Making good on Australia's hydrogen headstart

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The Federal Government is doubling down on its Hydrogen Headstart initiative, which aims to fuel the growth of Australia's green hydrogen energy industry.

With the most recent federal budget, more than $3.3 billion is now going towards investments to accelerate the nation's embrace of the future fuel[1]. But Australia already has a head start on hydrogen energy.

In fact, in 2022, Australia became the first nation to ever export liquid hydrogen. ABB provided end-to-end engineering and project management support for the Hydrogen Energy

Supply Chain (HESC) pilot, helping liquify hydrogen at the Port of Hastings in Victoria before shipping it to Kobe, Japan.

It was a pioneering effort to demonstrate the viability of international, mass-scale hydrogen transportation networks, and ABB was excited to be involved, supplying everything from instrumentation and electrification solutions through to automated systems.

HESC demonstrated that Australia could become a hydrogen energy superpower, but that does not mean dominance of this new energy market is inevitable.

Even with other natural advantages, such as renewable energy capacity, proximity to major Asian export markets and a workforce with highly relevant skills and experience building a world-leading liquefied natural gas (LNG) export industry, we still have a way to go to win the race.

Developing a competitive industry that can place Australia at the forefront of becoming a hydrogen superpower will require coordination of disparate economic actors and integrating complex supply chains. Partners with broad capabilities will be essential to navigating the new zero-emissions hydrogen ecosystem.

Hydrogen energy competition

The Headstart program has shortlisted six projects for potential share of funding[2] that together represent a total electrolyser capacity of more than 3.5 GW – not far off double the existing global electrolyser capacity.

In addition, a hydrogen production tax incentive worth $6.7 billion will support renewable hydrogen produced from 2027, while a further boost arrives via the Future Made in Australia initiative, which seeks to increase investment in hydrogen capacity and green metal production.

But this effort is part of a race to hydrogen dominance being fought internationally. Australia's measures are competing, for instance, with the US's Inflation Reduction Act, which contains the most generous hydrogen subsidies in the world.[3] Tax credits of up to US$3 a kilogram for green hydrogen mean that the US has already made it cost-competitive with grey hydrogen.[4]

Why hydrogen experience matters

Of course, creating a green hydrogen ecosystem starts with producing green hydrogen.

With most green hydrogen production not yet cost-competitive with traditional approaches to hydrogen production, maximising the efficiency of the plant – such as the electrolysers green hydrogen production depends on – is vital for the success of green hydrogen energy.

The faster the industry can drive up overall efficiency, the quicker it becomes cost competitive not just with grey hydrogen, but with other fossil-fuelled energy sources as well. In the French city of Auxerre, an ABB energy management system has reduced energy costs by up to 16% at a low-carbon hydrogen production and distribution station.

The station uses ABB's Optimax software to increase the efficiency of the energy-intensive electrolysers that are used in green hydrogen production. By providing data to determine optimal energy consumption levels during the production process, while minimising waste, the technology improves efficiency at every step of the plant's lifecycle, from design and engineering through to operation.

Optimax also considers such factors as asset availability and price variation, and the hydrogen produced from the improved electrolysis processes at the plant is used to supply buses, light commercial vehicles and trucks in the local transit network, saving thousands of tonnes of carbon emissions each year.

ABB is also making efficiency gains with modular green hydrogen plants in Italy, using automation, electrification, and digital leadership in industrial operations to lower the carbon footprint and reduce operating costs. Leveraging this domain expertise is helping to minimise the total cost of running the plant, enabling widespread uptake of hydrogen in the future.

Energy now, energy later

The hydrogen ecosystem depends upon more than production, however. A key advantage of green hydrogen is its ability to store and relocate green energy, but it also comes with some challenges.

Hydrogen in gaseous form is three times less energy-dense than methane, making it much costlier to transport. While it requires less energy to transport hydrogen if it is first converted to ammonia, this adds environmental risks, and the ammonia will still need to be converted back to hydrogen at its destination. Although hydrogen can be transferred through existing pipeline infrastructure, these connections must be retrofitted if they are to carry a hydrogen blend that exceeds 20%.

ABB's transportation technology seeks to address these inefficiencies and technical challenges by incorporating containerised, modular automation infrastructure; tank farm automation; and compressor and pumping stations.

It was ABB technology like this that brought Australia's HESC pilot into reality. Although pipelines are suitable for inland transport of bulk quantities of hydrogen, the trans-oceanic distances involved in HESC require the gas to be converted into a higher density form, such as liquid.

Significant costs can be involved in both this conversion process and the transportation. It is estimated that the cost of converting and moving hydrogen 1500 km by ship comes to US $0.6/kg for liquid organic hydrogen compounds, US$1.20/kg for ammonia and US$2/kg for liquid hydrogen.[5] Managing collecting systems and tanking facilities in a safe way also requires specialised technology and deep expertise.

ABB's support for HESC incorporated electrification and instrumentation solutions, along with services for production and liquefaction in Australia, as well providing automation for the regasification plant at the Japanese end.

Fuelling up

Once transported, hydrogen needs the right systems and processes in place at the consumption end before it can be used effectively. Existing infrastructure such as gas turbines and household appliances can handle a mixture of methane and varying amounts of methane and hydrogen (5% to 30 %, depending on what is used for), and new designs could increase the viable concentration of hydrogen.

Fuel cells are already available in cars and suitable for other transportation systems, and they're widely used to provide heat and power for critical infrastructure such as hospitals. There is potential, too, for residential scale use, although current costs in this sector are high. ABB's domain expertise and understanding is doing much to refine the downstream processes that make hydrogen consumption more viable. Hydrogen is a highly flexible form of energy storage, and ABB initiatives have demonstrated how it can be used in small and large projects on water and on land.

ABB is working with Hydrogene de France to build megawatt-scale fuel cell systems suitable for large ocean-going ships, while a 2021 pilot program had fully hydrogen-powered vessels operating in the Rhone River under the EU's Flagships initiative. For this, ABB provided fuel cell-based power and propulsion, which drew entirely on emission-free, shore-based power. Another vessel included in the initiative is a self-propelled barge designed to operate on the Seine in Paris. Originally designed to use diesel-electric power, the barge was reconfigured to store 350 kg of hydrogen at a pressure of 300 bar, fuelling 200 kW fuel cells supported by lithium-ion batteries that adjust their power supply to ensure optimal performance.

On land, the US's first hydrogen-powered train will operate along a 15 km stretch of track in San Bernardino, California, as part of the Redlands Passenger Rail Project. The locomotive is supported by ABB traction systems in the form of a traction converter, a DC/DC converter, three 28 kWh battery packages, and a battery thermal management system.

Building partnerships

The nascent green hydrogen sector needs partners with broad capability across power systems and process control to simplify the project by reducing the number of cooks in the kitchen, particularly when managing complex projects spanning sectors such as pipelines, renewable power and shipping.

Space for renewable energy generation and supportive government policies are two key ingredients for building a thriving green hydrogen sector, but there is a third as well – effective partnerships, to ensure the inputs create quality outcomes.

As ABB has demonstrated, its expertise has already taken pioneering hydrogen projects from conception to reality, showing a concrete way forward for a fuel source that is seeing rapid take up and significant investment. These are the factors helping to take Australia's innate strength as a potential player in the green hydrogen ecosystem and make it into a sophisticated and lucrative industry.

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