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DISCOVER OUR COMPRESSED AIR WHITEPAPERS

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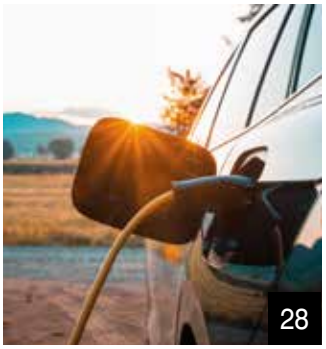

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WORDS from the EDITOR

The federal government's Future Made in Australia policy is all about seizing the local opportunities for our country's move to renewable energy. The government doesn't just want to meet our goal of net zero emissions by 2050, it wants to achieve it locally using our own resources and minerals.

Of course it makes sense to ramp up our local manufacturing capabilities, but at the same time we must be careful to manage our finite resources effectively.

In our lead opinion article, Jim Goddin explains how a circular economy is essential for a sustainable transition to renewable energy. While we need to scale up our mining practices in order to create enough wind farms, solar panels and batteries for electric vehicles to meet demand, he says this must be done sustainably — recycling will not be enough.

In addition to managing our resources sustainably, we also take a look at a new type of thermochemical reactor that has the potential to decarbonise many industrial processes, including cement manufacturing.

Also, remember the 2024 Waste Expo AusÂtralia event is just around the corner, so be sure to note it in your diary. The two-day event runs from 23–24 October at the Melbourne Convention and Exhibition Centre.

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Critical materials must go circular for energy transition

Jim Goddin – Head of Circular Economy thinkstep-anz

As we decarbonise our energy sources, the demand for critical materials is growing. Lithium, nickel, cobalt, manganese, graphite and rare earth elements are among the materials needed to create wind farms, solar panels and batteries for electric vehicles. thinkstep-anz's Head of Circular Economy, Jim Goddin, explains how a circular economy is essential for a sustainable transition to renewable energy.

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There's no way around mining critical elements. Those materials that are commercially essential but rare are only found in certain regions and prone to price volatility or exposure to social or environmental risks. If we accept that we need them for technologies that replace energy from fossil fuels, the only solution is to mine them. They're unavailable elsewhere in the volumes we'll need them, and although we should keep working on substitutes, time is now against us.

This means that sustainable mining practices are crucial. Today, comminution (crushing rocks) accounts for around a third of a mine's typical energy use. Collectively, this accounts for around 3% of global energy use — just crushing rocks.

For many minerals, we've already extracted the rich deposits. The concentration of desired materials in the rocks we mine has reduced significantly since the early 1900s. This means we must crush more rock to get the minerals we seek.

The European Union is heavily focused on sustainable extraction as it aims to produce more of what the region needs at home. Mining can leave visible scars on the landscape, and reports of its environmental and societal impacts are all too common. This means that the bar for a social licence to operate is high. Taking genuine action to promote sustainable mining is vital, but just as important is how we use the materials we extract.

The link between critical minerals and the circular economy

The circular economy is all about retaining manufacturing value. It's about keeping the products we manufacture in service for longer and how we can reuse, remanufacture and ultimately recycle or reintroduce materials back into the environment to nurture more growth.

Recycling alone isn't the solution.

A significant challenge in recycling critical materials is the loss of trace elements during the process. When we recycle high-value alloys containing critical minerals, those critical minerals often get lost or diluted through the recycling process. This means that we must replace those critical elements and the only way to do that is to mine some more.

> "The circular economy is all about retaining manufacturing value ... recycling alone isn't the solution.

One of the best ways to minimise the impacts of mining — and our exposure to supply risks — is to reduce the material we need. This means using materials for longer and then reusing or remanufacturing components, so we keep their properties and maintain the value added through manufacturing.

Doing this doesn't reduce what we need to mine to establish our low-carbon future but drastically reduces our need to replace these materials. This, in turn, enables other regions to secure what they need sooner and accelerates the low-carbon transition. It also creates opportunities for new jobs and shelters our economy from supply shortages, price volatility and geopolitical factors that would otherwise undermine our economic resilience.

The role of geopolitics

The geopolitical landscape significantly influences the supply of critical minerals. Countries like China have established a monopoly over certain minerals through state-supported mining and refining processes.

To mitigate supply chain risks, countries must collaborate with friendly nations and adopt circular economy principles. Businesses, particularly in advanced manufacturing, play a vital role in managing these risks. It's imperative for a business to understand their risks and find ways around them.

Businesses must understand and manage the risks associated with the supply of critical materials. Developing strategies to retain ownership and access to these materials is vital for mitigating supply chain disruptions and ensuring long-term sustainability.

Shifting the mindset

Our traditional economy involves making and selling products. Once we've sold the product, we no longer have access to the materials it contains, and we have to buy more. As the demand for materials outstrips supply, our costs and risks increase.

In the circular economy, the focus isn't on selling the product but on selling the function that the product delivers. A growing number of businesses have adopted this model and now rent access to their products. They retain ownership and continue to have access to the critical materials they've already bought. In some cases, this approach has also motivated the business to design better, more durable and more repairable products. Philips' light-as-a-service is an excellent example of this.

However, one of the most challenging aspects of this transition is changing societal attitudes. A large part of how we define ourselves and broadcast our success in life is through buying things. How do we shift the old markers of success to something else that doesn't require us to consume vast amounts of material?

What should we aspire to instead as a society and as individuals? The most frequent response to this question is that we need to redefine success in life, shifting our markers from material possessions to free time, experiences, relationships and community contributions.

Sustainable mining and circular economy models are crucial to our economic resilience and to our low-carbon, sustainable future. However, the real challenge is changing what we aspire to and how businesses deliver value to us.

Magnetic way to heat

Decarbonising the industrial process sector

A new type of thermochemical reactor has the potential to decarbonise many industrial processes, including cement manufacturing.

Researchers at Stanford Engineering have designed and demonstrated a new type of thermochemical reactor that is capable of generating the immense heat required for many industrial processes with fewer carbon emissions. The electrified design, published in *Joule*, is also claimed to be smaller, cheaper and more efficient than existing fossil fuel technology.

"We have an electrified and scalable reactor infrastructure for thermochemical processes that features ideal heating and heat-transfer properties," said Jonathan Fan, an associate professor of electrical engineering at Stanford and senior author on the paper. "Essentially, we're pushing reactor performance to its physical limits, and we're using green electricity to power it."

Most standard thermochemical reactors work by burning fossil fuels to heat a fluid, which then flows into pipes in the reactor — like a boiler sending hot water to cast iron radiators in an old house, but with better insulation and at much higher temperatures. This requires a large amount of infrastructure and there are many opportunities to lose heat along the way.

The electrified reactor uses magnetic induction to generate heat — the same sort of process used in induction stoves. Instead of having to transport heat through pipes, induction heating creates heat internally within the reactor, by taking advantage of interactions between electric currents and magnetic fields. If you wanted to inductively heat up a steel rod, for example, you could wrap a wire around it and run an alternating current through the coil. These currents create an oscillating magnetic field which, in turn, induces a current in the steel. And because steel is not a perfect conductor of electricity, some of that current turns into heat. This method effectively heats the whole piece of steel at the same time, rather than creating heat from the outside in.

Adapting induction heating for the chemicals industry is not as easy as just turning up the heat. Industrial reactors need to evenly create and distribute heat in a three-dimensional space and be much more efficient than the average stovetop. The researchers determined that they could maximise their efficiency by using particularly high frequency currents, which alternate very quickly, in conjunction with reactor materials that are particularly bad conductors of electricity.

The researchers used new, high-efficiency electronics developed by Juan Rivas-Davila, an associate professor of electrical engineering and co-author on the paper, to produce the currents they required. They then used those currents to inductively heat a three-dimensional lattice made of a poorly conducting ceramic material in the core of their reactor. The lattice structure is just as important as the material itself, Fan said, because the lattice voids artificially lower the electrical conductivity even further. And those voids can be filled with catalysts — the materials that need to be heated to initiate chemical reactions. This makes for even

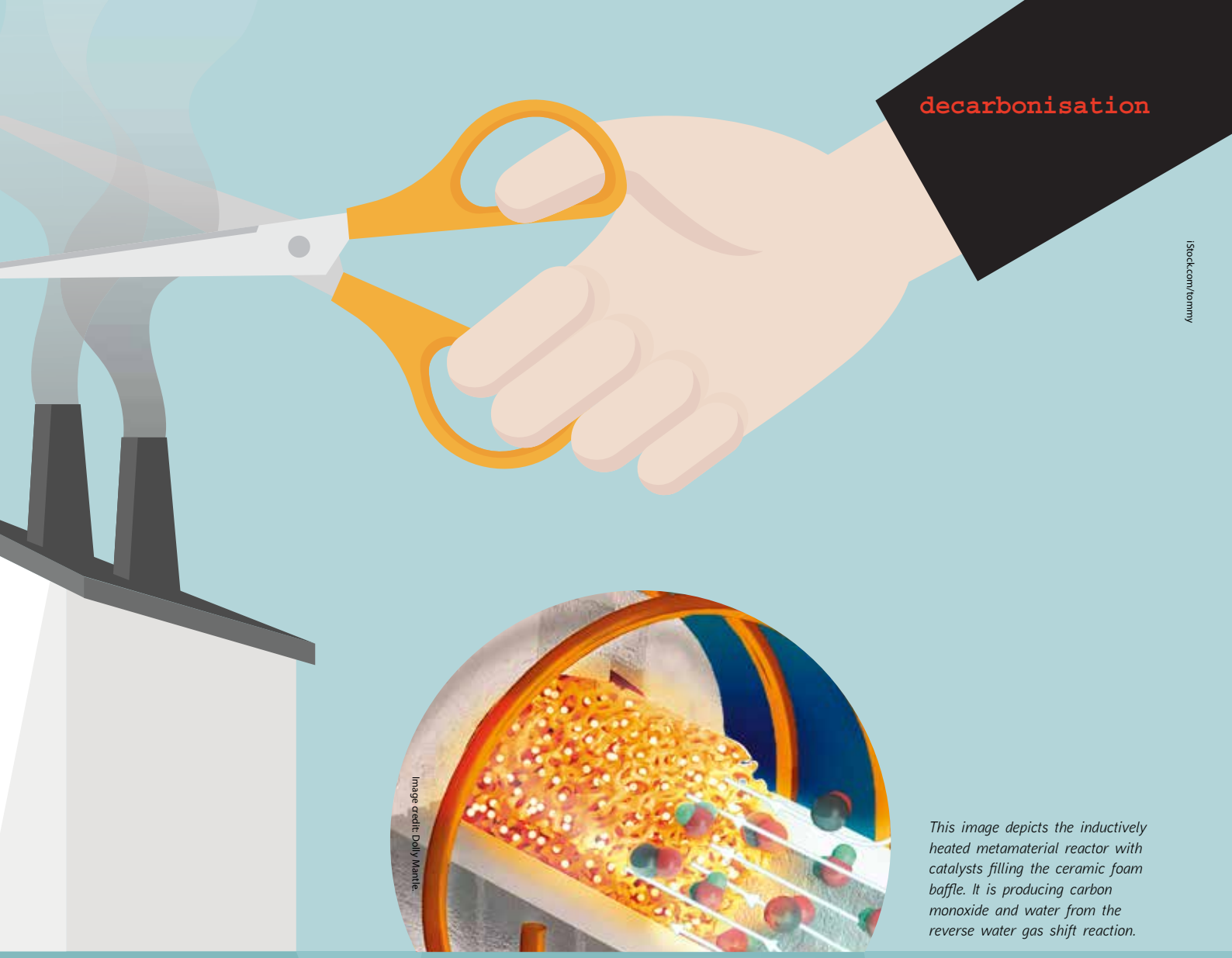

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Image credit: Dolly Mantle

This image depicts the inductively heated metamaterial reactor with catalysts filling the ceramic foam baffle. It is producing carbon monoxide and water from the reverse water gas shift reaction.

> **Adapting induction heating for the chemicals industry is not as easy as just turning up the heat.**

more efficient heat transfer and means the electrified reactor can be much smaller than traditional fossil fuel reactors.

"You're heating a large surface area structure that is right next to the catalyst, so the heat you're generating gets to the catalyst very quickly to drive the chemical reactions," Fan said. "Plus, it's simplifying everything. You're not transferring heat from somewhere else and losing some along the way, you don't have any pipes going in and out of the reactor — you can fully insulate it. This is ideal from an energy management and cost point of view."

Capturing industrial applications

The researchers used the reactor to power a chemical reaction, called the reverse water gas shift reaction, using a new sustainable catalyst developed by Matthew Kanan, a professor of chemistry in the School of Humanities and Sciences and co-author of the paper. The reaction, which requires high heat, can turn captured carbon dioxide into a valuable gas that can be used to create sustainable fuels. In the proof-of-concept demonstration, the reactor was over 85% efficient, indicating that it converted almost all electrical energy into usable heat. The reactor also demonstrated ideal conditions for facilitating the chemical reaction — carbon dioxide was converted to usable gas at the theoretically predicted rate, which is often not the case with new reactor designs.

"As we make these reactors even larger or operate them at even higher temperatures, they just get more efficient," Fan said. "That's the story of electrification — we're not just trying to replace what we have, we're creating even better performance."

Fan, Rivas-Davila, Kanan and their colleagues are already working to scale up their new reactor technology and expand its potential applications. They are adapting the same ideas to design reactors for capturing carbon dioxide and for manufacturing cement, and they are working with industrial partners in the oil and gas industries to understand what those companies would need to adopt this technology. They are also conducting economic analyses to understand what system-wide sustainable solutions would look like and how they could be made more affordable.

"Electrification affords us the opportunity to reinvent infrastructure, breaking through existing bottlenecks and shrinking and simplifying these types of reactors, in addition to decarbonising them," Fan said. "Industrial decarbonisation is going to require new, systems-level approaches, and I think we're just getting started."

OPTICAL EMISSION SPECTROMETER RANGE

The Thermo Fisher Thermo Scientific ARL iSpark Plus optical emission spectrometer range is designed to streamline elemental analysis in the metal production, processing and recycling industries, as well as in contract and research labs.

Suitable for metal producers, processors and recyclers as well as contract and research labs, the range combines state-of-the-art technologies, user-friendly features and advanced automation algorithms to enable the wide-range spectral analysis of metal samples and detection of non-metallic inclusions. An improved spark stand has been added to the line, which is designed to extend maintenance intervals by 30%, minimise signal drift for most elements and ensure virtually no memory effect from preceding samples. It also has seamless software and firmware interaction, cutting down on processing time by 15%.

The increased analytical speed and stability of the spectrometers allows steel plants and foundries to minimise tap to tap times, save energy and reduce carbon footprints.

The product features high sensitivity photomultiplier tube optics, digital spark generation, single spark acquisition, smart argon management, advanced data collection technologies and intelligent processing algorithms.

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The EM400-MUD Multifunctional Ultrasonic Distance Sensor targets larger bins, featuring a range of 3–450 cm and multiple operational modes. This sensor also supports LoRaWAN and 4G connectivity, helping to provide consistent data transmission.

By delivering real-time data on bin fill levels, these sensors can enable the optimisation of collection routes and improve operational efficiencies, ultimately conserving resources and reducing emissions.

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ELECTROMAGNETIC FLOWMETERS

A magnetic flow meter provides many merits over traditional flow measurement and instrumentation in a wide range of applications. It takes measurement of conductive liquid, even fluids with particles, such as paper pulp, industry sewage, residential wastewater, milk, juice, aggressive chemical solutions and so on.

An electromagnetic flow meter is made of flow transmitter and flow sensor; it is a kind of volumetric flow meter designed to detect liquid flow rate in a closed pipeline, and has no moving parts inside the mag sensor, so little maintenance work is needed. This mag flow meter can measure dirty liquid even with solids inside, such as slurry, grease and mud, etc. Also, the flow rate measurement is not affected by the liquid properties, such as temperature, viscosity and density.

Modsen mag flowmeters have large turn down ratio (150:1), accuracy (0.5%), size range from DN3-DN3000, transmitters output (4-20 mA or pulse), communication protocols (RS485, Modbus RTU, Hart protocol and Profibus-DP), choice of different liner and electrodes materials, process connection (flange, tri-clamp, insertion type, threaded) and types of flowmeters (remote or integral type).

Electromagnetic flow meters have basic applications to demanding flow and custody transfer (CT) measurements. They have designs and liner materials for various applications — from potable water to extremely adhesive, abrasive or aggressive fluids.

The electromagnetic flow meter, being a non-intrusive type, can be used in general for any fluid which has a reasonable electrical conductivity greater than 5 μS/cm. Fluids like sand water slurry, coal powder, slurry, sewage, wood pulp, chemicals, water other than distilled water in large pipelines, hot fluids, high viscous fluids specially in food processing industries, cryogenic fluids can be metered easily by the electromagnetic flow meter.

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NAVIGATING ASSET TRANSITIONS FOR A SUSTAINABLE AND EQUITABLE FUTURE

Michelle Kiejda, Technical Director — Environment and Closure Planning, GHD

Closing major assets like power stations or mines can profoundly impact local communities, sometimes leading to job losses, a decline in local services, and a drastic reduction in population. In today's world, there's a clear expectation that mining and utility companies navigate these transitions thoughtfully. This requires developing a comprehensive stakeholder consultation and communication engagement plan, one that communicates a responsible transition and explores a wide variety of options to support impacted stakeholders. The industry is seeing a growing focus on ensuring that external stakeholders are included more as part of this process to consider the community and socio-economic impact of decisions made. By involving the right people and resources, we can better support communities through these challenging changes, minimising any negative impacts and paving the way for a more sustainable future.

What does a sustainable and equitable asset transition look like?

Australia has robust environmental standards for asset closure, requiring thorough land assessments and remediation to make sure the land is safe, stable and non-polluting. In many cases, carbon and biodiversity offsetting is employed as part of the transition. However, there is room for improvement in integrating economic, social, and intergenerational equity into these transitions.

Traditionally, land reuse options — like reforesting, turning land into grazing areas, or creating water reserves — can take 20 to 30 years to develop. These approaches often fail to generate the economic activity needed to replace the jobs lost when a major asset like a power station or mine closes. The result can be "ghost towns" where there are few opportunities for those left behind.

Arguably, in some regions, the voices of traditional landowners are not adequately sought or captured prior to asset planning and transition. Without legislative requirements and strong company values and strategies to support positive indigenous outcomes to enforce such practices, some companies can still avoid engagement with these groups when defining what success looks like for the transition of an asset. This kind of oversight risks undermining the cultural and social fabric of the community and overlooks the opportunity to co-create more inclusive and sustainable solutions that are respectful of cultural heritage.

For asset transition to leave a better, more inclusive legacy, we need to involve all stakeholders, including traditional landowners, and create economic opportunities that align with the community's needs, values and aspirations. It means thinking beyond short-term fixes and working towards solutions that offer long-term benefits for generations now and into the future.

What are our options?

Land capability or suitability assessment is a critical step in determining the future of sites undergoing transition. In Australia, the process involves more than just deciding what to do with the land. It's about navigating complex zoning constraints, environmental considerations, and community, business and socio-economic needs to find the best possible future use.

Many companies are open to a variety of ideas for repurposing land, from creating parks and hotels to developing spas and recreational areas. The reality is that many sites, particularly those associated with industrial activities, like coal-fired power stations, face a range of limitations that may present barriers to land uses more sensitive in nature.

As an example, land contaminated by metals, hydrocarbons and other containments and remediation requirements often

restricts a transition to light industrial use, making more ambitious and sensitive land use projects difficult to realise. On the other hand, large areas of former mining sites can be better suited to agricultural reuse, depending on limitations associated with steep slopes and available remediation options.

Another key factor to consider is the financial viability of either retaining ownership or selling the land. The land rehabilitation process required to make a site suitable for a new purpose can be costly. Most companies will naturally lean towards options that offer the highest returns with the most cost-efficient rehabilitation and least long-term liabilities. This financial bias can sometimes limit the scope of creative or community-focussed land reuse projects.

Asset transition also offers the opportunity to embrace the principles of a circular economy. Companies can repurpose materials from existing property, plant and equipment for new developments on the land, reducing waste and potentially lowering costs. Taking this approach supports sustainability goals while also adding in a layer of innovation to the asset transition process.

Who do we need to involve?

Involving the right stakeholders is crucial for asset transitions to be sustainable and equitable, starting with local communities and governments. Communities are looking to companies for guidance on potential land uses for transitioning assets and are eager to share their own insights about what will work best for them. A collaborative approach means the transition will align with the needs and aspirations of those directly impacted.

State governments and local councils play a significant role in shaping the outcomes of asset transitions. They have the power to influence regional planning, making sure considerations like housing affordability, transport and job creation are factored into the decision-making process for potential land uses. When communities express strong support for a sustainable and equitable transition, local governments can be instrumental in driving the necessary changes, improving planning, establishing legislation and enforcing compliance to achieve these goals.

While we need government bodies and asset owners to lay the groundwork for positive asset transitions, it's just as important to bring in people with big, bold ideas. Innovators from the private sector, local businesses, academia, or the community can offer fresh perspectives and creative solutions, making sure the transition is both sustainable and forward-thinking.

According to GHD's recent CROSSROADS report — a wide-ranging exploration of community sentiment with a focus on infrastructure preferences and priorities — more than 70% of citizens in all surveyed countries agree that governments should do more to grow community understanding about the importance of clean energy and the associated infrastructure required to make it happen. In Australia, 64% of those surveyed believe the switch to clean energy will open new industries and jobs for their communities. The substantial support for clean energy underscores the need for governments and the energy industry to invest in and advocate for sustainable energy solutions as part of their asset transition plans.

A roadmap for asset transition

As industries grapple with the challenges of the energy transition, asset transition planning has become a crucial part of the process. Sectors like mining and coal-fired power are already looking decades ahead, with some planning for closure at the very start of the asset lifecycle. Foresight and early planning are essential. Waiting until just a few years before closure to start thinking about the future of a site is far too late.

The earlier the planning, the more opportunities there are to transition sustainably and equitably. Delaying these decisions not only puts the success of the transition at risk but also threatens the wellbeing of affected communities.

So, what should you do if you're on the cusp of an asset transition? Start planning now. Engage with local communities, businesses and governments early and often. Look beyond traditional land reuse options and explore innovative approaches that align with both economic and environmental goals.

Asset transition is more than a logistical challenge — it's an opportunity to do right by the environment, the economy, and the community.

GHD

www.ghd.com

Melbourne Water finds an energy-saving solution

Sewage and wastewater treatment is a highly energy-intensive process, presenting a challenge for water utilities seeking to meet net zero goals.

The HRS Biogas Dehumidification System (BDS) is specifically designed to improve the operating life and energy efficiency of biogas engines. Images courtesy of HRS Heat Exchangers.

Melbourne Water's Eastern Treatment Plant (ETP) treats almost half of all Melbourne's sewage, an average of 330 million litres a day. Located in the Melbourne suburb of Bangholme, approximately 30 km south-east of the city centre, the 1000 ha site was upgraded in 2012 to treat sewage to an advanced tertiary standard, producing Class A recycled water.

Shooting for net zero

Since opening in 1975, the ETP has always generated energy from sewage gas, and the site houses seven power generators that are capable of running solely on biogas — produced through the anaerobic digestion of sludge during the first and second phases of water treatment.

In 2020, Melbourne Water began a project with John Holland-KBR Joint Venture to upgrade the biogas handling system at the Eastern Treatment Plant to make it more efficient, resilient and futureproof. The project aimed to expand capacity, prevent corrosion and sedimentation, and extend the working life of equipment — with specific requirements to remove liquid droplets and moisture and to minimise the size and cost of any necessary cooling system.

Sewage transfer and treatment are responsible for about 85% of Melbourne Water's total greenhouse gas (GHG) emissions, so contributing to the company's net zero commitment was a main target for the project. "However, with existing assets nearing the end of their service life, ensuring that the new asset can service future production growth and plant upgrades was also essential," said Nick Fung, Senior Project Manager at Melbourne Water.

Increasing reliability for the operations team onsite and improving safety across both operation and maintenance were further aims.

Selecting an energy-saving solution

Biogas contains hydrogen sulfide (H_2S) gas, which condensates out to form a highly corrosive liquid. Including a system to remove most of the moisture from the gas was therefore essential to minimise the amount of corrosion and degradation of the power station generators, while also limiting operational downtime and reducing the need to import electricity from the grid.

HRS Heat Exchangers was one of five companies invited to tender for the moisture removal equipment in the project. The HRS Biogas Dehumidification System (BDS) removes water from biogas, protecting combined heat and power (CHP) engines and generator sets from corrosion and cavitation. According to HRS, it condenses more than 90% of the water present in biogas by reducing the temperature to leave a clean gas. The addition of heat regeneration technology means the cold biogas produced can be used to pre-cool the incoming warmer biogas. This reduces the load on the final cooling heat exchanger and saves valuable energy.

The BDS supplied for the project has a maximum capacity of 4161 m^3/h (4710 kg/h), while the inclusion of an energy recovery section subsequently reduces the eventual

chiller load by 30%. This BDS consists of two heat exchangers, a regeneration unit and a final cooler, supplied on two skids. One skid — located in a hazardous area zone — contains the heat exchangers, a condensate knockout pot, a condensate drain line and all the relevant IECEx-rated instrumentation. The second skid contains a buffer tank, standby and duty glycol pumps, and all the relevant glycol line process control valves and instruments.

HRS also supplied an additional chiller and detailed process control descriptions, enabling the joint venture engineers to provide overall control and automation systems for the client.

Overcoming complex design parameters

The BDS needed to meet the requirements of two different operational stages, each of which contains four duty requirements. This meant a complex thermal design process was necessary to make sure that the supplied unit could meet all eight of the potential design scenarios.

Ella Taghavi, Project Manager and Technical Lead at HRS Heat Exchangers, explained: "Designing the BDS for the Melbourne Water project posed a significant challenge as it needed to cater to both current and future demands, with two very different conditions in each phase.

"The current first phase uses biogas supplied by the compressors and aftercoolers at an average pressure of 66 kPa. In the second (future) scenario, the gas is supplied following a number of additional treatments at an average pressure of 5 kPa and then supplied to the compressors. We therefore had to deal with two very different inlet conditions.

"The addition of heat regeneration added further complexity in terms of design. However, thanks to our cutting-edge technology, not only were capital costs reduced as a smaller chiller could be specified, but regeneration is also helping to lower ongoing operational costs."

An efficient result

From being awarded the contract in July 2021, it took less than 12 months for HRS to install the bespoke BDS onsite, with commissioning completed in June 2022.

The John Holland-KBR team noted that of the five tendered solutions, the technology of the HRS BDS stood out, including the excellent technical support it provided to help develop the project further with Melbourne Water.

> **"Sewage transfer and treatment are responsible for about 85% of Melbourne Water's total greenhouse gas (GHG) emissions, so contributing to the company's net zero commitment was a main target for the project.**

"Our experience in project management, construction and logistics enabled us to overcome early design challenges and respond to necessary changes during the design and construction process. As a result, we were able to deliver a high-quality product that has performed to specification since its installation," Taghavi said.

The upgrade project has improved the quality of the biogas supply to the power station at ETP, providing more confidence in its ability to deliver more than 36,000 MWh (approximately 130 TJ) of thermal energy for process heating. This means a reduced reliance on natural gas, cutting down on emissions and making the operation more self-sufficient.

HRS Heat Exchangers Pty Ltd

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The HRS BDS at Melbourne Water's Eastern Treatment Plant incorporated some complex design elements.

Compostable plastic hub

CSIRO and Murdoch University have launched The Bioplastics Innovation Hub, an $8 million collaboration that will work with industry partners to develop a new generation of 100% compostable plastic.

Based at Murdoch University's main campus in Perth, WA, the Bioplastics Innovation Hub aim is to revolutionise plastic packaging by developing biologically derived plastic that can break down in compost, land or water.

Dr Andy Whiteley, CSIRO Research Program Director, said the hub aims to bring together experts in microbiology, molecular genetics, synthetic biology, biochemical engineering, advanced manufacturing and circular economy by translating advancements in bioplastics research to real-world applications.

"Our primary focus is the development of 100% compostable, bio-derived packaging for use as sprays, films, bottles, caps and wrappers which are engineered to fully break down in compost, land and in aquatic environments," Whiteley said.

With global concerns over plastic pollution and fossil fuel depletion driving an increased demand for compostable bioplastics, the hub will aim to equip the plastics industry with the tools and expertise required to manufacture materials and continue to drive a green economy for plastic waste.

The first key focus area will be a co-investment with WA-based biotechnology company Ecopha Biotech to develop a new process for water bottle production using compostable bioplastics derived from waste products from the food industry.

Image credit: CSIRO

Murdoch University Deputy Vice Chancellor Research & Innovation Professor Peter Eastwood said managing the growing plastic waste crisis required innovative technological solutions, including bioplastics.

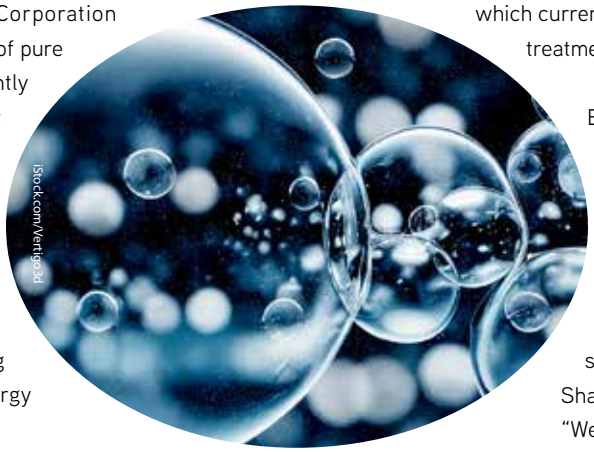
"Together with CSIRO, Murdoch University will fast-track the production of novel compostable bioplastic and introduce a green plastic to the market which will significantly minimise the requirement for non-sustainable plastic production," Eastwood said.

"We also aim to assist industry in establishing an advanced biomanufacturing sector, to commercialise compostable bioplastics that meet the manufacturing design needs and certification standards for 100% biodegradation.

"The outcomes of this project will boost the capability of Australia for commercial production of compostable bioplastics. In particular, the Hub meets the sector priority of increasing technical leadership of Australian manufacturing."

Using pure oxygen to treat wastewater

Victoria's Barwon Region Water Corporation (Barwon Water) is exploring the use of pure oxygen to treat water more efficiently at its Geelong Northern Water Plant and to reduce wastewater treatment plant emissions.



iStock.com/Vertigo3d

The Green Oxygen for Wastewater Treatment project, which will use oxygen produced as a by-product of electrolysis, has secured up to $3 million in funding from the Australian Renewable Energy Agency (ARENA).

ARENA CEO Darren Miller said Barwon Water's project will demonstrate how renewable hydrogen producers and wastewater treatment players can work together to decarbonise.

"This will highlight the application for green oxygen and enhance the commercial viability of renewable hydrogen, offering unique learnings in navigating the regulatory, technical and commercial aspects of oxygen offtake," he said.

The first stage of the project will involve Barwon Water conducting a front-end engineering and design study to determine the technical and commercial feasibility of using pure oxygen captured from an electrolyser in its wastewater treatment process, which currently employs an oxygen-based aerobic treatment process.

Oxygen will be sourced from Viva Energy's new hydrogen refuelling station at the nearby Viva Energy Hub, which is deploying a 2.5 megawatt electrolyser.

"At Barwon Water, we're always looking for innovative solutions for the problems of today and tomorrow," said Barwon Water Managing Director Shaun Cumming.

"We're excited to explore the beneficial use of pure oxygen as a by-product of renewable hydrogen production at the Viva Energy Hub hydrogen refuelling station. It's an exciting opportunity to reduce emissions from wastewater treatment."

Viva Energy was approved for $34 million in ARENA funding in 2022 to develop, build and operate its refuelling station to support the uptake of hydrogen fuel cell electric vehicles (FCEVs) in heavy fleets.

"We look forward to building on the benefits of Viva Energy's new service station project with this investment and sharing the potential benefits for wastewater treatment with the water sector," Cumming said.

WIND TURBINE SOLUTIONS

Bonfiglioli's 700TW Series is its new-generation Yaw Drive planetary gearbox designed to provide high radial/thrust load capacity and efficiency.

Featuring an integrated motor-inverter, the series is designed for performance in low duty cycles. It is also 8% lighter than its predecessor, thanks to its simplified design.

Designed to reduce the lifetime cost of a wind turbine plant, the gearbox can provide improved energy consumption. It delivers good control both as a motor and as a generator, and can also be used as a battery backup solution. The series is easily integrated with Bonfiglioli sensors to provide technicians with real-time data on the turbine system (speed, load and current) as well as maintenance indicators (ie, temperature, vibration, etc).

In addition to the 700TW, Bonfiglioli also has permanent magnet synchronous AC motors, suitable for use in Pitch and Yaw systems. The motors are available in totally enclosed or fan ventilated executions, and with a fail-safe electromechanical brake.

Through more than 30 years of collaboration with leading wind turbine OEMs, Bonfiglioli has developed dedicated wind turbine solutions. For the last five years, it has served as a member of APQP4Win.

Bonfiglioli Transmission Pty Ltd
www.bonfiglioli.com.au

N-TYPE SOLAR PANELS

Tindo's Walara Series of solar modules is designed for the Australian climate using n-type and bi-facial technologies.

These technologies allow the panels to capture sunlight from both sides to boost overall power output.

Engineered and manufactured locally, the panels are designed with half-cut cell technology that can help to reduce energy loss due to resistance and heat, leading to higher overall efficiency.

The panels are durable with a new robust 35 mm framing that is designed to minimise micro-cracks and ensure long-term performance.

Additionally, the improved packaging allows for up to 31 panels per pallet, streamlining the logistics and installation process.

Tindo solar panels are delivered on pallets with custom recycled material corner caps, ready for installation.

Tindo Solar Pty Ltd
www.tindosolar.com.au

ELECTROMAGNETIC FLOWMETER

MagneW PLUS+ electromagnetic flowmeters are designed to measure every sort of liquid, including water, chemicals, slurries and corrosive liquids. The standard model has a mirror-smooth PFA liner for good adhesion resistance that enables good durability even in long-term use. It is available in an integrated and a remote type and can be used in a wide range of settings, including explosion-proof and outdoor environments.

Features include: improved performance and greater stability, improved factory data memory function to facilitate checking after shipment, high-speed batch function for batch applications and compatible with HART and CommPad communicators as a standard feature.

Suppression of flow noise is 3.5 times that of the conventional model for stability in the presence of noise. It achieves more reliable measurement in individual applications through features such as an excitation frequency change function, an optional auto spike cut-off setting, travel averaging and manual zero adjustment.

In addition to the serial number and production date on the product tag plate at shipment, the human-machine interface enables checking in maintenance mode. Statuses that may be difficult to read on the product tag plate are backed up as electronic data.

A high-speed response function with a damping time constant of 0.1 s can be selected as an option. This enables compatibility with high-speed batch applications, allowing use with a pulse frequency of up to 3000 Hz.

AMS Instrumentation & Calibration Pty Ltd
www.ams-ic.com.au

BATTERY ENERGY STORAGE SYSTEM

Schneider Electric's battery energy storage system, BESS, is the foundation for an integrated microgrid solution driven by the company's controls, optimisation, electrical distribution, and digital and field services. BESS is offered as a 20-foot NEMA 3R enclosure that is AC coupled and available from 250 kW–2 MW in 2 h and 4 h configurations.

Comprising battery modules, battery racks, a battery management system, power conversion unit and controller, BESS has been tested and validated to work as an integral component with Schneider Electric's microgrid systems. It is also integrated into the company's software suite, which includes EcoStruxure Microgrid Operation and EcoStruxure Microgrid Advisor.

Full integration capabilities enable multiple BESS units to function as a unified entity, encompassing inverters, batteries, cooling systems, transformers, safety features and controls. Designed for fire safety, the solution is fully certified and compliant, using ANSI/UL standards for deployment across multiple geographies.

BESS offers bidirectional connectivity to the grid, providing the flexibility to operate as either grid-connected or off-grid. With the capacity to store energy for immediate access during outages, the unit can deliver up to 2 MW of power when needed. Services and support are available throughout the lifecycle of the product.

Schneider Electric
www.se.com/au

Ultragreen high-rise planned for St Kilda

An upcoming multi-residential project in St Kilda is aiming to become one of Melbourne's most sustainable buildings.

Gamuda Land's $90 million Fareham development, designed by architecture firm BayleyWard, is focused on achieving net zero in operations and a minimum 8-star average NatHERS rating. The building will be powered by an embedded network that provides 100% renewable energy, including rooftop solar photovoltaic panels.

The 73 residences in the 16-level building will feature a mix of water-efficient WEL-rated fixtures and fittings, including dishwashers and taps. Residents will also be encouraged to use greener forms of transport through facilities such as EV charging capabilities, secure bike parks and an onsite bicycle workshop.

In order to minimise the carbon footprint of the construction, Gamuda Land chose Markscon to implement sustainable construction techniques throughout the build.

This includes incorporating passive design principles, using green concrete technology where possible and prefabricating concrete elements offsite to reduce the amount of new materials used. During the build, there will be an attempt to utilise recycled materials or locally manufactured products where possible, as well as paints with low to zero volatile organic compounds (VOCs).

Markscon will aim to divert 90% of its waste from landfill by sorting materials for recycling.

Gamuda Land General Manager Jarrod Tai said the company's mission has always been to work with nature, preserve what was there before and find innovative ways to incorporate it into Gamuda Land's design.

"In 2021, Gamuda Land unveiled the Gamuda Green Plan — a commitment to sustainable construction and development, with specific steps to reduce corporate greenhouse gases emission intensity by 30% in 2025 and by 45% in 2030," Tai said.

"We are bringing this same commitment to our Melbourne projects and believe Fareham will help set the standard with its target of 8-star NatHERS and its goal of being net zero in operation."

Fareham is currently under construction and is due for completion in 2026.

Image credit: Studio Piper.

Artist's impression of Fareham.

Beef processor selects wastewater pump solution for dual purpose

John Dee Warwick is a beef processor (abattoir) located in South East Queensland. The processor wanted to upgrade its wastewater pump system to enable it to handle the day-to-day wastewater flows from its plant, estimated to be 25 to 35 litres per second (L/s), but then to be able to ramp up to meet additional flow demands during storm conditions (estimated to be at least 60 L/s).

The static head in the system is only 3 m, with discharged effluent running through 450 m of 150 mm PVC piping.

John Dee wanted to use self-priming pumps to minimise its occupational health and safety issues and to minimise service costs over the life of the installation.

The options

The following options were considered for the application. These were:

- **Option A:** A smaller wastewater pump to handle "day-to-day" flows, with the second pump being a larger one to handle higher "storm condition" flows.
- **Option B:** Two "medium-sized" wastewater pumps to operate alternately during normal conditions, but both pumps running in parallel during higher flow demands.
- **Option C:** Two "medium-sized" wastewater pumps to operate alternately during normal conditions, but both pumps operating in series during the higher flow demands.

Option A: One small and one large wastewater pump

It was ideal for John Dee to operate at 25–35 L/s during normal operation. This suited the Gorman-Rupp T4A3S-B Super T Series Sewage pump. It could operate at 1100 rpm with a 5.5 kW electric motor to deliver 25 L/s.

John Dee needed the second sewage pump to deliver at least 60 L/s, but wanted to be able to pump at less than this flow occasionally to cover some "peak" normal conditions that the smaller pump was not coping with.

It was therefore ideal for this sewage pump to be controlled with a variable frequency drive (VFD). This duty suited the Gorman-Rupp V6A60-B self-priming pump, which can run at 1550 rpm with a 37 kW electric motor to deliver 61 L/s in the system.

The advantage of this system is its capacity to handle the wide flow range, but the disadvantages are cost (because of the large pump and need for VFD) and parts incompatibility between the two different sized pumps required.

Option B: Two "medium-sized" wastewater pumps in parallel

To try to get maximum flow from this option (without going to a VFD), a higher 'normal' flow rate would be needed to start with, because bringing the second wastewater pump in when there is a long discharge main does not often result in a great deal of increased flow. For this option, a pair of Gorman-Rupp T6A3S-B Super T Series wastewater pumps was selected. A single pump will produce 44 L/s at a calculated head of 17.5 m. This is slightly more than desirable, but because these self-priming pumps can operate alternatively, shorter pump cycles will pose no problems for the motors in the "starts per hour" area.

The problem here is when they bring the second pump on and operate the pair in parallel, the flow rate only increases to 48 L/s because of the steepness of the system head curve. The disadvantage of this system is that it will not deliver the required higher flows for peak flow conditions, and when operating at maximum flow, the individual pumps operate at inefficient points on their respective curves.

Option C: Two "medium-sized" wastewater pumps, with parallel/series piping

This option is exactly the same as option B (Gorman-Rupp T6A60S-B pumps) except for the piping arrangement. Instead of both wastewater pumps discharging into the common discharge line, interconnecting piping is added along with an additional non-return valve and an additional isolation valve. Gorman-Rupp calls this "Parallel/Series Piping".

This innovative piping system allows a single pump to deliver the required minimum flow, but when higher flows are required and the second pump is energised, the pumps operate as series-connected pumps, enabling them to double their pressure and overcome the friction losses in the discharge line and deliver the required maximum flow rate.

The solution

John Hart of John Dee Warwick elected to go with option C as the best-engineered solution.

The advantages of this system are as follows:

- The cost is less than option A.
- There is spare parts compatibility between the two sewage pumps.
- Pumps can alternate after every pumping cycle.
- One wastewater pump running can handle the regular flow rate.
- When higher inflows demand a higher output, both wastewater pumps operating in series can deliver 1 L/s (or 38.6% more than when a single pump is operating).

Hydro Innovations

www.hydroinnovations.com.au

Magnetism could hold key to battery recycling

Researchers at Rice University, Texas, have devised a new method to extract purified active materials from lithium-ion battery waste. Their findings, published in the journal *Nature Communications*, could lead to the effective separation and recycling of valuable battery materials at a minimal fee, contributing to the more sustainable production of electric vehicles (EVs).

"With the surge in battery use, particularly in EVs, the need for developing sustainable recycling methods is pressing," said James Tour, the T.T. and W.F. Chao Professor of Chemistry and professor of materials science and nanoengineering at Rice University.

Typical recycling techniques involve breaking down battery materials into their elemental forms through thermal or chemical processes. This is energy-intensive and costly, with significant environmental impacts.

The Rice team's method instead exploits magnetic properties to facilitate the separation and purification of spent battery materials. Their innovation uses a process known as solvent-free flash Joule heating (FJH). This technique, devised by Tour, involves passing a current through a moderately resistive material to rapidly heat and transform it into other substances.

FJH enabled the researchers to heat battery waste to 2500 Kelvin within seconds. During the process, the cobalt-based battery cathodes — typically used in EVs and associated with high financial, environmental and social costs — unexpectedly showed magnetism in the outer spinel cobalt oxide layers, allowing for easy separation from the core. This magnetic separation in turn allowed for efficient purification.

The researchers' approach resulted in a high battery metal recovery yield of 98% with the value of battery structure maintained.

"Notably, the metal impurities were significantly reduced after separation while preserving the structure and functionality of the materials," Tour said. "The bulk structure of battery materials remains stable and is ready to be reconstituted into new cathodes."

Rice graduate students Weiyin Chen and Jinhang Chen as well as postdoctoral researcher and Rice Academy Junior Fellow Yi Cheng were the co-lead authors of the study. The research was supported by the Air Force Office of Scientific Research, U.S. Army Corps of Engineers ERDC and Rice Academy Fellowship.

New method has potential to manage 'forever chemicals'

Scientists at UNSW Sydney have devised a method that has the potential to manage the PFAS that contaminate water and do not break down in the human body.

Per- and poly-fluoroalkyl substances (PFAS) are known as 'forever chemicals' because they are notoriously resistant to degradation. Due to their stable chemical structure, PFAS — which are found in thousands of variants — are used in oil- and grease-resistant food packaging, non-stick cookware, cosmetics, clothing and firefighting foams.

These chemicals have become widespread, infiltrating water sources and soil. With recent reports revealing that many global water resources exceed the drinking limits of PFAS, concerns over their environmental and health impacts have escalated.

The chemical is so resistant to degradation that people all over the world are likely to have low levels of PFAS in their bodies. "PFAS is such a robust chemical that it cannot be degraded within the human body," said Professor Naresh Kumar from UNSW. "And that has become a concern."

Despite ongoing efforts to develop ways of degrading PFAS, current methods are limited by a lack of efficient, scalable and environmentally friendly processes.

In seeking to tackle this problem, the team of scientists from UNSW's School of Chemistry designed a catalyst system that can activate a reaction to break down common types of branched PFAS. The new method, developed by Kumar with Dr Jun Sun and recently published in the journal *Water Research*, could potentially be used for more efficient and sustainable PFAS remediation in the future.

"Owing to its robust nature, simple application and cost-effectiveness, the new system we have developed shows successful PFAS remediation in the lab, which we hope to eventually test at a larger scale," said Sun, first author of the paper.

Due to the chemicals' potential risks and their durability, many regulatory bodies have tightened PFAS regulations and set precautionary drinking water limits, including in Australia.

"The pressing need for effective PFAS remediation has driven the investigation into a wide array of treatment methods, spanning from physical separation processes to advanced destruction techniques, all which have their limitations," Sun said.

Current processes used to reduce PFAS

PFAS is a fluorinated chemical bound by strong carbon-fluoride (C-F) bonds, which are famously hard to break.

An existing method to remove PFAS from water and soil works by absorbing PFAS onto carbon material. "So if you've got a pad of activated carbon and you pass water through it, you can absorb PFAS onto the activated carbon, but you then have to burn it to destroy the PFAS or safely store it," Kumar said.

This is laborious, inefficient and not good for the environment. Also, while physical separation techniques such as this offer potential for isolating PFAS, they do not actually destroy the chemical, ultimately exacerbating the management challenges associated with PFAS-contaminated waste.

Another method uses a strong oxidising agent to break PFAS apart. However, this process requires aggressive chemicals that break PFAS down into smaller structures, which can become even harder to remove completely.

"There is an ongoing need to come up with an energy-efficient and environmentally friendly way to remove PFAS from water," Sun said. "The method we have developed is a type of reductive defluorination, which

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decreases the toxicity of PFAS by breaking the strong C-F bonds of branched PFAS."

Developing an effective catalyst

Nano zero-valent metals (nZVMs) are a type of eco-friendly chemical-reducing agent that scientists have used for decades in the treatment of groundwater and soil contaminated with chlorinated compounds, using a dechlorination process.

Despite their effectiveness elsewhere, there has been a lack of research into the use of nZVMs to break down PFAS, largely due to the lack of appropriate catalysts required to activate the reaction.

Previous studies indicate that PFAS can be degraded using nano zero-valent zinc and the naturally occurring catalyst vitamin B12, a water-soluble vitamin present in our daily diet. But again, the process is slow and inefficient.

"Inspired by the fact that B12 has the potential to catalyse this reaction, we wanted to synthesise a catalyst that mirrors the unique ring shape of B12, which we did using a structure known as a porphyrin ring," Sun said.

> "Due to the chemicals' potential risks and their durability, many regulatory bodies have tightened PFAS regulations and set precautionary drinking water limits, including in Australia.

Testing their method out on two common types of PFAS — branched PFOS and PFOA — Kumar and Sun mixed the PFAS chemicals with nZVMs and the porphyrin ring in a buffer solution and measured the breakdown of the PFAS.

The results from this latest study revealed that within five hours, approximately 75% of the fluoride had been released from branched PFOS and PFOA, significantly reducing the amount of PFAS within the solution. Meanwhile, a B12-based catalyst system only showed less than 8% defluorination within five hours.

Potential for large-scale application

Further research is needed before the method could be applied at scale, but the team fully intend to take their discovery further.

"The next step for us is to really try this on a pilot scale to see if this can be done out of the laboratory on a real sample," Kumar said. "Then we'd like to try it out in a real water purification system or sites which are contaminated with PFAS."

The researchers are also exploring how to scale up the process in an environmentally friendly way by incorporating the catalyst into an electrode.

"We hope to try this method out on linear PFAS, not just branched types," Sun said. "But we're already one step closer to solving a widespread environmental problem."

Kumar and Sun worked alongside Prof Denis O'Carroll, Prof Michael Manefield and Dr Matthew Lee from the UNSW School of Civil and Environmental Engineering. Their research was funded by a $3 million grant from the Australian Research Council in 2019.

Cleaning trucks and preventing contamination

A new fertiliser plant in Western Australia was in need of an effective solution to clean the wheels and chassis of its trucks and other vehicles. The plant chose Tecpro to design and supply a comprehensive washing system.

The project came with a few key challenges: An obvious consideration was preventing contamination, ie, ensuring no residue on trucks and other vehicles from the fertiliser plant left the site. Secondly, the system needed to be efficient, handling a high volume of trucks with minimal downtime and minimal water usage. Thirdly, it had to incorporate automation; cutting down on manual intervention to ensure consistent cleaning, reduce time per clean and reduce labour costs.

Tecpro devised a tailored solution using its Italian-made washing technology, including rotating nozzles and a high-pressure automated pump skid. The system was designed as a fixed-location, drive-through wash to accommodate different vehicle types and sizes. Construction drawings were developed to help the construction company integrate the system seamlessly into the plant's new infrastructure.

Four high-pressure rotating wash heads were installed, each capable of delivering powerful jets to remove stubborn dirt and residues from the wheels and undercarriage. A robust 150 L/min, 110 bar high-pressure pump set was also selected to carry out thorough cleaning with each cycle. The pumps are capable of handling large trucks with minimal water wastage.

Automation was incorporated into the system through the use of ultrasonic sensors, which are designed to detect the presence of vehicles. These sensors activated the pump when a vehicle approached and shut it off once the vehicle passed through, supporting efficient water and energy use.

Image courtesy of Tecpro.

The system additionally featured water management options for both disposable and recycled water.

Tecpro's wheel and chassis washing system resulted in: environmental compliance, operational efficiency and enhanced safety and cleanliness.

Tecpro Australia

www.tecpro.com.au

Turning CO_2 into an eco-friendly resource

A new Australian research initiative based at The University of Queensland (UQ) could see carbon dioxide becoming a useful resource in the production of fuels and chemicals.

Dubbed 'GETCO$_2$', the ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide is a $45 million, seven-year collaboration between seven Australian universities alongside industry and government. It is being led by Professor Xiwang Zhang within UQ's School of Chemical Engineering.

"With electrochemical conversion, CO_2 is transformed from being the biggest problem of our time to a valuable resource," Zhang said.

"We've assembled world-leading experts with strong connections to industry along with talented early-career researchers."

A GETCO$_2$ team has already built a device that generates electricity by absorbing CO_2. Zhang and Dr Zhuyuan Wang are finalists for the 2024 Eureka Prize for Innovative Research in Sustainability for their work on this device — a small, proof-of-concept nanogenerator that is carbon negative as it consumes greenhouse gas.

"Imagine in the future a device like this powering a mobile phone or a laptop computer using CO_2 from the atmosphere," Zhang said.

"On a larger scale, this technology could integrate with an industrial CO_2 capture process to make electricity.

"It is very exciting, and we will keep developing this technology and many others at GETCO$_2$."

The centre was officially launched on 30 July 2024 by Assistant Minister for Education Senator Anthony Chisholm.

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Photosynthesis inspires net-zero ammonia research

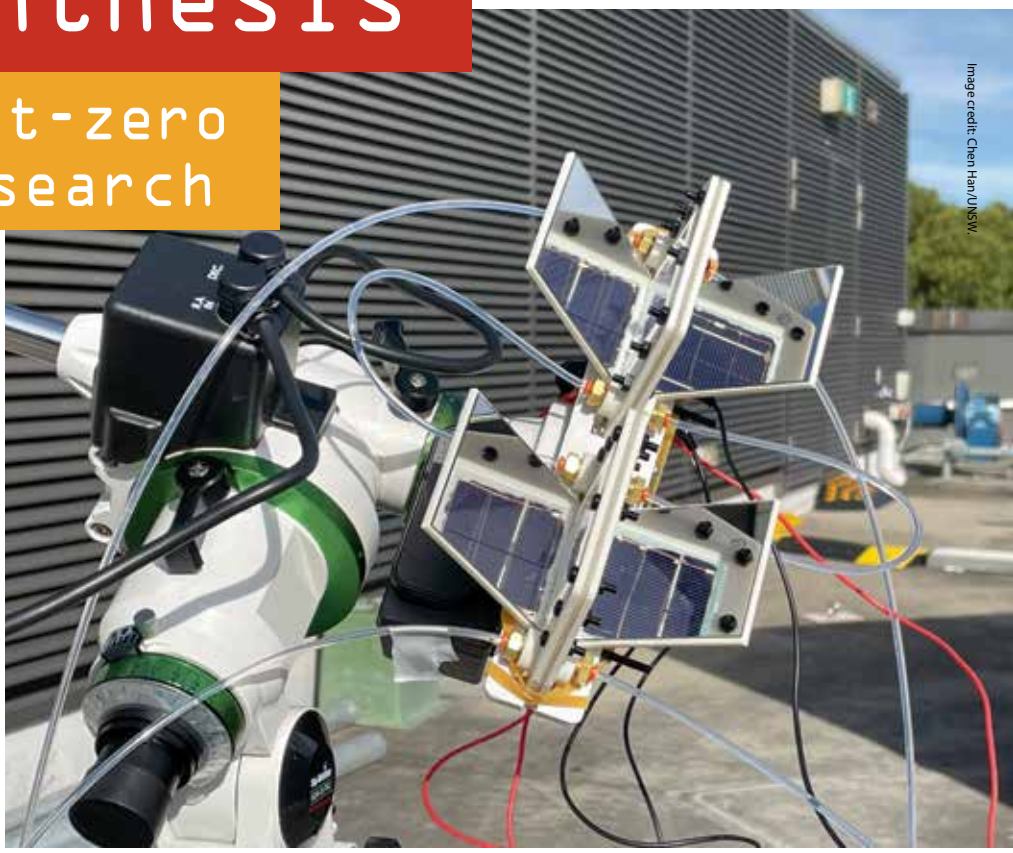

Image credit: Chen Han/UNSW.

Artificial leaf system developed at UNSW to create ammonia from wastewater using only the sun.

Scientists from UNSW Sydney have come up with a novel way to sustainably produce ammonia, inspired by the natural process of photosynthesis. Their research has been published in the *Journal of Energy and Environmental Science*.

Ammonia is a gas that is essential for producing the fertilisers that support global agriculture and food production. However, traditional methods of making ammonia create significant greenhouse gas emissions, since fossil fuels are required for the hydrogen production and energy that power the process.

"Traditional ammonia production requires high temperatures — around 400–500˚C — and high pressure, historically necessitating the use of fossil fuels," said UNSW Scientia Professor Rose Amal, from the School of Chemical Engineering.

To address this problem, teams led by Amal and Professor Xiaojing Hao, from the School of Photovoltaic and Renewable Energy Engineering, developed a way to generate ammonium ions from nitrate-containing wastewater using only a specially designed solar panel that works like an artificial leaf. Using a process known as photoelectrocatalytics (PEC), the researchers placed on the panel a nanostructured thin layer of copper and cobalt hydroxide that acted as a catalyst for the chemical reaction needed to produce ammonium nitrate from the wastewater.

In a real leaf, photosynthesis is the process by which plants use sunlight, water and carbon dioxide to create oxygen and energy in the form of sugar. This new photoelectrocatalytic process mimics photosynthesis, with the solar panel acting like an artificial leaf, using sunlight and nitrate-containing wastewater to create ammonium nitrate.

The research team, which includes lead author Chen Han and Dr Jian Pan (a DECRA fellow), built a 40 cm^2 artificial leaf system on the roof of Tyree Energy Technologies building at UNSW that has been able to produce ammonium ions that can satisfy 1.49 m^2 of cropland.

"We think this new technology could be implemented on a relatively small scale in agricultural locations to produce ammonium onsite, which would decentralise the production process and further reduce CO_2 emissions that are associated with the transportation process," Amal said.

"Our findings provide a clean, efficient and cost-effective solution for utilising solar energy and chemical wastes to produce ammonia and other value-added products," Han added.

"You do not need a high concentration of ammonia in fertiliser, so we believe the amounts of ammonia we are producing using our system make it a viable application in the real world, although we definitely still have some ways to further improve it."

The researchers hope that the generation of the ammonium from the wastewater will allow the processed water to be used to irrigate crops and further help them to grow.

"It's important to acknowledge that the wastewater we convert isn't coming directly from municipal waste or runoff — it still needs to be processed first to filter out the organic matters and particulates," Amal said.

"But we are hopeful that once we have generated ammonium from the nitrate wastewater, the treated water can then be put into irrigation."

Amal is keen for further collaboration and involvement with potential industry partners to develop the process into a fully viable commercial system.

"Industry partners would help us scale up this device, and we definitely would like to utilise a full-scale, traditionally sized solar panel for our application," she said.

"This is important for helping us reach our emissions targets of 2030 and 2040, and ultimately achieving net zero by 2050. We want to produce ammonia in a cleaner and greener way that minimises CO_2 emissions."

WARR industry celebrates success

Gayle Sloan, CEO of Waste Management and Resource Recovery Association of Australia

In the time since the Waste and Resource Recovery Association of Australia's ENVIRO Conference in Brisbane I've been reflecting on the positive impact our inaugural ENVIRO Award winners have had on our industry in achieving Australia's goal of a transition to a circular economy.

When WMRR decided to launch the awards, we deliberately set out to find some of the hidden gems or those who were previously unrecognised within the waste and resource recovery industry — and I'm proud I think we achieved just that with the help of our expert judges, John Gertsakis, Nicole Greenwood and Michelle Mandl.

As Michelle noted in her award presentation speech, the term circular economy was first coined in a research report completed for the European Commission by economist and architect Dr Walter Stahel in 1976. He sketched a vision of an economy in loops promoting product-life extension, long-life goods, reconditioning activities and waste prevention.

He went on to refine his so-called 'closed loop' approach, eventually publishing *The Circular Economy: A User's Guide* in 1999 in collaboration with the Ellen Macarthur Foundation in what has become known as the definitive worldwide guide for the circular economy.

But before the term circular economy even existed, there was Reverse Garbage, a self-funded not-for-profit enterprise operation and creative reuse centre in Sydney's Inner West.

Reverse Garbage was the winner of the ENVIRO Circular Transformation Award.

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What sets this group apart from the rest is that it does not turn away anything for donation that is safe for reuse in some form. It saved 120,000 kg of material from landfill in 2022/23 — a remarkable effort from just one centre.

The winner of the 2024 ENVIRO Circular Project Award was Wannon Water, through its Circular Economy Roadmap and Toolkit which was developed after the state-owned water and sewerage provider in South West Victoria identified the opportunity to take a system approach to work together across the value chain.

Through this work, Wannon Water built a network and provided the catalyst for regional collaboration and collective action leading to greater innovation, building the capability across a number of organisations, and the identification of projects that met circular economy principles.

What this demonstrated with great clarity is that circularity is not just a 'nice to have' for organisations looking to tick an ESL box, but one that can make a real difference to operating efficiency and business outcomes in a positive way. It shows the value of a circular economy is not just to the environment, but to business objectives as well.

And everyone's favourite winner was Greg Welsh, who took out the Circular Pioneer Award. Greg is the sort of person who should be a legend within our industry given his enormous impact, but he's too unassuming and modest for that.

Almost every one of this nation's Gen Z children will have sat in one his 100% Australian-made recycled plastic chairs stemming from his time as CEO of Sebel.

As his nominator wrote: "Greg has pioneered many things in the furniture industry that we now take for granted — like product stewardship — and he used his market power to drive changes."

About a decade ago, Greg set up a majority Indigenous-owned and controlled business, Winya, supplying desks, lounges and other office furniture to customers such as the Defence Department, Australian Taxation Office and Lendlease utilising salvaged timber from an Arnhem Land mine site that would otherwise have been burnt.

While there is plenty to be disheartened about in our industry at the moment, these three winners provide a much-needed dose of optimism and hope for us all.

They didn't wait for government action — in fact some pushed on in spite of it.

It shows you the enormous positive impact the WARR industry can have. I, for one, came away from the Awards energised and invigorated.

2024 NEW SOUTH WALES WATER INDUSTRY OPERATIONS

CONFERENCE & EXHIBITION

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Get ready for the ultimate gathering of water industry professionals in Tamworth! Join us for a day filled with insightful discussions, networking opportunities, and exciting exhibitions. Whether you're a seasoned pro or just starting out in the Water industry, this event is perfect for expanding your knowledge and connecting with like-minded individuals.

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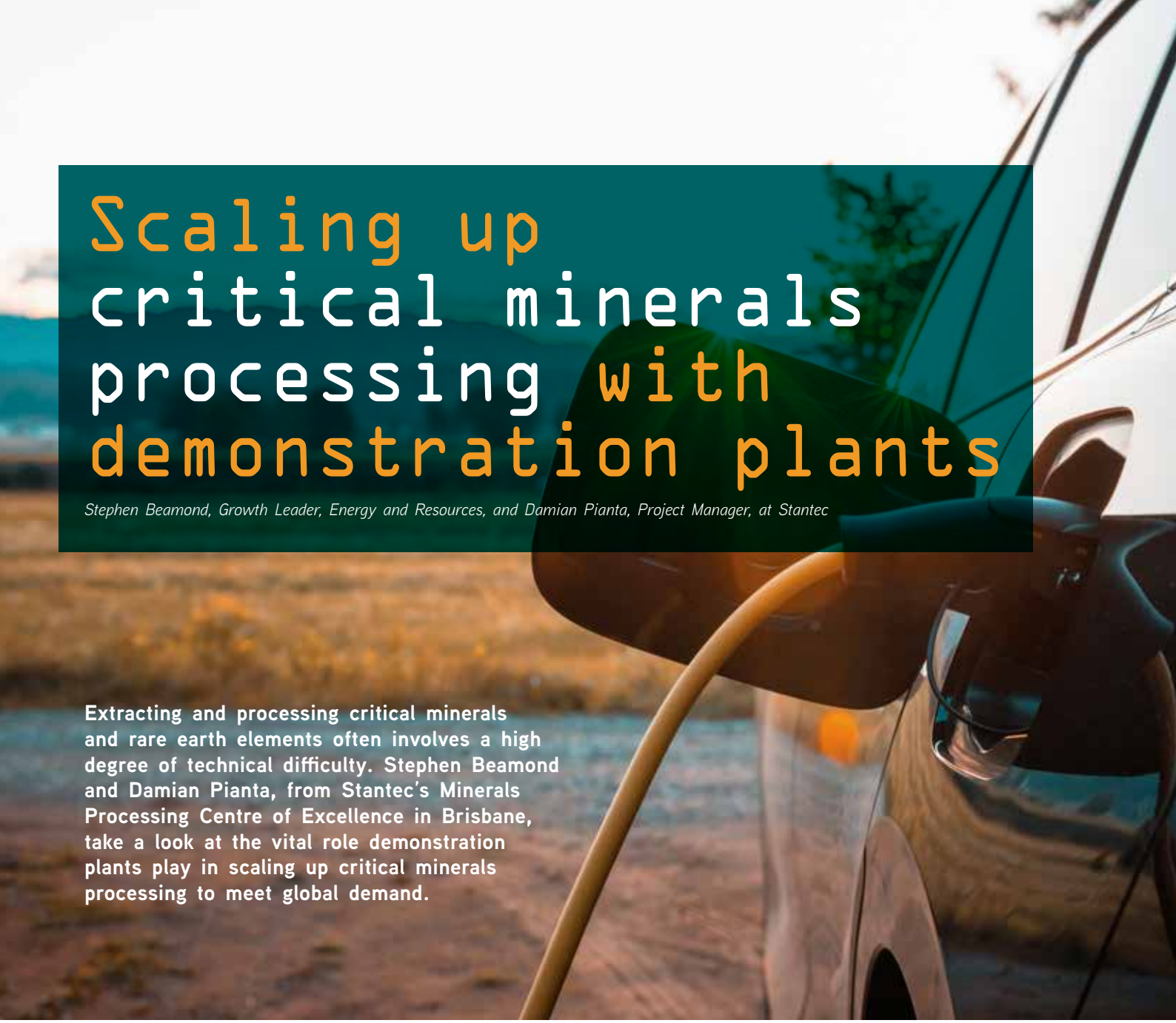
Scaling up critical minerals processing with demonstration plants

Stephen Beamond, Growth Leader, Energy and Resources, and Damian Pianta, Project Manager, at Stantec



Extracting and processing critical minerals and rare earth elements often involves a high degree of technical difficulty. Stephen Beamond and Damian Pianta, from Stantec's Minerals Processing Centre of Excellence in Brisbane, take a look at the vital role demonstration plants play in scaling up critical minerals processing to meet global demand.

Today's world runs on critical minerals. And so will tomorrow's. Critical minerals are crucial to the renewable energy technologies we need for a more sustainable future. We're already seeing demand for critical minerals and rare earth elements (REEs) skyrocket. According to the International Energy Agency (IEA), the average amount of minerals needed for a new unit of power generation capacity has increased by 50% over the past decade. This is because investments in renewable technology have increased.

The IEA estimates demand for critical minerals will quadruple in the next five years as the transition to green energy speeds up. This is based on an estimated 3 billion tonnes of minerals and metals needed to build the technologies that generate and store wind, solar and geothermal power.

Scaling up critical minerals processing is essential to meet this demand. Plus, with many critical minerals and REEs concentrated in other countries, we need to find ways to do this in Australia if we want to ensure a more sustainably powered future.

But we haven't previously mined critical minerals at this scale, so we need to develop new processes. These must be effective, economically viable and environmentally sustainable. We've seen mines lose time and money when things haven't gone to plan. But in the fight against climate change, we have no time to waste.

Demonstration plants — like the high-purity alumina (HPA) processing plant Stantec has recently designed, engineered and built in Brisbane — will be essential to developing processes that work at scale. Here's how.

Critical minerals processing at scale is a whole different ball game

Extracting critical minerals and REEs often involves a higher degree of technical difficulty than processing bulk commodities like iron ore or coal. In the past, the demand for some critical minerals and REEs has been in the tens or hundreds of tonnes globally. Now we're talking about billions of tonnes. Until the 2010s, the energy sector represented a small part of demand for most minerals.

Not anymore. Electric vehicles and battery storage have taken over electronics to become the largest consumer of lithium. Soon, they'll take over from stainless steel as the largest user of nickel by 2040, according to the IEA. This comes as the world races to meet its climate change targets. In the next 20 years, renewable energy technologies

will make up 40% of the demand for copper and REE, 60–70% for nickel and cobalt, and almost 90% for lithium.

Extracting and processing critical minerals and REEs on this scale is a whole different ball game. As mines move forward, they face a great challenge. Their processes need to be technically feasible, financially viable and sustainable for the environment. Only then should they invest in full-scale commercial production.

But how do mines make sure their critical minerals processes are ready to scale? Demonstration plants.

Skipping demonstration plants is a risk mines can't afford to take

Demonstration plants allow miners to test their processing outside of the lab. They validate new technologies and the materials used in construction to verify they will work at a commercial scale.

Going straight from a lab scale to a 500 or 1000 scale-up is too risky — there are no guarantees that what works in a lab will work in a commercial-scale processing plant. We've seen companies stagnate after skipping demonstration plant phase. Our rule of thumb is to never increase operations by more than 200 times on the first go-round. We recommend increasing some unit operations in increments of 50 times.

Demonstration plants give miners a level of certainty when scaling up their critical minerals processing. If something doesn't go to plan in a demonstration plant, there are ways to make changes. If everything runs smoothly, they can keep refining their processes or confidently take their operations up a notch.

Designing demonstration plants for a renewable future

We're working with clients to build demonstration plants that help them scale their critical minerals processing without the risk. HPA, a key component of lithium-ion batteries and solar panels, is one mineral in high demand — and we're helping design a way to process it.

We worked with technology developer Lava Blue and the Queensland University of Technology (QUT) on an HPA demonstration plant. It takes their innovative method from the lab to a plant in Brisbane that processes 20 kg batches.

QUT developed a process for removing contaminants in the lab. We worked with them to transition this into a demonstration plant. This included designing bespoke equipment when off-the-shelf equipment couldn't cope with the chemical environment and temperatures, or wasn't available at the scale involved.

We can use the HPA plant as a template for the development of large-scale HPA plants in Australia and around the world. It also gives other users of HPA a chance to develop their processes and products, while reducing our reliance on imported materials.

The ongoing value of demonstration plants to mining operations

Demonstration plants can also deliver long-term value to miners. While they might be designed to test a specific process at scale, they also provide a space for engineers to refine and adjust their processes based on real-world performance and changing market demands.

Miners can test changes in a controlled, scalable environment. Then they can move forward and commit to more expensive, large-scale shifts in their main production facilities. Beyond research and development, these plants can also be a good training ground for entry-level engineers and operations personnel.

This flexibility allows a mineral processing demonstration plant to operate for many years. We've seen some of them still running after a decade.

Demonstration plants are the future of critical minerals processing

Critical minerals are vital to the transition to renewable energy. That means it's essential that mines can confidently scale up their processing to meet the demand. Demonstration plants are crucial in moving from "we think this will work" to "we know this will work".

Demonstration plants bridge the gap between the lab and practical viability. They play a key role in evolving and advancing critical minerals processing. Thus, they will help us efficiently, economically and sustainably extract the critical materials and REEs to power our future.

Carbon-negative power stations possible in NZ

A modelling study from the New Zealand University of Canterbury and Ngāwhā Generation Ltd shows that retrofitting a geothermal power station could allow carbon capture from other sources like forestry residue.

Ngāwhā power station in Northland is already carbon neutral, capturing and re-injecting the carbon dioxide (CO_2) from the geothermal waters it uses to make electricity. Researchers calculated the potential impact of a retrofit that could capture extra carbon dioxide from burning forestry slash.

To transition the power station from carbon neutral to carbon negative, atmospheric or biogenic CO_2 (carbon dioxide which is emitted through organic matter) must also be injected concurrently with geogenic CO_2 (carbon dioxide within the earth). The latter is the focus of this study due to intrinsic synergies between geothermal and bioenergy, and the abundance of forestry waste for feedstock in the Far North.

There were three income streams identified for the modified station — geothermal electricity, carbon capture and sequestration, and capturing high-purity food-grade carbon dioxide — of which food-grade carbon dioxide was said to be the biggest money maker.

Following the conducting of research, published in the *Journal of the Royal Society of New Zealand*, researchers concluded that New Zealand has the natural resources and regulatory framework to potentially become a world leader in CO_2 removal. Geothermal energy has played an important role in both the country's domestic development and foreign relations. According to the research, New Zealand also has a robust forestry industry and a growing need to address forestry slash. Combining these three concepts could offer multiple value chains, durable pathways to achieve climate targets, and the building of international relationships via the exchange of expertise and aid.

Boral developing lower carbon concrete

Construction materials company Boral Limited (Boral), in partnership with industry players and researchers, is developing a lower carbon concrete product using Australian calcined clay as an alternative supplementary cementitious material (SCM).

Calcined clay concrete sample preparation at UTS Boral Centre for Sustainable Building.

Boral has partnered with the University of Technology Sydney (UTS), Transport for NSW and environmental technology company Calix as part of a project supported by SmartCrete CRC, an independent cooperative research centre (CRC) that brings together collaborators from industry, research and government to help ensure the viability of Australia's concrete infrastructure.

The two-year project, co-funded through the Commonwealth's CRC Program, aims to further demonstrate the technical feasibility of calcined clay concrete for use in Australian buildings and infrastructure. The partners — comprising suppliers, university researchers, asset owners and providers — will work on accelerated lab testing and field trials as part of the validation stage.

A first batch of clay has been successfully calcined by Calix's renewably powered electric calcination technology, demonstrating the potential of the approach to produce a low carbon intensity SCM.

The project follows research and development at the UTS Boral Centre for Sustainable Building carried out over the past three years whereby the suitability of a number of Australian clay sources were identified.

Vik Bansal, CEO and Managing Director at Boral, said: "Boral is committed to a lower carbon future and we never stand still. We are continuously improving and diversifying our lower carbon concrete offering by identifying new ways to reduce the cementitious intensity of our products."

Dr Ali Nezhad, Head of Sustainability and Innovation at Boral and Boral lead on the calcined clay project, said: "It's an exciting time to be at the forefront of the research and development being done on lower carbon concrete. The industry is constantly looking for ways to innovate, push the boundaries and find ways to be more sustainable. Given the abundance of clay in Australia, using Australian calcined clay was a natural decision for us.

"We have been impressed with the work done to date and initial testing in this project is promising. We look forward to the building and construction industry in Australia embracing these new innovations."

PERISTALTIC PUMP

The Ragazzini Peristaltic Pump is suitable for sludge and slurry.

With no mechanical parts in contact with the fluid and no valves or seals to wear, fail or clog, the pumps are easy to maintain.

The pumps use a peristaltic mechanism, where rotating rollers compress a flexible, resilient tube, thus creating a wave-like motion that transfers liquids through the system. Pumped media includes viscous fluids, corrosive fluids, abrasive fluids or fluids with solid particles.

Because they use rollers, the pumps do not require the casing to be filled with lubricating fluid.

Pumps can also be run in reverse to fill or empty, and can run dry without damage.

This versatile pump finds its application across diverse sectors — from food and beverage processing to pharmaceuticals, and from mining to wastewater treatment. It has a gentle pumping action, enabling the handling of shear-sensitive fluids, but it is also heavily constructed for handling solids-laden liquids like sludge and slurry.

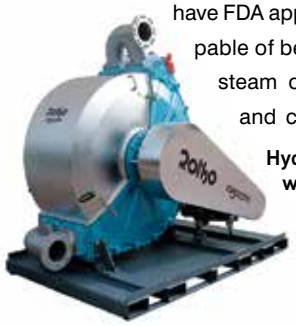
The pump's simple design reduces downtime, requiring minimal maintenance and spare parts. Hoses are easy to change because there is no messy fluid in the pump casing, and no other parts are required for regular maintenance.

Capable of handling abrasive and viscous materials, the pumps are also able to handle large solid particles (to almost half the diameter of the hose).

Using rollers instead of shoes to compress the tubular element not only reduces heat and wear but also reduces the power needed to move the rotor.

The slow-moving nature of the pumps is designed to deliver a precise amount of fluid transferred with each revolution, minimising waste and ensuring consistent quality.

Some hoses available with these pumps have FDA approval and are capable of being cleaned with steam or with hot water and cleaning agents.



Hydro Innovations
www.hydroinnovations.com.au

Waste not, want not: exploring the 2024 Waste Expo Conference

The 2024 Waste Expo Australia event is around the corner, with over 100 industry leaders and speakers set to share insights and encourage discussion around waste and sustainability topics.

The two-day event runs from 23–24 October at the Melbourne Convention and Exhibition Centre. The expo brings together leaders in waste, recycling, resource recovery and sustainability, providing a platform for discussion and collaboration.

The conference schedule includes an extensive program of industry speakers covering four key streams: Government & Policy; Circular Economy; Construction and Demolition & Commercial and Industrial (CD&CI); and Waste to Energy & Case Studies.

It will feature over 100 speakers across 60 sessions, including TOMRA Cleanaway CEO James Dorney, ALOA Chairman Daniel Fyfe and Return It CEO Marc Churchin.

Over 3000 attendees are expected, including representatives from waste services, landfill, government, consultancy and material recovery facilities.

Waste Expo Australia provides an important opportunity to collaborate with and hear from industry-leading experts across the waste and resource recovery value chain.

Waste Expo Australia Exhibition Manager Sherri Pearson is thrilled to be bringing the expo back for another year. Between the exhibition, conference and networking event, Pearson said there is something for everyone.

"Maintaining the reputation of excellence from previous Waste Expo Australia conferences, we are very fortunate to be joined this year by some fantastic speakers and industry leaders in the waste management sector. We are proud to provide a platform from which people can gain industry insights through case studies and panels."

"Through the Expo, we hope to encourage thought leadership and progress within the sector while also offering a sourcing platform for business and operational needs, and peer-to-peer networking," Pearson said.

The conference, trade exhibition and networking function are free to attend, and registration is open now.

Register to attend and view the full conference program at wasteexpoaustralia.com.au.

From drums to drums: Pact's agricultural recycling project

Images courtesy of Pact Group.

Plastic recycler and packaging manufacturer Pact Group has developed recycled plastic agricultural chemical containers in what the company describes as an Australian first.

The new AgriG8 containers can be made in 10, 15 and 20 L variants with up to 30% recycled plastic. Pact said it has undertaken extensive testing to ensure the containers are compliant with design requirements for chemicals used in the agricultural sector, such as fertilisers and insecticides.

The AgriG8 containers are part of a new initiative, 'Drums-to-Drums', resulting from a partnership between Pact, CropLife and CropLife's not-for-profit stewardship subsidiary Agsafe. CropLife is the national peak industry organisation for the plant science sector.

"Plastic packaging plays an essential role in Australia's agricultural industry by protecting seed, agricultural chemicals and pelletised pesticide for their safe transport, storage and use," said Matthew Cossey, Chief Executive Officer of CropLife Australia.

"The plant science industry takes whole-of-life stewardship of its products very seriously, investing heavily in genuine initiatives that ensure we're responsibly managing products at each stage of their life cycle."

Drums-to-Drums aims to close the loop on agricultural chemical containers by collecting, recycling and remaking them into new agricultural chemical packaging.

The initiative grew out of the long-running agricultural product stewardship program drumMUSTER, a national program for the collection and recycling of plastic agricultural and veterinary chemical drums.

drumMUSTER was started by CropLife 25 years ago and to date has collected more than 40 million drums from its 830 collection points across regional Australia. Pact has been recycling about 450,000 of the drumMUSTER containers per year, but due to technical challenges these containers could only be recycled into plastic pellets to make other products, such as irrigation pipes and bollards.

Now, under the Drums-to-Drums program, Pact is aiming to collect and recycle 900,000 agricultural chemical containers from drumMUSTER annually to make its new AgriG8 recycled containers. 900,000 containers is approximately 1080 tonnes of plastic, or the equivalent of more than 350 Toyota Hilux vehicles.[1]

"Pact is committed to creating a strong local circular economy that diverts plastic waste materials from landfill, recycles it and then remakes it into new products," said Ben Andrews, Pact's General Manager of Industrial Manufacturing.

"The Drums-to-Drums initiative demonstrates that industry-led initiatives are often best placed to develop effective solutions for industry-specific need."

1. Based on average weight of 1.2 kg for a 20 L plastic AgriG8cube (unfilled) and average weight of 3050 kg for a Toyota Hilux (Toyota HiLux SR (4x4) Price & Specifications | CarExpert).

Sustainable vision for LA28 Games

Images courtesy of Autodesk.

Still from Autodesk's LA28 promotional video.

The LA28 Olympic and Paralympic Games has enlisted software multinational Autodesk as its 'Official Design and Make Platform'. In this capacity, Autodesk, which specialises in software for designers, engineers and builders, will support LA28's more than $1 billion temporary overlay and construction plan, incorporating sustainable design principles.

Central to the plan is the intention not to construct any new permanent venues. Instead, LA28 is committed to adapting existing or building temporary infrastructure.

"At Autodesk, we believe the most sustainable building is the one already built. That's why we're excited by LA28's ambitious plan to retrofit existing structures to ensure sustainability is at the forefront of the LA28 Games venue plan," said Amy Bunszel, Executive Vice President, Architecture, Engineering and Construction Solutions at Autodesk.

"Over the next four years, our software will help set a new standard for creating a sporting event that intentionally designs, builds, repurposes and reuses existing venues."

Autodesk software will guide the retrofitting of the 40+ competition and major non-competition venues across Southern California that will make up the LA28 Games' footprint — including the LA Memorial Coliseum. The company said its technology would help to shorten timelines, cut costs and incorporate sustainable design principles across the project.

Over the next four years, LA28 will use the software, including Autodesk Construction Cloud, as a central tool to facilitate better collaboration with thousands of critical stakeholders on the design, development and ultimate delivery of the venues.

"Autodesk's software is a part of our LA28 story: the behind-the-scenes technology that brings our vision of the LA28 Games to life," said Casey Wasserman, LA28 Chairperson.

"Together, we will develop the right plan to support 12–15 million ticketed fans over such a short period of time. We are honoured to have Autodesk on board for the next four years as we embark on our shared commitment in innovative design that can serve as a precedent for many Games to come," Wasserman said.

Beyond the construction itself, LA28 has committed to making a positive and lasting impact on the city and communities of Los Angeles, and it will use Autodesk's cross-industry expertise and relationships to help achieve this aim.

In addition to the circular and low-carbon building design ethos, Autodesk will support LA28's collaboration with key public transportation agencies over the next four years to keep LA residents, workers, businesses and more moving reliably throughout the region. This includes the use of Autodesk software to aid in the design of key Games-related transportation elements and traffic control plans.

Three things climate reporting will never do

Tess Ariotti, Lead Consultant — Salterbaxter

iStock.com/VectorMine

Australian businesses are about to face the most significant change in corporate reporting in decades. Corporate Australia is fixated on the incoming mandatory climate disclosures and how to be compliant. Corporate reporting is designed to increase transparency and accountability, but the act of reporting alone will not make your business any more resilient to climate change. There are some things mandatory disclosures just will not achieve.

Here's three things reporting will never do:

1. Actually manage the risks that could be about to hit your business, hard.

Reporting alone will never reduce your emissions. Reporting will never remove risks throughout your supply chain. Reporting will not reduce your reliance on nature. What reporting does is help businesses understand their current state of play and provide an opportunity to analyse internal commitments against progress and external expectations to understand the sufficiency of action.

2. Manage data

The standards require you to have access to data, but do not provide you with the ways and wherefores for managing it. Having good quality data is key. You must have good systems and governance to manage appropriately. Consider investing in a technology platform to help you manage and use data effectively. Good data hygiene makes reporting and validation more transparent and accurate.

3. Build capability

Too many (read: most) companies in Australia are inadequately resourced when it comes to sustainability, both in terms of head count and the knowledge that exists in those heads. The days of sustainability being done off the side of someone's desk is over. Companies need people to manage the increased workload in mandatory disclosures, but also need resourcing to deliver actions, so you have something to report. Consider honestly what resourcing you need (whether inhouse or outsourced) to both undertake the work and to develop adequate disclosures.

But mandatory reporting does achieve some important outcomes. Here's three things reporting does do:

1. Compel board and executive level engagement on sustainability

How much engagement, however, will depend on the board. The more informed the board and executive are, the easier it will be for a company to remain compliant, manage risks and identify business opportunities. Leaders will need to challenge their business in the right way and support complex decision-making; they must upskill and continue to learn to do this.

2. Provide external stakeholders with information

Companies are likely to happily share some of the required information with stakeholders. Other information, well, perhaps less so. For example, the standards require companies to disclose whether the board have received training or have capability in this area. Disclosing that they have not and/or do not is a compliant answer, but do you really want to be highlighting limitations so publicly? How might this affect your business reputation and relationships over time?

3. Provide your business with a robust framework to understand the work that needs to be undertaken and how to prioritise action over time

Standards are a good place to understand basic requirements and to provide a structure for your approach. In taking this approach, you can better understand system-level risk, how it applies to your business and how you can use it to unearth opportunities to stabilise and grow your business across the short and longer terms. But standards frameworks will not tell you what your company specifically needs to do to achieve progress. Getting disclosure right means getting the actions that inform those disclosures right too.

So what's the takeaway?

Mandatory disclosures present a significant uplift in focus for a particular business area, carrying the potential to deliver commercial benefits. Reporting is also time-intensive and painstaking. Managing this onerous responsibility while deriving commercial benefits is only possible when you understand what reporting will and will not do. Make disclosures work for you.

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