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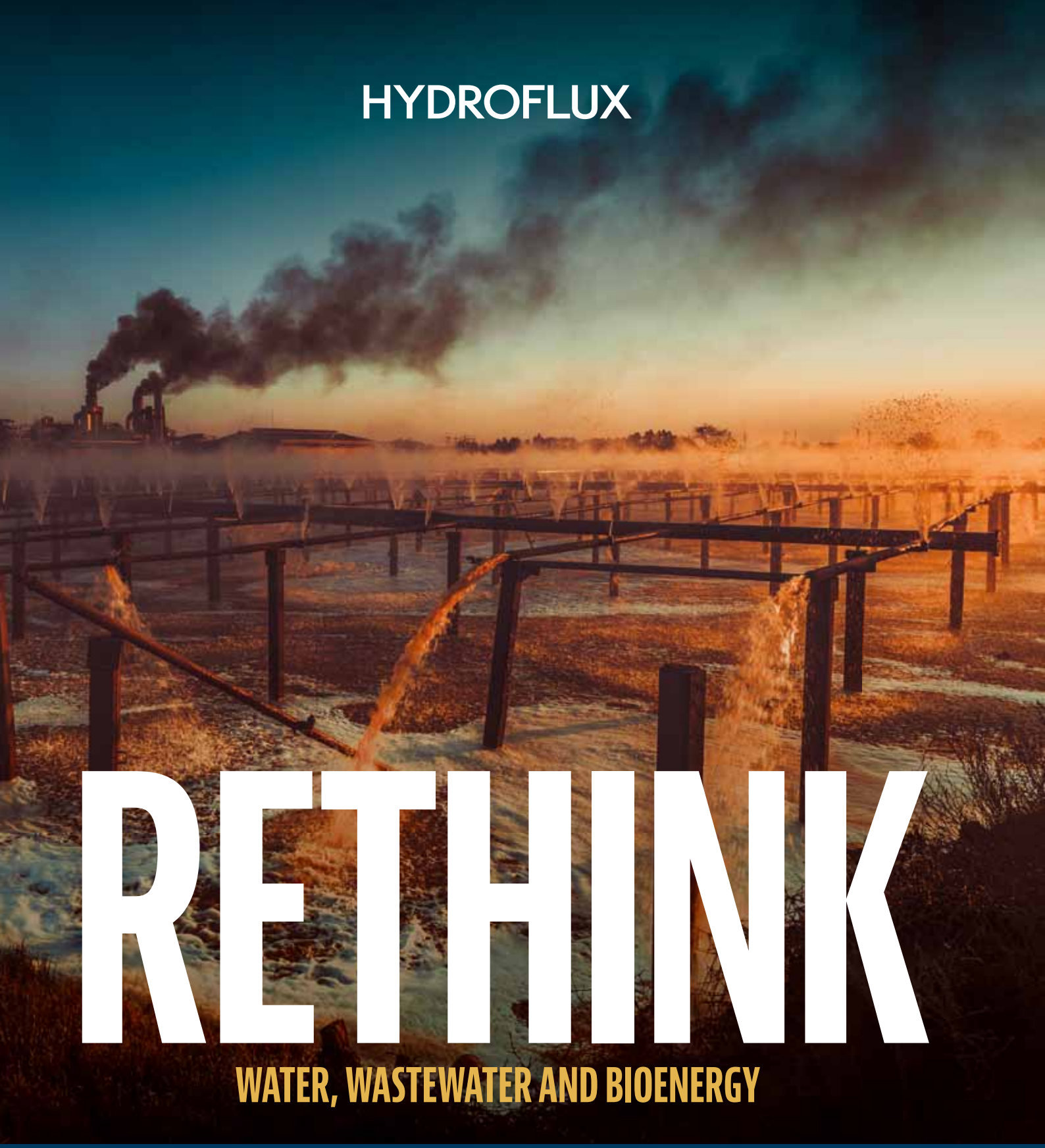
sustainability matters

80% resource recovery by 2030 – how do we get there?

Sustainability reporting | Electrification | Hydro energy storage | Embodied carbon



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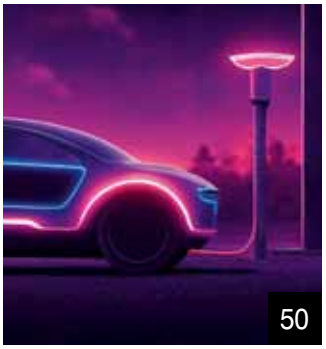

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WORDS from the EDITOR

Eighty per cent resource recovery by 2030; net zero emissions by 2050 or earlier — many targets have been set in Australia, but is now the time for more mandatory rules to be set in order to achieve the desired results?

On page 6, Gayle Sloan, Chief Executive Officer of WMRR, details the current status and the many achievements made in the resource recovery sector. Mandatory packaging rules have been implemented but Gayle calls for a national framework, similar to the US Inflation Reduction Act and Europe's Green Deal, in order for the sector to reach that 2030 target.

On another front, mandatory climate reporting rules are being implemented across the globe to help many countries reach net zero emission goals while eliminating greenwashing.

US-based companies operating in the state of California are now legally required to publicly disclose their annual greenhouse gas emissions across Scopes 1, 2 and 3. Public and private companies with annual revenues exceeding $1 billion must disclose emissions across Scopes 1 and 2 by 2026, with Scope 3 GHG emissions starting in 2027.

This move in the US follows similar mandatory GHG emission disclosure rules that are set to be implemented across Europe in 2024, and signals to Australia that mandatory non-financial climate reporting is not too far away. We take a closer look at how to get prepared for this non-financial reporting shift on page 34.

And there's plenty more in this issue.

Enjoy the read!

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80% resource recovery by 2030 – how do we get there?

Gayle Sloan

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> **"There is a certain irony in green tape holding up investment in vital recycling and resource recovery infrastructure necessary to achieve our environmental targets.**

They say the road to hell is paved with good intentions. And it's increasingly looking like this might be the case with Australia's goal of achieving 80% resource recovery by 2030.

It's only a little over six short years away.

As it stands, resource recovery in Australia is at around 62% and remains stubbornly difficult to budge higher.

According to the latest National Waste Report, there has been an increase of only one million tonnes over the last two reporting years, whereas we need over 10 million additional tonnes recovered over the next seven years (excluding ash recovery).

Those numbers demonstrate the trend is not our friend.

Drastic action is required if we are to meet that target. It will require some urgent and decisive leadership.

But let's first acknowledge some of the good work going on across the country.

Federal and State Environment Ministers recently agreed to take action on packaging, with design rules aimed at cutting waste and boosting recycling.

The introduction of mandated targets for recycled content is a crucial first step on the path to creating a level playing field between virgin and recycled materials.

To grow demand for the recyclate we produce as a country requires a strong domestic market to buy these materials back. It's clear this can only be achieved through mandated targets. Two decades of voluntary targets have failed to do the job, so this move is to be welcomed.

As is the co-investment from various governments in waste and resource recovery facilities, such as the expanded Visy facility in Melbourne opened in July, which adds 95,000 tonnes of fibre-processing capacity to the sector and the Albury-Wodonga PET recycling plant opened in 2022 operated as a joint venture between Pact Group, Cleanaway Waste Management Ltd, Asahi Beverages and new partner Coca-Cola Europacific Partners, which recycles about 30,000 tonnes a year.

But we need more. Much more. And fast.

This is why we are calling for a national commitment to a streamlined planning process to enable quick and efficient delivery of more of these facilities.

The WARR (waste avoidance & resource recovery) sector doesn't seek to cut corners — indeed, those planning processes are important to giving the community confidence in our facilities — but approval differs across the states, adding layers of complexity. Furthermore, there are examples of it taking up to seven years.

This simply isn't good enough and acts as a barrier to investment for those companies that want to play their part.

There is a certain irony in green tape holding up investment in vital recycling and resource recovery infrastructure necessary to achieve our environmental targets.

The very rules that are meant to protect the environment are often holding us back.

It's also why a national framework is necessary to ensure uniformity across Australia.

It's no wonder people are confused when the definition of waste varies from jurisdiction to jurisdiction.

As Elizabeth Wild and Leon Batchelor point out in an article for the *Australian Environmental Review*, the definition of waste in Australia is unpredictable and lacking transparency across the states, which means the waste and resource recovery sector can be "poorly equipped to make operational and investment decisions which is adversely impacting the development of a circular economy".

If we can't even agree on what waste is, what hope do we have?

Europe has the 'Green Deal'. The US has something similar as well as the Inflation Reduction Act, which wisely links environmental change to the economy.

It is this framework that everything needs to hang off. Instead, it seems like we are going the other way with a raft of siloed reviews and actions, then desperately hoping it will all fit together by 2030.

Well, sadly it's not and it's leaving massive holes. For example, the PFAS (per- and polyfluoroalkyl substances) consultation is looking into just three of the more than 4000 POPs (persistent organic pollutants).

The national framework would ensure the industry is considered in its entirety — not just papering over the last bad headline a government copped.

The good news is, there is a pathway forward. We can look to our friends in Europe and the US for inspiration.

The goodwill from the community is there, which should embolden governments to act.

There is time to start paving the road in a different direction and change tack, so we reach 80% by 2030, but that action needs to happen now and at a pace with which government to date appears unaccustomed.

Gayle Sloan is the Chief Executive Officer of the Waste Management and Resource Recovery Association of Australia (WMRR), Australias peak body for both the waste and resource recovery industry. Prior to becoming CEO in 2016, Gayle spent many years working for the NSW Attorney General's Department before moving into the Attorney General's Ministerial Office in 1998, and then the NSW Police Minister's Office in 2000. Following this time in state government, Gayle worked as a director in a number of NSW councils, primarily looking after service delivery and assets. She developed and delivered a number of waste management contracts on behalf of councils, as well as managing environment and regulatory departments, including rangers and compliance officers. After two years of being a stay-at-home mum, Gayle returned to work in 2013 at Visy before being appointed CEO of WMRR in 2016.

Electrification as an accelerator towards net zero

Ron Beck, Senior Director, Aspen Technology, Inc.

With climate change at the top of everyone's mind, even food choices are impacted. According to a Boston Consulting Group (BCG) report in 2022, each dollar invested in the production of meat and dairy alternatives resulted in seven times more greenhouse gas reductions than green buildings and 11 times more than zero-emission cars.

Beyond lifestyle changes that individuals can make, industry is tackling the dual challenge across Asia: namely, meeting the increasing demand for resources from a growing population with rising standards of living, while addressing sustainability goals. Today, energy accessibility and affordability are critical issues. Projections from the United Nations (UN) indicate that the world population will hit 9.7 billion in 2050, up from 8 billion today.

South-East Asian economies lead world growth; the growing middle-class is emerging to comprise almost half of the world's population (at 48%) or 3.8 billion people today. This burgeoning economic power places massive strain on power demand in the energy industry. According to the U.S. Energy Information Administration (EIA), this demographic group is also likely to be responsible for a 50% increase in global energy demand by 2050, and a 75% increase in electricity demand. Countries like India, China, Japan, Indonesia and Malaysia are incentivising electrification of mobility (with electric vehicles on a steep regional growth curve) and heavy industry alike.

To meet this growing regional market demand, it is necessary to ramp up electricity resources, particularly from renewable origins. An estimated investment of over $1.5 trillion a year in capacity; grid improvements; low-carbon generating capacity; and transmission and decentralised distribution will be needed to enable suitable electrical generation. In planning, energy companies will need to consider the current situation, that approximately 770 million people cannot access affordable electricity today, most of them in sub-Saharan Africa (IEA, 2022).

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Tapping into electrical power

The move towards electrification is an opportunistic one for organisations across sectors, including chemicals; mining; conventional and green energy; and power generation and distribution. However, there are challenges ahead.

Grids need to be expanded, modernised, enabled to rapidly evolve to support distributed (renewable) power and power storage, and be more resilient in the face of cyberthreats. As part of this strategic move to electrification, more organisations are decarbonising assets to achieve carbon abatement pledges and use electrical power. Advanced power distribution management and distributed energy management (DERMS) through digitalisation is crucial to keep electric power supply reliable for all consumers and works in favour of the trend toward distributed renewables (solar, wind, geothermal and hydro) and storage (battery arrays in the grid). For critical assets, microgrids can optimise and reduce the carbon footprint of the asset owner, as well as ensure that vital assets do not suffer sudden electric supply loss.

Globally, many initiatives are implemented to enable the ability to ensure traceability and accountability (in terms of audit requirements). This enables the industry to track green power content through its value chain and further understand its impact on the carbon-intensity of products. This is particularly crucial in gaining increased access to capital for decarbonisation investment in economically developing regions and for auditing outcomes. Investments in renewables and intelligent grids go together with carbon trading, in order to monetise decarbonisation efforts.

Digital solutions supporting distributed generation sources and grids play a crucial role. This includes tracing carbon emissions (from renewable source to industrial end use); the calculation and tracking of carbon intensity in finished products (produced via renewable energy); and the issuance of green certificates.

A greener and better grid

Organisations with their finger on the pulse are already exploring renewable solutions, such as energy storage technology, direct air carbon capture, wind and solar farm optimisation, hydrogen fuel cells and distributed generation and distribution. With the proliferation of distributed renewable power sources, grids need to be more digi-

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tally enabled. In doing so, these grids can dynamically manage the variability of supply and demand to ensure 100% availability, as grids begin to operate increasingly in a bi-directional mode. The primary objective is to ensure complete network reliability.

Data incorporated in both generation and storage solutions should be part of an intelligent digital system to predict load and demand, as well as route power efficiently. Digital upgrades are essential to support new pricing and revenue models for electricity, certifying an organisation's green investments. Intelligent distribution solutions encourage price-based usage during periods of surplus supply, while removing barriers to the expansion of distributed generation and storage nodes. They also enhance cybersecurity. In both transmission and distribution networks, the ability to forecast weather-based peaks and valleys in renewable power supply can optimise the use of renewable capacity. It also helps to avoid overloading lines and effectively uses storage (battery array) capabilities.

Other benefits can also be derived from using advanced distribution management solutions, including configurable capacity; visibility into distributed generation; resiliency amid increasingly dynamic supply and demand; advanced situational awareness for operators and managers; and enhanced grid support for smarter meters, generators and storage nodes. However, to maximise value from distributed power, developments in digital software will be required.

Connection of smart home and commercial devices will help incentivise consumers to preferentially use available power during surplus, low-price periods.

Power generation gaps are also being filled by the rapid growth and uptake of microgrids. The right digital solution enables optimised development of microgrids, integrated with regional grids and developed in a cohesive, intelligent way. This approach promotes and enables entrepreneurial investment and innovation in new power generation strategies and connected storage innovation. Microgrids provide local concentrations of power for users, which helps maximise their reliability.

Global march towards net zero

Without any doubt, the global march towards net zero carbon emission is gathering pace, as more countries commit to stringent targets and objectives. This move forward provides a bright future for electrification and offers new opportunities to organisations in the energy sector.

Across multiple industrial sectors, organisations have the chance to carve out a competitive edge and achieve true market differentiation. For example, power and utility companies can harness the move towards electrification by increasing investments in generation and transmission assets. Other companies can bring in new equipment and processes to achieve greater efficiencies. With more resilient and stronger grids being deployed, developing regions can sidestep traditional approaches to power and take on full-scale adoption of renewable power for cheaper, widescale access to energy.

To harness this strong electrification market opportunity, digital software provides the foundation for widescale adoption of electricity as a power source, while providing choice — in terms of technologies deployed to enable regional and microgrids, on a global scale. In closing, the adoption of electrification by fertiliser and food production industries can reduce the carbon intensity of food production, hence giving the consumer a broader set of choices to follow a greener lifestyle.

Ron Beck is the Senior Director of Aspen Technology.

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DE-RISKING ENERGY PROJECTS BY INTEGRATING WATER FROM THE START

Matthew Brannock, Rod Naylor

Water's place on the energy transition agenda

In a recent research report conducted by GHD, 94% of energy leaders globally believe the current energy crisis is the most severe their market has ever experienced. SHOCKED revealed that the energy sector is battling three distinct, but interconnected, shocks: security, society and climate.

Water risk is embodied in all three shocks — water security affects the bankability of energy projects, societal shocks are impacted by changing water use and policy, and climate risk is associated with increasing droughts, flood and storms. It is crucial that the energy sector understands the varying and complex risks that must be navigated to catalyse the energy transition, including the impact of rising water risk.

To be successful in de-risking the energy transition, water must be considered early. Water and energy intersect at a critical nexus point — water is vital to many forms of energy generation and used in a wide range of production processes. While integral to enabling the energy transition, water has the potential for both positive and negative impacts on energy organisations — energy projects can 'live or die' by water.

To effectively assess and manage the various risks posed by water to projects and businesses, energy projects must account for:

1. water access and security
2. by-product or residuals management.

Access: water as a critical ingredient

Many renewable energy projects need sufficient access to water to be successful. To be investable, energy projects need a guaranteed supply of 'high security' water. The problem is that high security water is expensive to guarantee and without guarantees, banks and investors are less likely to finance energy developments.

While deciding where to locate energy projects is commonly dictated by logistical factors such as access to transmission lines, ports and skilled workers, water should not be overlooked. Water has the potential to 'kill' what looks like a good economic opportunity, especially where many energy users or buyers are located. Whether water may be a fatal flaw in an energy project depends on the local water situation, which is different every time. Considering water early in the project lifecycle will help to identify any potential fatal flaws.

Matthew Brannock
Water for Future Fuels Lead, GHD

Rod Naylor
Global Water Leader, GHD

Where large volumes of water are required, energy projects risk being hamstrung by impact to water access and availability. Careful consideration and early engagement with local water authorities and utilities will help to ensure that water is sustainably managed and not diverted away from local communities, industries, environments or cultural needs.

With longer droughts, more frequent floods and worsening storms, there is less certainty and reliability around water. Production requiring large volumes of water can be impacted by drought and evaporation, such as pumped hydro and hydropower operations, which are critical to some geographies. Less rainfall can reduce the availability of surface water sources, while floods can affect water quality. To address this risk, seawater desalination and recycled water may offer more resilient water sources in terms of yield and quality.

Kidston Pumped Hydro

Alternative sources of water do not come without challenges, and considering the social and environmental impacts means regulatory approval times can delay projects. Seawater desalination, for example, requires suitable sea conditions and access to ocean environments where impacts can be appropriately managed. There are only so many sites that can deliver good quality seawater with as little social and environmental impact as possible.

Another factor to consider is how the changing climate and social expectations can impact a project's bankability. Increasing requirements for climate change declarations and disclosure for companies and investors mean that long-term climate risks must be assessed early on. Water is a critical element of the regulatory requirements for risk assessment and to bring climate risk quantification into financial markets. To practically mitigate economic risk, energy projects need to account for the shifting climate uncertainty that will inevitably change over time.

Waste streams: managing by-products resulting from water use

A realistic waste management strategy — one that considers waste treatment, minimisation and disposal as well as end-of-life issues —is essential to green light energy projects. Historically, some energy projects have failed to properly manage highly concentrated waste streams, creating an environmental legacy that can lead to negative outcomes.

What's more, due to rising water risk, future energy projects will be driven to adopt more complex and potentially saline water sources, which leave behind substantially higher amounts of highly concentrated residual by-products. To mitigate these risks, energy projects must carefully consider and manage waste streams to prevent environmental degradation or habitat loss.

A common issue with many inland energy projects is the inability to release salty waste streams directly into the environment due to the significant environmental impact. In Australia's Hunter Valley, the Hunter River Salinity Trading Scheme limits the amount of salt that power stations can release because of the environmental impacts. This has resulted in substantial accumulation of waste salt on site.

Another example is the coal seam gas industry, where the process of accessing natural gas brings brackish water to the surface. While this brackish water is usually desalinated to enable beneficial reuse of the water, the whole process accumulates salts at the surface. The planned industry approach for the brine — which is currently stored and concentrated in hundreds of hectares of ponds — is to crystallise and store the salt in landfill for perpetuity.

Early, thoughtful consideration is key

With climate change and population growth increasing the demand for already limited water resources, energy projects will become more complex and uncertain over the timeframe of the project or investment lifecycle. Therefore, water must be embedded in a project's feasibility and development stages to de-risk the energy transition and meet decarbonisation expectations.

Water access and security is crucial to the bankability and ongoing financial asset management of an energy project. Equally important is the cost of treatment as well as the transport and disposal of waste arising from water systems and use.

Through early, thoughtful consideration of water's role in future energy projects, energy companies can successfully navigate the varying and complex risks associated with the energy transition, leaving behind a positive legacy for future generations.

Dam good:
Water reservoirs for energy storage

Tens of thousands of small-scale hydro energy storage sites could be built from Australia's farm dams, supporting the uptake of low-carbon power systems in rural communities, according to new UNSW Sydney-led research.

The study, published in *Applied Energy*, finds agricultural reservoirs, like those used for solar-power irrigation, could be connected to form micro-pumped hydro energy storage systems — household-size versions of the Snowy Hydro hydroelectric dam project. It's claimed to be the first study in the world to assess the potential of these small-scale systems as an innovative renewable energy storage solution.

With the increasing shift towards variable energy sources like wind and solar photovoltaics, storing surplus energy is essential for ensuring a stable and reliable power supply. In other words, when the sun isn't up or the wind isn't blowing, stored energy can help balance energy supply and demand in real time and overcome the risk of shortages and overloads.

In a micro-pumped hydro energy storage system, excess solar energy from high-production periods is stored by pumping water to a high-lying reservoir, which is released back to a low-lying reservoir when more power is needed, flowing through a turbine-connected generator to create electricity. However, constructing new water reservoirs for micro-pumped hydro energy storage can be expensive.

"The transition to low-carbon power systems like wind and solar photovoltaics needs cost-effective energy storage solutions at all scales," said Dr Nicholas Gilmore, lead author of the study and lecturer at the School of Mechanical and Manufacturing Engineering at UNSW Engineering. "We thought — if you're geographically fortunate to have two significant water volumes separated with sufficient elevation, you might have the potential to have your own hydro energy storage system."

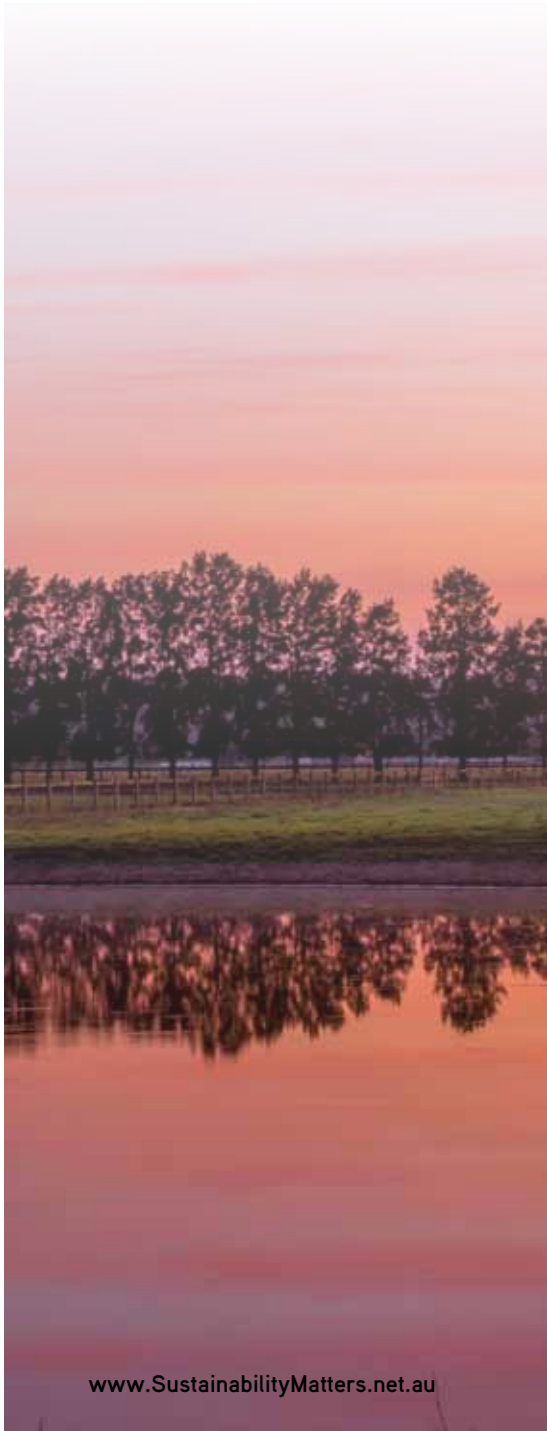
Unlocking the untapped potential of farm dams

For the study, the team, which also included researchers from Deakin University and the University of Technology Sydney, used satellite imagery to create unique agricultural reservoir pairings across Australia from a 2021 dataset of farm dams. They then used graph theory algorithms — a branch of mathematics that models how nodes can be organised and interconnected — to filter commercially promising sites based on minimum capacity and slope.

"If you have a lot of dams in close proximity, it's not viable to link them up in every combination," said Dr Thomas Britz, co-author of the study and senior lecturer at UNSW Science's School of Mathematics and Statistics. "So, we use these graph theory algorithms to connect the best dam configurations with a reasonable energy capacity."

From nearly 1.7 million farm dams, the researchers identified over 30,000 sites across Australia as promising for micro-pumped hydro energy storage. The average site could provide up to 2 kW of power and

"From nearly 1.7 million farm dams, the researchers identified over 30,000 sites across Australia as promising for micro-pumped hydro energy storage. The average site could provide up to 2 kW of power and 30 kWh of usable energy — enough to back up a South Australian home for 40 hours.



30 kWh of usable energy — enough to back up a South Australian home for 40 hours.

"We identified tens of thousands of these potential sites where micro-pumped hydro energy storage systems could be installed without undertaking costly reservoir construction," Gilmore said. "That's thousands of households that could potentially increase their solar usage, saving money on their energy bills, and reducing their carbon footprint."

The research team also benchmarked a micro-pumped hydro site to a commercially available lithium-ion battery in solar-powered irrigation systems. Despite a low discharge efficiency, they found the pumped hydro storage was 30% cheaper for a large single-cycle load due to its high storage capacity.

"While the initial outlay for a micro-pumped hydro energy storage system is higher than a battery, the advantages are larger storage capacity and potential durability for decades," Gilmore said. "But that cost is significantly reduced anyway by capitalising on existing reservoirs, which also has the added benefit of less environmental impact."

Building micro-pumped hydro energy power systems from existing farm dams could also assist rural areas susceptible to power outages that need a secure and reliable backup power source. Battery backup power is generally limited to less than half a day, while generators, though powerful, are dependent on affordable fuel supply and produce harmful emissions.

"People on the fringes of the electricity network can be more exposed to power outages, and the supply can be less reliable," Gilmore said. "If there's a power outage during a bushfire, for example, a pumped hydro system will give you enough energy to last a day, whereas a battery typically lasts around eight hours."

Although encouraging, the researchers say some limitations of the study require further analysis, including fluctuations in water availability, pump scheduling and discharge efficiency.

"Our findings are encouraging for further development of this emerging technology, and there is plenty of scope for future technological improvements that will make these systems increasingly cheaper over time," Gilmore said.

"The next step would be setting up a pilot site, testing the performance of a system in action and modelling it in detail to get real-world validation — we have 30,000 potential candidates!"

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Infinite recycling R&D facility to be built


Samsara Eco CEO Paul Riley with researcher Vanessa Vongsouthi.

Australian enviro-tech startup Samsara Eco has announced it is creating an infinite recycling R&D facility. Located at the Poplars Innovation Precinct in Queanbeyan in Regional NSW, the new facility will provide a home base for Samsara Eco to scale its patented enzymatic capabilities and will serve as a key milestone for the company as it moves towards recycling 1.5 million tonnes of plastic per annum by 2030.

Since launching in 2021, Samsara Eco's R&D has been based at the research laboratories at the Australian National University (ANU). Samsara Eco will continue to partner with ANU as it works to scale up its technology in readiness for commercialisation.

"You can't solve the climate crisis unless you solve the plastics crisis," said Paul Riley, CEO and Founder of Samsara Eco. "Plastic is one of the greatest inventions of the 20th century and provides enormous utility because of its durability, flexibility and strength. Yet, it's also an environmental disaster with almost every piece of the 9 billion tonnes ever made still on the planet."

The R&D facility will be solely focused on accelerating Samsara Eco's scientific research, ready for commercialisation in future facilities. Samsara Eco is working with Poplars, the Queanbeyan-Palerang Regional Council and the local community to develop Australia's first infinite recycling R&D facility, which is expected to be operational by late 2024.

"We've had fantastic growth out of our ANU lab so far, but the plastic problem is growing fast. As we gear up towards commercialisation, access to our first R&D facility will enable us to accelerate the capabilities of infinite recycling and scale our solution which breaks down plastics in minutes, not centuries," Riley said.

Samsara Eco's solution to the problem is that instead of mining for fossil fuels to create new plastic or relying on current recycling methods — which result in less than 10% of plastic waste actually being recycled — Samsara Eco takes plastic that already exists and infinitely recycles it.

Samsara Eco's infinite recycling technology returns plastic to its core molecules, which can then be used to recreate brand new plastic, again and again. Currently, Samsara Eco's enzymatic library can tackle challenging plastics including coloured, multi-layered, mixed plastics and textiles like polyester and nylon 66. The R&D facility will be pivotal to expanding its enzymatic library.

$40.5m material recycling facility opening soon in Qld

Construction of a $40.5 million material recycling facility (MRF) on the Sunshine Coast is close to completion, with the facility set to be operational by the end of the year.

Claimed as the largest new investment publicly-owned recycling infrastructure in South East Queensland in a decade, the MRF will be able to process 60,000 tonnes or more per year to recover glass bottles, plastic containers, cardboard, paper, and steel and aluminium cans, supplying a range of products for re-use across several industries.

"The facility will sort glass bottles and jars, paper, cardboard, plastics, steel cans and aluminium cans from household and business yellow-lidded bins at 98% purity — the highest quality of any Australian recycling facility," said Sunshine Coast Council Mayor Mark Jamieson.


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Combined with industry-leading intelligent sorting equipment, the extra recycling capacity will help reduce waste-to-landfill and create new circular economy opportunities in downstream markets.

Funding for the facility has been through a tripartite funding agreement between all levels of government, with $22m from the Palaszczuk government's Recycling and Jobs Fund, $13.5m from Sunshine Coast Council and a $5m contribution from the Albanese government's Recycling Modernisation Fund.

"To protect our environment, we have set ourselves an ambitious goal of diverting 80% of waste from landfill and recycling 65% of materials by 2030," said Queensland Environment Minister Leanne Linard.

Sunshine Coast Council Environment Portfolio Councillor Maria Suarez said the facility would help Council deliver the Sunshine Coast Waste Strategy and build on its goal to be a zero-net emissions organisation by 2041.

Piggery reduces maintenance with wastewater pumps

BettaPork Piggery has been breeding pigs for over 30 years. A mid-size enterprise, the piggery raises the animals and then sells them to market.

As part of the piggery's recycling philosophy, all pig waste is collected and broken down before being used as fertiliser on the grounds and turned into biogas to power the farm.

"We collect the pig waste in what we call sump pits," explained Paul Brosnan, Owner/Director of BettaPork Piggery. "The effluent is then pumped from the sump up to a holding dam. It then moves progressively through a series of processes before the effluent is eventually ready to be pumped into biogas holding tanks to collect the biogas."

The problem

To move the pig waste from the sump to the holding tanks, the piggery was using a few different types of pumps including submersibles. Located in the effluent pit, and needing a chain and lifting device to raise to the surface, these pumps were proving increasingly inefficient and costly to maintain.

"After we bought the submersible pumps, we quickly discovered that they have a very fine tolerance. The suction inlet/impeller started to block continuously and the pumps would run dry, resulting in the internals of the pump wearing and needing to be replaced on a regular basis."

The solution

Brosnan started to search for a more efficient solution. Coincidentally, he works closely with a local business that uses a number of Gorman Rupp pumps in its processes, and highly recommended the brand. Brosnan contacted Hydro Innovations (authorised Australian distributor for Gorman-Rupp pumps) for a solution to the issues he had with the current pumps he had been using.

"Having purchased and used a number of different types of pumps in the past, we didn't want to spend any more money on pumps that could not do the job. So, it was great coming across a supplier who was happy to stand by their product and prove it was the right pump for the job," Brosnan said.

After reviewing the piggery's requirements, Hydro Innovations suggested that Brosnan install a Gorman-Rupp T6A60S-B wastewater pump fitted with a 7.5 kW motor — a packaged unit that would provide both the flow and the pressure that was needed.

According to Garry Grant, General Manager of Hydro Innovations, the Gorman-Rupp T6A60S-B is a rugged and reliable self-priming centrifugal solids-handling pump. Very easy to maintain, the pump is capable of handling a 3″ solid (so it will pump a cricket ball) as well as stringy materials. In addition, if any choking does occur, the pump can be easily and quickly unclogged via the lightweight removable cover plate.

The design of the pump also allows users to adjust the clearance externally (in minutes) to ensure optimum performance without having to remove the pump from the system or open it. For major services, the removable rotating assembly can be replaced by simply loosening four bolts from the drive end of the pump, eliminating the need to disturb the pump casing or piping.

The results

According to Brosnan, "Within a few months of having the pump installed at the piggery we knew that it was capable. It moves more liquid than the previous pump and it's extremely easy to maintain, which, for me, is the major bonus. The open impeller design makes it very simple to remove any blockages. You only have to loosen two bolts to get inside the pump and clear it, which only takes 15 minutes.

"And of course, an added bonus is that we no longer have to waste money purchasing a constant number of parts due to breakdowns," Brosnan added.

So impressed was Brosnan with the performance of the Gorman-Rupp T6A60S-B, he purchased a second pump and is now considering a third.

Hydro Innovations
www.hydroinnovations.com.au

Solving a sticky problem in recycling

Scientists from the University of Surrey have developed a dissolvable adhesive to prevent sticky residue left on recyclable materials such as glass and cardboard.

Sticky residue causes problems in the recycling industry, ranging from low-quality products, blocked water systems and even damaged recycling machinery.

The newly invented adhesive is similar to that used on commercial packaging tape and contains a chemical additive known as thionolactone, which makes up 0.25% of the composition. This additive allows the adhesive to be dissolved in the recycling process. Labels can also be detached up to 10 times faster when compared to a non-degradable adhesive.


University of Surrey

Professor Joseph Keddie, Leader of the Soft Matter Physics laboratory at the University of Surrey and fellow of the Surrey Institute for Sustainability, said adhesives are made from a network of chain-like polymer molecules which are linked together. These create the residue build-up left behind when recycling materials such as glass and cardboard. Residues have consequences on an industrial scale, compromising the quality of recycled products.

The additive creates degradable thioester connections in the polymer network and provides a solution to making recycling processes residue free.

Peter Roth, Senior Lecturer of Polymer Chemistry at the University of Surrey, and fellow of the Surrey Institute for Sustainability, said there are existing degradable adhesives on the market, but they are not similar to what is currently used industry-wide in their chemical make-up.

The researchers are aiming to prove that it is possible to use similar adhesives and show that a simple additive can help increase the quality of recycled materials. The next step is to look at the commercial viability of the additive, as well as the sustainability impact.

The adhesive has been tested on glass, steel, plastic and paper, including cardboard.

"The interdisciplinary approach across chemistry and physics has been incredibly useful in building the knowledge and skills to solve a very real sustainability problem. There is no doubt that many countries across the world need to review how they recycle major materials, and this brings us one step closer to reaching our sustainability goals on an industrial scale," said Rohani Abu Bakar, a PhD student working on the project.

The paper has been published in the German Chemical Society journal *Angewandte Chemie*.

Charging times could affect EV sustainability

Researchers from The University of Queensland will investigate whether the charging habits of electric vehicle owners could lower the cost of reaching Australia's climate targets.

Dr Andrea La Nauze, an environmental economist from UQ's Australian Institute for Business and Economics, said EV owners are in a unique position to support the renewable energy transition.

Australia has pledged to reach net zero by 2050, with 15% of carbon reductions expected to come from the switch to EVs.

According to La Nauze, charging an EV battery uses a lot of electricity, so it's beneficial to charge vehicles when cheap electricity is abundant. This is especially true as electricity starts to come from more renewable sources like solar, which makes it important to avoid charging when the sun goes down and electricity is in demand.

"Our project will look at whether EV owners can be incentivised to charge their cars when the power grid has peak renewable energy," La Nauze said.


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Earlier research has found that EV owners who have rooftop solar panels are more likely to charge their cars in the middle of the day than owners without solar. They plug in when electricity is cheapest, which is what the researchers will try to mimic by offering monetary incentives for other EV owners to charge during the day.

The project will also look at the effect of automation software that can automatically charge vehicles at times of peak solar energy production.

According to La Nauze, the researchers expect that this will be a valuable tool for EV owners, helping them to use electricity when it's cheapest.

"EVs powered by renewable energy help to lower emissions from transportation, but they can also help support grid security as we transition to renewables by using electricity at times when we have an excess," she said.

Though the uptake of EVs in Australia is encouraging, charging at optimum times is crucial to the technology having maximum impact.

"This project will help inform policymakers, grid operators and electricity retailers on this important transition to sustainability," La Nauze said.

Research: From coffee to concrete

Australian engineers have found a way of making 30% stronger concrete with roasted used coffee grounds. The technique involves turning waste coffee grounds into biochar using a low-energy process without oxygen at 350°C.

Lead author Dr Rajeev Roychand from RMIT University said the disposal of organic waste creates an environmental challenge as it emits large amounts of greenhouse gases such as methane and carbon dioxide.

Australia generates 75 million kilograms of ground coffee waste every year, most of which ends up in landfills. Globally, 10 billion kilograms of ground coffee waste is generated annually.

Several councils have engaged the researchers for upcoming infrastructure projects incorporating pyrolysed forms of different organic wastes.

Pyrolysis involves heating organic waste in the absence of oxygen.

Joint lead author Dr Shannon Kilmartin-Lynch said construction industries around the world can play a role in transforming the waste into a valuable resource.

The concrete industry has potential to contribute to increasing the recycling of organic waste, greatly reducing the amount of it that goes into landfill.

Coffee biochar can replace a portion of the sand that is used to make concrete, further impacting the environment by reducing the ongoing extraction of natural sand.

50 billion tonnes of natural sand are used in construction projects globally every year.

"There are critical and long-lasting challenges in maintaining a sustainable supply of sand due to the finite nature of resources and the environmental impacts of sand mining," said corresponding author and research team leader Professor Jie Li.

Co-researcher Dr Mohammad Saberian said the construction industry needs to explore alternative raw materials to ensure its sustainability.

The research team has developed a range of biochars from different organic wastes, including wood, food, agriculture and municipal solid-waste.

The researchers plan to develop practical implementation strategies and work towards field trials.

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Embodied carbon in buildings:

a new frontier in greenhouse gas reduction

UNSW Sydney

By upcycling and expanding AMP Tower in Sydney to create Quay Quarter Tower, rather than a knock-down build, Danish architecture firm 3VN saved 7500 tons of CO_2.

Image credit: Adam Mork.

In October this year the new Sustainable Buildings State Environmental Planning Policy will require architects and developers in NSW to start measuring the embodied carbon in their designs as Australia seeks to transition to a low-carbon built environment.

Associate Professor Philip Oldfield, head of UNSW's School of Built Environment in the Faculty of Arts, Design & Architecture, explains the dilemma faced by professionals working in the built environment.

"Every square metre we build has a carbon footprint, and that can be quite high because the materials we rely on to construct buildings are very carbon-intensive. But we can't simply stop building. We have a social obligation to provide healthy, comfortable, safe and sustainable places for people to live, to work and to play, around the world," Oldfield said.

"So, a key question for people working in the built environment is how can we build while ensuring new construction has the smallest possible impact on the environment?"

What is embodied carbon?

Embodied carbon is the greenhouse gas emissions associated with creating a building, maintaining it over its life and eventually demolishing the building. "In a nutshell, it's the greenhouse gas emissions associated with extracting and creating materials, and construction and deconstruction. And that's different to 'operational carbon', which is the emissions released through the operation of the building, air conditioning, heating, cooling, lighting, plugging in your computer."

The Australian construction industry is responsible for 18.1% of our national carbon footprint, or more than 90 million tonnes of greenhouse gas emissions every year. Twenty years ago, the thinking

around the carbon footprint of buildings was that operating CO_2 was about 80% of the building's emissions, while embodied CO_2 was maybe 20%. So the focus when reducing a building's greenhouse gas emissions was all about making it more energy efficient, and embodied emissions were generally ignored.

"We have relatively mature building regulations focused on reducing operating emissions," Oldfield explained. "But there are very few regulations concerning embodied emissions anywhere in the world. But the thinking about the relative importance of embodied emissions has changed as we've got more energy efficient and become better at measuring embodied carbon. So, for any new building constructed in Australia today, we expect at least half of its total carbon footprint over its life will be embodied carbon, possibly even more."

The World Green Buildings Council (WGBC) has set a target for all new buildings to be net zero operationally by 2030. What this means is the carbon footprint of our buildings will effectively be all about embodied carbon. This necessitates a big shift in the thinking about how we create sustainable buildings.

This challenge is made more difficult in the context of a growing world population and increasing urbanisation. Due to this, we are currently constructing the equivalent to every building in Japan every year. That is a lot of concrete, a lot of steel and a lot of embodied carbon. The challenge is how can we build to meet the needs of a growing society, while also reducing these environmental impacts?

The WGBC has set two targets around embodied carbon. The aim is for all new buildings, infrastructure and renovations to have at least 40% less embodied carbon by 2030 and to reach 'net zero embodied carbon' by 2050.

Four ways to reduce embodied carbon in the built environment

1. Adaptive reuse

A key way to reduce embodied carbon is to build less by maximising the use of existing assets. In the words of the former president of the American Institute of Architects, Carl Elefante, "The greenest building is the one that already exists."

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Architecture needs to shift from automatically building new buildings to thinking more about reuse and redesign. "Keeping the structure and becoming increasingly creative about building around it is a design strategy with big CO_2 savings," Oldfield said.

A good example is seen in preparations for Paris 2024 and Los Angeles 2028, with a shift from planning new buildings to host the Olympic Games to using existing venues, retrofitting and creating temporary buildings. In fact, LA's mantra is Radical Reuse and the city will host the 2028 games without building a single new permanent venue.

Brence Culp, LA2028's Chief Impact Officer, said, "We were fond of saying during the bid phase, and it remains true, that the most sustainable venue is the one you don't have to build. To tear down a venue and build a new one, purely from an environmental standpoint, represents an enormous carbon footprint. For us, working with existing venues is the best way to go."

An example closer to home is the upcycling of Quay Quarter Tower in Sydney by Danish architecture firm 3VN. "I think this is one of the most important buildings of the 21st century," Oldfield said. "The radical upcycling of a 1970s office block to almost double the floor area while saving around 7500 tons of CO_2 as well." The building retained more than two-thirds of its original structure, including beams and columns, as well as 95% of the building's original core.

"Medium-density housing and apartments tend to be smaller, more compact and often share amenity and infrastructure, all of which reduces embodied carbon," Oldfield said.

2. Build smaller

It is stating the obvious to say that smaller homes require fewer materials in their construction, giving them lower embodied carbon.

"Australian homes are among the biggest in the world and they've grown dramatically over the past 30 to 40 years," Oldfield said.

In 2020, according to a CommSec Home Size Trends Report, the average Australian house of 235.8 m^2 made it the world's largest, larger even than houses in the US.

The kind of home makes a difference too. "Building a lot of single detached houses on the fringes of our city is not great for embodied carbon either," Oldfield said. "Medium-density housing and apartments tend to be smaller, more compact and often share amenity and infrastructure, all of which reduces embodied carbon."

Cork House in Berkshire, England, is made almost entirely from solid load-bearing oak, a renewable material sustainably harvested from the bark of the cork oak tree.

3. Use low carbon materials

Replacing carbon-intensive materials such as steel and concrete with lower carbon equivalents is important for reducing embodied carbon. Making use of biomaterials like timber, bamboo, straw, cork and even hemp (which can be used to make hempcrete) leads to lower overall embodied carbon, as they use less energy to create and store carbon absorbed during their growth.

"Timber is a great material to use to reduce embodied carbon," Oldfield said. "It's like the anti-concrete. Cement is responsible for 8% of global CO_2 emissions. To put that in perspective the aviation industry is around 2.5% — and just think about how much bad press air travel gets!

"When you make cement, you heat limestone, causing it to chemically release CO_2. It's the opposite with a tree. As it grows, it absorbs CO_2 through photosynthesis and locks the carbon into the woody biomass. If we build sustainably from timber, buildings can effectively become a long-term carbon sink.

"Our research has shown that if we can increase our use of timber up to 30% of all new multi-storey buildings by 2050, this will play a key role in getting the built environment down to net zero emissions.

"We can also build out of earth, out of stone; there are a huge variety of ways to build rather than creating concrete, steel and glass monoliths.

"This is not to say we must get rid of concrete and steel, rather that we've got to use materials far more carefully — and treat these high carbon materials as a precious commodity. An optimal building might have timber floors, concrete foundations and stone columns, with steel connections. We need to use materials far more intelligently, optimising their use."

Using fewer materials through pared-back design reduces embodied carbon. "Think less is more in everything from the structure of a building to finishes and fixtures," Oldfield said.

4. Dematerialise

The structural steel used in 19th-century buildings was delicate and thin in comparison to a lot of structures today. At that time, materials were expensive but labour was cheap so it made economic sense to design in this way.

A reduction of steel or concrete in a building leads to a reduction in embodied carbon. Innovations such as 3D concrete printing are already being used to minimise the amount of concrete in some buildings. A recent innovation has been the redesign of concrete beams. UK company Minimass has created hybrid beams with a 78% reduction in concrete in comparison to a conventional beam.

"Think less is more in everything from the structure of a building to finishes and fixtures," Oldfield said. "So for example, instead of suspended ceilings, no ceiling and exposed beams. Instead of carpets which need to be replaced every 10 years, have polished floors. It's about questioning whether you need every material in the first place."

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DESIGNING TOMORROW'S INFRASTRUCTURE TODAY:
CIRCULAR ECONOMY AND BIM COLLABORATION

Linda Nordin — Circular Economy Specialist, Senior Associate Engineer, Waste & Resource Recovery, SMEC and John Callahan — Digital Engineering Practice Lead, SMEC

The construction industry plays a considerable role in global energy consumption and energy-related carbon emissions, attributed to the manufacture of building materials and products. The current, linear 'take-make-dispose' model of resource consumption has led to environmental degradation and resource depletion.

In Australia, according to the CSIRO 70% of infrastructure required by 2050 is not yet built, as engineers this provides an opportunity and importantly a responsibility to change our approach as we design Australia's future infrastructure. We play a vital role in advancing sustainable practices for our clients and the communities we serve, and by adopting circular economy principles coupled with advanced digital technology, in this instance Building Information Modelling (BIM), we are able to shift the dial on current practice and actively contribute to a more sustainable built environment for future generations to enjoy.

Circular Economy in the Built Environment

In 2023, Chalmer's University of Technology in Gothenburg released four high level principles on introducing a circular approach in the built environment in their journal article 'Developing regenerate: A circular economy engagement tool for the assessment of new and existing buildings'.

Model developed by Chalmers Technical University to indicate the four high level principles for circular building

Design for Adaptability
Examines how the infrastructure in a project can be adjusted in the future to prolong the lifespan of the project's infrastructure, while preserving materials at their highest value.

Design for Deconstruction
Considers how a project can be deconstructed at the end of its life. This principle embraces modular design concepts that facilitate effective deconstruction.

Circular Material Selection
Considers how materials are selected to ensure maximum circularity. This principle promotes the selection of incorporating reusable components and recyclable materials instead of relying solely on virgin resources.

Resource efficiency
Explores how the project can be undertaken by using the fewest possible resources and generating minimal waste through embracing dematerialisation and industrial symbiosis. Highlighting the importance of efficient design and the selection of reused components and recycled materials to design out waste.

Moving forward the process of designing new infrastructure or housing for the advancement and construction of our built environment requires engineers and designers to consider and prioritise building for long-term use and future adaptability. This involves designing for longevity, adaptability, modularity and deconstruction, whilst also ensuring building utilisation and implementing policies for circular procurement in construction.

How do we measure Circularity?

Numerous qualitative and quantitative methods for assessing Circular Economy (CE) exist in today's market. SMEC's Circular Economy team is dedicated to aiding clients in gathering the necessary data to form a baseline. A good start when wanting

to establish a baseline is to undertake a Material Flow Analysis (MFA) to measure the material flow for each project or building project and categorising these flows in terms of their connection to energy, water, and waste consumption.

There are several tools for measuring circularity on the market, the Ellen McArthur Foundation has indicated that harmonisation is important and will be discontinuing their Circulytics tool, instead referring to European Sustainability Reporting Standards (ESRS) which is embedding Circularity principles and future ISO Standards. Ultimately, there is not one tool which fits all but there is one tool or standard for all.

Leveraging BIM to implement Circularity

BIM extends beyond its use as a noun to denoting a 3D digital model. It equally describes the process that encompasses the creation, management, and utilisation of these models throughout a project's lifecycle.

BIM goes beyond 3D models as a holistic approach that utilises technology and collaboration to improve efficiency and effectiveness across an asset's lifecycle. Incorporating diverse data, or metadata, traditionally supporting design, construction, and asset management activities.

More recently BIM has been used to help measure a project's sustainability rating, as part of the Infrastructure Sustainability Council (ISC)'s IS rating scheme which assesses the Sustainability performance of Infrastructure. Some of the various measures include environmental impact, community engagement, resource efficiency, and project management.

SMEC provide metadata connected to model elements that assist in capturing the performance of infrastructure projects. Taking a step further BIM can be leveraged to assess the circularity of projects, asset portfolios, or programs of works through structured metadata. Just as BIM aids sustainability, it can also facilitate the application of circular economy principles.

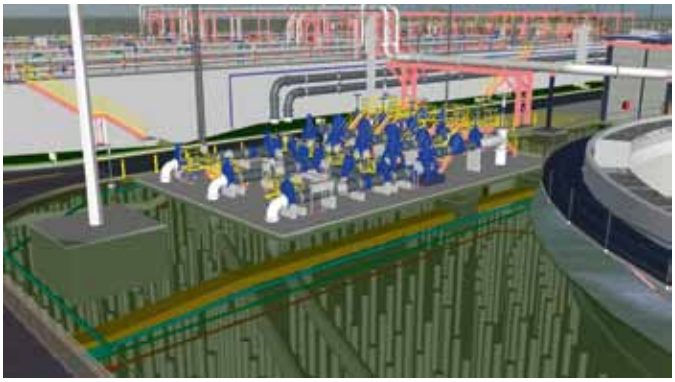
Metadata that aligns with circular economy principles is defined as pavement (e.g. material, recyclable content, expected decommissioning date, removal method, storage method) and plant and equipment (e.g. product, circular procurement, expected decommissioning date, hazardous material, end-of-life use including reuse, refurbish, recycle, and landfill).

By utilising BIM and standardised metadata, circularity improvements can be fostered. Projects and organisations can collaborate by sharing standardised metadata, fostering "Industrial Symbiosis". This practical application of circular economy principles involves sharing resources, waste materials, energy, and expertise to create mutually beneficial relationships and to design out waste.

BIM, as a process offers a pathway to integrate circular economy principles seamlessly into infrastructure projects. Through collaborative efforts and strategic use of metadata, our projects' sustainability and circularity can be elevated, contributing to a more resource-efficient and resilient built environment.

The Benefits

It is feasible to achieve a reduction of environmental impacts ranging from 40 to 90% by employing traditional materials and modular design approaches within the construction process. Beyond reducing the pressure on earth's resources, reducing greenhouse gas emissions and increasing liveability, there are



additional compelling reasons for construction projects to adopt a circular economy mindset.

Circular economy in construction should additionally be pursued to:

Align with Global Principles:
Embracing circular economy strategies in construction aligns harmoniously with the United Nations principles, Environmental, Social, and Governance (ESG) principles, as well as broader sustainability strategies and policies.

Attainment of Certification Standards:
Pursuing circular economy practices allows for the achievement of certification standards like the ISC and Green Building certifications. Often, construction sites are required to adhere to these standards, which encompass metrics such as recycled content and material choices.

Cost Savings:
Products utilising recycled content and/or sustainable aspects such as low energy usage/waste usage may cost more initially though long-term there is a value. Similarly applying a circular design approach may seem harder and take longer time to develop as the concept is new, the rewards are noticeable later on.

Looking towards the future there needs to be a shift from the current linear to a circular built environment. Incorporating the four high level principles for circular building, alongside the 10Rs of a circular economy and leveraging the Building Information Modelling (BIM) system can help facilitate this crucial shift across the lifecycle of our infrastructure assets.

By actively embracing these principles and taking concrete steps, we can contribute significantly to the transformation of our built environment into one that is more sustainable, adaptable, and circular. This is not only critical for our environment but enhances the quality of life for our communities and generations to come.

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'Mussel membrane' for sustainable wastewater treatment

Engineers have developed a membrane that separates chemicals within wastewater so that they can be reused, which could allow industries to improve sustainability while extracting valuable by-products and chemicals from wastewater.

Created for use in wastewater treatment, the thin-film composite nanoporous membrane, known as a TFC NPM, exhibits good capability to separate salts and other chemical components from water, and could be suitable for water management in a range of industries such as pharmaceuticals, oil and gas, textiles and food processing.

Authored by academics from the UK's University of Bath alongside colleagues based in China, South Korea, Singapore, Australia and Belgium, a research paper published in *Nature Water* said the membrane could replace current equivalents used in electrodialysis, a process used to treat water by transporting ions through membranes from one solution to another under an electrical current. Existing membranes are expensive and can achieve separation efficiencies of 90–95%. The authors of the new work say the TFC NPM can improve on this significantly, with efficiencies of more than 99%, while using less energy at a lower cost.

Dr Ming Xie, lecturer in Chemical Engineering at the University of Bath and one of the paper's authors, said: "Traditionally, many industries have regarded the wastewater they create as a trade waste that is a necessary cost of business. Technologies such as the membrane we have created can help us take steps toward lowering carbon emissions by reducing the energy requirement of wastewater treatment, while finding ways to efficiently separate the components in it such as chemicals, salts, energy, biomass and nutrients, before reusing them as high-value by-products."

The researchers took inspiration from mussels when designing the coating on the membrane surface, which is made up of the polymer polyethyleneimine (PEI) and polydopamine (PDA), a compound which mussels excrete and use to stick to rocks or wood in wet conditions. The coating's stickiness makes the membrane highly selective, allowing water to pass through but blocking other compounds and organic materials. This multi-stage process results in improved filtration of the water, and a highly efficient, low-energy way to fractionate (or separate) chemicals individually.

Electrodialysis is a technology that has shown its adaptability to several applications, in this case, management of highly saline waste streams. In the electrodialysis process, electrical potential is used to drive the positive and negative ions of dissolved salts through separate semipermeable synthetic membrane.

During tests, the researchers used four antibiotics to prove the PDA/PEI-coated membrane's electro-driven filtration performance. The membrane showed high recovery efficiency in removing the antibiotics from saltwater solutions (water and sodium chloride) — with more than 99.3% desalination efficiency and more than 99.1% recovery of the antibiotics. If incorporated in industrial wastewater treatment, the membrane has the capability to carry out highly effective electrodialytic fractionation (separation) of various organic/NaCl mixed solutions.

Co-author Dr Dong Han Seo from Department of Energy Engineering, Korea Institute of Energy Technology, said, "This work demonstrates the state-of-the-art electrodialysis to address the grand challenge in the pharmaceutical industry to bio-based wastewater treatment, to enable effective recovery of the high-value chemicals while obtaining reusable water in the other end using a low energy consumption."

Dr Jiuyang Lin from the Chinese Academy of Sciences, also a co-author, said: "This simple yet effective coating provides long-term stability and guarantees low energy consumption regardless of the wastewater conditions. This is a breakthrough finding electrodialysis for wastewater treatment involving clever design of membrane, simulation and analysis."

The authors are exploring routes to commercialise the membrane and said they would welcome approaches from relevant parties.

PERISTALTIC PUMP

The Ragazzini Peristaltic Pump has been designed to optimise fluid transfer processes. It employs a peristaltic mechanism, where a rotating roller compresses a flexible hose against a resilient tube, creating a wave-like motion that propels liquids through the system. This design prevents cross-contamination, making it suitable for both sanitary and industrial applications.

The versatile pump finds its application across diverse sectors. From food and beverage processing to pharmaceuticals, from mining to wastewater treatment, the Ragazzini Peristaltic Pump caters to an array of industries. It can gently handle shear-sensitive fluids and solids-laden liquids.

With a hose as the only contact part, the pump is sanitary. Its peristaltic motion is designed to deliver accurate dosing and transfer, minimising waste and providing consistent quality. Its simple design reduces downtime, and requires minimal maintenance and spare parts.

The pump is versatile and capable of handling abrasive and viscous materials. With its streamlined construction, it can optimise energy consumption. It is also user-friendly and has an intuitive set-up for ease of operation.

Hydro Innovations
www.hydroinnovations.com.au

Upcycling polystyrene

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Polystyrene is a widely used polymer, but it is currently difficult to recycle. A team of US researchers, reporting in the journal *Angewandte Chemie*, have developed a thermochemical approach, making it possible to recover valuable chemicals from polystyrene waste in a two-step process. This approach could enable the recycling of insulating and packaging materials for a circular plastics economy.

The Degradation Upcycling (Deg-Up) process makes it possible to produce aromatic chemicals from polystyrene waste. It involves a two-step cascade: in the first step, polystyrene is chemically modified in the same reactor. This process gives rise to benzene derivatives, covering important substances for the cosmetics and pharmaceuticals industry.

The method, developed by Guoliang Liu and colleagues, uses aluminium chloride catalysts and can be performed in reactors at a moderate 80°C. It also uses benzene as a solvent, meaning that only the amount of benzene recovered from the polymer is converted into the desired chemical and any unused benzene is recycled to process more polymer feed.

As a proof of concept, the team dissolved various types of polystyrene waste, such as packing peanuts and plastic utensils, in benzene and heated the mixture in a reactor under air-free conditions with aluminium chloride as the only reagent. The liquid product, consisting primarily of benzene, could be used directly to obtain the desired value-added chemicals in high yield and with high selectivity.

By adding the reagent acetyl chloride, the team obtained acetophenone, an important chemical used in cosmetics and pharmaceuticals. By adding the related reagent oxalyl chloride, the team obtained benzophenone, a common ingredient in sunscreen products and plastic additives. Sulfur-containing aromatics, some of which are used as high-performance solvents in the polymer industry, were produced with a high degree of selectivity from polystyrene waste.

The goal of the chemical upcycling method is to recycle large volumes of polystyrene waste into value-added chemicals for other industrial processes. Due to their low density, polystyrene insulating materials are not well suited to mechanical recycling. The Deg-Up process is more suitable for these materials and is robust and tolerant of contamination.

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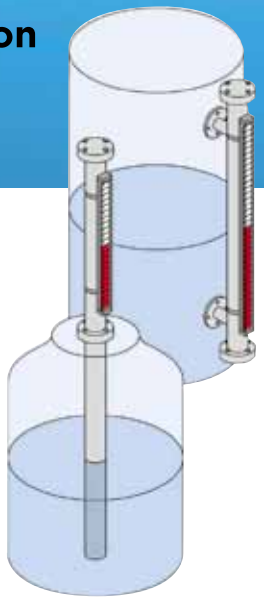

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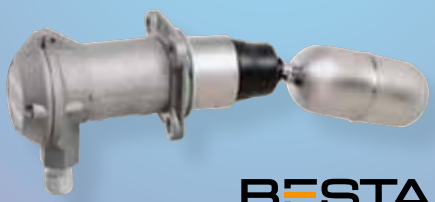

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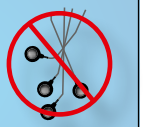

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Tackling plastic pollution

It is estimated that more than 75% of the 8.3 billion metric tons of plastic produced over the last 65 years have turned into waste, of which up to 13 million metric tons end up in our oceans every year.[1,2]

Organisations like ULUU are trying to solve the growing issue of plastic pollution by prototyping alternative materials to market.

"Unlike synthetic plastics, our materials are not produced using petrochemicals derived from fossil fuels. Instead, they are made from sustainable feedstocks with much more sustainable production processes. And, in the end, our products are compostable and marine-biodegradable, so they don't pose a lasting impact on the environment," said Dr Luke Richards, lead scientist at ULUU.

Dr Julia Reisser and Michael Kingsbury started ULUU in 2020, with the unique company name invented by the co-CEOs. ULUU's goal is to replace traditional plastics with a clean, sustainable process. Laboratory operations started in mid-2021 with four people, and has since grown to a team of 17 running the production line, R&D work and quality control lab. It's also in the process of building a pilot plant, which will be online soon.

The mission at ULUU is to tackle the ever-growing issue of plastic pollution. Using seaweed as a sustainable resource, ULUU is producing a versatile natural polymer called polyhydroxalkanoates (PHA). The material is functionally similar to traditional plastics, with the major benefit that it is also biodegradable and won't accumulate in oceans and landfills or linger as microplastics in biological systems.

The environmental benefits of ULUU's innovative material are also evident throughout its production process due to using seaweed as a feedstock. Seaweed farming captures carbon dioxide from the atmosphere and doesn't rely on conventional land-based farming, which can take land away from natural ecosystems. Also, research indicates that seaweed helps our oceans by cleaning up environmental pollutants and reversing acidification and eutrophication.[3–5] So, farming seaweed not only absorbs greenhouse gases to mitigate climate change, but also helps to restore the health of our oceans.

"It's an exciting, fast-paced environment. We've gone from experimenting with small amounts of seaweed at the lab bench to now producing PHA at a kilogram scale in our small production facility. And, we'll be increasing this significantly in a few months once our pilot plant is fully commissioned. So, it's been a series of quick milestones," Richards said.

Engineering a sustainable solution to plastic pollution

ULUU produces its PHA material in bioreactors ranging from 1 to 50 L. It also uses specialised equipment to investigate injection moulding and turning PHA into solid objects for prototyping. The entire production process from seaweed input to the finished PHA powder is monitored by its QC lab, in which most assays use chromatography instruments. These instruments include two liquid chromatographs (LCs) and one gas chromatograph (GC).

"Our chromatography instruments enable us to monitor and improve our entire production process. From the first input, we perform a biochemical analysis of the seaweed to analyse carbohydrates, as well as other compounds. We also use the instruments to measure nutrients in the fermentation broth, which is the medium that we feed to the microbes to produce PHA — it's a key QC step in our production," Richards explained.

He continued, "We monitor how the process is going throughout fermentation and production of the polymer. We measure the sugar consumption in the medium that's fed to the microbes and the PHA content within the cells. And, at the end of the fermentation process, we use the instruments again to measure the purity of the product and the composition and molecular weight of the polymer. Our LCs and GC are critical from start to finish."

The chromatography instruments are also necessary to ULUU's R&D processes. They are used to optimise ULUU's fermentation process, assessing different hydrolysis methods and fermentation strategies.

Helping ULUU further its sustainability goals

Knowing the resource-intensive nature of laboratory environments, a current trend in the scientific community is to assess the environmental impact of laboratory equipment. One example is Agilent, which has partnered with My Green Lab to have select instruments independently audited. The audit and verification results in My Green Lab's ACT (accountability, consistency, transparency) label, which details the environmental impact of an instrument's entire product life cycle, from manufacturing and shipping to use and end of life.

"With our mission to improve the quality of the environment, it's important that we

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keep our environmental impact as low as possible throughout our operations, including our analytical lab. The instruments are heavily used in — and essential for — our R&D and production line. So, it's great to have transparency around the environmental impact of our instruments," Richards explained.

ULUU plans to be independently audited for its own sustainability soon. Building its analytical lab around ACT-labelled solutions was an easy and important step towards this. With high-throughput sample analysis on a day-to-day basis, it will significantly contribute to its overall sustainability assessment.

Looking into the future with ULUU

To compete with fossil fuel plastics, ULUU is working to improve process efficiency. Its R&D is currently focused on increasing the PHA yield from as little seaweed as possible to get their material price to a competitive level.

ULUU also wishes to expand the versatility of its PHA material.

"We want our product to be used for an extensive range of applications. From solid objects to textile fibres and flexible films, this will allow us to replace all types of fossil fuel plastic with materials that are better for the environment," Richards said.

Luke Richards, PhD, lead scientist, ULUU has a PhD in biochemical engineering from the University of Melbourne and a bachelor's degree in biochemistry and bioprocess engineering. Luke's research experience involves the application of microbes for pharmaceutical production. He has also worked as a process engineer in the dairy industry.

ULUU scientists Dr Sheik Md Moniruzzaman and Vatsal Meshram in their QC lab using an Agilent 1260 Infinity II LC with Agilent InfinityLab LC/MSD iQ.

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AUSTRALIA'S INDUSTRIES GET BEHIND DECARBONISATION, BUT URGENT ACTION IS NEEDED

New national research demonstrates that Australian businesses, especially those in manufacturing, retail, and financial services sectors, recognise the imperative of achieving net zero emissions as a key driver for economic competitiveness and climate resilience, but indicates many companies are not acting quickly enough to address this urgent challenge.

The findings of Schneider Electric's *Sustainability Index, 2023* survey of over 500 key decision-makers across corporate Australia highlights the need for increased momentum in decarbonisation efforts. The report reveals that more than three-quarters (77%) claimed that sustainable transformation is needed to drive a competitive edge for companies.

This figure was the highest in the manufacturing industry, with 82% agreeing that sustainability creates a competitive edge. The research showed a broad agreement on the benefits of sustainability, with retail and financial services industries following close behind at 80% and 79% respectively.

Over two-thirds (69%) of businesses also agree that Australia must meet net zero emissions targets to remain economically competitive. Here, professional, scientific, and technical services came out on top with eight in ten of its industry leaders seeing sustainability as an economic imperative. This is well above the national average of 69%.

The retail and manufacturing industries also rated highly on decarbonisation, with 71% of leaders acknowledging the economic advantage of meeting net zero emissions.

Schneider Electric is a global leader in the digital transformation of energy management and automation and its **Pacific Zone President, Gareth O'Reilly** said "It's clear that businesses

recognise the strategic importance of sustainable transformation. With less than 80 months until 2030, the challenge for businesses now is to fulfil that strategic opportunity at pace."

Despite growing awareness and commitment to sustainability, the survey reveals that many businesses are falling short in implementing decarbonisation strategies. Only 52% of respondents across industries reported discussing or having a decarbonisation strategy in place. This indicates that a significant portion of Australian companies have yet to fully commit to the transition to a low-carbon future.

"To achieve the necessary emission reductions, it is essential that businesses set ambitious targets and map out the path to achieving them," **Mr O'Reilly** said. "Many of the steps companies can take to improve energy efficiency and introduce their own renewable energy supply will not only improve their bottom line, but also protect them from volatility in energy supplies and pricing."

The survey reveals that 42% of companies expect to achieve zero Scope 1 emissions by 2030, which refers to direct emissions from owned or controlled sources. Additionally, 37% aim for zero Scope 1-2 emissions, which adds indirect emissions from generation of purchased electricity, heating, and cooling consumed by the company.

Finally, 34% of businesses aspire to achieve zero Scope 1-3 emissions, which encompasses all indirect emissions in the value chain, including those associated with the procurement and use of products and services and are the hardest to achieve.

The professional, scientific, and technical services industry is also above the national average for decarbonisation plans with the research findings showing net zero expectations reach 56% for Scope 1, 41% Scope 1-2, and 39% 1-3. This is in comparison to the national averages of 42%, 37%, and 34% respectively.

Other industries showing increased optimism about the ability to impact emissions across the board include retail and healthcare.

Comparisons across industries present a range of complexities in the road to net zero. The data underlines the need for industry-specific leadership on decarbonisation. Manufacturing leaders, for example, were some of the most likely to report that sustainability provides a competitive edge and is essential to Australia's economic future, yet it is one of the least optimistic industries when it comes to reaching net zero across Scope 1, 2 and 3.

Conversely, healthcare leaders are among the most optimistic about their ability to reach net zero but had some of the lowest rates of positive engagement with sustainability as a competitive edge or economic imperative. This indicates leaders are facing varying challenges from industry to industry, requiring specific plans to drive sustainability engagement and impacts.

The Schneider Electric Sustainability Index, 2023 report underscores the need for immediate action and the importance of digital technology, with 78% of companies acknowledging its key role in achieving sustainability goals. In retail, this figure was 79%, in line with the national average. Meanwhile, professional, scientific, and technical services (89%), manufacturing (87%), and financial and insurance services (85%) were well above this figure.

Mr O'Reilly reiterated the urgency for businesses to act swiftly, stating, "Corporate Australia is ready to fully embrace sustainability, but we need to support businesses in turning these intentions to outcomes.

"Organisations must embrace sustainable transformation, prioritise digitalisation, and implement robust decarbonisation strategies now. The time for incremental change has passed; we must act with urgency to secure a sustainable and prosperous future. The moment is now."

To gain further insights into sustainability as an economic imperative and the role of technology in driving transformation, download Schneider Electric's *Sustainability Index, 2023* report.

About Schneider Electric

Schneider's purpose is to empower all to make the most of our energy and resources, bridging progress and sustainability for all. We call this Life Is On.

Our mission is to be your digital partner for Sustainability and Efficiency.

We drive digital transformation by integrating world-leading process and energy technologies, end-point to cloud connecting products, controls, software and services, across the entire lifecycle, enabling integrated company management, for homes, buildings, data centres, infrastructure and industries.

We are the most local of global companies. We are advocates of open standards and partnership ecosystems that are passionate about our shared Meaningful Purpose, Inclusive and Empowered values.

Schneider Electric
www.se.com/au

Mandatory climate reporting:
three C's for optimal preparedness

The epoch of mandatory non-financial climate reporting is rapidly drawing closer and will no doubt have a profound impact for investors, banks, corporations and trusts, advise energy transition experts Partners in Performance.

With the deadline looming, now is a crucial time for organisations to determine whether they are adequately prepared for the impending changes. Understanding the essential tasks and ensuring there is a solid roadmap to get there will be vital.

The Australian Treasury's release of the climate-related financial disclosure consultation paper in June marks a decisive step towards implementing the new reporting regime for companies across Australia. At its core, the reporting shift centres on non-financial information, such as sustainability issues and climate-related metrics.

The government's approach aims to integrate non-financial information with the existing framework of financial data and corporate disclosure, leveraging established auditing and assurance structures. It is a big change, with an ambitious timeline, making it imperative for affected organisations to act now.

According to Rob Fowler, Partner, Energy Transition, Partners in Performance: "The reality is that this push to integrate non-financial information is not going away. International bodies are releasing frameworks and standards at pace, with Australia committed to following the global momentum. And time is of the essence, with the first reporting period for Australia and New Zealand's listed companies just 10 months away. Now is the time to check whether organisations have the right internal wiring to face the challenges created by mandatory reporting of non-financials.

"The path to success lies in a proactive approach by all stakeholders, who must embrace this transformative change with foresight and preparation. By adapting to the evolving requirements, businesses will not only fulfil compliance mandates and minimise risk, but will also unlock opportunities for sustainable growth and global alignment."

The three C's

Fowler points to exploring the following three key considerations to get businesses on the right track:

Capability:

As organisations embark on a path towards mandatory non-financial reporting, it becomes paramount to evaluate whether your team has the requisite expertise, skills and technology to effectively gather, analyse and disclose pertinent non-financial information. Identifying any potential gaps in capabilities early on will enable you to proactively address them and ensure a seamless transition.

Capacity:

Gauge whether or not there are adequate resources available within the timelines required. Assess if there are sufficient

human resources, financial backing and technological infrastructure to support the efficient and comprehensive reporting needed. Planning and allocation of resources will be instrumental in avoiding last-minute hurdles and ensuring a smooth compliance process.

Credibility:

Credibility is crucial. The information disclosed must be perceived as trustworthy, reliable and accurate. To ensure credibility, establish robust processes and governance structures that uphold the integrity of the data collected and reported. Engaging in third-party audits adhering to internationally recognised reporting frameworks can enhance your organisation's credibility and foster trust with stakeholders. Building a reputation for credibility will not only benefit compliance efforts but can also enhance the organisation's standing and reputation in the market.

Avoiding the risk of greenwashing

"In Australia, taking early action is becoming more urgent due to the current risks of greenwashing. This concept has recently graduated from being a reputational risk to a regulatory issue across Australia's corporate, financial and consumer ecosystems. Empty narratives hold no ground anymore if companies need to access capital markets or bank finance.

"Greenwash risk management has now become a considerable focus. The best defence is through transparency and disclosure. The best offence is to have rich stories backed up by solid data. However, both these strategies are unattainable unless the right internal infrastructure and processes can support and validate those narratives. This is where external support can accelerate your progress," Fowler said.

The integration of non-financials also opens up exciting possibilities and potential. Partners in Performance has consistently observed that emphasising non-financial information and key performance indicators (KPIs) within a business can unlock tremendous value for clients. When we look at the physical aspects of business operations from a value perspective, and work with our clients on looking through this lens, businesses can unleash potential in production volumes, energy conservation, labour productivity and asset uptime.

Updated reporting regime

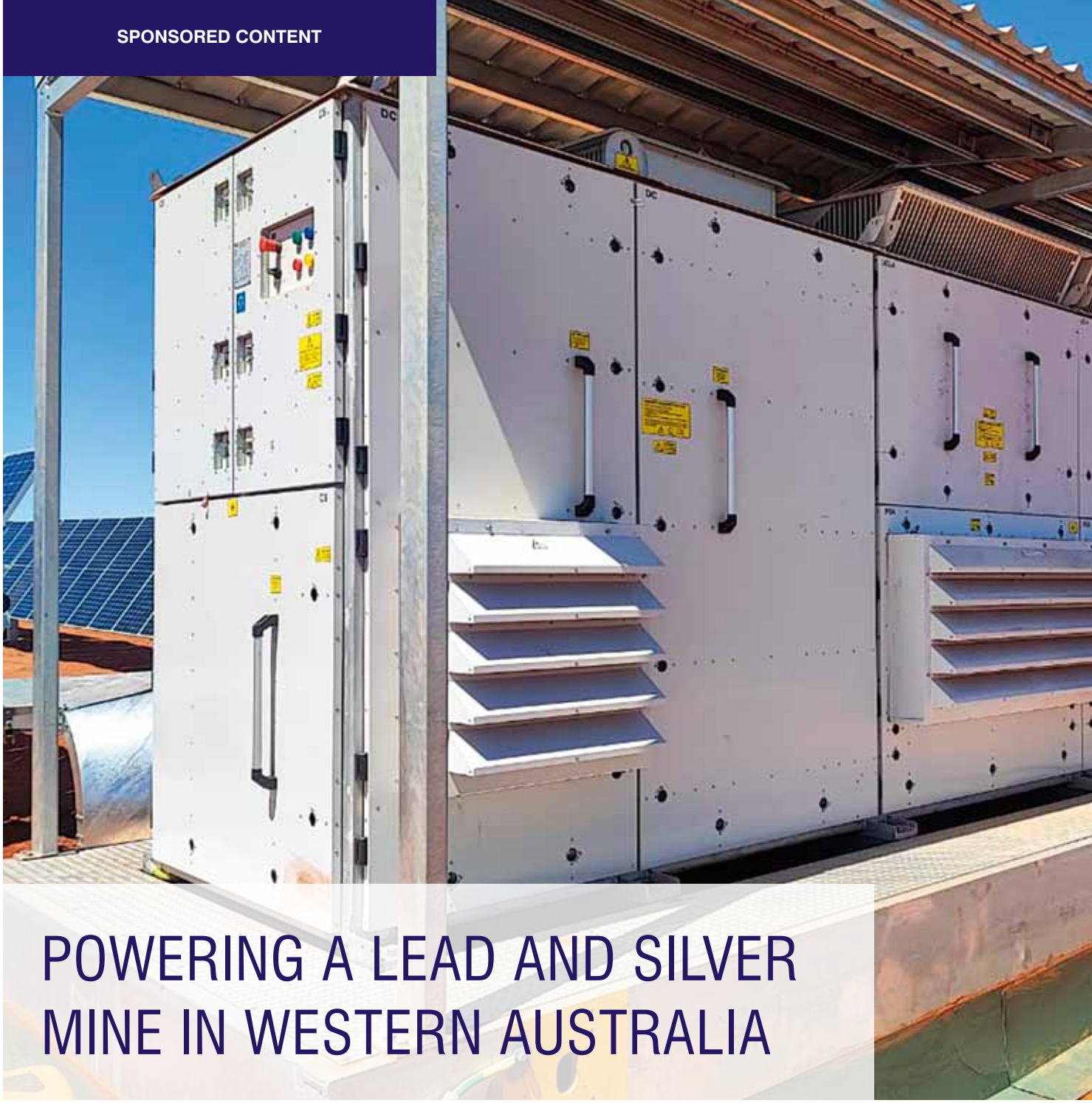
As part of the updated reporting regime, large companies in Australia will be required to formally disclose the following data on an annual basis:

- **Scope 1**: Carbon emissions — directly from the company's operations.
- **Scope 2**: Carbon emissions — from the electricity purchased by the company.
- **Scope 3**: Carbon emissions — from the company's value chain, including upstream, downstream and financed emissions.
- **Scenario analysis**: To systematically lay out how the company will be impacted by climate change in the future, taking into account the physical risks to assets and supply chains, as well as the risks associated with the transition to a low-carbon world.
- **Transition plan**: To lay out how the company is going to transition from its current state to the nirvana of zero carbon emissions and enhanced resilience to climate change. This should include time-based targets and credible plans to achieve them, which are all forward-looking statements from a corporate disclosure perspective.

Company boards will be required to sign off on these disclosures along with the usual audited financial statements.

Investing in and enhancing a company's capability, capacity and credibility can yield multiple benefits that extend far beyond mere compliance. By making strategic and forward-thinking decisions, companies can effectively manage risks while simultaneously tapping into the potential for significant performance improvements.

Rob Fowler is an energy transition expert and Partner at Partners in Performance.



POWERING A LEAD AND SILVER MINE IN WESTERN AUSTRALIA

Abra Base Metals Mine is a new high-grade lead-silver mine currently being constructed between Meekatharra and Newman in Western Australia (approximately 1,000 km northeast of Perth).

Due to the remote nature of the mine, ensuring reliable energy to power the site was critical. Galena Mining wanted to incorporate a power station that would help lower the mine's operating costs and reduce its carbon footprint.

The hybrid thermal and renewable power station is owned and operated by **Pacific Energy**, an industry leader providing remote, off-grid energy in Australia.

The hybrid power station is a 21 MW fully integrated system combining a 6 MWac solar farm, 2 MW Battery Energy Storage System (BESS) with a 10 MW high-efficiency/low emissions gas generation plant and 1,100 kl LNG storage and regas facility.

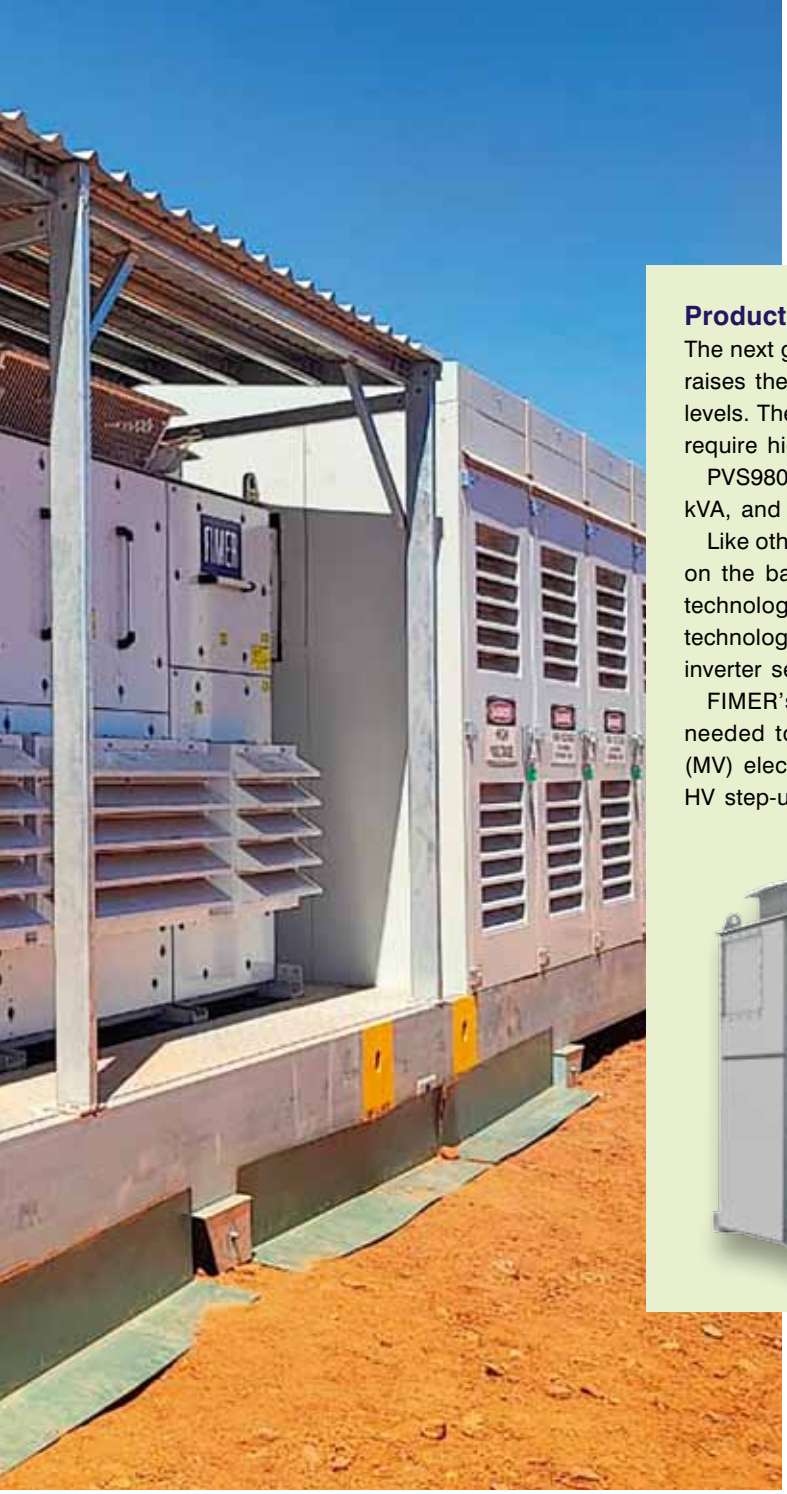
Pacific Energy's subsidiary, **Hybrid Systems Australia**, designed, constructed and commissioned the solar farm and BESS solution, which incorporates the following:

- 15,024 mono facial 460W panels with a NEXTracker single-axis tracking system
- 2 x 4.6 MW (4,565 kVA) FIMER PVS980-58 Central Inverters
- 2 MWh Battery Energy Storage System

In mid-2021, FIMER was engaged by Hybrid Systems to provide an 8.8M VA solution to meet the site's energy requirements. FIMER provided several solutions, but the PVS980 4.6 MW solution was selected for its cost-effectiveness and performance capabilities.

"We were extremely impressed with the capability and responsiveness of FIMER's local and global product team throughout the project, specifically the product selection process and the commissioning of the products. Their level of communication provided us with comfort that our requirements had been met and we could meet our project milestones," said Daniel Jackson, Hybrid Systems General Manager Operations.

FIMER's PVS980 solution has a large install base worldwide, with many located in harsh environments. The Abra Base Metals



Product spotlight: FIMER PVS980-58 5 MVA

The next generation, high power, central inverter from the PVS980 family raises the performance, cost efficiency and ease of installation to new levels. The inverters are aimed at system integrators and end users who require high-performance solar inverters for large, solar power plants.

PVS980 central inverters are now available from 909 kVA up to 5000 kVA, and are optimised for multi-megawatt power plants.

Like other FIMER central inverters, the PVS980-58 has been developed on the basis of decades of experience in the industry and a proven technology platform. Unrivalled expertise from the world's market and technology leader in frequency converters is the hallmark of this solar inverter series.

FIMER's compact skid houses all the electrical equipment that is needed to rapidly connect a solar power plant to a medium-voltage (MV) electricity grid, or to a high-voltage point of connection through HV step-up grid facilities.

Mine is in the Australian desert, where summer temperatures can reach 45–50 degrees Celsius. The performance of the PVS980 inverter when derating at high temperatures was an essential requirement. FIMER's proven technology allowed the teams to plan for and ensure the size of the inverter could still provide sufficient generation when derated at temperatures above 35 and 50 degrees Celsius.

Jason Venning, FIMER Australia's Country Manager, highlighted this, saying, "FIMER's PVS980 inverters have proprietary technology using self-contained two-phase thermo-syphon heat exchangers, which are totally passive and provide high performance with a low-pressure drop, with an efficiency equivalent to liquid cooling and with the simplicity of an air-cooled system. This enables the inverters to be installed in high temperatures while still providing reliable performance."

The PVS980-58 5MVA is also extremely durable and is equipped with extensive electrical and mechanical protection to provide a long and reliable service life of at least 25 years.

FIMER's PVS980 was delivered in January 2022 in time for the solar farm's construction. During this time, FIMER provided technical training to Hybrid Systems and Pacific Energy engineers to commission and maintain the PVS980 units. One of FIMER's technicians visited the site in early November to commission the two central inverters and certify their staff to become authorised technicians.

The solar farm will meet nearly 30% of the mine site's power needs. The solar generation and battery energy storage solution has an expected annual output of over 16,602 MWh and will reduce CO_2 emissions by approximately 11,800 tonnes per annum.

FIMER

FIMER Australia
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Building a sustainable future through digital innovation

Barbara-Anne Bensted, Head of Sustainability for APAC, Capgemini

In the pursuit of a sustainable future, the convergence of human energy, technology and environmental responsibility has emerged as a powerful force. As we navigate the complexities of the digital economy, the imperative to embrace sustainability has become undeniable. This article sheds light on the critical role of digital innovation in shaping a sustainable future and fostering collaboration between stakeholders to drive transformative change.

Unleashing human energy for an inclusive and sustainable future

At the heart of building a sustainable future lies the recognition of the intrinsic link between environmental responsibility, economic viability and digital innovation. The fusion of these elements enables organisations to unleash human energy through technology, charting a path towards inclusivity and sustainability. By harnessing the capabilities of technology, individuals and communities are empowered to make meaningful contributions towards a better world.

In this new era of interconnectedness, it is evident that a low-carbon business model is not only ethically responsible but also essential for economic success. Embracing sustainability as a strategic imperative, organisations understand that the journey towards a sustainable future begins with small, purposeful steps.

Embracing sustainability as a strategic imperative

A low-carbon business model aligns financial success with ecological consciousness, benefiting both the company and the planet. The pillars of sustainability are not merely an addendum to the business model; rather, they are integral components that enhance resilience, foster innovation and create lasting value for stakeholders.

Sustainable practices yield multifaceted benefits. From increased operational efficiency to improved brand reputation, organisations that imbue sustainability into their DNA are better positioned to adapt to changing market dynamics and stakeholder expectations. By embracing sustainability, organisations can embrace the principles of shared value, where business success is intertwined with societal wellbeing. Prioritising decarbonisation, 71% of Australian organisations are now committed to replacing carbon-intensive business aspects.[1]

In addition, 61% of Australian organisations recognise low-carbon hydrogen as a cornerstone for long-term decarbonisation solutions.[1] Further, a remarkable 55% of companies have committed to investing in low-carbon hydrogen by 2030, while 58% of organisations anticipate a gradual reduction in low-carbon hydrogen production costs by 2040. Finally, there is now an ambitious goal of integrating low-carbon hydrogen into national energy consumption envisioned to be a 22% share by 2050.[1]

Collaboration: paving the way for transformative change

Achieving sustainability goals requires a joint commitment from all stakeholders.

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Collaboration between vendors and clients is essential for automation and sustainability to go hand in hand; no organisation or entity can tackle the complex challenges of sustainability in isolation. By working together, establishing open dialogue and shared goals, we can drive transformative change and innovation, accelerating the transition towards a more sustainable future.

This joint commitment and collaboration are essential given 63% of Australian energy and utility organisations identify "lack of skills and expertise" as a prime challenge in their hydrogen initiatives.[1]

Driving sustainable technology adoption in Australia

In Australia, the focus on sustainability is driving transformative technology adoption. Collaboration with local businesses is key to scaling technologies that drive sustainability and address unique challenges faced in the region. Emphasising collaboration with Australian stakeholders, Capgemini works closely with public and private sector partners to foster sustainable practices. Capgemini prioritises partnerships with local organisations, academic institutions, and government bodies to foster innovation and enable the application of sustainable technologies. Through active participation in government initiatives aligned with Australia's climate action plans and financial frameworks, Capgemini reinforces its commitment to driving sustainable progress in the region.

> **"In this new era of interconnectedness, it is evident that a low-carbon business model is not only ethically responsible but also essential for economic success.**

The journey towards a sustainable future hinges upon the fusion of technology, human energy and environmental responsibility. As we traverse the digital landscape, we must recognise sustainability as a strategic imperative and collaborate relentlessly to drive transformative change. By fostering sustainable practices and embracing a low-carbon business model, we can pave the way for a future that is not just technologically advanced but also environmentally responsible and inclusive. Together, we can build a more sustainable world for future generations.

1. Capgemini Research Institute, low-carbon hydrogen survey, November–December 2022.

Barbara-Anne Bensted, Head of Sustainability for APAC, Capgemini

Aerofloat constructing new wastewater treatment plant

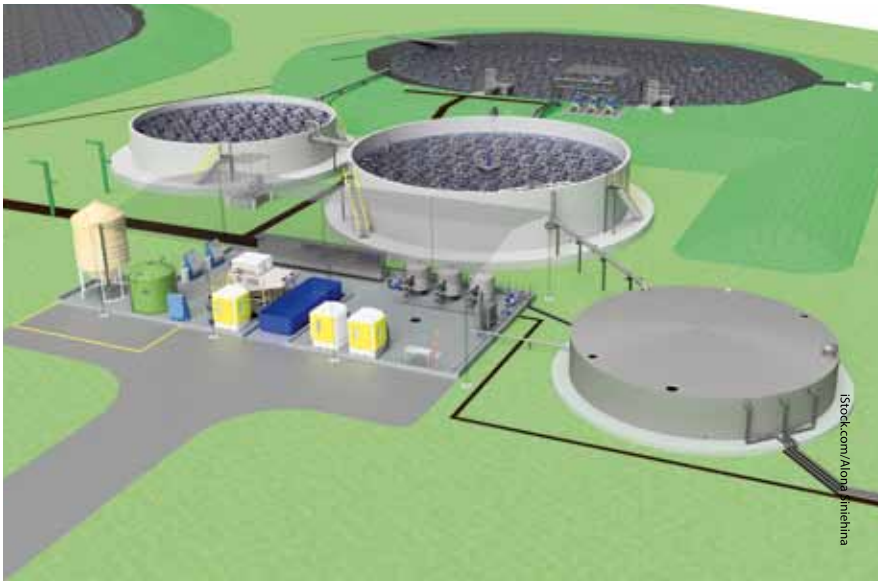
Wastewater treatment specialist Aerofloat has been awarded the contract to design and build a wastewater treatment plant at Incitec Pivot Limited's (IPL) facilities at Gibson Island in Brisbane. The project required a comprehensive treatment plant to meet IPL's strict environmental requirements.

Aerofloat was selected for the project due to its history in creating sustainable solutions that meet stringent environmental guidelines and its innovative approach towards wastewater system design.

Michael Anderson, Aerofloat General Manager, said, "Ensuring solutions are sustainable and environmentally friendly is at the forefront of what we do. As an Australian company, our technology must ultimately support our local environment and community."

The plant will treat contaminated stormwater and groundwater. It will be housed at Gibson Island and there will be no impact on IPL's operations during its construction.

According to Anderson, it will biologically treat the effluent from the site using its AeroSBR technology and address nitrogen, phosphorus, zinc and other contaminants from the site via nitrification, denitrification and clarification processes.



Aerofloat will install a three-tank biological system comprising an anoxic reactor, AeroSBR and nitrifying lagoon. Denitrification will take place in the anoxic reactor with the AeroSBR being the final part of the process for further nitrification and clarification.

A multi-media filtration system will further clarify the effluent after the AeroSBR to ensure low suspended solids in the effluent. Aerofloat will be installing a belt press to dewater any excess biosolids prior to disposal offsite.

Aerofloat's chemical dosing system will condition sludge and assist in sludge dewatering.

"The entire system will be fitted with HMI and remote monitoring capabilities," Anderson said. "Our engineering design team have completed designs and we have begun works onsite."

Aerofloat's wastewater treatment system is scheduled to be operational in early 2024.

Aerofloat (Australia) Pty Ltd

www.aerofloat.com.au

SHREDDING UNIT FOR RECYCLING

With a small to medium footprint, the Genox Vision series machines are suitable for processing a wide range of materials to a uniform particle size. The range of products that can be size reduced and then recycled includes soft and rigid plastics, plastic film, general plastics, wood, metals, textiles, tyres, e-waste and more.

The Vision series rotor knives are manufactured from heat-treated DC53 steel and can be rotated and used on four edges before replacement. Long life fixed blades can be adjusted to maintain cutter clearance. Quick change screens provide particle size control.

Twin-speed hydraulics maximise the shredding throughput, while an integrated oil/air cooler maintains temperature allowing continuous operation. A heavy-duty reduction gearbox is mounted directly onto the rotor shaft. A shock absorbing gearbox mounting arrangement reduces stress on drive components.

The units feature a standalone electrical control panel, which uses a Siemens PLC control system featuring Schneider electrical components.

Applied Machinery Australia Pty Ltd
www.appliedmachinery.com.au

The AIP partners with Waste Expo 2023

The AIP will be continuing its partnership with Waste Expo 2023, which is being held from 25–26 October in Melbourne.

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Waste Expo Australia will be one of the country's largest gatherings of waste management and resource recovery professionals and will feature 100+ brands with presence from both local and international exhibitors, providing a platform to discover the latest breakthrough innovations shaping the future of the waste, recycling and resource recovery industry.

AIP will be hosting a free packaging session on how to embed the 10x Sustainable Packaging Design Principles into your business, will be moderating a session on organics and compostable packaging recycling, and will have stand #102 at the exhibition. The Institute invites all Members and industry colleagues to attend the packaging sessions and come and visit the stand.

SESSION 1: The challenges of organic recycling, food waste and compostable packaging

Thursday, 26 October 2023

11:00–11:50 am

Theatre 2 (Show Floor)

The environmental challenges currently being addressed by the Organic Recycling industry cover three areas:

1. The reduction of the amount of organic waste that is going to landfill.
2. Ensuring the full value out of organics waste is achieved.
3. The cutting of greenhouse gas emissions currently produced from food/organic waste decomposing in landfill.

Food waste recovery through the household/kerbside collections Food Organics and Garden Organics (FOGO) is the major focus for reducing the amount of organic waste still going to landfill.

Certified compostable packaging plays a role in assisting the recovery of food waste where the packaging has been contaminated and can't be recycled. The challenge facing composters & certified compostable packaging is overcoming the government and councils' current concerns with the additional contamination occurring from non-certified packaging and the use of fibre packaging containing forever chemicals like PFAS that are coming through industrial and FOGO collections schemes. Vistors are invited to join this panel discussion and listen to the experts discuss these current challenges facing organic recycling, food waste and compostable packaging.

Panel discussion includes John McKew, National Executive Officer, AORA; Natasza Letowt-Vorbek, National Executive Officer, Australasian Bioplastics Association (ABA); and Rowan Williams, Global Advocacy and Sustainability, Biopolymers BASF. It will be moderated by Keith Chessell, FAIP, Education Team, Australian Institute of Packaging (AIP).

All attendees will attain 1 CPD point towards the CPP designation.

SESSION 2: Understanding the value of embedding sustainable & circular packaging principles through award-winning best practice case studies

Thursday, 26 October 2023

2.05–2:35 pm

Theatre 2 (Show Floor)

The Sustainable Packaging Guidelines (SPGs) have been designed to optimise packaging to make more efficient use of resources and reduce environmental impact without compromising product quality and safety. The SPGs are designed to integrate the Sustainable Packaging Principles (principles) into the right business areas to achieve the optimal outcomes for packaging functionality and to collectively work to meet the 2025 National Packaging Targets. 'Sustainable Packaging' is packaging that is not only fit for purpose and functional but also has a lower environmental impact compared to an existing or conventional packaging. Sometimes achieving the lowest possible environmental impact can be challenging, particularly when balancing various environmental criteria with the other functional and commercial considerations. This session will showcase how to embed the SPGs into your business through best practice award-winning examples.

Presenters will include Nerida Kelton FAIP, Executive Director, Australian Institute of Packaging and Vice President Sustainability & Save Food, WPO; and Ralph Moyle FAIP, CPP, Education Coordinator, Australian Institute of Packaging.

Australian Institute of Packaging
www.aipack.com.au

Waste Expo Australia 2023

advancing towards sustainable

With a growing focus in corporate and business circles on waste management, the circular economy and sustainable resource consumption, Waste Expo Australia 2023 comes at an opportune time for leaders to discuss trends, challenges and opportunities for the sector.

With a core theme of 'Advancing Towards Sustainable Resource Recovery', Waste Expo Australia features a multi-stream conference and exhibition that will showcase the best and brightest of the waste industry in Australia. Held at the Melbourne Convention and Exhibition Centre over two days from 25–26 October, attendees interested in resource recovery, sustainability, environment and circularity will have plenty to discover.

The annual conference attracts over 2700 attendees and 60 conference speakers over four streams hosting 100 sessions including:

- Reuse is the way to go! Say goodbye to single-use, presented by Sandra Mack, Sustainability Victoria.
- An opportunity not to waste: The case for collaboration across the value chain, presented by Richard Pittard, Cleanaway.
- The central role of waste to energy in a circular economy, presented by Benoit Englebert, Keppel Seghers.
- Close the Loop — Turning problem plastic waste into high-value products within the same community the waste was generated, presented by Steve Morriss, Close the Loop.

Consultant and innovator Scott McArdle will contribute to several sessions in the Waste to Energy stream, addressing new technologies on the waste-to-energy scene. McArdle's company, Zerogen, is investing in waste to hydrogen (WXH) technology, which he says has a key role to play in decarbonising both the waste economy and regional economies.

"The waste-to-energy sector is an under-utilised area of impact when it comes to addressing waste management challenges and supporting sustainable solutions. There are several key issues facing the industry in Australia, including policy and regulatory challenges, waste composition and investment."

Outside the conference, more than 100 international and domestic suppliers will exhibit including Bucher Municipal, EEA Group, Repurpose It, Komatsu, Eldan Recycling and TOMRA Collections, making Waste Expo Australia a good sourcing platform for waste and resource recovery sectors fostering an environment that encourages innovation, robust discussions and idea generation among industry leaders.

Warrick Grime from Bucher Municipal says the opportunity to connect with the industry over two action-packed days is a time-efficient one.

"The waste management industry is in a period of transformation, with ideas like circularity and sustainability coming to the forefront of the national conversation. Being on the ground to connect with fellow industry at Waste Expo Australia allows us to form valuable relationships and share ideas to move the industry forward."

Waste Expo Australia is strongly supported by industry associations, with the Victorian Waste Management Association (VWMA), Australian Institute of Packaging (AIP) and Australian Organics Recycling Association (AORA) all playing key roles in the event's programming.

Both the conference and exhibition are free to attend, with registrations open now. Register to attend Waste Expo Australia 2023 at www.wasteexpoaustralia.com.au.

RX Global
www.rxglobal.com

Animal feed stock company upgrades systems to save energy

Red Range Stock Supplements is a family-run business located in Kununurra, Western Australia. It manufactures animal stock feed using imported domestic and local produce while offering a range of customer blend supplements for cattle, tailored to individual dietary requirements.

Its manufacturing operations consist of a combination of conveyors, augers, crushers, mixers, pumps and fan-related applications. Due to the nature of its products, Red Range must ensure accuracy of the blends its produces.

It was originally using traditional direct on line starting (DOL) drive technology to control its manufacturing equipment in process applications.

Material was building up in the augers used to deposit grain into the storage silo, where it is then collected for further processing and distribution. With its high-powered nature, the augers require high torque from the motors to power them enough to start under heavy load and prevent stalling. The existing drive technology in Red Range's operations did not suffice, leading to the augers to continuously stall, increasing material build-up and bringing manufacturing to a halt.

Additionally, the start-up torque of such a demanding application was causing high starting currents in the motor in the start-up, leading to voltage inrush casing circuit breakers to trip.

To help solve Red Range's challenges, 15 ACS580 all-compatible variable speed drives (VSDs) were supplied by ABB Channel Partner Current Engineering Solutions and Red Range contractor Agtric Pty Ltd. Agtric introduced VSDs with fieldbus communications to automate and streamline the production process.

For the feed mill application, with the use of ABB drives and Agtric's expertise on Red Range's processing requirements, the speed of conveyors could be slowed down in specific stages of the feed production, leading to both a reduction in energy usage and reduction in wear and service frequency.

The VSDs have optimised start-up and operational control of the motors. The reduced starting current helped increase motor lifetime by protecting it from electrical stress. With the starting currents optimised to load and application, they keep operational equipment safe from network irregularities. Torque control enables Red Range to operate its processes at full potential, improving efficiency.

With the motors now operating more efficiently, Red Range is cutting energy costs and reducing carbon emissions.

In its first year following the installation of the ABB drives, Red Range experienced a 2500-tonne feed output of its operations. Now in its second year, Red Range's feed output has increased substantially to record product levels of tens of thousands per annum.

The breakdown of total energy saved per application equates to:

- Dust collector: Over 17,727 kWh, or more than 8.9 CO_2 metric tonnes.
- Liquid pump: Over 2071 kWh, or more than 1 CO_2 metric tonnes.
- All three conveyors: Over 17,518 kWh, or more than 1.3 CO_2 metric tonnes.
- Mixer: Over 96,652 kWh, or more than 48.3 CO_2 metric tonnes.

Tom Beresford, Agtric Director, said, "These ABB drives have an IP55 rating suitable for our long-term operations in the hot and humid and often harsh West Australian climate."

All ACS580 drives are tested at maximum temperature and with nominal loads to ensure their durability.

ABB Australia Pty Ltd
www.abbaustralia.com.au

OVAL GEAR FLOWMETERS

The Trimec Multipulse Oval series PD flowmeters are designed to provide a high level of accuracy turndown and repeatability. The precision meters are used for flow rate measurement in flow monitoring and control applications, and for totalising in dispensing and batching.

Trimec Multipulse gear meters are suitable for use with a wide range of clean liquids including additives, fuels, viscous lubricants, chemicals, food bases and non-conductive, low-viscosity solvents either pumped or gravity fed.

The rotary piston meters are manufactured in line sizes from 4 to 50 mm and in a variety of body materials, such as aluminium, stainless steel and high-pressure stainless steel.

Standard options include flanged and hygienic process connections, explosion proof, integral and remote LCD totaliser-batch totaliser, flow rate totalisers, scaled pulse, 4~20 mA and flow alarm outputs, electronic batch controllers and a mechanical register.

Other features include optional mechanical and electronic registers and certified Exd hazardous area versions in all sizes. There is no need for flow conditioning. The flowmeters also feature quadrature pulse output option and bidirectional flow, as well as high-pressure meters for mining and exploration.

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

GAS DETECTOR

The Emerson Rosemount 925FGD Gas Detector is the first Rosemount-designed and -engineered point gas detector. It has been designed with high-performance gas leak detection for accuracy, response time, operating temperature ranges and zero drift specifications. Using non-dispersive infrared (IR) technology, the gas detector is designed to provide early combustible gas leak detection within the user's processes to help to keep workers safe while reducing greenhouse gas emissions.

The product includes an advanced Local Operator Interface (LOI) and a smart sensor module. Built for extreme environments, it comes with a factory pre-calibrated sensor to butane, propane, methane, ethylene or ethane. It can be calibrated offsite and installed later, and sensors retain their own configuration settings and calibration information. This enables calibration and maintenance without additional tools, reducing maintenance costs and downtime.

The gas detector is certified to SIL2, ATEX, Canada, US and IECEx safety standards.

Emerson Automation Solutions
www.emerson.com/au/automation

Energy-saving compressed air for sustainable growth

With a renewed emphasis on local manufacture, there is an increased demand for economical, sustainable compressed air generation to power machinery and tools across a wide variety of industries. Opportunities in manufacturing of scientific instruments, new-age technologies and equipment and a return to home-grown design and engineering has created a demand for new generation, highly efficient air compressors and ancillary equipment.

Growth of new industries sees the need for existing manufacturers to upgrade their equipment to the new world standards required to compete in both the local and international markets.

With energy costs rising constantly, compressed air reliant industries need to lower the cost of energy input while maintaining or increasing compressed air power output. This can be achieved by upgrading outdated equipment and offsetting capital expenditure with energy savings over years of operations.

To ensure these energy saving measures are maintained at peak operating efficiencies, trained support and service teams are required for new equipment installations and regular service programs.

Sustainable strategies for high efficiency compressed air power

Using the latest advances in global compressed air technology, Australian industry can operate with a viable compressed air source well into the future.

The development of highly automated functioning of industrial air compressors through variable speed drives programs the compressors to provide for fluctuating demands in production schedules, thereby using less energy across multiple applications.

Advanced 2-stage compressors split the compression ratio over two distinctive airends resulting in around 3:1 ratios across each. The result is less slippage, lower bearing loads and, with intercooling, higher outputs for the installed motor power. The output of a 2-stage compressor is typically around 20% higher than an equivalent single-stage compressor.

Kaishan's new-age, permanent magnet, variable frequency, 2-stage compressors use the latest energy-saving technologies to provide an optimised advanced compressor unit. Precision airend dynamics are integrated with the latest in permanent magnet motors requiring lower kW input to provide required air demand. When PMFV is applied through two-stage technology models it can provide up to 50% increased efficiency over conventional compressor types.

Kaishan Compressors supply and service energy-efficient air compressors for all types and sizes of industry over a wide range of applications. The global manufacturer places R&D high on its priorities to ensure it's proactive in the development of advanced technologies and engineering solutions that will benefit industry throughout the world while reducing energy consumption for environmental sustainability.

Kaishan Australia Pty Ltd
www.kaishan.com.au

Building Victoria's largest urban solar farm


Artist's impression of the La Trobe University Renewable Zone.

La Trobe University is creating what is claimed to be the largest urban solar farm in Victoria, with around 4300 solar panels generating enough renewable energy to reduce total university emissions by 15% and eliminate household emissions for the equivalent of the entire neighbouring suburb of Kingsbury.

The La Trobe University Renewable Zone is being built on 3.5 hectares at its Bundoora Campus and is part of the university's goal to achieve net zero by 2029.

The Zone includes a 2.9-megawatt solar energy system and 2.5-megawatt battery energy storage system, which will take the total solar generation at the Bundoora campus to 5.8 megawatts.

Vice-Chancellor Professor John Dewar AO said the $10 million Renewable Zone, fully funded by La Trobe using funds from the recently raised Green Bond, was the next step in La Trobe's commitment to being an industry leader in sustainability.

"Our commitment to net zero by 2029 will see our University City of the Future become a leading energy- and water-efficient city, using renewable technologies to support local climate resilience and positive environmental impact," Dewar said.

The Renewable Zone will be located on vacant, unused university land on the corner of Plenty Road and Kingsbury Drive.

Construction is due to begin in early 2024.

CASE STUDY: NORDFAB DUST EXTRACTION SYSTEM FOR A GLASS RECYCLING AND RESOURCE RECOVERY COMPANY

Nordfab Pty Ltd has engineered a dust extraction system for a glass recycling and resource recovery company to assist with the filtration and extraction of moist glass dust from their processes.

Here are some key advantages of a Nordfab dust extraction system.

Improved Air Quality:

Dust generated during the glass recycling process can contain fine particles that can pose health risks to workers and contribute to air pollution. A dust extraction system helps remove these harmful particles from the air, leading to improved indoor air quality and a healthier working environment.

Compliance with Regulations:

Here in Australia we have strict environmental regulations regarding air quality and emissions. Installing a dust extraction system can help your company comply with these regulations, avoiding fines and legal issues.

Increased Worker Safety:

Eliminating airborne moist glass dust reduces the risk of respiratory problems and eye irritation for employees. It also minimises the risk of slips and falls caused by dusty floors, creating a safer workplace.

Enhanced Equipment Longevity:

Dust can be abrasive and cause premature wear and tear on machinery, such as crushers, conveyors, and screens. By reducing the dust in the environment, a dust extraction system can extend the lifespan of your equipment, reducing maintenance costs and downtime.

Energy Efficiency:

A well-designed dust extraction system can be energy-efficient, helping a company reduce its energy consumption and operational costs. Modern systems often incorporate features like variable speed drives (VSDs) and energy-efficient motors.

Improved Product Quality:

Dust in the recycling process can contaminate glass cullet (recycled glass) and affect the quality of the final product. Removing dust ensures that the recycled glass meets quality standards and can be sold at higher prices.

Reduced Housekeeping Costs:

A dust-free environment requires less frequent cleaning, saving time and labour costs associated with housekeeping tasks.

Cost Savings:

Over time, the benefits of a dust extraction system can lead to significant cost savings through improved worker health, reduced equipment maintenance, and increased product quality.

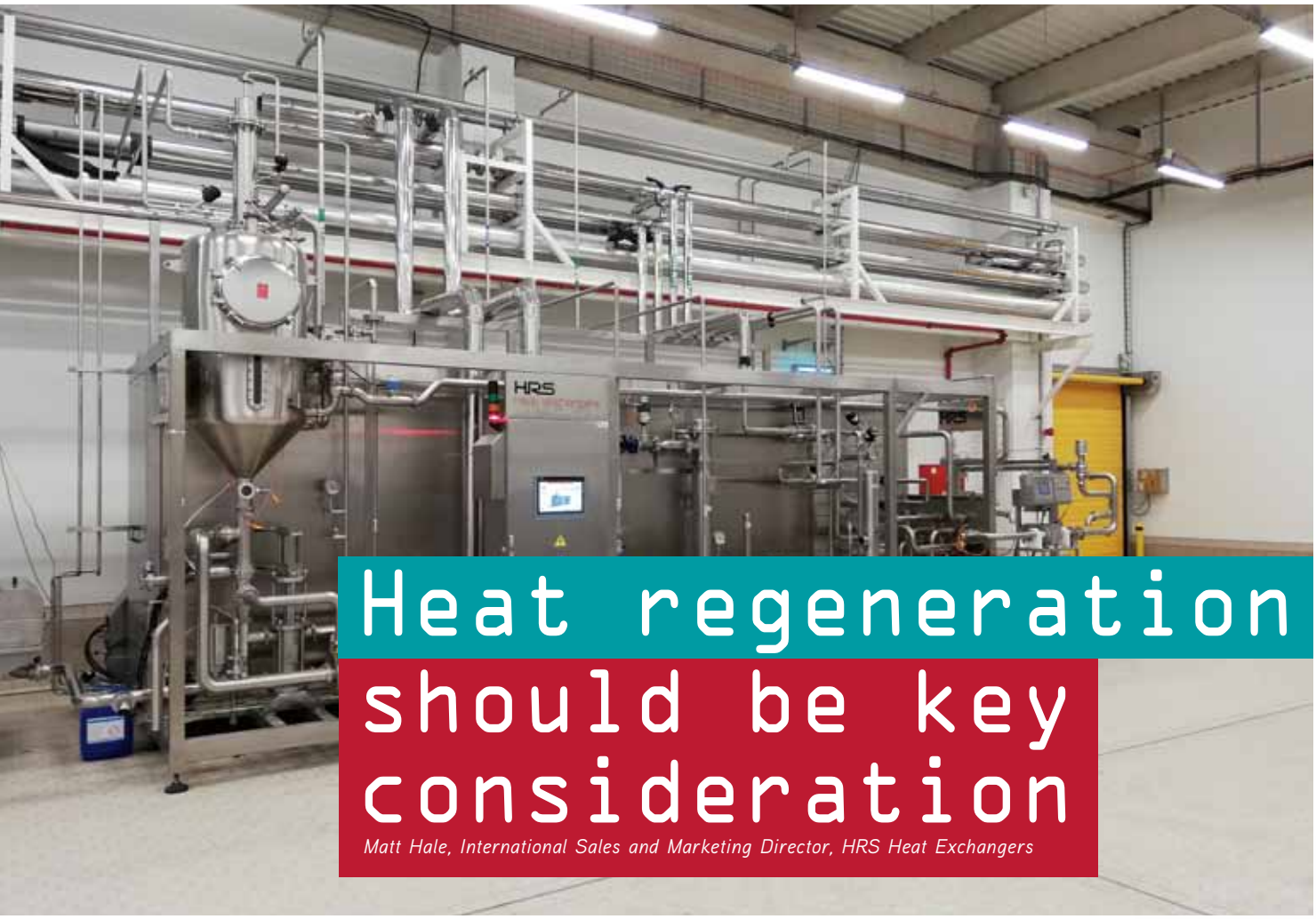
Sustainability:

Glass recycling is an environmentally friendly activity, and a dust extraction system aligns with sustainability goals by reducing emissions and promoting cleaner air.

In conclusion, Nordfab Pty Ltd dust extraction system was a valuable investment for the glass recycling and resource recovery company. It has improved the company's air quality, enhances safety, ensures compliance with regulations, and will lead to cost savings while promoting environmental sustainability and boosting the company's reputation.

NORDFAB Ducting

Nordfab Pty Ltd
www.nordfab.com



Heat regeneration should be key consideration

Matt Hale, International Sales and Marketing Director, HRS Heat Exchangers

Many industrial processes require energy, but only a portion of that energy input is used for each operation such as pasteurisation or evaporation. Unused energy is wasted, often passing to the environment as hot gas or liquid. However, by using heat exchangers, it is possible to recapture most of this untapped energy through waste heat regeneration.

Heat regeneration (or heat recovery) is the process whereby heat from a process which would otherwise be lost or wasted is recaptured and used for useful heating purposes. Heat regeneration should not be confused with 'regenerative heat exchangers', which are a specific type of heat exchanger in which the product and service fluids flow alternately, and the heat is stored in the structure of the heat exchanger.

At HRS when we talk about heat regeneration, we mean the recovery of as much surplus heat (or cooling capacity) as possible after the primary function of the heat exchanger has been performed. This can then be reused to either improve the efficiency of the heat exchange process or used elsewhere. "Recovery and re-use of industrial waste heat is an attractive concept that could simultaneously reduce energy costs and CO_2 emissions."[1]

Given the importance of energy efficiency in reducing the use of fossil fuels and greenhouse gas (GHG) emissions, it can be argued that it is imperative to employ heat regeneration and recovery at every opportunity. As at least one paper has pointed out, "The use of excess heat could also be important to improve the economic and climate footprint feasibility of new processes... by avoiding the addition of new heat production capacity."[2]

Benefits of heat regeneration

Heat recovery improves the energy efficiency of heat exchange processes, so the greatest benefit of heat regeneration (recovery) is that less energy is required for a particular heating or cooling operation. This obviously provides financial benefits but is also better for the environment compared to systems without heat recovery.

Repurposing recovered heat can also reduce the amount of heat required for certain processes. For example, if a material is pre-heated with recovered heat, then it may be possible to complete the necessary heating (for example, for pasteurisation) using hot water from another source or part of the factory, instead of requiring a dedicated boiler to provide the necessary temperature rise.

By increasing the energy efficiency of the heat transfer process, heat recovery can also make it possible to reduce the size of the heat exchange equipment required or reduce the necessary processing time.

Heat recovery in action

One example can be found in food pasteurisation processes, where products such as cream need to be heated to the necessary temperature to achieve pasteurisation, then rapidly cooled to maintain shelf life and quality. Such systems involve the use of two heat exchangers: one uses hot water to raise the tempera-

ture, while the second uses chilled water to cool the cream down again. The cooling process produces warm water which can be discarded, cooled for re-use or cooled with some of the heat contained being used to pre-heat the cream before the pasteurisation process. This last option utilises heat recovery or heat regeneration, reducing the amount of new energy required for the subsequent first heating phases.

As another example, many biogas plants use heat exchangers to pasteurise the digestate produced during the anaerobic digestion (AD) process. The 'surplus' heat that is generated after the system has been running can also be used to pre-heat the digestate, reducing total heat load and improving overall efficiency.

Heat recovery can also be used in gaseous applications. Whether it is using the heat from the flue gas of a biogas combined heat and power (CHP) engine to pre-heat digestate or a large gas-to-gas heat exchanger to capture waste heat from chemical processing, there is no reason to waste the heat present in gaseous products or waste streams.

Perhaps the most common use of heat regeneration is demonstrated in multi-effect evaporation systems, where a number of heat exchangers are combined, for example, in the HRS DCS Digestate Concentration System. The first evaporation stage heats liquid digestate and uses a cyclone separator; the steam produced from this first cycle (usually available at 70˚C) is then used as the heating media for the second effect, whereby the process is repeated. The subsequent steam (usually available at 60˚C) is then used as the heating media for the third cycle. The number of effects is determined by the level of dry solids required and the amount of surplus heat available, up to a maximum of four cycles. After the final stage, the steam is condensed back to water and this heat is used to pre-heat the incoming product before the first stage of evaporation. In all, the heat is regenerated up to four times in the process.

Other considerations

To determine the potential value of waste heat, and therefore determine what it can be used for, it is necessary to know a number a parameters about the process temperature, the product and heating (or cooling) medium being used, and the performance of the heat exchange process in terms of heat transfer area and flow rate, for example. It is therefore important to consider energy regeneration or recovery as early as possible. Heat recovery systems can be retrofitted to many processes, but their design is often a compromise and retrofitted solutions may involve excessive pipework and other connections.

To maximise the benefits of heat regeneration it is important that waste heat is transferred to the storage media (for example, water or thermal transfer fluid such as glycol) as soon as possible after its source. This is particularly true where the waste heat is in the form of a gas, as this has a much greater energy constant than liquid, meaning that the heat is lost much faster.

By considering all of these factors, it will be possible to calculate both the additional capital costs associated with specifying heat regeneration in a project, together with the savings in running costs and energy, and from this determine the return on investment for the project. Although capital costs may be higher, the longer term financial and environmental benefits will make the use of heat regen in heat exchanger projects highly attractive.

1. The potential for recovering and using surplus heat from industry. Final report for DECC, 2014. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/294900/element_energy_et_al_potential_for_recovering_and_using_surplus_heat_from_industry.pdf
2. https://www.frontiersin.org/articles/10.3389/fceng.2021.679454/full

HRS Heat Exchangers Pty Ltd

www.hrs-heatexchangers.com/anz

The drive for a more circular Li-ion battery industry

iStock.com/sefa ozel

Magnis Energy Technologies (MET), an Australian vertically integrated lithium-ion battery technology company, identifies downstream industry competition driving innovation in the lithium-ion battery sector. This innovation can also act as a catalyst for Australian domestic incentives and help address industry inefficiencies.

Through its Tanzanian graphite mining project, US-based graphite anode active material (AAM) plant and lithium-ion battery operation iM3NY, MET is at the forefront of the graphite industry, which is being propelled by the demand for Li-ion batteries for electric vehicles (EVs).

Dr Jawahar Nerkar, MET Director of Battery Technologies, notes competition is driving the sector.

"The electrification of the transportation sector alone is expected to account for 80% of the global battery demand by 2030," Nerkar said. "EV manufacturers are competing to provide consumers with optimum-range vehicles powered by high-capacity, high-energy-density, safe, sustainable and cost-effective Li-ion batteries. To do this, EV manufacturers are forming strategic partnerships with innovative Li-ion battery manufacturers, who in turn are employing advanced battery chemistries, battery pack designs and processing technologies in their batteries."

Nerkar observes that competition-driven innovation is pushing battery manufacturers to use next-gen materials such as nickel-rich cathode materials and higher loading of silicon in graphite composite anode in batteries to enhance energy density, while next-gen technologies offering fast charging capability are also sought.

"The commercial viability of alternative high-energy-density technologies such as high-voltage cathodes, lithium-sulfur, solid-state electrolytes and lithium metal anode is being explored," Nerkar said. "At the same time, solvent-free dry electrode manufacturing and cell-to-pack battery assembly are being pursued as processing and cell engineering battery technologies respectively.

Graphite demand to improve inefficiencies

The demand for EVs and lithium-ion batteries is increasing graphite demand, which is poised to surpass the capacities of existing graphite mines — with supply forecast to be in deficit by 2025, according to Macquarie's Graphite Market Outlook.[1]

"Irrespective of a battery's cathode chemistry over the coming decade, graphite will remain the predominant AAM in Li-ion batteries; therefore, securing the supply of these critical components to meet demand and mitigate production delays is crucial," said Nerkar, who believes enabling a circular lithium-ion battery economy will reduce the burden on securing raw materials and improve inefficiencies. "Scrap and waste formation, a major Li-ion battery process inefficiency, will benefit from the adoption of more sustainable solutions, such as recycling and repurposing battery components."

Energy use and environmental impacts are significant issues in upstream lithium-ion battery production. "The majority of battery raw material production takes place in China, with the refinement dependent on energy- and toxic chemical-intensive processes predominantly powered by fossil fuels," Nerkar said. "Using renewable energy sources over conventional power sources across the whole Li-ion battery supply chain can help mitigate these inefficiencies."

Domestic incentives

Government policy plays a crucial role in the development of the lithium-ion battery sector. International policies including the US Inflation Reduction Act, the US Bipartisan Infrastructure Law, the EU Green Deal, Canada's Critical Minerals Strategy and India's FAME II Strategy are bolstering the international market. For companies under the US Inflation Reduction Act, financial incentives are dependent on non-Chinese graphite being used in projects, driving continued global opportunities for graphite mining and Li-ion battery development.

"Like the US Inflation Reduction Act and the European Commission's incentives, Australian federal agencies should investigate equivalent incentives for domestic battery cell manufacturing," said MET Chair Frank Poullas. "Supporting businesses across all sectors of the lithium battery value chain will attract investors with certainty around the viability of the commercial-scale manufacturing. Supportive international trade agreements that will benefit Australian manufacturers' access to North American, European and Asian markets also warrant discussion."

1. Macquarie Graphite Market Research, 24 March 2023.

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