



ASX Announcement | 14 December 2021
Hexagon Energy Materials Limited (ASX: HXG)

Substantial progress made on the Northern Territory (Pedirka) Clean Hydrogen Project Pre-Feasibility Study, creating further opportunities.

Key Highlights:

Hexagon has made substantial progress on its Pre-Feasibility Study to develop a clean hydrogen project that will service the rapidly emerging Asia Pacific hydrogen market.

Specific areas of progress include:

1. Engineering

- Hydrogen production technology options reviewed with selections completed.
- Hydrogen plant design and engineering Pre-Feasibility Study scope of work substantially advanced. Overall energy, mass and carbon balances and Capital Expenditure (CapEx) and Operating Expenditure (OpEx) estimates completed across multiple technology options.
- Progress made on renewable energy electricity supply options; meeting feedstock conversion requirements; negotiations for working with multiple large scale, well-established providers advanced.
- Construction options assessed.

2. Raw Materials, Transport and Handling

- End product, Raw material and Plant and Equipment (P&E) transportation options assessed for various potential plant sites. New transport infrastructure requirements CapEx and OpEx costs specified.
- Water supply options for multiple locations assessed in terms of quality, quantities and long term, sustainable access and costs.

3. Decarbonisation

- Multiple Carbon Capture and Storage (CCS) options have been identified, with access and cost negotiations advanced.

4. Commercials

- High level, overall project risk assessments have been undertaken.
- Financial modelling to establish and compare commercial Project returns across multiple scenarios, based on all Pre-Feasibility Study generated information received, has been substantially progressed
- Optimisation studies are underway comparing Pedirka with other feedstocks and matched technologies. As part of this, Hexagon and a large scale, well established renewable energy project development partner recently applied through the Federal Government's Clean Hydrogen Industrial Hub grant program¹, for funding to collaboratively complete a Hydrogen Hub feasibility study for Middle Arm at the Port of Darwin.

¹ AusIndustry Clean Hydrogen Industrial Hub grants <https://business.gov.au/grants-and-programs/hydrogen-hubs-development-grants>

Hexagon Energy Materials Limited, (ASX: HXG), “Hexagon” or “the Company”, is pleased to announce that substantial progress has been made on Hexagon’s Northern Territory (Pedirka) Hydrogen Project, “NT H₂ Project” or “the Project” Pre-Feasibility Study (PFS) against the original scope of work and creating further opportunities.

1. Executive Summary

Hexagon’s Hydrogen strategy focusses on development of large-scale clean hydrogen projects supplying Australian domestic and Global export markets. The Company is focussed on assessing the potential to achieve this at the lowest risk and highest potential for commercial success in Australia, through various opportunities.

Hexagon’s intent is to participate in the Global clean hydrogen market that is forecast to reach US\$300 billion in sales by 2050². As part of which, Japan is of particular interest to Hexagon. The Basic Hydrogen Strategy by the Ministry of Economy, Trade and Industry (METI) 2017 puts Japan’s hydrogen consumption alone at 5 -10 million tonnes per annum post 2030.

Hexagon’s focus will initially be blue Ammonia, as a Hydrogen carrier, produced through fossil fuel feedstock and Carbon Capture and Storage (CCS). Hexagon will maximise its use of renewable energy on commercial terms in blue Ammonia production. Longer term, Hexagon plans to transition to green hydrogen in liquid form once hydrogen production technologies and liquid hydrogen handling and transportation technologies deliver further cost reductions, making fully renewable based hydrogen a commercially viable product.

Hexagon is assessing all options and opportunities in relation to the NT H₂ Project. The Hexagon team has identified the following as key to realising success on its hydrogen projects:

- Use of proven at scale technology;
- Capacity to leverage established port and transportation (end-product export) infrastructure;
- Sustainable access to large scale, low-cost energy (feedstock wise and in terms of conversion);
- Sustainable access to quality water supply;
- Access to established, long term capacity Carbon Capture and Storage (CCS) reservoirs and associated infrastructure;
- Securing of development and project financing to underpin Final Investment Decision (FID);
- Best practice stakeholder engagement including with landowners and communities; and
- Binding, long-term end customer offtake contracts.

2. PFS Deliverables and Variations

The Critical Success Factors (CSF) for the NT H₂ Project PFS currently underway are set out in Figure 1 below. These Project CSFs have been presented previously (ASX Announcement: 9 July 2021) and significant progress has been made to address all CSF to date.

A number of key decisions that address these CSFs have now been made, including:

- a) Choice of end product: Initially production of ammonia combined with CCS (i.e., blue ammonia, as a hydrogen carrier) is planned. This decision has been made based on technical and commercial ‘whole of value chain’, inclusive of technology, assessments made, as detailed within this announcement.
- b) Identification of a preferred location: A preferred location has been selected at Middle Arm, at the Port of Darwin.
- c) Assessment of feedstock transportation options: Feedstock transportation options have been assessed, with the final decision-making to be feedstock dependent.

² Source: Strategy& part of the PwC Network “The dawn of green hydrogen” Maintaining the (Gulf Co-operation Council) GCC’s edge in a decarbonized world 2020 report. <https://www.strategyand.pwc.com/m1/en/reports/2020/the-dawn-of-green-hydrogen.html>

- d) NT Government engagement has continued: With support secured for a recent Hydrogen Industrial Hub feasibility study grant application by the Hexagon led consortium for a Hub at Middle Arm at the Port of Darwin.
- e) Financial modelling and commercial analysis have been substantially progressed.



Figure 1 – NT H₂ Project PFS CSF

In relation to project feedstock, Hexagon advises that the drilling program which was initially planned at PFS commencement has been delayed pending the approval of a Mine Management Plan (MMP) by the NT Government. As stated in Hexagon’s recent Quarterly Report (See Hexagon’s July – September 2021 Quarterly Activities Report released on 29 October 2021), MMP discussions are ongoing. On 26 November 2021 a pathway through which Hexagon could progress the MMP approval process was provided by NT Government representatives within the Department of Environment, Parks and Water Security, who provide services to the NT Environment Protection Authority (EPA). As a result, drilling at Pedirka and any JORC compliant resource assessments will not be completed to feed into the PFS by the targeted 31 December 2021 PFS completion date.

Hexagon has progressed other initiatives to ensure project advancement during these drilling delays. The team has identified and assessed as positive other feedstock options, in parallel with other downstream PFS works.

This announcement sets out the substantial progress that has been made with Hexagon’s NT H₂ Project PFS.

A range of commercial discussions around opportunities that could significantly improve the NT H₂ Project PFS Base Case have been advanced. These include, for example, the use of renewable energy generated electricity to convert plant feedstock to ammonia. This could significantly reduce overall CO₂ output, subsequent CCS related costs and, consequently, overall project costs. On this basis, natural gas plant feedstock and downstream technology option assessments have also been progressed.

A wide range of information has been produced and delivered to the Hexagon team by environmental, geology, mining, water supply, bulk transport, heritage and land access specialists who have been engaged to undertake the PFS. Genesis has been one of these parties (ASX Announcement 24 June 2021). Genesis has made substantial progress, as planned for the PFS, on:

- a) Technical requirements;
- b) Project risk and opportunity identification;
- c) Further development options; and
- d) Capital and operating cost estimates.

In commercial terms, all of the outputs of the PFS received to date are currently being collated and entered into a comprehensive financial model of the NT H₂ Project. The opportunities which may enhance the project have also been incorporated to allow comparisons against the originally contemplated Alice Springs plant Project Base Case to be made.

Key sensitivities will be run, with the outputs of this financial modelling work due to be presented to the Hexagon Board shortly.

Hexagon expects to provide an update to shareholders and the market thereafter.

3. Australian Hydrogen Market Context.

Hexagon's Hydrogen strategy and the NT H₂ Project PFS is driven by the increasing global attention on hydrogen by governments as well as private enterprise as clean hydrogen firmly becomes part of the world's decarbonisation solution.

Hydrogen is routinely categorised as grey, blue or green:

- Grey hydrogen is fossil fuel derived, where CO₂ produced as part of production is released to the atmosphere.
- Blue hydrogen is fossil fuel derived with a decarbonisation approach to capturing the CO₂ produced as part of production. Carbon Capture and Storage (CCS) is the most common way of decarbonising to achieve blue hydrogen.
- Green hydrogen is renewable energy derived hydrogen. The most common method of producing green hydrogen is through electrolysis (Alkaline or Polymer electrolyte membrane (PEM)).

Clean hydrogen is defined by the Australian Federal government³ as both blue and green hydrogen.

The question amongst Australian market researchers and commentators is where are the best, most commercially viable, large scale, sustainable clean hydrogen projects located, and what will it take for them to be successfully commercially developed.

An Australian hydrogen market study completed by Advisian Pty Ltd for the Clean Energy Finance Corporation (CEFC) on 24 May 2021 reports:

"Based on the forecast trend in the price of "industrial scale" natural gas supply and the cost of steam methane reformer plants to convert this gas to hydrogen ... the cost of grey hydrogen production on both the East and West coasts of Australia ...(currently and) out to 2050 (is estimated) at A\$1.70 per kg for Hydrogen produced on the West coast, and A\$2.20 per kg on the East coast".

In relation to blue Hydrogen, the Advisian study found: "The incremental cost of carbon capture and storage (CCS) added means a pre-transportation and export production figure of A\$2.80 per kg (2020)."

That is, on top of production, an additional cost of A\$(0.5 to 1.1) needs to be added for CCS, depending on location, when assessing the current commercial viability of blue Hydrogen projects.

Coal gasification with CCS is not specifically covered in the Advisian 2021 Hydrogen Report. It has however, been included in a number of hydrogen production cost analyses completed globally by agencies including the International Energy Agency (IEA), International Renewable Energy Agency (IRENA) and the U.S. Department of Energy (DOE). In the DOE's 2020 Comparison of H₂ costs/Hydrogen Production path figures, pre-CCS costs of around A\$2 per kg of Hydrogen⁴ using coal gasification were published. This figure is acknowledged as being highly dependent on multiple factors and in particular on coal feedstock prices.

³ Australian hydrogen market study, Sector analysis summary, Advisian Pty Ltd for the Clean Energy Finance Corporation (CEFC) published 24 May 2021

⁴ Source: Hydrogen from Coal. May 7, 2021, by Greg Kelsall, Principal associate, IEA clean coal centre. <https://www.coalage.com/>

Work currently underway in the LaTrobe Valley by the Hydrogen Energy Supply Chain (HESC) Project consortium comprising of Kawasaki Heavy Industries, Ltd (KHI), Electric Power Development Co., Ltd. (J-POWER), Iwatani Corporation (Iwatani), Marubeni Corporation (Marubeni), AGL Energy (AGL) and Sumitomo Corporation (Sumitomo), supported by the Victorian, Australian and Japanese Governments, will ultimately deliver contemporary insights into the production costs of Australian coal gasification with CCS (blue hydrogen).

The Advisian 2021 Hydrogen Report stated that Green Hydrogen production costs were “A\$3.90/kg” (2020) with the key challenges in achieving low cost of Green Hydrogen production acknowledged as:

- a) the securing of low-cost electricity supply into electrolysis plants and how this is managed;
- b) management of the cost of the post-production handling of hydrogen produced.

The Advisian 2021 Hydrogen Report stated that “Production of liquid hydrogen from (compression of) gaseous hydrogen, (and storage) and handling at export facilities, in shipping and at import facilities is currently expected to add more than A\$9/kg to the cost of hydrogen. This results in a total, delivered to end user cost, of nearly A\$13 per kilogram.”⁵

The liquid hydrogen handling side of hydrogen production comprises a factor of at least three times that of the actual current hydrogen production costs. Very large capital costs are associated with hydrogen compression, storage, handling/load-out, shipping and receipting as a result of the properties of hydrogen. Until a number of key technology breakthroughs which many sector participants are investing in are made, commercial liquid hydrogen export will prove challenging.

Whilst the challenges that the building of a global hydrogen economy presents are substantial so are the opportunities.

The size of the hydrogen export market that Australian companies like Hexagon are seeking to participate in is enormous. Depending on whose market forecast you rely upon; Shell, ARENA, Bloomberg NEF, McKinsey or the Australian Hydrogen Centre; the demand for Hydrogen globally is forecast to grow by 2050 by a factor of up to 10 times 2020 levels, which are around 70 million tonnes per annum (notably, in 2020 almost all hydrogen available for sale and use, for example for industrial feedstock purposes, at scale, is grey hydrogen). Japan alone in its Basic Hydrogen Strategy by METI in 2017 puts national hydrogen consumption between 5 and 10 million tonnes per annum post 2030.

The clean hydrogen usage growth frontiers lie in transportation – heavy vehicles and buses, particularly on set routes where vehicles return back to a base supporting centralised refuelling infrastructure installation; for industrial energy e.g., in commercial building heat and power; as an industrial feedstock and in electricity generation.

“Strategy&”, part of the PriceWaterhouseCoopers (PwC) Network, outlines in its 2020 *The dawn of green hydrogen* report:

“Global demand for ... clean hydrogen (i.e., minimal CO₂ emissions) could reach 530 million tonnes per annum by 2050... (with) the ... clean hydrogen export market ... worth US\$300 billion (in sales) yearly by 2050.”⁶

As part of this, the team at Hexagon believes that opportunities are emerging to integrate blue and green hydrogen. This approach supports practical establishment and growth of the Hydrogen economy in Australia and globally. Hexagon’s Hydrogen strategy is underpinned by this approach.

⁵ Source: Australian hydrogen market study, Sector analysis summary, by Advisian Pty Ltd for the Clean Energy Finance Corporation (CEFC) published 24 May 2021

⁶ Source: Strategy& part of the PwC Network “The dawn of green hydrogen” Maintaining the (Gulf Co-operation Council) GCC’s edge in a decarbonized world 2020 report. <https://www.strategyand.pwc.com/m1/en/reports/2020/the-dawn-of-green-hydrogen.html>

4. Background to Hexagon's NT H₂ Project's PFS.

Hexagon's strategic vision is to develop and progress the large-scale production of decarbonised hydrogen for export and domestic sale within the Asia Pacific region, to become an early mover, on a commercial basis, in emerging hydrogen markets and therefore well positioned for growth.

In early 2021, an agreement to acquire Ebony Energy Limited was finalised (ASX Announcement: 29 March 2021) which made Hexagon the exclusive owner, builder and operator of the NT H₂ Project, the first of Hexagon's hydrogen projects to be progressed towards potentially deliver the Company's vision.

Hexagon successfully completed an A\$6.2 million placement in early 2021 to progress the NT H₂ Project PFS. This funding enabled drilling preparations and a scope of PFS work to commence in May 2021 (ASX Announcement: 3 May and 19 May 2021). Since then, substantial NT H₂ Project PFS progress has been made.

The original scope of work for the PFS included all aspects of the Project business case and value chain, from coal resource delineation and mine planning, through to plant site selection, technology selection, raw material supply, fully integrated plant engineering and design, to transportation of the end product to port for export to end customers. Drilling was at the outset of the PFS expected to commence early in calendar Q3, 2021.

Completion of the PFS in December 2021 continues to be targeted, with a Definitive Feasibility Study (DFS), based on PFS results, to subsequently commence in early 2022 (ASX Announcement: 19 May 2021).

As announced in early July 2021, a Mine Management Plan (MMP), including an environmental plan, was lodged with the NT Government (ASX announcement 9 July 2021). Initial MMP feedback was received by the Hexagon team on 8 October 2021 with high level discussions held on 18 October with NT Government representatives around options available for Hexagon to progress drilling program approvals with regulators.

On 26 November 2021 these options and their associated processes were provided to Hexagon, in detail, by the NT Government's Department of Environment, Parks and Water Security staff, who provide services to the NT Environment Protection Authority (EPA). Further clarifications have been requested before a final course of action is decided upon. As a result, drilling at Pedirka will not be completed by 31 December 2021, meaning that a JORC compliant resource will not form part of a PFS completed in the short term, as was originally planned.

Despite this delay, the PFS has still been able to be progressed with a range of opportunities identified that have the potential to deliver improved NT H₂ Project outcomes.

5. NT H₂ Project PFS Progress Summary.

The PFS work completed to date on the NT H₂ Project includes:

1. Engineering

- Hydrogen production technology options reviewed with selections completed.
- Hydrogen plant design and engineering Pre-Feasibility Study scope of work substantially advanced. Overall energy, mass and carbon balances and CapEx and OpEx estimates completed across multiple technology options.
- Progress made on renewable energy electricity supply options; meeting feedstock conversion requirements; negotiations for working with multiple large scale, well-established providers advanced.
- Construction options assessed.

2. Raw Materials, Transport and Handling

- End product, Raw material and Plant and Equipment (P&E) transportation options assessed for various potential plant sites. New transport infrastructure requirements CapEx and OpEx costs specified.

- Water supply options for multiple locations assessed in terms of quality, quantities and long term, sustainable access and costs.

3. Decarbonisation

- Multiple Carbon Capture and Storage (CCS) options have been identified, with access and cost negotiations advanced.

These findings have resulted in Hexagon focussing on decarbonised blue ammonia production (as a hydrogen carrier), incorporating CCS. Ammonia already has globally established transportation systems ranging from handling to containerisation to storage and customer receipting, along with associated infrastructure and health and safety systems.

Hexagon's blue ammonia plant or hydrogen Hub is currently being planned for within the Middle Arm Sustainable Development Precinct (Middle Arm) at the Port of Darwin.

Hexagon has undertaken to imbed as high a renewable component as possible in its hydrogen production processes and will ultimately seek to transition to fully renewable based liquid hydrogen production once technology breakthroughs and associated commercial benefits make this viable.

Creation of a Hydrogen Hub at Middle Arm in Darwin has the potential to deliver a number of critical hydrogen project components to Hexagon. These include access to large scale CO₂ geo-sequestration (CCS) and port (export) infrastructure along with access to large quantities of competitively priced and sustainably supplied long term, renewable energy and, from a plant construction perspective, could allow for greater prefabrication of plant components for barging to site.

Hexagon's optimal hydrogen plant location choice is being heavily influenced by existing port/export infrastructure that can be leveraged off, as well as access to low-cost feedstock and feedstock conversion energy, plus sustainable water quantity and quality availability and pricing and the cost of access to established CCS infrastructure and reservoirs.

Hexagon's aim is to establish a lowest risk and highest potential for commercial success clean hydrogen project which can rapidly be scaled up as markets emerge and grow. This has led the team to explore all options and opportunities with a number of potential project locations under assessment in Australia.

Throughout the PFS the Hexagon team has actively built relationships with a number of NT Government Departments and agencies as well as in other potential Australian project locations.

6. Moving Forward

The immediate next step for the Hexagon team is completion of the financial modelling and commercial analysis work. This will assess Hexagon's NT H₂ Project commercially as it was originally contemplated and evaluate and compare this Project against other opportunities that have been identified through the PFS process to date which have the potential to improve how Hexagon delivers against its Hydrogen strategy.

A presentation of the financial modelling and commercial analysis results/outputs will be made to the Hexagon Board when completed.

The financial model outputs and subsequent Board decision-making will dictate final NT H₂ Project PFS work program and timings. This will include any changes for Hexagon's Hydrogen strategy and the Company.

Further announcements will be made as soon as possible, including in relation to the targeted 31 December 2021 PFS completion date.

Hexagon's cash position at the end of the September quarter was A\$3.4 million. (See Hexagon's July - September 2021 Quarterly Activities Report released on 29 October 2021).

The Hexagon team has significantly added to its knowledge and experience throughout the PFS, working with a number of Australian and Global specialists and also through new Managing Director, Merrill Gray's insights gained from working in Hydrogen and Renewable Energy over the past fifteen years.

The insights gained will be of significant value to the Company as we determine the next steps to be taken towards realisation of Hexagon’s Hydrogen strategy for both Australian and global emerging markets.

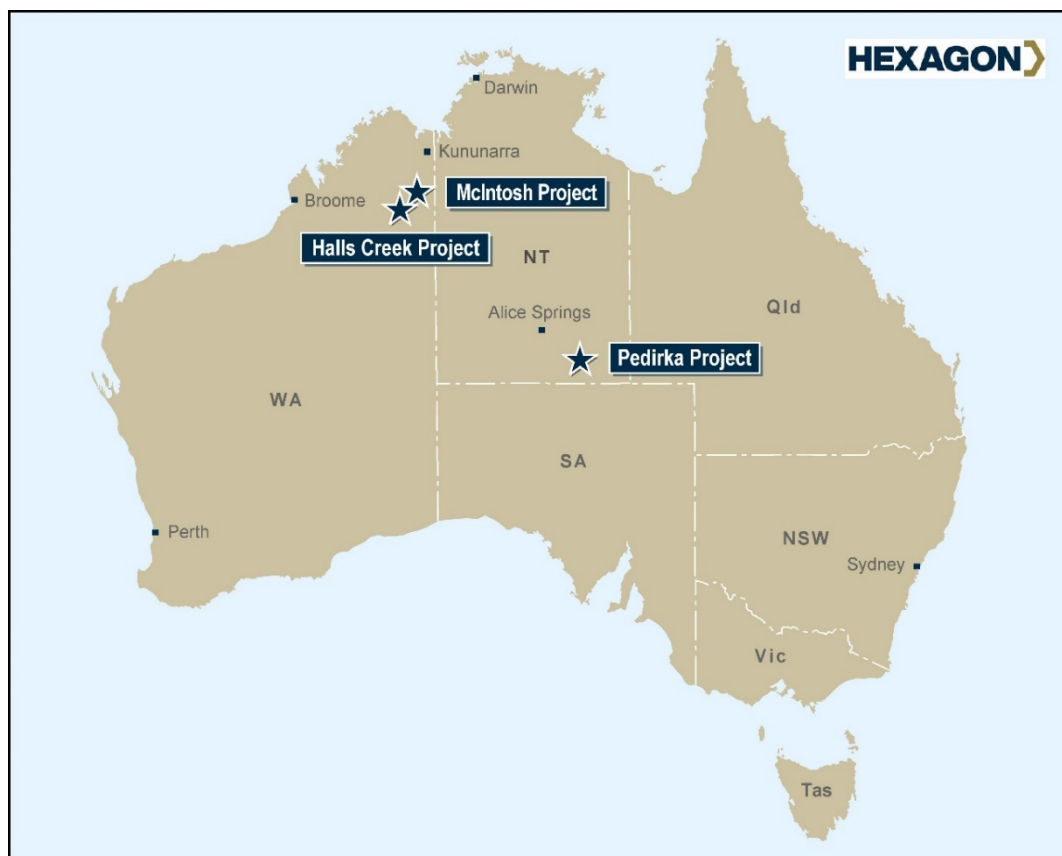


Figure 2: Hexagon’s Australian project locations

Authorisation

This announcement has been authorised by the Hexagon Board of Directors.

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ABOUT HEXAGON ENERGY MATERIALS LIMITED

Hexagon Energy Materials Limited (ASX: HXG) is an Australian company focused on clean energy project development and energy materials project exploration and development.

Hexagon is developing a business to deliver decarbonised hydrogen into export and domestic markets. The Pre-Feasibility Study for the NT (Pedirka) H₂ Project located in Australia’s Northern Territory, utilising gasification and Carbon Capture and Storage (CCS) is in progress.

Hexagon’s plan is to progressively increase its renewable energy inputs and lower its carbon emissions as it transitions from blue to green liquid hydrogen production, on a commercial basis, over time.

Hexagon also owns the McIntosh Nickel-Copper-PGE and Graphite project in Western Australia (WA) and the Halls Creek Gold and Base metals project also in WA. In the US, Hexagon has an 80 per cent controlling interest of the Ceylon Graphite project in Alabama, over which South Star Battery Materials Corp. (TSXV: STS) on 7 December 2021 signed an Option to earn up to 75% in.

Hexagon is actively progressing value accretive transactions consistent with its strategy, skill set, and focus on clean energy materials and clean energy.

To learn more please visit: www.hxgenergymaterials.com.au

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