

# Green hydrogen tech ready for investment on Australian farms

■ By Holli Walsh

**P**OWERING the future and achieving net zero is one of the greatest challenges of our time. Hydrogen, the most abundant element in the universe presents a unique opportunity – when it's converted to green hydrogen.

HydGene Renewables is leading this charge with its carbon neutral and high purity hydrogen solution, produced onsite at the farm, from renewable plant-based feedstocks, which removes the high-costs of transport and storage, long associated with hydrogen.

The Co-founders and bioengineers of HydGene, Louise Brown, Robert Willows, Kerstin Petroll and Tony Jerkovic, are changing the way green hydrogen is made and were recently awarded for their efforts, as one of Australia's top 23 game changing companies in the Tech23 2021 Showcase.

Established in 2020, the Macquarie University spinout, now based in The Future Project at Kings School in Parramatta, Sydney boasts a team of eight scientists. With a goal to reach \$2 per kilogram, HydGene energy will be cost-competitive with fossil fuels, replace grey hydrogen and help to fast-track the green hydrogen economy – all the while edging the world that bit closer to the 2050 net zero carbon emissions target.

Their hydrogen producing biocatalyst solution is deployed in a modular cartridge, which can be readily scaled to support the decarbonisation of major existing hydrogen industries including the farming, chemical manufacturing, and transportation sectors.

HydGene is able to take the sugars from feedstocks, such as straw and food waste. Using synthetic biology, they reprogrammed the bacterial microbes using the DNA blueprint of algae to turn these sugars into clean renewable hydrogen gas. The team first started looking at straw and how they could extract the sugars.

It just blew our minds how well it could work explained CEO and co-founder, Louise Brown. "You can extract a lot of sugars from straw. If you take 100 tonnes of straw, you can get 40 tonnes of sugars to use – that's enough to power 1000 houses each day. We're now trying to make the process more efficient fivefold to be able to power even more houses."

The startup is now seeking investment and partners to explore

other agricultural sources to help support sustainable farming, such as hay and woodchips, and continue scaling the technology.

## Why should farmers care about hydrogen?

There are many benefits to using hydrogen on-farm to make farming practices more sustainable and efficient. HydGene is focusing on three areas:

- Ammonia;
- Transport; and,
- Seasonal energy storage.

"Farmers use ammonia in their fertilisers. This is a great pain point for farmers, as costs are starting to increase across the world. The hydrogen used to make ammonia is from the fossil fuel industry, we need to decarbonise hydrogen to make green ammonia. We want to supply this to farmers," said Louise.

HydGene envisage their technology to be used on-site by the farmer to switch to green hydrogen for ammonia production, used for fertiliser. This puts the control back in the farmers' hands – making fertiliser when they need it, all on-site.

HydGene is excited about the new tractors, vehicles and technologies coming into the farming sector that are fueled by green hydrogen and how they can support this through the production of green hydrogen.

Louise explained, "Replacing diesel generators with hydrogen generators is a game changer for farmers. A lot of farms use diesel generators when their wind and solar energy supplies are intermittent, and they need to fill this energy gap. Whereas, if you have the hydrogen and a fuel cell, you can start to use green hydrogen to fill that gap."

It is estimated that transporting and storing hydrogen can more than triple the costs to hydrogen – this is where HydGene comes in.

Using their technology, they can make clean hydrogen on-site, and on-demand, which eliminates the need, complexities and high costs of storing and transporting hydrogen to the end user.

"It's a plug-and-play approach. Feeding the sugars from the feedstock directly into the biocatalyst to produce hydrogen, with the ability to turn it off and on so you have control for making



HydGene Renewables founding team. From left – Robert Willows, Kerstin Petroll, Louise Brown and Tony Jerkovic. (Photo: Nick Cubbin)



Selection of high performing hydrogen producing bacterial strains. (Photo: Nick Cubbin)

the hydrogen. The farmer has full control of their hydrogen supply and there is no need to transport feedstock, reducing major costs.”

**What’s next for HydGene Renewables?**

The team’s first funding support to grow the technology, was received while at Macquarie University, through an R&D Grant for clean hydrogen production from the Australian Renewable Energy Agency (ARENA).

HydGene have since received funding from the Department of Industry, Science, Energy and Resources through the Business Research and Innovation Initiative (BRII). They are also working

with the GRDC and CSIRO to develop a proof-of-concept process for the conversion of farm biomass waste, such as grain crop stubble, into clean hydrogen.

“The GRDC grant has been fabulous for HydGene. We have been able to develop the pipeline that we need to look at feedstock, understand the sugar profile and further engineer our strengths to make them more efficient, but it’s currently limited to looking at what a grain crop can do. We want to find further investment to look at other feedstock markets and supply chains to scale,” Louise explained.

“We’re also looking for support to help scale the biocatalyst module that is being developed. We currently are working



HydGene has taken sugars from feedstocks such as grain straw, and by using synthetic biology, can turn these sugars into renewable hydrogen gas.



Processing of various straw sources to extract sugars for hydrogen production. (Photo: Nick Cubbin)

# LIGHT YEARS AHEAD



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towards what we call our commercial unit that makes 100 grams of hydrogen per day, which is the equivalent energy output to what one commercial solar panel can make. We're looking for capital investment to scale that technology," Louise says.

HydGene are also interested in talking to anyone with connections to biomass supply chains and those looking for clean hydrogen for new and emerging technologies.

"Hydrogen has such a buzz out there at the moment, which is

great. There is a strong focus on making hydrogen through green electrolysis to get to the reduction target by 2050, but there are other ways that we can get there and faster.

"We are changing the supply market a little bit and can do it more quickly with lower costs to open up new industries, especially across agricultural and forestry sectors," said Louise.

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## RENEWABLES REMAIN CHEAPEST, BUT COST REDUCTIONS ON HOLD

Renewables remain the cheapest new-build electricity generation option in Australia, although inflation and supply chain disruptions will likely put cost reductions on hold for the next year, CSIRO's annual GenCost report has found.

Each year, Australia's national science agency CSIRO, and the Australian Energy Market Operator (AEMO), work with industry to give an updated cost estimate for large-scale electricity generation in Australia.

The report considers a range of future scenarios to understand the mix of technologies that may be adopted and costs for each of these possible pathways.

The 2021–22 report confirms past years' findings that wind and solar are the cheapest source of electricity generation and storage in Australia, even when considering additional integration costs arising due to the variable output of renewables, such as energy storage and transmission.

### Important electricity market insights

According to CSIRO Chief Executive Dr Larry Marshall the detailed scientific and engineering analysis reported on in GenCost provide important insights into the electricity market, helping industry and government navigate Australia's energy transition.

"Australia's energy sector faces a number of unique challenges as we navigate the transition to net zero emissions. GenCost is a rigorous analysis to help inform decision makers with detailed insights to support the decarbonisation of Australia's energy system," says Larry.

"The latest report shows renewables are holding steady as the lowest cost source of new-build electricity.

"With the world's largest penetration of rooftop solar, unique critical energy metals, a world class research sector and a highly skilled workforce, Australia can turn our challenges into the immense opportunity of being a global leader in renewable energy," he said.

Projections in the report assume that cost reductions for all technologies will stall for the next 12 months because tight global supply chains will require more time to recover from the pandemic.

But after the current inflationary cycle ends, solar, wind, and batteries are all projected to keep getting cheaper.

CSIRO Chief Energy Economist Paul Graham said researchers had observed year-on-year cost reductions for most technologies and this year's report is no exception.

"What will be different in the next year is that we will have a confluence of factors impacting project costs. The war in Ukraine has resulted in fossil energy price inflation which flows through to all parts of the economy through transport and energy costs. We also have tight supply chains that are still recovering," he said.

### Faster transition to hydrogen

The final 2022 report also includes an update on costs of hydrogen electrolyzers which are experiencing rapid cost reductions and could support a faster transition to green hydrogen, particularly in the current context of high natural gas prices.



The CSIRO report found solar (and wind) to be the cheapest renewable sources of electricity in the national grid.

The updated analyses also found that:

- Both onshore and offshore wind costs have fallen faster than expected. Onshore wind cost changes reflect Australian projects. Offshore wind is yet to be developed in Australia but cost reductions achieved overseas mean that Australian projects are expected to be lower cost than previously expected.
- Solar and wind continue to be the cheapest sources of electricity for any expected share of renewables in the grid – anywhere from 50 to 90 per cent. A 100 per cent renewable system would not be entirely made up of wind and solar but include other renewables such as hydro power, biomass, and green hydrogen.
- Solar and wind begin to require additional investments in storage and transmission once variable renewables reach around 50 per cent share of generation. Solar and wind require new transmission connections to access the best resource. Storage, in the form of batteries or pumped hydro, together with existing flexible gas generation ensures that demand can be met reliably from these variable generation sources.

Cost reductions for technologies not currently being widely deployed such as carbon capture and storage (CCS), nuclear Small Modular Reactors (SMRs), solar thermal, and ocean energy are lagging and would require stronger investment to realise their full potential.

The status of nuclear SMR has not changed. Following extensive consultation with the Australian electricity industry, report findings do not see any prospect of domestic projects this decade, given the technology's commercial immaturity and high cost. Future cost reductions are possible but depend on its successful commercial deployment overseas.

AEMO's Executive General Manager – System Design Ms Merryn York said analysis shows that timely investment in new, firmed renewables will provide the most economic form of electricity generation moving forward.