USD\$4/kg) and requires a large amount of water and renewable power. As a result, there is a significant need for investment, which is compounded by additional challenges surrounding transportation and storage.



The remaining alternative is blue hydrogen, which is formed using the same method as grey hydrogen but uses CCS to reduce CO₂ emissions. Similar to green hydrogen, blue hydrogen production is typically expensive and requires significant investment in technology and infrastructure in order to make its production feasible at scale. However, a far more attractive opportunity exists if existing pipeline infrastructure and oil & gas assets can be utilised.

Colour	Name	Production method	Carbon credentials	Pros	Cons	Current % of H ₂ output
Grey	Steam methane reformation	H ₂ from methane via steam with CO ₂ as by-product. Primary current method.	Direct CO ₂ emissions: ~9kg CO ₂ /H ₂ kg. LCE: ~10-17kg CO ₂ /H ₂ kg	Existing technology well used & offers cheap hydrogen at 2-3x cost of input of natural gas. Predominant method.	Large CO ₂ emissions & environmentally unfriendly. Requires fossil fuels. Costs to increase as carbon pricing becomes prevalent.	78% (natural gas 48%/oil 30%)
Green	Electrolysis	H ₂ from electrolysis of water using 100% renewable electricity	Zero direct CO ₂ emissions in production. LCE: ~1-5kg CO ₂ /H ₂ kg	Zero CO ₂ emissions. Integrates with renewable power & storage. Costs expected to fall over time.	Expensive & inefficient. Requires large amount of water & renewable power. Transportation/storage challenges.	Negligible
Blue	Steam methane reformation with carbon capture & storage	Same method as grey but uses carbon capture & sequestration to reduce CO ₂ emissions	Direct CO ₂ emissions ~1kg CO ₂ /H ₂ kg. Overall LCE ~3-6kg CO ₂ /H ₂ kg.	Offers 70-90% reduction in CO ₂ emissions. Possible to utilise some existing infrastructure.	Technology not at commercial scale. CCS cost high & leaves CO ₂ emissions upstream. Political resistance.	Negligible

Source: JP Morgan, Ord Minnett Research

EXISTING INFRASTRUCTURE – CLIFF HEAD

Coastal **Mid West** is one of Australia’s highest rated renewable energy resource regions for both wind and solar and the **only existing offshore oil & gas infrastructure along this region is the Cliff Head Oil Field**. The Cliff Head facilities are jointly held by Triangle Energy (78.75%) and Pilot Energy (21.25%). In addition, Pilot holds two onshore exploration permits (EP-416 and EP-480), as well as material working interests in WA-481-P, which is located offshore in the area surrounding Cliff Head (refer figure below). We also note that WA-481 permit is one of the largest offshore exploration permits in Australian Commonwealth waters. Collectively, these facilities and permits form the foundation assets for a suite of competitive clean energy projects that provide Pilot with a considerable first mover advantage over its competitors, most of which are lacking infrastructure and/or the required regulatory approvals.

BLUE HYDROGEN AND CARBON CAPTURE

In 2019, a detailed study was completed by Geoscience Australia on the prospective hydrogen regions of Australia. As part of the study, the Mid West Coastal Region was identified as being one of the **most suitable and prospective hydrogen regions in Australia** for both green and blue hydrogen production. In particular, significant advantages were noted for coastal or inland hydrogen generation, whereby hydrogen is transported via a pipeline and constrained by existing infrastructure. It is therefore unsurprising that Pilot, with its existing gas storage operations (that can support carbon capture and storage), started to investigate the potential for blue hydrogen production on an industrial scale. Given its advantages in location and infrastructure, Pilot began to attract a number of large industry players and in November, a consortium with APA Group (APA) and Warrego Energy (Warrego) was announced to jointly undertake and fund the Mid West Blue Hydrogen and CCS Feasibility Study. The study, expected to complete in Q1 FY22, involves APA providing the gas pipeline infrastructure, Warrego providing the natural gas supply and Pilot managing the carbon production. Industry leading consultants, Technip Energies (Technip), Genesis and RISC Advisory (RISC), have also been engaged to provide sector expertise, with a particular focus on blue hydrogen technology. The Consortium arrangements set out a process for further joint participation in progressing towards project development following completion of the feasibility study. If successful, Pilot will also be able to leverage APA’s gas pipeline to deliver to customers to meet increasing demand.

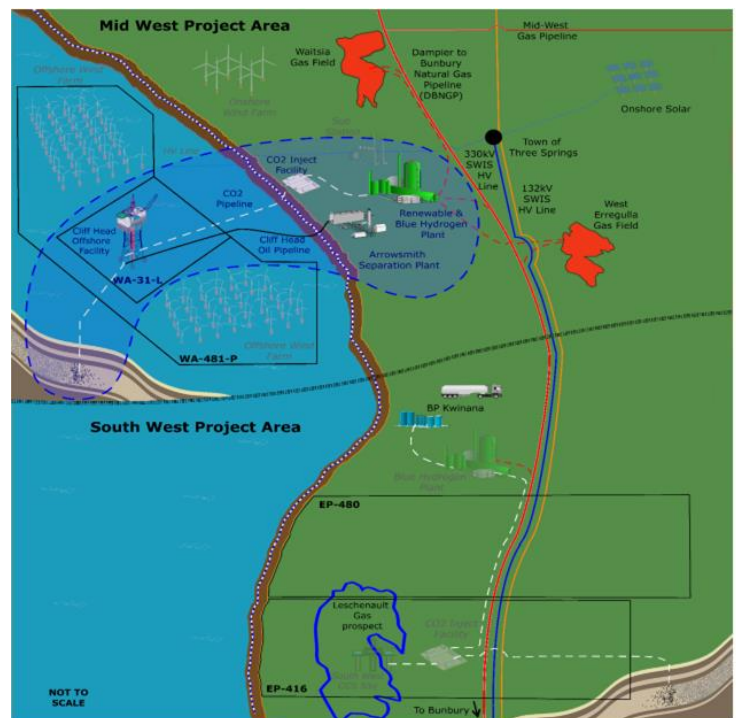
Consortium formed to progress feasibility study with key consultants:



Blue Hydrogen projects: require expertise and collaboration from across the energy industry with the following consortium established to represent the key components for the project.

Objective: Consortium members to work with key consultants to provide sector expertise and participate in and jointly fund the Feasibility Study with a focus on Blue Hydrogen technology, regional CCS potential, hydrogen markets, project infrastructure and commercialisation. Feasibility study to be complete Q1 CY22.

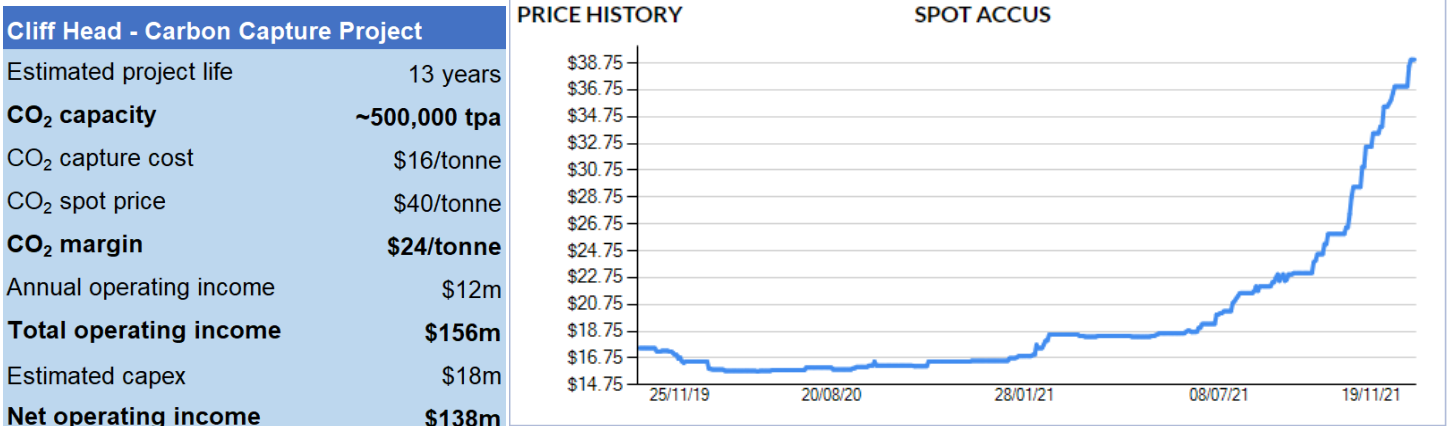
Key Components	Consortium
Infrastructure	apa
Natural Gas Supply	warrego energy
Carbon Management	Pilot Energy



Source: Pilot Energy

Carbon capture and storage

With the help of RISC, Pilot is also undertaking a pre-feasibility study of the CCS potential at Cliff Head to provide the feasibility study with the necessary assumptions regarding the potential CO₂ injection rate and CO₂ storage capacity. The study indicated that it could provide carbon geo-sequestration of approximately 500,000 tpa of CO₂ for a period of 13-years at an injection cost of approximately \$16/tonne of CO₂ (through utilising the existing Cliff Head Oil Field onshore and offshore infrastructure). Further, it is estimated only \$18m of capital expenditure will be required to transition the existing water inject pipeline for CCS. The project is anticipated to be fully operational by 2025. We understand Pilot has also applied for Commonwealth funding under the CCUS Hubs and Technologies Program.



Source: Pilot Energy, Whairo Capital analysis

Source: JARDEN ACCUs.com.au

price of CO₂ is predicted to increase to ~\$40/tonne by Q1 of FY22 (currently ~\$37/tonne), Based on this estimate and a capacity of 500,000 tpa, Pilot would receive a margin of \$24/tonne with only a 1.5 year payback period (on \$18m capex). **This means that at a capacity of 500,000 tpa over 13 years, Pilot could deliver \$138m in net operating income from CCS alone.** Even more compelling, is that the existing Commonwealth regulatory framework at Cliff Head allows for immediate CCS, meaning no additional Commonwealth legislation is required for the project.

The carbon market doesn't appear to be slowing down either, as the climate crisis continues to escalate so too does the pressure on companies to adopt clean technologies in the attempt to transition to net zero carbon emissions. This is expected to continue to drive prices up to incentivise low carbon action and avoid locking in more fossil fuel-intensive investments. Australia's carbon market is also continuing to develop and mature, with the introduction of national schemes, state and territory government schemes and international carbon units. This includes the Emissions Reduction Fund (ERF), whereby a number of activities are eligible under the scheme and participants can earn Australian carbon credit units (ACCUs) for emissions reductions. One ACCU is earned for each tonne of carbon dioxide equivalent (tCO₂-e) stored or avoided by a project. ACCUs can be sold to generate income, either to the Government through a carbon abatement contract, or in the secondary market, representing potential for an additional revenue stream to Pilot for its CCS activities should approval be granted by the regulator.

We also note that the trading of ACCUs is anticipated to become much simpler through the development of the Australian Carbon Exchange by the Clean Energy Regulator (currently underway and expected to commence by 2023), which will support the rapidly increasing demand from the corporate sector. It will also help foster the growth in Australia's carbon markets, where ACCUs credited from approved ERF projects can be traded among individuals and businesses.

Blue hydrogen

Steam methane reforming (SMR) is the typical process used to produce blue hydrogen. However, it is inefficient due to poor CO₂ recovery and limited scalability. To overcome this, 8 Rivers Capital (8 Rivers) developed its 8RH2 technology (refer below for further information). **8RH2 is able to generate clean hydrogen and produce zero emissions power, while ensuring fully integrated carbon capture at a cheaper cost than existing hydrogen technologies.** This is achieved by generating hydrogen at high pressure and using a proprietary refrigeration-based CO₂ separation system. Pilot has engaged 8 Rivers to conduct a preliminary feasibility study to assess the integration of its technology into Pilot's operations. Initial activities include sizing key modules for the power generation and 8RH2 technology suitable for Western Australian conditions and preparing a basis of design. Pilot has applied for Commonwealth funding for the establishment and integration of a hydrogen production plant. Based on Pilot and RISC's assessment of CO₂ capacity (500,000 tpa) and base power supply load (7MW) from using 8RH2 technology, Pilot will be able to produce 42,000 tonnes of blue hydrogen. At \$6/kilo, **this represents an additional \$256m in revenue per annum**, which is in addition to the ~\$12m annual revenue from CCS and excludes revenue that can be generated from sending electricity to the grid. And that's not all, there is potential to scale up to ~25MW should an additional pipeline be installed. We understand Pilot has already identified a suitable site to achieve this, which offers greater wind capacity than the existing site.

HEADING SOUTH

In Oct-21, Pilot commenced the South West Carbon Management feasibility study by expanding the scope of its work with the Mid West project consultants', RISC, Genesis and Technip. The study will define the South West Hub's flue gas and CO₂ emission opportunity set, assess the CCS potential and commercialisation via the provision of carbon management services and sale of hydrogen. The hydrogen option is dependent on the evaluation of the Leschenault gas prospect, which sits within Pilot's EP-416 and EP-480 tenements and has a Gross Prospective Resource of 725 BCF (Best Estimate) and up to 1.595 TCF (High Estimate). Drilling is anticipated to commence by Dec-22 with Pilot holding a 50% interest alongside Advanced Energy Transition Pty Ltd. The study will incorporate the blue hydrogen assessments from the Mid West feasibility study and 8 Rivers' blue hydrogen technology study.

Pilot notes that the South West Hub CCS Project is well progressed, with c.\$50 million of federal and state funding to date. Since 2011, led by the Department of Mines, Industry, Regulation and Safety (DMIRS – formerly the WA Department of Mines and Petroleum), four wells have been drilled to test the suitability of the target reservoirs for carbon sequestration and 2D and 3D seismic surveys have been completed. Four generations of reservoir modelling confirm a base case for the Wonnerup reservoir (being the lower layer of the injection reservoir) system to capture 24 million tonnes of CO₂ over a 30-year period, with injection rates of up to 800,000 tpa and to remain in the reservoir for over 1000 years. Extensive reservoir modelling has demonstrated that the 1,500-metre thick Wonnerup sandstone represents a major carbon storage resource that is perfectly located due to its proximity to local industry and infrastructure, and an absence of the regional aquifer.

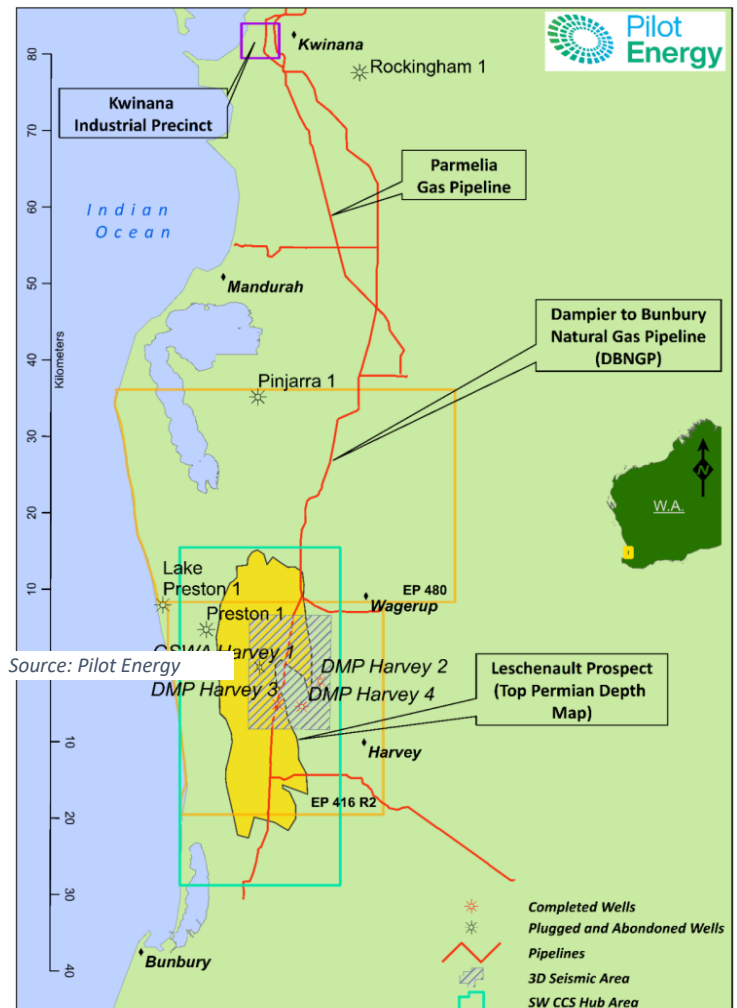


Figure 1. South West Feasibility Study project area

WORLD CLASS WIND AND SOLAR

As one of the world's best renewable energy jurisdictions, the Mid West region offers the perfect location for a combined wind and solar project, which if successful, will provide a cost-effective transition into green hydrogen production. Pilot has engaged Laotec, a specialist offshore wind farm development consultant, and Green Fuel Development (GFD), a renewable energy infrastructure developer with specific experience identifying and developing projects in WA, to provide an assessment of the region's offshore and onshore renewable energy resources and project infrastructure requirements focusing on ports and electrical transmission aspects of the project. Laotec, in conjunction with C2Wind ApS ("C2Wind"), is also assisting with an offshore wind resource baseline survey, using a fixed LiDAR system, in parallel with the feasibility study.

Upon completion of feasibility, Pilot plans to develop a demonstration project that will involve installing three-six wind turbines, which will generate up to 60MW and be connected back to the Cliff Head platform. The project is based on the Beatrice Offshore Wind Farm located in Scotland, which is a commercial scale operation involving 588MW (84 turbines) of power being exported into the UK National Grid. Pilot have also identified an additional site approximately 30km south of Cliff Head, which will provide 2-3% greater wind quality than Cliff Head, such that it will more than offset the cost to install a transmission cable to Cliff Head. The demonstrator will provide an early-stage proof-of-concept working model ahead of a potential full-scale roll out should the relevant regulatory approvals be received.

The onshore solar study is also being progressed and could be executed within the next 24-36 months, subject to the feasibility study, ASX re-compliance and regulatory approvals. We note the project could include up to 307,200 solar modules generating up to 184MW.

GOING, GOING, GREEN

Mid West Hydrogen & South West Hydrogen Projects are uniquely positioned for both blue and green hydrogen



Low-cost industrial scale renewable energy – wind & solar



Readily available natural gas feedstock for blue hydrogen leveraging existing infrastructure and Perth Basin gas discoveries. Hydrogen produced with natural gas utilising low-cost conventional SMR/ATR technology with full CCS



Existing readily accessible, established CCS/CCUS site at Cliff Head. Preliminary estimates indicate 500,000tpa capacity and highly attractive \$16/tonne CO₂ storage cost

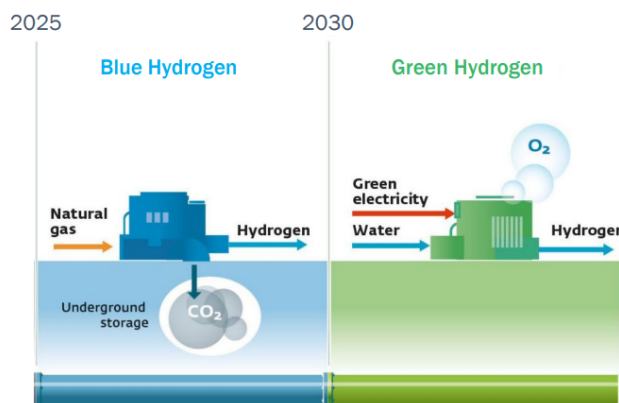


South West Hub CCS Project under-appraisal for sequestration of 800,000+ tpa of CO₂ within PGY petroleum tenures¹



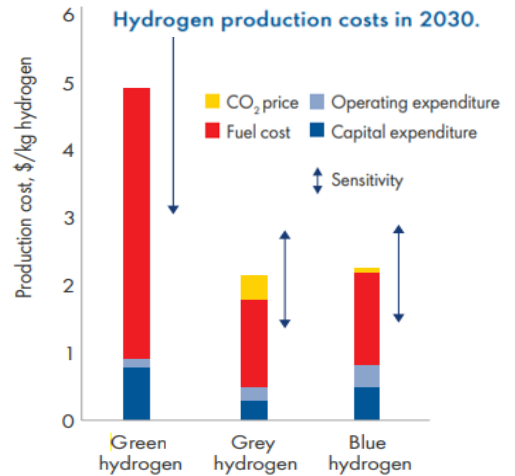
Existing Commonwealth regulatory framework allowing CCUS/CCS in offshore Commonwealth waters – Cliff Head.

1. Dynamic Modelling of CO₂ Sequestration in the Harvey Area. A report by ODIN Reservoir Consultants for DMIRS 2018/7



Source: Gasunie - "Indications of Hydrogen"

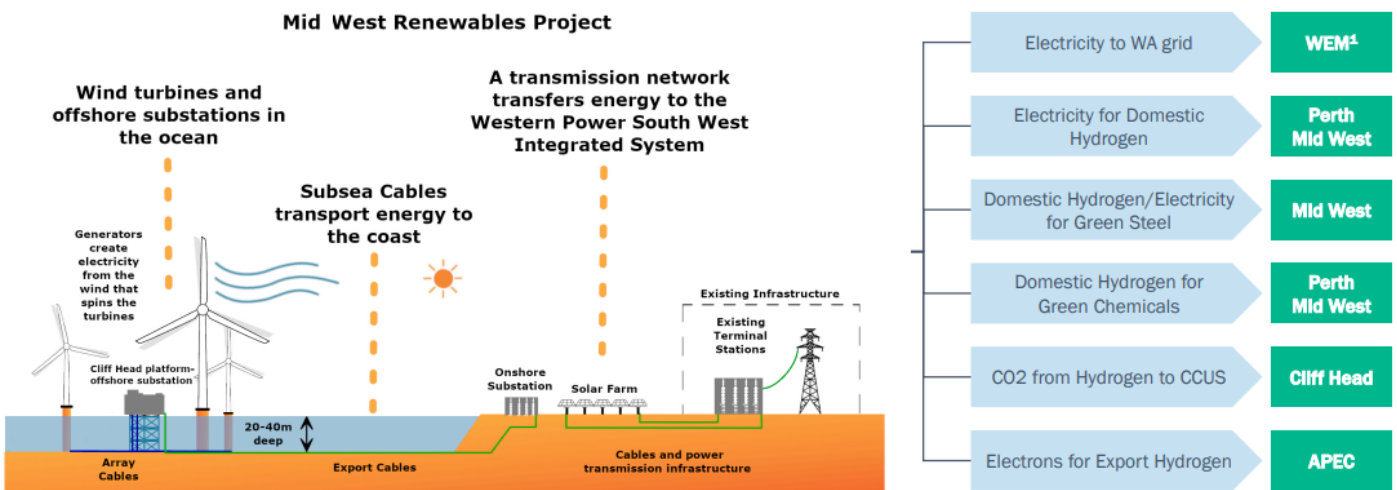
As noted earlier, green hydrogen is produced from the electrolysis of water powered by renewable energy with zero carbon emissions. With the Government and a growing number of energy companies announcing net zero emission ambitions, green hydrogen is becoming a popular thematic in many green strategies. However, for hydrogen to contribute to carbon neutrality, it needs to be produced on a far more significant scale and there is currently insufficient renewable energy available to support large-scale green hydrogen production. Therefore, it is widely acknowledged that scaling up blue hydrogen production will provide a clear pathway to transition to green hydrogen production. For example, the EU strategy says that “**other forms of low carbon hydrogen [i.e., blue] are needed, primarily to rapidly reduce emissions... and support the parallel and future uptake of renewable [green] hydrogen.**”



Source: The Shell blue hydrogen process whitepaper

The need for a cost-effective model to transition into green hydrogen production highlights the strength of Pilot’s projects. The combination of its existing Cliff Head infrastructure with offshore wind turbines and substations and an onshore solar farm transmitting energy into the Western Power grid will allow Pilot to make a meaningful, low-cost transition into green hydrogen production at scale. Not to mention the potential to partner with other large gas players within close proximity of Pilot’s operations, which would enable the fast-track of its development and assist in opening up multiple commercialisation pathways (as shown below).

The Cliff Head infrastructure may enable the fast-track development and commercialisation pathway for the development of the Mid West Integrated Renewables Project



Source: Pilot Energy

RECENT DEVELOPMENTS

Government support

Adding strength to Pilot's project, is the support of the WA Government, with the McGowan Government announcing it will invest an additional \$61.5 million to supercharge WA's growing renewable hydrogen industry to create 21st century jobs and move towards a low-carbon future. This includes a new \$50 million fund to stimulate local demand for renewable hydrogen in transport and industrial settings and to drive investment into renewable hydrogen, as well as \$7.5m in funding to provide an access road into the Oakajee Strategic Industrial Area (SIA) with the aim to kick-starting the activation of the precinct, as part of a broader plan to establish a major renewable hydrogen hub in the Mid West. These initiatives form part of WA's Renewable Hydrogen Strategy and Roadmap, which seeks to drive WA's position as a major producer and exporter of renewable hydrogen.

As noted above, Pilot has applied for Government funding under [the \\$150m Carbon Capture, Use and Storage Hubs and Technologies Program – Technologies Stream](#) to support the acceleration of the Cliff Head CCS project and the associated blue hydrogen production facility. This program was initiated to support innovative advancements in CCUS technologies and help to identify and develop viable CO₂ storage sites. Grant funding is available from \$1m - \$30m, with successful applicants anticipated to be announced in early 2022. We understand that the outcome of any grant funding is not anticipated to impact on the progression of Pilot's project.

8 Rivers Capital

8 Rivers Capital is a company focused on developing sustainable, infrastructure-scale solutions to important societal problems. At the forefront of this, is the need to cut carbon emissions through clean hydrogen generation. To combat this, 8 Rivers has developed a new process – [called 8RH2](#) – for generating clean hydrogen with full carbon capture that is cheaper than all other hydrogen production technologies today. This is achieved by using pure oxygen, combined partial oxidation/gas heated reforming, and a novel CO₂ capture system to generate clean hydrogen at higher efficiency.

The technology was developed by Rodney Allan, who joined 8 Rivers and teamed up with two large companies - engineering firm, McDermott International and energy company, Exelon Generation--that invested a combined \$150 million to create and fund a company called Net Power. Net Power developed a \$150 million power plant in Texas. The plant was first fired up in May, producing 25 megawatts, being enough to power 5,000 homes simultaneously, while producing no carbon emissions. However, the key milestone was achieved only recently, when Net Power was able to successfully deliver electricity into the American power grid for the first time, marking a significant "proof of concept". The company is now focusing on deploying its technology more widely, including into Pilot's operations, with feasibility studies currently underway and a joint application made for Government funding (as mentioned above). **8 Rivers' commitment to the project has been aligned through the recent issuance of ~13.3m options at an exercise price of \$0.08, expiring in November 2024.**

Lastly, and important to note, is that the [Morrison Government is in support of the technology](#). This was evidenced by its nomination as an "emerging technology" in the [Technology Investment Roadmap](#) published last year, which is the cornerstone of [Australia's Long-Term Emissions Reduction Plan](#), potentially placing Pilot in the box seat to receive funding.

SO, WHY PGY?

With the rise in clean energy companies hitting the ASX as a growing number of national Governments and energy companies announce net-zero-emission ambitions, it is becoming increasingly difficult to assess the value proposition of any given stock.

With a market cap of only ~\$35m, Pilot stands out from a valuation perspective, and here's a summary why:

- Market leader in the energy transition space with a considerable first mover advantage in CCS due to existing Cliff Head infrastructure, which also substantially reduces capital requirements
- Significant partnerships and progress with leading Australian energy players (APA Group and Warrego)
- Material feasibility studies underway with world-leading consultants using industry leading technology
- Diversified revenue streams and portfolio of development opportunities (including CCS, hydrogen, and wind & solar renewables) with a clear commercialisation pathway that offers significant upside potential
- Government support, including alignment with key clean energy initiatives and long-term emissions reduction plan
- Highly competent Management team with extensive experience in energy sector and proven track record.

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