BECKHOFF New Automation Technology

The future of hydrogen in Australia's resources sector

Unlocking automation for a greener industry

Set to be a leading zero-emissions fuel alternative, hydrogen is at the threshold of becoming an industrial-scale reality. The Australian mining and resources sectors are on track to be early adopters of this technology, the growth and accessibility of which will rely on modern automation.

Larger sites will likely begin with a hybrid approach, utilising both electrification and hydrogen to replace diesel-powered equipment. Not all activities can be decarbonised through electrification, and hydrogen has wide-reaching potential across different applications such as transport, refining, and even as feedstock in the production of 'green minerals' like steel.

This white paper discusses why the next few years will prove critical as the industry navigates key challenges related to supply and demand. It also outlines the case for adopting PC-based control technology to automate processes and improve the safety and efficiency of hydrogen facilities. Importantly, it includes a case study with Australian solutions provider Energys, which demonstrates the potential for hydrogen in practical applications.

Hydrogen snapshot: Leading the way

Australia is one of the most well-placed countries in the world to adopt hydrogen as a versatile and safe energy solution. In addition to abundant renewable resources, it has geological storage capacity and an established place in the energy export market.

The National Hydrogen Strategy outlines how the domestic economy can use the opportunity of global momentum to become one of the largest hydrogen suppliers by 2030. In doing so, it must navigate the most prominent barriers to growth: building demand, establishing low-cost hydrogen production, and reducing the expense of delivery.[1]

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According to Australia's most recent State of Hydrogen Report, public sector investment is higher than ever before, with private funding also increasing rapidly. Importantly for the resources market, gigawatt-scale projects are now in the pipeline, and expected to begin operations within the next few years. Additionally, the cost of green hydrogen is set to decline, and substantial government financing has gone towards piloting microgrids for mining and remote projects.[2]

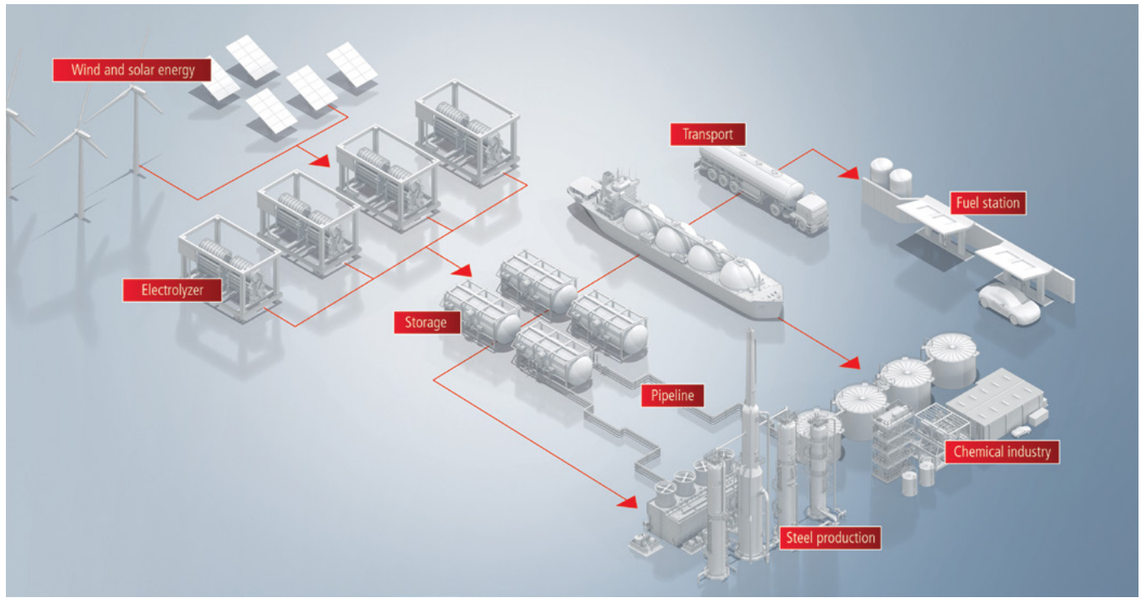
Green hydrogen costs declining

$103.6m funding for mining and remote projects

Gigawatt-scale projects by: 2025

According to Nick Psahoulias, Managing Director at Beckhoff Automation Australia, the potential for hydrogen is at a tipping point, as the technologies required to upscale and streamline production begin to align. He explains that the critical dynamic going forward will be balancing supply and demand, driving production costs down to encourage an upswing of usage that will fund future advancements in the technology.

"I believe we are the cusp of something great. Hydrogen is widely regarded as the energy storage medium of the future and has a central role to play in the resource sector's transition to decarbonise. Electricity generated from renewables – such as wind, wave and solar – can be converted by electrolysis into hydrogen and stored or transported for use anywhere, any time."



Why hydrogen, why now?

Under international climate agreements, Australia has committed to 26-28 per cent reduction on 2005 emission levels by 2030.[3] The more recent 2022 Climate Change Bill has taken a step further, outlining a target of 43 per cent reduction by 2030, and net zero by 2050.[4]

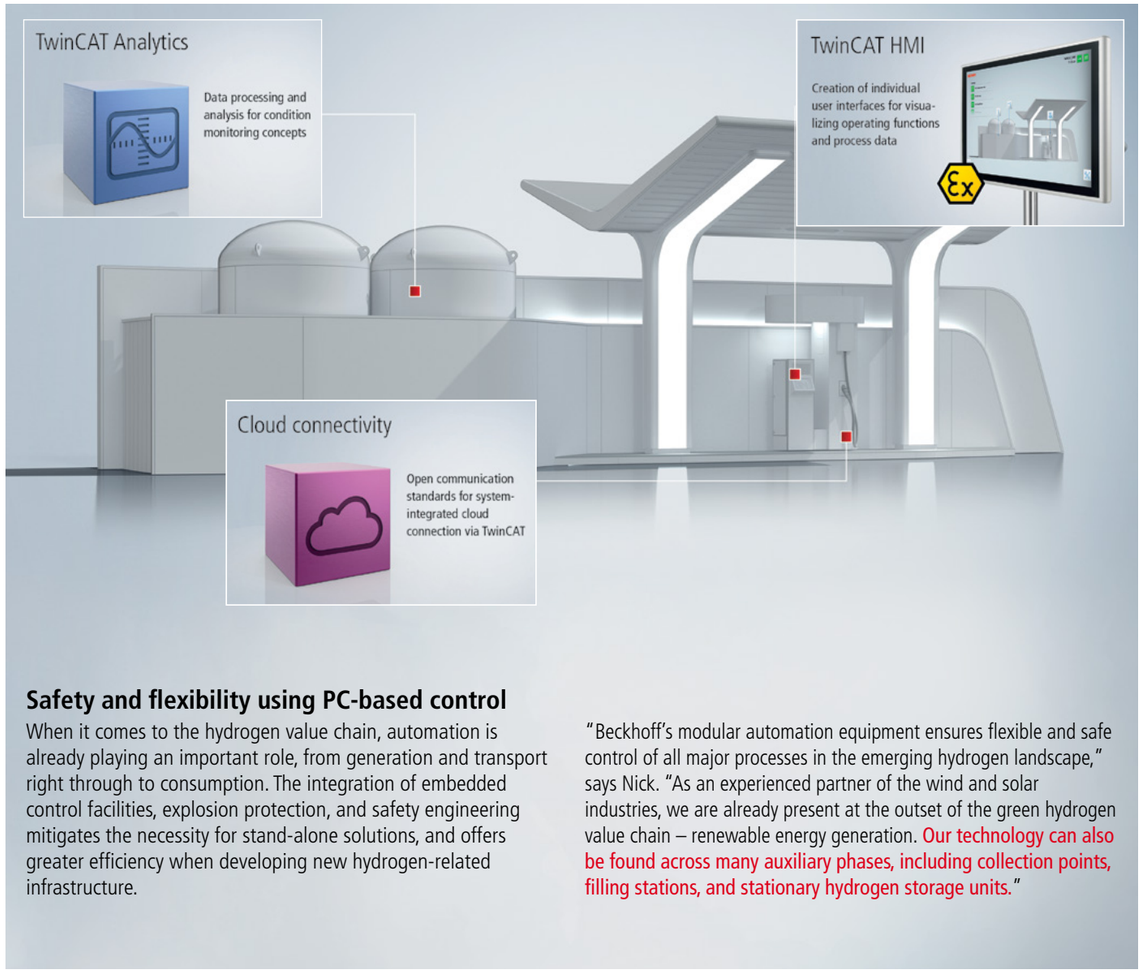
The Paris Agreement, which came into action in 2016, draws on comprehensive modelling to demonstrate that the coming decade must be one of transformational action, particularly within emission-heavy industries such as energy and mining. More specifically, global temperature rise must be limited to well below two degrees Celsius above pre-industrial levels.[5]

"These ambitious targets effectively mean transitioning away from fossil fuels, and embracing renewable, green and technologically advanced solutions," says Nick. "Investors and consumers alike are beginning to recognise the crucial impact that decarbonisation will have in the future growth and sustainability of the resources industry."

Electricity production and industrial processes are the two largest contributors to Australia's overall greenhouse gas emissions.[6] According to some calculations, if Australia is to meet its climate change goals set out by the Paris Agreement, coal mining, oil and gas must see a significant drop in production by 2050.[7] Despite this, the transition to replacement energy sources – including hydrogen – will likely facilitate a national mining boom.[8]
To accelerate the production of assets such as wind turbines, electric vehicles, solar panels, and large batteries, the nation will need to increase its production of critical materials including copper, nickel, cobalt, and lithium. To accommodate for this, players in the resources sector will need to take stock of their own emissions footprint, and implement measures to reduce them wherever possible.

Australia has a clean track record for hydrogen related safety, and a robust, internationally accepted certification scheme in place.[9] Building on these strong foundations, the resources sector stands to inherit considerable financial benefits by embracing it as a pathway forward.

Decarbonisation has potential as a major revenue opportunity, from the extraction and sale of raw materials needed for the energy transition, to premium pricing on lower-carbon products. According to a report released by Deloitte on the journey to decarbonisation by 2030, reduced capital costs from carbon pricing schemes and ESG incentives are already making an impact.[10]



Safety and flexibility using PC-based control

When it comes to the hydrogen value chain, automation is already playing an important role, from generation and transport right through to consumption. The integration of embedded control facilities, explosion protection, and safety engineering mitigates the necessity for stand-alone solutions, and offers greater efficiency when developing new hydrogen-related infrastructure.

"Beckhoff's modular automation equipment ensures flexible and safe control of all major processes in the emerging hydrogen landscape," says Nick. "As an experienced partner of the wind and solar industries, we are already present at the outset of the green hydrogen value chain – renewable energy generation. Our technology can also be found across many auxiliary phases, including collection points, filling stations, and stationary hydrogen storage units."

Linking electrolysers

A fundamental stage in the creation of green hydrogen is electrolysis – the reaction that splits water into hydrogen and oxygen using electrical energy sourced from renewables. Harnessing PC-based control for this process makes it possible to combine the widest range of I/O components within a single system, allowing it to become completely automated and closely monitored.

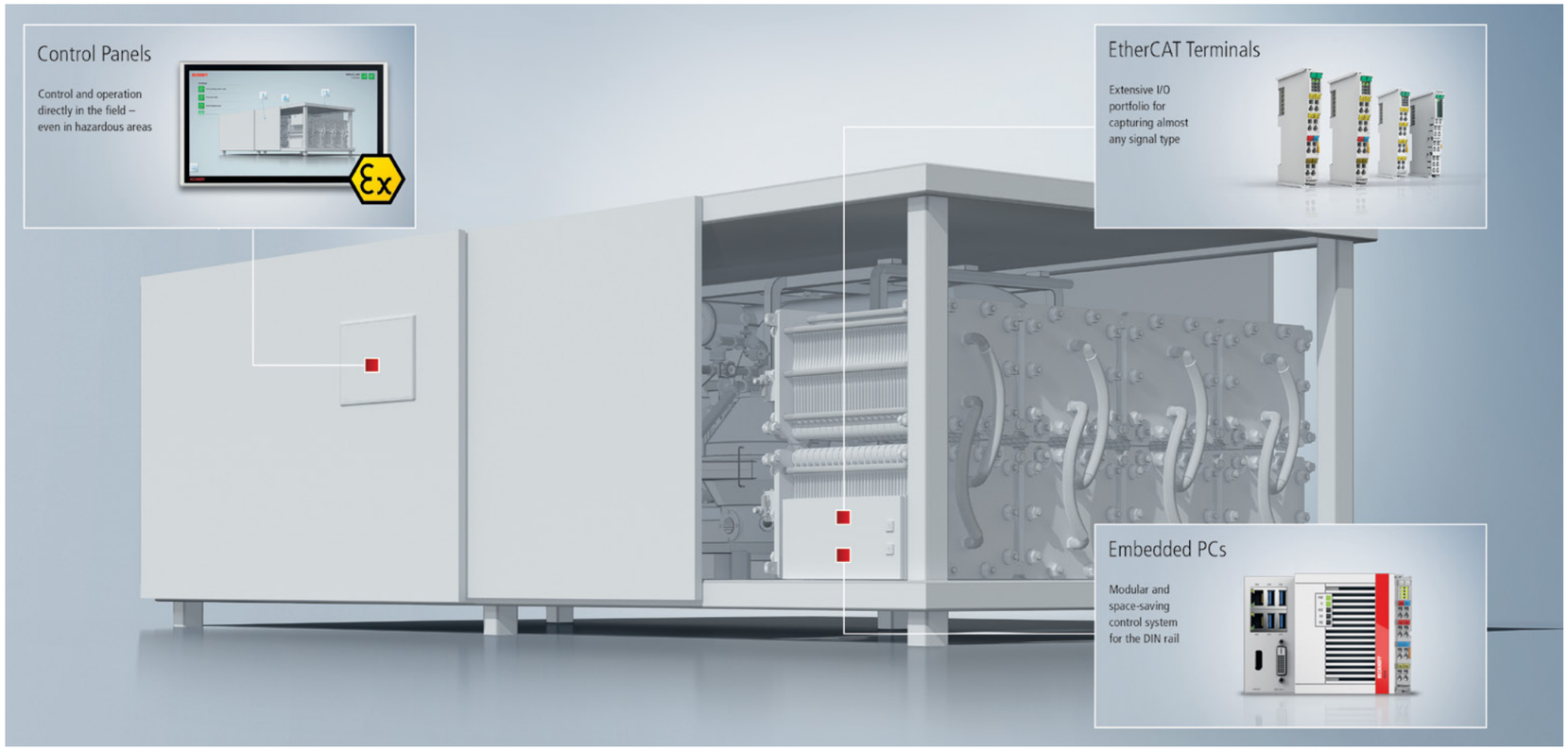
"The TwinCAT control software provides a central platform for highly complex systems, as well as intercommunication between facilities and cloud-based analytical functions," explains Nick. "Tailored algorithms can be executed in real time, allowing for different programming styles."

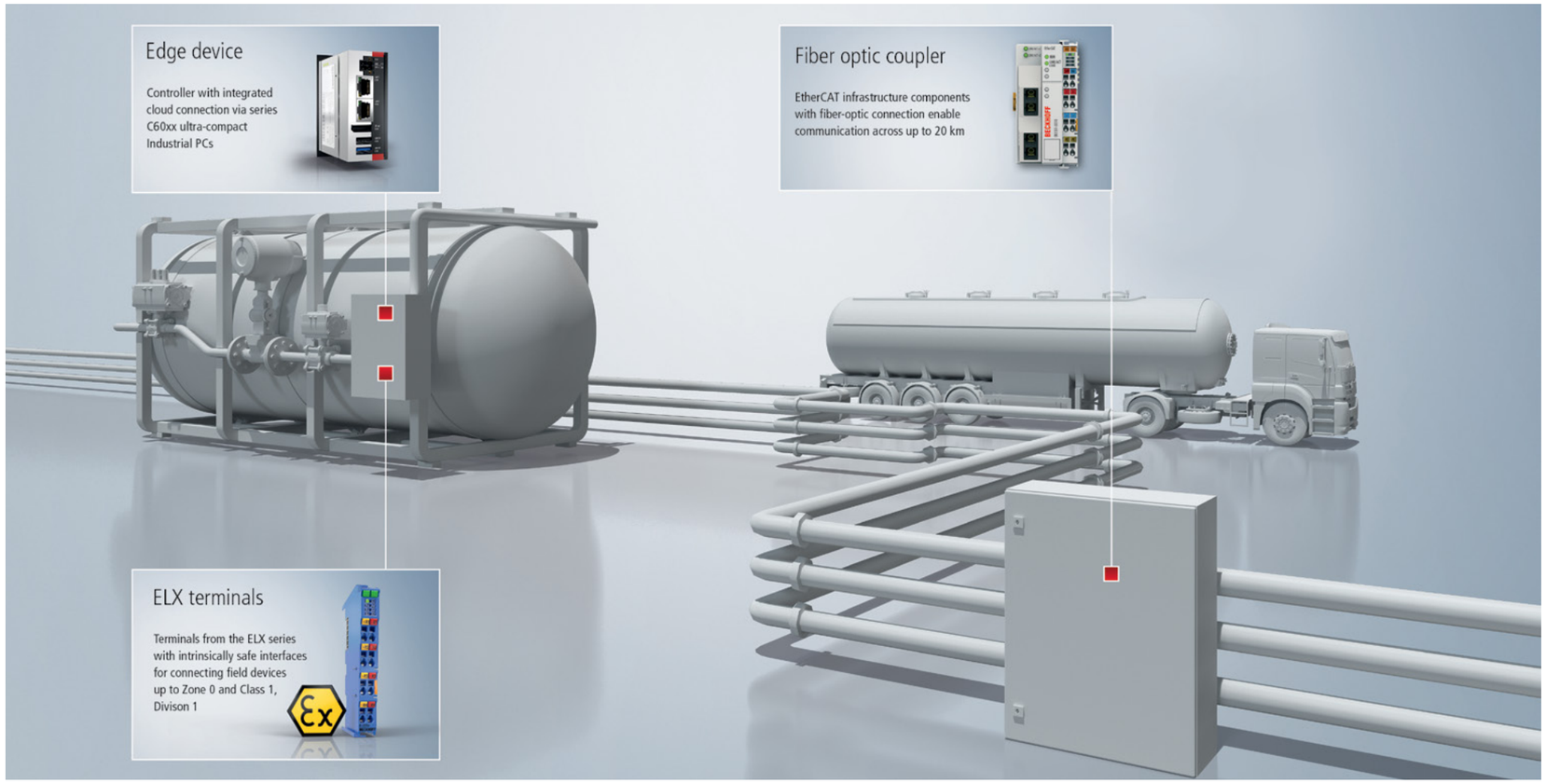
Each EtherCAT Terminal acquires and processes relevant data from the electrolysis cell, such as temperature and pressure readings, before transferring the signal via a fieldbus to a powerful embedded PC.

Control panels can be equipped to operate the plant, and remotely monitor asset status within the vicinity.

The portfolio's diagnostic concept introduces complete and fast error identification, providing greater control over maintenance procedures to increase plant availability and avoid costly downtime. Furthermore, all other common communication protocols can be integrated into this system, giving uniformity and greater visibility for operators.

As hydrogen emerges at an industrial scale, this data acquisition framework must have capacity for larger areas. Energy parks will expand over time, which is why EtherCAT is designed to allow communication over distances of up to 300 metres. Where greater distances are required, fibre optic solutions offer transmission length up to 20 kilometres.





How does electrolysis work?

An electrolyser is made up of a cathode and an anode, which are separated by a partially permeable membrane. A voltage is passed between these two components, creating an electrical current that splits water. The result is oxygen and hydrogen becoming separated, collecting at opposing ends of the cell. The hydrogen is then extracted and stored as a compressed gas or liquid for future use.

Preventing explosions

Aside from the optimisation of electrolysers, PC-based control also proves highly beneficial for safe storage and transport. Hydrogen is usually stored in a compressed state within high pressure storage tanks, which require close monitoring of pressure, temperature, and limit levels to prevent system damage or uncontrolled release.

To allow for this, Beckhoff has developed ELX Terminals, which capture the relevant signals from within the tank. These signals are then processed by an edge device (such as an ultra-compact PC) via EtherCAT, before being transferred to the cloud for analysis. This same concept can be utilised to monitor hydrogen pipelines for leaks, flow rate, and pressure.

The terminals are also certified to meet all industry-specific guidelines for explosion protection. When paired with Beckhoff's TwinSAFE portfolio, they form a full solution appropriate for up to Zone 0 and Class 1, Division 1, suitable for every application across the growing hydrogen industry.

Case study
Energys: Hydrogen in practice

Energys is an Australian company turning the promise of clean, sustainable hydrogen into a reality. Well-equipped to meet the challenges of a shifting energy market, they are focused on eliminating diesel dependency, making green hydrogen an economic reality, and providing tangible infrastructure to accelerate production.

"Energys have a very sophisticated approach, which encompasses the modular control philosophy of Beckhoff hardware, and the benefits of our universal EtherCAT architecture," says Nick. "They are acutely aware of automation requirements both now and into the future, and appreciate the investment protection offered by the portfolio's backwards-compatibility."

Noel Dunlop, Vice President and Co-founder of Energys, says there is a current economic advantage for Australia to transition to hydrogen power. Positioned away from an established electricity grid, remote communities and mining projects are operating on diesel gensets, which emit carbon, generate noise, and require ongoing costly maintenance.

> "Unlike in Europe, where there is a far-reaching and established grid network, we have a unique opportunity to make direct hydrogen replacements across rural and regional Australia," he says. "The challenge now is encouraging decision-makers to initiate the transition. Upfront capital for hydrogen projects is higher than diesel systems, but over the 10 to 25-year lifecycle of a mine, hydrogen is a significantly less expensive model."

Energys creates hydrogen gensets ranging from 10 kilowatt to 100 kilowatt outputs which are designed to operate as standard diesel replacements. Building on this, their Powerhouse Range offers 100 kilowatt to multi-megawatt output for the replacement of large diesel engines, and gas turbines.

"Most of these are what we call hybrid systems," Noel explains. "At the moment, there is growing interest in these for standalone power systems to replace SWER lines, which are struggling to deliver adequate power to the most remote locations in Australia. Rather than spending billions of dollars and waiting a decade or more to upgrade these lines, we have the option to implement solar battery hydrogen systems now."

The company is working on numerous concepts for closed systems on mining sites, which are expected to begin operation over the next few years. According to Noel, most of these will harness renewable solar, and include a localised hydrogen production facility. This is then paired with a battery system and hydrogen fuel cell.

"We have been in conversation with the resources sector for the last eight years, but when we started there was nothing like this in the pipeline. We developed our own proprietary modelling framework, which is now being used around the world to optimise hydrogen systems and drive the lowest cost of kilowatt per hour."

Energys is one of the few companies in Australia that currently supplies fully integrated, stackable fuel cells for fixed and mobile applications. Designed as a modular solution, they prioritise scalability as a means to overcome cost increase as hydrogen sites expand. Manufacturing in Australia is important to the company's ethos, says Noel, and using Beckhoff technology allows control system optimisation to drive the cost of production down.

> "We began with Beckhoff early on because we knew that EtherCAT programming wouldn't become redundant in five years' time. It's important for future growth, because we expect our products to have a decades-long lifecycle. We are leading in the hydrogen space to develop real-world solutions, and the reliability of Beckhoff's product allows us to commit to that."

"The other key drawcard for us has been their independently reviewed safety cases and TwinSAFE software. Because they have already been validated, we don't have to go back and forth to re-certify them. This saves us a lot of time developing our product to meet Australian and global standards."

In summary

In the next few years, the integration of industrial-scale hydrogen plants for mining and resources will depend on the reliability and futureproofing of PC-based control. Automation and digital monitoring align with Australia's robust certification framework, ensuring a scalable and safe model for a diverse set of applications.

"Combining a full range of functions – including data capture from sensors and actuators – into one system can protect people, assets, and environments," concludes Nick. "Over the last decade, we have begun catering to the emerging hydrogen industry, helping to keep cost of production low to meet growing demand. This will be vital as we work towards meeting national and global emissions targets."

Secure your lead in the hydrogen industry with PC-based control:

► **www.beckhoff.com/hydrogen**

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