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S&M

sustainability matters

COUNCILS
MANUFACTURING
INDUSTRY
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RESOURCES

Resource recovery on the up and up

Upcycling solar panels | Textiles to biofuels | Brewery waste for water treatment

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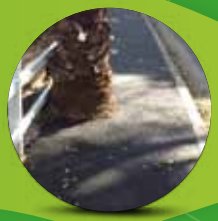

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Australian Government Accredited Product Stewardship Scheme

contents

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WORDS from the EDITOR

CSIRO has recently released a report on seven megatrends that are set to shape the next twenty year. They focus on adapting to climate change and sustainability issues as well as health, geopolitics and digital innovation. With the escalation of resource scacity across the globe, the organisation predicts "an increased focus on potential solutions to our resource constraints through synthetic biology, alternative proteins, advanced recycling and the net-zero energy transition. By 2025, renewables are expected to surpass coal as the primary energy source".

Trash to treasure has certainly taken on a new meaning in recent years as a result of a new level of upcycling and resource-recovery innovations becoming available to prevent waste heading to landfill. From upcyling textiles into fuel to using brewery waste for water treatment, in this issue you'll read about many of the solutions that are now coming to life. There's also a call for end-of-life programs for wind turbines and technology that upcyles old solar panels into an energy-harvesting thermoelectric material.

ESG standard-setting frameworks can be confusing, so we take a look in the regulations and what it means for waste operators. And when it comes to hydrogen hubs, we look at why all eyes are on Australia.

Look out for the *Sustainability Matters* team at the Australian Waste & Recycling Expo (AWRE) from 24–25 August at the ICC in Sydney — please visit us on stand B42!

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AUSTRALIAN MADE

Textile circularity: cotton fields 'swallow up' textile waste

A 12-month trial on a cotton farm just outside the rural town of Goondiwindi, Queensland, has shown it's possible to divert large amounts of end-of-life cotton textile waste from landfill with no harm done to soil health or cotton yields.

Project collaborators are confident that with a solid business plan and more research, returning shredded cotton products to cotton fields could soon offer benefits to soil health, and a scalable solution to the massive global problem of textile waste.

According to Cotton Research and Development Corporation supported soil scientist Dr Oliver Knox of University of Newcastle (UNE): "At the very least the trial showed that no harm was done to soil health, with microbial activity slightly increased and at least 2070 kg of carbon dioxide equivalents (CO_{2e}) mitigated through the breakdown of these garments in soil rather than landfill.

"The trial diverted around two tonnes of textile waste from landfill with no negative impact on cotton planting, emergence, growth or harvest. Soil carbon levels remained stable and the soil's bugs responded well to the added cotton material," Knox said.

"There also appeared to be no adverse effect from dyes and finishes although more testing is needed on a wider range of chemicals to be absolutely sure of that."

According to farmer Sam Coulton, the cotton fields easily "swallowed up" the shredded cotton material, giving him confidence that this composting method has practical long-term potential.

"We spread the cotton textile waste a few months before cotton planting in June 2021 and by January and the middle of the season the cotton waste had all but disappeared, even at the rate of 50 tonnes to the hectare," Coulton said.

"I wouldn't expect to see improvements in soil health or yield for at least five years as the benefits need time to accumulate, but I was very encouraged that there was no detrimental impact on our soils.

"In the past we've spread cotton gin trash on other parts of the farm and have seen dramatic improvements in the moisture-holding capacity on these fields so would expect the same using shredded cotton waste."

The project, under the guidance of circular economy specialists Coreo, was a partnership between the Queensland Government, Goondiwindi Cotton, Sheridan, Cotton Australia, Worn Up, and Cotton Research and Development Corporation supported soil scientist Dr Oliver Knox of UNE.

Around two tonnes of end-of-life cotton textiles from Sheridan and State Emergency Service coveralls were processed at Worn Up in Sydney, transported to 'Alcheringa'

farm and spread onto a cotton field by local farmer Sam Coulton.

According to Cotton Australia's Brooke Summers, there is keen interest in further collaboration from industry groups, government, farmers, brands and potential investors.

"There's certainly a huge amount of interest in this idea and the trial results, and while we don't want to get ahead of ourselves, we are hopeful that over time this will evolve to deliver a scalable solution for cotton textile waste here in Australia," Summers said.

"We're excited to announce the trial will be replicated in the 2022–23 cotton season, with cotton farmer Scott Morgan's Gunnedah property in NSW added as a second site. This will give us further confidence the results we've already seen can be replicated across time and geographies."

The project team will now set its sights on how best to collaborate on the way forward with a number of options already on the table:

- The Cotton Research and Development Corporation has committed to funding a three-year cotton textiles composting research project by the University of Newcastle that will further investigate the effects of dyes and finishes and look at ways to pelletise cotton textiles so they can be spread on fields using existing farm machinery.
- A repeat of the trial at Alcheringa with Sam Coulton and his team keen to also develop a business case, purchase a shredder and potentially provide a model for employment in regional cotton communities. The trial will also move to a second farm in Gunnedah NSW, 'Kensal Green', owned by cotton grower Scott Morgan.
- Sheridan, together with parent company Hanes Australasia, has committed to provide additional end-of-life cotton textiles and offcuts for the trial in 2022–23.

Coreo

https://coreo.com.au/

"The project, under the guidance of circular economy specialists Coreo, was a partnership between the Queensland Government, Goondiwindi Cotton, Sheridan, Cotton Australia, Worn Up, and Cotton Research and Development Corporation supported soil scientist Dr Oliver Knox of UNE.

Hydrogen hubs – all eyes on Australia

Malcolm Rushin, Australian Future Energy Leader, and Kylee Unwin, Global Strategy & Markets Leader, at GHD

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There is a sense of urgency to achieve hydrogen production at scale because it is considered an important part of most pathways to achieving global net zero emissions. The International Energy Agency has forecast we will require more than >500 Mta of hydrogen production globally by 2050 to achieve emissions targets. This is equivalent to more than three times the current global LNG industry and a daunting task in such a short period of time.

This is compounded by the crisis in Ukraine, which is changing the economics of hydrogen and making it increasingly important as an alternative fuel. In this future energy economy, Europe, South Korea and Japan are shaping up to become net hydrogen importers while the Americas, the Middle East, Africa and Australia are in a strong position to become hydrogen exporters.

Hydrogen hubs have emerged as arrangements and mechanisms to drive the viability of producing hydrogen at scale.

Following a significant amount of work to set the right policy and funding conditions, the concepts of hydrogen clusters, hydrogen hubs and even hydrogen valleys have materialised quickly in Australia — despite the pandemic.

It is now accepted that hydrogen hubs will be the catalyst that will unlock wider economic benefits of hydrogen activities in an identified region. Hydrogen hubs concentrate activity locally and enable infrastructure to be shared, scale to be increased and costs to be reduced. They also help coordinate and maximise engagement of local communities. They have the potential to facilitate industry investment and drive regional growth, allowing us to scale up faster.

Australia is not alone, with the US Government seeking to develop at least four hydrogen hubs. In Australia, hydrogen technology clusters exist in every state and territory.

Hydrogen hubs have emerged as arrangements and mechanisms to drive the viability of producing hydrogen at scale.

Through our involvement in several hubs across Australia, including Port Bonython in South Australia, Bell Bay in Tasmania and the Middle Arm Sustainable Precinct in the Northern Territory, we have identified several common elements that will help accelerate the development of hydrogen hubs:

Industrial ecologies: This concept is based on the notion of enabling an existing industrial precinct to transition to a future community utilising future energy and has the potential to de-risk developments. It consists of three elements:

1. Blending or changing the energy feedstock; for example, shifting from gas power to blended or converting energy-intensive processes to use green hydrogen.
2. Reskilling human capital to adapt to the changes necessary to utilise the change in technology and feedstock.
3. Creating local markets for the green products manufactured; for example, transport refuelling, green ammonia as a fertiliser or green steel for construction. This ecology can then grow and develop into an export hub as production increases.

Investor capital: While public sector approvals and investment are critical, hydrogen hubs will be capital-intensive and require significant investment from the private sector. It is important to bring private investors on the journey and get their buy-in early. Overlaying commercial models to inform decision-making and investment pathways has proved highly beneficial. For example, the modelling we have undertaken for projects such as the Geraldton Export Scale Renewable Investment Project tells us that scale is critical for export markets. Emerging thinking regarding the potential of local hydrogen ecosystems is worth exploring; however, most investment decisions will rely on a scalable proposition for viability.

Stakeholder engagement: While there is widespread acknowledgement and even support for hydrogen as a critical clean-burning energy source, large-scale infrastructure required for hydrogen hubs has broad implications for both the environment and the community. Our recent experience has shown that a facilitated, collaborative approach can be valuable in extracting stakeholder perspectives upfront and unlocking insights early.

Clear and efficient approval pathways: As we charter new territory, having defined approval pathways in place will facilitate the expediency with which these projects can evolve. The planning phase should not be underestimated in its ability to determine success.

Although bankability is not there yet, we need to capitalise on the progress and momentum generated. Creating reliable technology and productivity of electrolysers to meet their anticipated performance will help build confidence in long-term demand.

Australia has all the key attributes to be a major producer of clean energy servicing both the domestic and international market, particularly those countries with less natural advantage. We have ample space, energy sources such as sun and wind, extensive coast lines, low population density and high technology know-how. As a collective we can unlock more of the industry potential faster and set a benchmark for the global stage.

GHD Pty Ltd

www.ghd.com.au

Textiles to biofuels initiative

Ventia has collaborated with Veolia to deliver an innovative solution for textile destruction using a recycling system that converts textiles to biofuel. The system was first trialled at six Ventia-managed clothing store sites — CICKS Darwin, Townsville, Enoggera, RAAF Base Edinburgh, HMAS Cerberus and Bandiana — and has now been rolled out nationally.

The challenge

Australian Defence Force (ADF) personnel are required to return combat clothing for disposal to prevent access by unauthorised personnel. Historically, a clothing store employee would cut items into strips with scissors by hand. This manual process was both time-consuming and posed a safety risk, particularly when hand-cutting combat boots. The strips were then used as rags or taken to local animal shelters, but unfortunately often ended up in landfill.

The solution

Ventia collaborated with Veolia to find a solution that would divert the uniforms from landfill, ensure certainty of destruction, and support Ventia and ADF's sustainability targets.

In the trial, Veolia provided secure 600 L and 240 L tamper-proof disposal bins at each clothing store. Once full, Shred-X (sub-contracted by Veolia) collected the bins and the uniforms were machine-shredded, incinerated and converted to biofuel. The biofuel was sent to a facility that used it for electricity.

Across the three-month trial, nearly 7 tonnes (6894 kg) of combat uniform were diverted from landfill and converted to approximately 700 L of biofuel. That is the equivalent of the fuel required for approx 10 car trips from Albury to Canberra.

Phillip McIntosh, Ventia's Efficiency and Improvement Program Manager said: "The environmental and sustainability benefits of this initiative support Defence's environmental and sustainability targets by diverting a significant volume of waste from landfill."

The recycling solution has streamlined processes and reduced time in manual handling at the clothing stores.

Application across Australia

The system has now been rolled out across all National Clothing Stores nationally. It has also been applied in other areas of Ventia's Defence business such as linen disposal in its Housekeeping Services for its Defence-Based Services contract.

When Hayley French, Ventia's National Service Delivery Manager for Domestic Services, heard of the plans to upgrade beds on Defence sites, she looked into applying the system used at its National Clothing Stores. She applied for an 'Innovation to Defence' to have the new process formally approved and now all linen and long-term lost property items can be disposed of through the same system. RAAF Woomera has been the first base to use this disposal method, discarding a year's worth of redundant linen.

April Taylor, Ventia's Domestic Services Coordinator at the RAAF base in Woomera, said: "The whole process turned out to be very quick and simple, and it was a pleasure to work with all partners involved."

Ventia

www.ventia.com.au

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Creating meaningful impact and building consumer trust through action and innovation

Helen Mouscas, Senior Director, Inside Sales Management & Environment, Social and Governance Lead, Dell Technologies, Australia and New Zealand

The new financial year signals a period of reflection. Businesses consider what they've achieved and pencil in goals for the year ahead, which increasingly includes environmental, social and governance (ESG) goals, as companies realise the benefit and the opportunity to build consumer trust.

In 2022, that trust is essential. Consumers are considering what they spend their money on more carefully: they want to support businesses that are reducing their environmental impact and creating positive change. While setting ESG goals is a step in the right direction, innovation, evolution, partnerships, transparency and, most importantly, action are needed.

At Dell Technologies, our recently published 2022 ESG report highlights how consistent steps toward ESG goals can lead to meaningful impact, building consumer trust and moving towards a sustainable future that drives human progress.

Consumers expect climate action

A 2021 study by Deloitte found that nearly one in three consumers said they've stopped purchasing from certain brands because they had sustainability-related concerns, with 48% saying they highly value a reduced carbon footprint. Similarly, a 2020 report found that 90% of Australian consumers are more likely to purchase ethical and sustainable products, with 85% of consumers wanting brands to be more transparent about their sustainability.

Consumers want businesses to take decisive action and to provide evidence of progress. This is why detailed ESG reporting is critical for businesses. Measurable goals and robust data should drive ESG practice. It should consider internationally recognised frameworks and guidelines to ensure all businesses are held accountable to the same standards, while making ESG efforts easy to evaluate. At Dell Technologies, our 2022 ESG report endeavours to achieve this.

Reduce, reuse, recycle and make it renewable

In our ESG report, using common metric standards, we've highlighted our progress towards our 2030 goals. Our sustainability action focuses on three key areas: reducing e-waste through reuse and recycling, using eco-friendly packaging made with recycled

or renewable materials, and transitioning to renewable energy.

The idea of a circular economy underpins our e-waste reduction program, which seeks to tackle the often overlooked problem of discarded electronics. Mounting global e-waste is responsible for 70% of the toxic chemicals found in landfills. The percentage of products sold that were taken back for reuse and recycling increased by 26% compared with FY21 — with 1.1 billion kg of used electronics recovered since 2007. Our recent Sydney-based e-recycling day doubled down on our commitment to reducing e-waste.

Dell Technologies' Concept Luna takes the idea of our e-waste program and expands on it; unveiled in FY22, it's a sustainable design concept to inspire future laptop design, exploring ideas to make components readily accessible, replaceable and reusable. If all ideas in the prototype came to fruition, there would be an estimated 50% reduction in overall product carbon footprint compared to a similar Dell Technologies laptop. We believe circular innovation will drive sustainable progress and allow us to do more with less.

> **"A 2020 report found that 90% of Australian consumers are more likely to purchase ethical and sustainable products, with 85% of consumers wanting brands to be more transparent about their sustainability.**

Of course, while innovation will push us towards a sustainable future, businesses must also remember the basics to create immediate change. Last year, we made significant strides towards our 2030 moonshot goal of achieving 100% sustainable packaging. In fact, 90.2% of packaging across our entire product portfolio is now made with recycled or renewable materials, with 179.8 kg of sustainable materials used in products and packaging.

We're also shifting towards renewable sources. We've achieved an 82% increase in electricity generated by onsite solar panel installations compared with FY20, with 55% of electricity across our facilities coming from renewable sources. At Dell Technologies, we are proud of these achievements and are pleased to be able to highlight them in our FY22 ESG report.

Consistent steps towards a green future

In 2022, transparency around ESG goals and actions is key to building consumer trust and ensuring business resilience. At Dell Technologies, we lead with innovation to reach our ESG goals, taking consistent steps and sharing our progress. We encourage other businesses to do the same so we can collectively move towards a green future that benefits everyone, everywhere.

Dell Technologies

www.delltechnologies.com

Scientists use brewery waste to make 'artificial atoms'

Scientists have figured out a way to produce quantum dots using the spent grain from breweries. Researchers from the Institut national de la recherche scientifique (INRS) in Quebec, working in collaboration with a researcher from the École de technologie supérieure (ÉTS), produced a proof-of-concept model that used microbrewery waste as a source of carbon.

Quantum dots, also called artificial atoms, are nanoscopic particles that can be used for their light transmission properties in cutting-edge technologies including sensors in biomedicine, in inks and for LEDs in displays and screens. Producing them is an intensive process and typically relies on toxic and heavy metals like cadmium. Scientists have been looking to make the quantum dots using carbon sourced from renewable or sustainable sources to counteract the toxic methods used otherwise.

Brewery waste was chosen because it has a high amount of carbon, is readily accessible — so accessible that the researchers worked with a local microbrewery, Brasseurs de Montréal — and is naturally enriched with nitrogen and phosphorous, which means additional pure chemicals are not needed in the production process.

"The use of spent grain highlights both an eco-responsible approach to waste management and an alternative raw material for the synthesis of carbon quantum dots, from a circular economy perspective," said Professor Federico Rosei, from the INRS.

"This research was a lot of fun, lighting up what we can do with the beer by-products," said Claudiane Ouellet-Plamondon, Canada Research Chair in Sustainable Multifunctional Construction Materials at ÉTS. "Moreover, ÉTS is located on the site of the former Dow brewery, one of the main breweries in Quebec until the 1960s. So there is a historical and heritage link to this work."

The researchers wanted to demonstrate that quantum dots could be produced with relatively easily accessible tools, in addition to being made with brewery waste. They used a domestic microwave oven to carbonise spent grain. The resulting black powder was then mixed with distilled water and microwaved again. A passage in the centrifuge and advanced filtration were used to obtain the quantum dots that had been produced through this process.

With some testing, it was found that the dots were of a high enough quality to detect heavy metals and environmental contaminants and they demonstrated their quintessential fluorescence. The scientists have said that they will next want to move beyond this proof-of-concept model to fully utilise the microbrewery waste for making quantum dots that are easy to produce and useful in applications such as sensor technologies.

The full paper describing this process was published in the journal *RSC Advances*.

Brewery waste could help remove lead from water

A new analysis by researchers at MIT's Center for Bits and Atoms (CBA) has found that inactive yeast could be effective as an inexpensive, abundant and simple material for removing lead contamination from drinking water supplies.

The method is so efficient that the team has calculated that waste yeast discarded from a single brewery in Boston would be enough to treat the city's entire water supply. The findings were published in the journal *Communications Earth & Environment*.

Lead and other heavy metals in water are a significant global problem that continues to grow because of electronic waste and discharges from mining operations. Unlike organic pollutants, most of which can be eventually broken down, heavy metals don't biodegrade, but persist indefinitely and bioaccumulate. They are either impossible or very expensive to completely remove by conventional methods such as chemical precipitation or membrane filtration.

"We don't just need to minimise the existence of lead; we need to eliminate it in drinking water," said one of the paper's authors, MIT Research Scientist Patritsia Statathou.

The solution studied by the MIT team is a process called biosorption, in which inactive biological material is used to remove heavy metals from water, which has been known for a few decades. But the process has been studied and characterised only at much higher concentrations, at more than one-part-per-million levels.

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The team studied the use of a type of yeast widely used in brewing and in industrial processes, called *S. cerevisiae*, on pure water spiked with trace amounts of lead. They demonstrated that a single gram of the inactive, dried yeast cells can remove up to 12 mg of lead in aqueous solutions with initial lead concentrations below 1 part per million. They also showed that the process is very rapid, taking less than five minutes to complete.

ROTARY SCREW BLOWERS

Kaeser has launched its GBS series rotary screw blowers for the 75 to 160 kW power range. The blowers feature a flow rate from 22 to 104 m^3/min and differential pressures up to 1100 mbar as well as quiet operation, an optimised footprint and low maintenance requirements.

The range is designed to be up to 35% more efficient than conventional rotary lobe blowers and to have energy advantages compared to many other rotary screw blowers and turbo compressors available on the market. Its efficiency has been designed to remain consistent across the control range, rather than just at certain points, which makes the products a viable alternative to turbo compressors.

Power transmission from the motor to the compressor is via loss-free, maintenance-free gearing, which means that the products offer efficient operation and have low maintenance requirements. The products are designed for space-saving installation and quiet operation.

For fixed speed operation, Start Control (STC) versions are available. They feature an integrated star-delta starter equipped with a premium contactor, overcurrent relay and phase monitoring. The STC versions additionally feature an energy-saving IE4 Super Premium Efficiency motor.

Sigma Frequency Control versions are also available and feature an integrated frequency converter for dynamic adjustment of the flow rate to actual demand with the frequency converter and motor matched to deliver consistently optimised overall efficiency. For power outputs up to 110 kW, particularly efficient synchronous reluctance motors are used.

The range features power consumption per unit of flow rate (specific power consumption in kW per m^3/h) set according to the narrow tolerances of ISO 1217.

The integrated Sigma Control 2 controller provides operational reliability and smart communication via integration into process control systems, including those with Industry 4.0 requirements. The Sigma Air Manager 4.0 master controller is recommended for blower stations with multiple blowers, as it features control and regulation algorithms specially developed for the needs of low-pressure applications. This enables even greater energy savings and simplification of automation.

The blowers are suitable for applications with especially high energy requirements — such as the production of air for aeration in wastewater treatment facilities and bioreactors, as well as for flotation and fluidisation.

Kaeser Compressors Australia
au.kaeser.com

RECYCLED BUILDING MATERIAL

Biax is a recycled, recyclable, Australian-made product that can provide an alternative to the waffle pod. It is claimed to deliver the benefits of the polystyrene pod without the environmental downsides as it is made of recycled and recyclable material called Reprolene.

Produced by Biax's new parent company Holloway Group, Biax pods are stackable, so they're easier to transport and store onsite compared with foam pods. Pods for a 180 m^2 home can be delivered on a single-axle trailer and each pod weighs less than 3 kg.

Rather than simply replicating the same sizes as waffle pods, the Biax sizes are specifically calculated to provide good engineering outcomes when laying residential foundations. The range includes pods of different dimensions as well as new mini and adjustable pods to help ensure a more predictable result and accurate concrete forecasting.

Suitable for residential foundations of any size, the adjustable system is easy to install and endorsed by leading engineers and builders.

Biax
www.biax.com.au

Hose pump pushes sludge uphill

Blantyre Farms is a highly productive mixed farming and livestock business situated near Young, in New South Wales. They needed a pumping solution to transfer sludge from their covered methane gas dam. In other words, they found themselves facing that very old, Australian conundrum — pushing slurry uphill. That's when Mark Schulz, Maintenance Manager at Blantyre Farms, contacted Hydro Innovations to find a suitable pump for the application.

The problem

The problem for the farm was that the slurry had the consistency of molasses, and pumping it a kilometre uphill to the ponds was no easy feat for standard pumps.

"Ordinary pumps just couldn't handle the slurry," said Hydro Innovations' NSW Regional Manager, Phil Rothheudt.

The solution

Rothheudt's solution was to use a Ragazzini peristaltic pump model MS3. The operation of this style of pump derives from human 'peristalsis' intestinal muscle movements — an alternating contraction and relaxation of muscles around a tube to coax the contents through.

"Peristaltic pumps are usually found in medical situations, and often used to pump blood," he said.

The results

Schulz was happy with the results, stating: "The information supplied by Phil to select the correct pump for our application was great, as was the communication for the actual purchase.

"Our success is due to a team with many years of expertise," Rothheudt said.

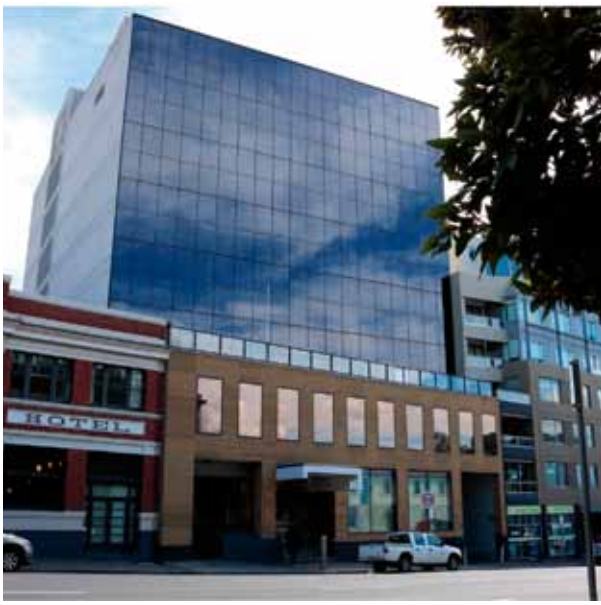
"We can turn around an enquiry same day and offer a solution; we know the specifics — that's what matters."

Ragazzini pumps use a roller on bearing design so the casing does not have to be filled and re-filled with expensive lubricating fluid. This means that hose changes are quicker and cleaner and also enables owners to take advantage of Ragazzini's fast leak detection system that alerts owners when a hose needs replacing. Pumps can be used on suction lifts up to 9 m and can produce pressures to 15 bar.

Hydro Innovations
www.hydroinnovations.com.au

ABB SYNCHRONOUS RELUCTANCE MOTORS AND DRIVES

ENABLE REDUCED CARBON EMISSIONS IN AN ENERGY EFFICIENCY UPGRADE FOR HOBART CBD BUILDING



The Sypkes Group's property at 85 Macquarie Street is a multi-tenancy commercial building that features corporate office spaces including those occupied by government and parliamentary officials. It is situated in the heart of Hobart's Central Business District (CBD), in Tasmania. The ten floors are occupied by approximately 250 workers on any given workday.

Stuart Davey Sypkes, Director of Property of the building recognised issues with aging equipment used to manage the heating, ventilation, and air conditioning (HVAC) operations, and consulted Enginuity Power Solutions, who collectively engaged ABB Authorized Value Provider A1 Electric Motors, to conduct an in-depth analysis of the existing system's process performance.

The HVAC application that underwent the analysis incorporated motors and drives responsible for powering and managing the chilled water for 85 Macquarie Street, and others that were depended upon for powering the supply air fan for the entire building.

Solutions identified

Tom Green, Managing Director at Enginuity Power Solutions, together with Chris Cheong, Director at A1 Electric Motors, conducted an analysis which recognised that 85 Macquarie Street was eligible to bring their existent motor selection down a size. The supply air fan was originally powered by a 15kW motor but it was determined that the necessary motor that would be adequate to drive the load was instead an 11kW motor. In turn this would enhance their system, reduce operating costs and increase energy efficiency.

ABB synchronous reluctance motors (SynRM) and ACH580 variable speed drives (VSD) were ultimately selected for this project.

The difference made when upgrading to a high-efficiency IE5 SynRM motor

HVAC systems worldwide rely on millions of low-voltage (LV) electric motors to run pumps, fans and compressors. However, these motors consume on average about 50% of the energy used in buildings. Most of the motors in our buildings today are only efficiency class IE1 or IE2.

Rory Paltridge, Division Manager for Motors at ABB Australia says, "Climate change and environmental responsibility are propelling changes across all industries. These SynRM motors offer industrial users a great opportunity to reduce their electricity usage and CO_2 emissions while also benefiting from increased productivity and lower life cycle costs."

Energy efficiency, cost effectiveness, and reliability without compromising on comfort

The ACH580 is a drive that stands out for its ability to guarantee air quality in the most energy efficient and cost-effective way in both normal and critical situations.

Because HVAC systems run at partial loads close to 99% of the time, VSDs can save energy by an average of 20 to 60% compared to traditional damper or valve control methods. It's possible because drives can adjust the motor speed of equipment directly to meet the current building needs.

When asked about the asset replacement at 85 Macquarie Street, Stuart Davey-Sypkes, Director at SFO Property said, "It just made sense every way I looked at it. Reducing energy consumption in the building by upgrading the foundation that underpinned the plant and where equipment played a pivotal role, was the logical first step in a broader strategy to reduce the running costs of our building. The ROI calculations looked compelling and it was backed with sound logic, which resulted in an easy 'yes' to undertake these upgrades."

12 months strong and data that radiates positive results

It's been found that the equipment upgrade has enabled a 5.1 tonne reduction in annual CO_2 emissions. To offset this much carbon you would have to plant approximately 2.5 hectares of trees every year for the life of the asset. That's equivalent to an area the size of 1.5 Melbourne Cricket Grounds (MCG), or five return trips between Paris and New York by plane.

A look at the supply air fan application shows energy consumption was reduced by around 40%. Thanks to the implementation of the ABB ACH580 VSD inrush currents have been reduced by over 140A per phase and kVA demand has been reduced by over 100kVA. This has the potential to further reduce the energy costs at 85 Macquarie Street by over $12,000 AUD annually.

With the chilled water pump application, energy consumption was reduced by around 35% with a reduction in line current of approximately 43%. Owing to the new VSD inrush currents have been reduced by over 92A per phase and kVA demand has

Existing Motor (DOL)		L1	L2	L3	
2/07/2021 7:42:22 AM 698msec	Vrms ph-n	239.86 V	240.22 V	241.07 V	
2/07/2021 7:42:22 AM 698msec	Vrms ph-ph	414.94 V	418.05 V	415.98 V	
2/07/2021 7:42:22 AM 698msec	Arms	152.4 A	154.9 A	155.9 A	
2/07/2021 7:42:22 AM 698msec	Power Factor	0.88	0.88	0.86	0.87
2/07/2021 7:42:22 AM 698msec	Active Power	19.79 kW	20.17 kW	20.07 kW	60.03 kW
2/07/2021 7:42:22 AM 698msec	Active Energy	17.90 kWh	21.03 kWh	19.80 kWh	58.73 kWh
2/07/2021 7:42:22 AM 698msec	Reactive Power	30.09 kvar	30.6 kvar	31.08 kvar	91.77 kvar
2/07/2021 7:42:22 AM 698msec	Apparent Power	35.8 kVA	36.43 kVA	36.78 kVA	109.02 kVA
2/07/2021 7:42:22 AM 698msec	Apparent Energy	28.79 kVAh	30.19 kVAh	32.94 kVAh	92.24 kVAh

Replacement SynRM Motor and Variable Speed Drive		L1	L2	L3	
6/09/2021 11:36:07 AM 376msec	Vrms ph-n	239.68 V	240.11 V	241.71 V	
6/09/2021 11:36:07 AM 376msec	Vrms ph-ph	414.55 V	418.04 V	417.11 V	
6/09/2021 11:36:07 AM 376msec	Arms	13.7 A	12.3 A	14.5 A	
6/09/2021 11:36:07 AM 376msec	Active Power	2.52 kW	2.34 kW	2.9 kW	7.74 kW
6/09/2021 11:36:07 AM 376msec	Apparent Power	3.28 kVA	2.94 kVA	3.5 kVA	9.72 kVA
6/09/2021 11:36:07 AM 376msec	Reactive Power	700 var	240 var	340 var	1.26 kvar
6/09/2021 11:36:07 AM 376msec	Power Factor	0.77	0.8	0.83	0.8
6/09/2021 11:36:07 AM 376msec	Active Energy	2.39 kWh	2.22 kWh	2.77 kWh	7.38 kWh

Figure A: Example inrush current data capture/system start profile of the old motor using Direct On Line motor starting (DOL) at 85 Macquarie Street for the supply air fan application.

Figure B: Comparative data of the old system versus the new system at 85 Macquarie Street when analysing current draw/inrush current during the start up of the supply air fan application.

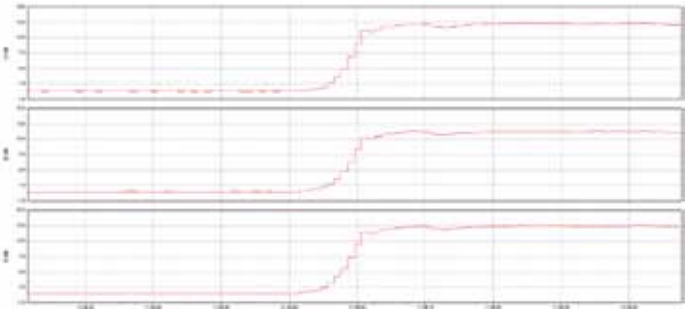


Figure C: Analysis of the inrush current/system start profile of the supply air fan application at 85 Macquarie Street when using ABB's SynRM motor and drive package.

been reduced by over 65kVA. This has the potential to further reduce the energy costs by over $8,400 AUD annually giving the project's capital investment an ROI of approximately 18 months.

By the numbers — a comparison of then and now

Figure A demonstrates the significant reduction in inrush current on start-up (the old system showed around 155 Amps per phase, versus the new system of around 14 Amps per phase). The old system required 109 kVA to start the motor and following the implementation of the ABB SynRM motor and drive package, this was reduced to just 9.74 kVA. This is substantial as most commercial customers in Australia are charged for peak kVA demand. A reduction in kVA demand, therefore, equates to significant operational cost savings.

Figure B is again a revealing comparison of the benefits of the new supply air fan system and highlights the current draw/inrush current during system start. It demonstrates the load profile of the current draw of the system when the motor starts. Notice the massive peak in current draw in the top graph when the old system was using Direct On Line motor starting (DOL).

In comparison, Figure C which profiles the performance of ABB's SynRM motor and ACH580 drive package shows the load ramp rate increase gradually signifying more managed control of speed and power. This results in reduced mechanical stress on the system and equipment as a whole which extends equipment lifetime, reduces the need for service downtime, and emphasises the reduced energy consumption in the application and associated costs.

Results

- The equipment upgrade has enabled a 5.1 tonne reduction in annual CO_2 emissions.
- For the supply air fan application energy consumption was reduced by a staggering approximation of 40%.
- For the chilled water pump application, energy consumption was similarly reduced by around 35%.
- The building property managers have experienced significantly lower operational costs and energy bills.

Tom Green says, "We focus on supporting industry and bridging the gap between intangible ideas and delivering evidence-backed innovative, future-proof solutions.

Our partnership with Chris and his team at A1 Electric Motors and our collaborative approach cements our ability to consult, design and deliver on projects such as these."

Chris Cheong says, "We're always thrilled when we're able to see potential energy savings from equipment upgrades with the use of the ABB EnergySave calculator coupled with ROI data such as that provided by Enginuity Power Solutions."

ABB Australia Pty Ltd
www.abbaustralia.com.au

Out of puff

End-of-life plan needed for wind turbine blades

A new study led by Professor Peter Majewski at The University of South Australia indicates tens of thousands of wind turbine blades will end up in landfill by the end of the decade unless end-of-life programs are established soon.

The study highlights the challenges of recycling wind turbine blades, which are made of either carbon fibre or glass fibre composite material, both of which are expensive to break down, with the recovered materials having minimal market value.

"The same features that make these blades cost-effective and reliable for use in commercial wind turbines make them very difficult to recycle in a cost-effective fashion," Majewski said.

"As it is so expensive to recycle them, and the recovered materials are worth so little, it is not realistic to expect a market-based recycling solution to emerge, so policymakers need to step in now and plan what we're going to do with all these blades that will come offline in the next few years."

In many parts of the world, wind turbine blades are currently dumped in landfill, but this practice has been banned in some European countries, and with estimates suggesting there will be more than 40 million tons of blade waste worldwide by 2050, alternative solutions are urgently being sought.

Majewski said that while there is some very limited potential for reuse of blades in niche construction settings and a small market for some of the reclaimed materials, it is likely the costs of disposing of the blades in a sustainable fashion will need to be factored into their production and running costs.

"Our research indicates the most likely viable option is a product stewardship or extended producer responsibility approach, where the cost of recycling the blades is factored into either the cost of their manufacture or the cost of their operation.

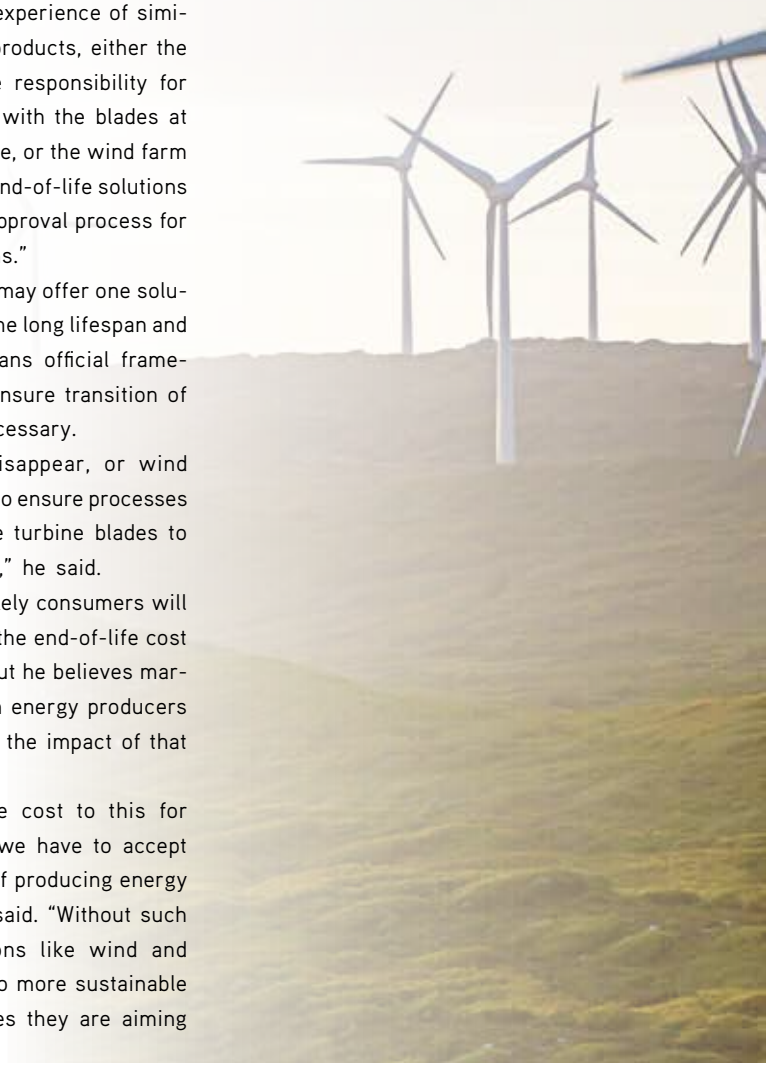
"So, drawing on the experience of similar programs for other products, either the manufacturer must take responsibility for what needs to be done with the blades at the end of their useful life, or the wind farm operators must provide end-of-life solutions as part of the planning approval process for their business operations."

While self-regulation may offer one solution, Majewski believes the long lifespan and high cost of blades means official frameworks are required to ensure transition of responsibility where necessary.

"If manufacturers disappear, or wind farms go broke, we need to ensure processes are still in place for the turbine blades to be disposed of properly," he said.

Majewski said it is likely consumers will ultimately bear some of the end-of-life cost through energy tariffs, but he believes market competition between energy producers should help to minimise the impact of that on the public.

"There will be some cost to this for everyone involved, but we have to accept that as part of the cost of producing energy in this way," Majewski said. "Without such solutions, energy options like wind and solar may prove to be no more sustainable than the old technologies they are aiming to replace."



> Our research indicates the most likely viable option is a product stewardship or extended producer responsibility approach, where the cost of recycling the blades is factored into either the cost of their manufacture or the cost of their operation.

Upcycling solar panels into thermoelectrics

A team of scientists from the Agency for Science, Technology and Research (A*STAR) and Nanyang Technological University, Singapore (NTU Singapore) has developed technology that can turn old solar panels into a high-performance, energy-harvesting thermoelectric material that harvests heat and converts it into electricity. The joint study was published in the scientific journal *Advanced Materials* in March 2022.

With the increased use of solar renewable energy over the last few decades, and a limited lifespan of 30 years for solar panels, the global waste generated from silicon in end-of-life solar panels is projected to hit 8 million tonnes by 2030 and 80 million tonnes by 2050[1].

Solar panels are made up of solar cells, which contain a complex mix of various materials such as aluminium, copper, silver, lead, plastic and silicon. Separating such materials and recycling them each in a unique way is a complex and costly process; therefore, current recycling approaches mainly recover only the glass and metallic support structures from solar panels.

Silicon, which makes up 90% of solar cells, normally ends up in landfills. It is challenging to upcycle silicon as recycled silicon has impurities and defects, which cannot be used to create functional solar cells. This makes it difficult to recycle used silicon into solar cells or other silicon-based technologies.

The joint team turned this limitation into opportunity by developing technology to transform expired solar cells into enhanced thermoelectric material. Compared to solar cells, this technology capitalises on the contrasting properties of thermoelectrics, where the incorporation of impurities and defects serves to enhance rather than diminish their performance.

Scientists from A*STAR's Institute of Materials Research and Engineering (IMRE) and Institute of High Performance Computing (IHPC), led by Dr Ady Suwardi, Deputy Head of the Soft Materials research department at IMRE, contributed their expertise in material properties and computational modelling, respectively, to determine the optimal composition of materials.

Scientists from NTU's Singapore-CEA Alliance for Research in Circular Economy (SCARCE), led by Associate Professor Nripan Mathews, leveraged their expertise in extracting valuable materials from solar waste to develop the technologies required for recovery of silicon from solar panel waste.

To impart thermoelectric characteristics such as power conversion and cooling efficiency to waste silicon and to enhance the performance of the upcycled silicon-based thermoelectrics, the team first pulverised solar cells into fine powder using ball milling technology. Next, phosphorus and germanium powder were added to alter their original properties before the powder combination was processed under high heat and temperature using spark plasma sintering.

After evaluating the electrical property of various combinations, the team achieved a sample offering the most optimised thermoelectric performance, with a thermoelectric figure of merit (zT) of 0.45 at 873 K — the highest amongst elemental silicon thermoelectrics.

"This study demonstrates that thermoelectrics is a fertile ground for upcycling defect- and impurity-sensitive semiconductors," said Suwardi.

"Our goal is to create sustainable materials, extend the life cycle of various products and reduce waste to cultivate a circular economy, and we can only do this through partnership with institutes of higher learning and other collaborators from the local R&D ecosystem," added IMRE scientist Dr Jing Wu, who was co-corresponding author of the paper together with Suwardi.

This effort highlighted the intertwined research by SCARCE whereby silicon recovered from solar panel waste is being upcycled by A*STAR into silicon-based thermoelectrics for harvesting of electricity from heat. The team will also look to pilot the technology for large-scale upcycling of waste silicon, which can be used for high-temperature energy-harvesting applications such as converting heat generated from industrial waste processes into electricity.

1. G. A. Heath, T. J. Silverman, M. Kempe, M. Deceglie, D. Ravikumar, T. Remo, H. Cui, P. Sinha, C. Libby, S. Shaw, Nat. Energy 2020, 5, 502.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OVERCOMING CHALLENGES IN CCUS OPERATIONS

Amy Loi, Director at Emerson Automation Solutions

Carbon capture, utilisation and storage (CCUS) is the process of capturing carbon dioxide (CO_2) emissions at the source, or directly from the air, and preventing them from entering the atmosphere. Once captured, CO_2 is then purified, liquefied and transported to a suitable storage location for long-term isolation from the atmosphere or utilised in a variety of industrial products.

The process of capturing carbon dioxide has been used within gas processing for decades to remove CO_2 from natural gas to improve purity. Since the 1970s, captured CO_2 has been injected into oil fields and utilised to enhance oil recovery. In more recent times, capture technology has been successfully coupled with underground injection and sequestration of CO_2.

Emerson has decades of experience in engineering, operating and optimising industrial facilities, providing the foundation for its expertise in CCUS. Emerson understands the unique challenges posed by the needs of CCUS operations.

In Australia, Emerson has been involved in a major carbon capture project, working with the engineering contractor and end user from the early-stage front-end engineering design (FEED) stage to follow best practices in providing instrumentations required in different sections of the plant for critical measuring points and applications, while also enabling full automation of the plant.

CCUS challenges

The deployment of carbon capture and storage involves substantial capital and operational costs, presenting challenges to its commercial viability:

- **Cost of implementation and operation**: The upfront capital investment for capture technology, transport pipelines and geological storage is high, and significant energy and water usage is required to capture and compress the CO_2.
- **Transportation challenges**: New infrastructure is required to safely carry liquefied CO_2 to storage or utilisation sites, and significant energy is also required to compress the CO_2 and to maintain high pressure and low temperature throughout the pipelines.
- **Custody transfer**: Reliable methods are needed to precisely measure large volumes of CO_2 transferred between producers and consumers, as well as for reporting carbon tax credits and regulatory compliance.
- **Emissions challenges**: Impurities in the CO_2 stream, including water, can result in dangerous leaks and explosions as the compressed fluid rapidly expands to a gas.

Accurate instrumentation of the entire CCUS process is imperative to maintain safety and minimise operational costs.

The carbon capture process

Post-combustion amine-based absorption is the most mature carbon capture process. It consists of an absorber, where a chemical solvent captures CO_2 from the flue gas, followed by a stripper where the chemical solvent is regenerated and the CO_2 is extracted.

CO_2 capture efficiency is dependent on the solvent circulation rate. By increasing the circulation rate, the energy required for the stripper reboiler is increased. There is a trade-off between the capture efficiency and energy cost to regenerate the solvent. The greatest challenge is to meet the targeted CO_2 capture rate in an efficient manner.

Liquefaction efficiency

Liquefaction is an essential process for long distance transportation of CO_2 and consists of a series of compressor stages and cooling. Efficiency of the liquefaction process depends on reliable measurement and control. CO_2 must be compressed to a pressure between 1,500 and 2,200 pounds per square inch (psi) for pipeline transportation. Compressors are key assets used across all phases of CCUS, with unexpected failures resulting in capacity outage, equipment damage, excessive maintenance and costs, and scheduling delays.

Maintaining CO_2 in its liquid state is critical, but it has proven to be difficult. CO_2 purity is important to maintaining a single phase without requiring extra energy. Impurities and humid conditions can cause the formation of dry ice, which result in corrosion and potential leaks.

Emerson's Micro Motion high-pressure Coriolis meter

Emerson's Rosemount 3144P Temperature Transmitter

Emerson's Rosemount CT5800 Continuous Gas Analyzer

Loss of containment

A leak, as a result of corrosion and erosion, is a significant concern during all stages of the CCUS process. In an amine carbon capture unit, carbonic acid attack is possible where water vapour condenses in the presence of CO_2. Two-phase flow at the feed to the stripper also results in erosion concerns. Sheer rates, turbulence and steam velocities are also key for corrosion and erosion control. Within liquefaction, water content in CO_2 can also lead to corrosion-based leaks and must be controlled.

CCUS Instrumentation Solutions

As for any industrial process, the success of a CCUS project depends on the accurate measurement of critical parameters throughout the process.

Accurate flow and phase measurement

At all points in the CCUS process, accurate measurement of the flow and density of the CO_2 is essential. Volumetric flow measurement will be difficult due to the changes in CO_2 phase and density. Direct mass flow measurement is the best option at these critical measuring points. Emerson's portfolio of mass flow devices using Coriolis metering technology provides reliable CO_2 measurement data in critical applications throughout the capture process.

The Coriolis meter's ability to measure multiple variables, such as mass flow, density, temperature, drive gain (an indicator of phase fraction conditions) means that it is possible for these meters to continue measuring with entrained liquids in gas. This type of measurement works by combing data from the meter with readily available process variables, such as density of liquid and gas at standard conditions. It is possible to detect the presence of entrained water in the CO_2 stream, so that action can be taken to mitigate the risk of corrosion.

In the amine unit, Coriolis density meters also help to automate lean amine concentration measurement to determine solvent circulation rate to achieve the desired capture efficiency at the lowest cost.

Emerson's Micro Motion high-pressure Coriolis meters work reliably at the required pressure and no straight pipe run is required. This results in a compact custody metering skid, reduced engineering complexity and lower materials cost in the building of the CCUS system. The integrated metering skid complies with international custody transfer standards and has the accuracy suited for carbon credit trading purposes.

Temperature measurement

Throughout the entire process of carbon capture, liquefaction and transport, temperature is a key property of the CO_2 that must be managed. Traditionally, accurate measurement of temperature requires the installation of thermowells into the process fluid streams in order to bring the temperature sensor in contact with the fluid; however, this method of measurement is complex to design and install, and increases the risk of process leaks — potentially defeating the purpose of a CCUS project.

Emerson's Rosemount X-well Technology provides an accurate, reliable and non-intrusive temperature measurement at a lower cost while reducing the risk of process leaks by making it possible to achieve accurate process temperature data without the need for thermowell or process penetration. Using a thermal conductivity algorithm with an understanding of the conductive properties of the temperature measurement assembly and piping, this surface temperature sensor solution accurately measures internal temperature. This ensures the efficiency and safety of the CCUS process and the proper state of gases and liquids are maintained during processing, transport and storage.

Gas analysis

Depending on the process from which the CO_2 is being captured, various types of impurities other than water may be present in the gas stream.

Concentration and composition measurement of the CO_2 purity and its impurities during the carbon capture process as well as further down the value chain are also important. Emerson's gas analysers based on Quantum Cascade Laser technology offer fast, high-resolution spectroscopy measurements that provide near-live data and trend information for operators. This visibility into the process allows operators to take quick action if the impurity levels exceeded the required data set points.

Carbon capture success through automation

In the Australian CCUS project, Emerson was able to provide, along with critical instrumentation technology, the complete automation solution for the successful implementation of carbon capture, utilisation and storage.

Emerson's advanced automation technologies, designed specifically to monitor and control the CCUS process, have helped the Australian CCUS project to ensure operational certainty by delivering advanced control, increased process visibility and actionable information for improved decision-making.

For more information, visit go.emersonautomation.com/ap-carbon-capture.

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

MASTER OF DISASTER RESILIENCE AND SUSTAINABLE DEVELOPMENT

The University of Newcastle's Master of Disaster Resilience and Sustainable Development is designed for people from a range of careers to understand resilience and sustainable development principles, and systematically apply them to avoid disasters, operate through extreme events and emerge better placed to face the future.

This program is jointly developed by the United Nations and CIFAL Newcastle, a United Nations training centre with a focus on disaster resilience and sustainable development. Students will be co-certified by UNITAR and UNDRR and be prepared to implement the UN Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction.

Built with flexibility in mind, this program is available 100% online with multiple courses also offered face-to-face, and students can choose to study full-time or part-time so they can fit study in around their lifestyle.

The program is available for people from a range of backgrounds and experience. There are study pathways from 80 units to 160 units depending on relevant professional experience and qualifications. Students can also elect to study at a time that suits them, with multiple intakes per year.

University of Newcastle
www.newcastle.edu.au

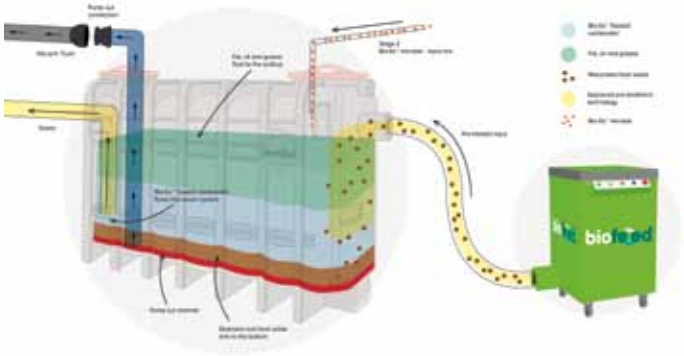
REAL-TIME ENERGY MONITORING FOR SMART METERS

Sense has announced the establishment of a local operation in Australia within 12 months as the company sees strong potential for its artificial intelligence (AI) technology to be embedded with the next generation of smart energy meters. It will be establishing local electricity retailing and manufacturing partners for its AI technology that uses machine-learning algorithms to analyse high-resolution electricity data, providing a breakdown of individual domestic electricity consumption to an appliance level in real time.

Sense AI technology — which can be embedded in the smart meter — can provide data that is vital to flexible grid management, including the provision of energy disaggregation information in real time.

The technology incorporates high-resolution processing that can be built directly into next-generation smart meters. Its load disaggregation samples power more than 10,000 times per second, then uses high resolution waveform data analysis to track device activity in homes down to individual appliances, even those that aren't smart. Users can therefore get insight into their home, which can save them on average around 9% of their energy bill, according to the company's spokesperson.

Sense
sense.com



FOOD WASTE MANAGEMENT TECHNOLOGY

The Biofeed Separator is an innovative, scalable and proven food waste management technology that sustainably closes the loop on all types of food waste. The self-contained, organic food waste management unit is designed to convert solid food waste into a liquid using Biofeed's patented maceration and separation process. This process is virtually odour-free, and the excess liquid is safely disposed of through existing public wastewater treatment systems. The residual material containing its original calorific value is then repurposed into numerous environmentally and financially beneficial alternatives. The technology is simple and scalable and can help to contribute to the user meeting triple bottom line commitments — profit, people and planet.

Benefits of the system include: contributes to meeting triple bottom line requirements; data capture option accessible through the cloud-based client portal; robust, scalable, low-maintenance technology; eliminates odour issues; compact size allows for easy installation in most areas and frees up valuable space; and 100% Australian made and owned.

Biofeed
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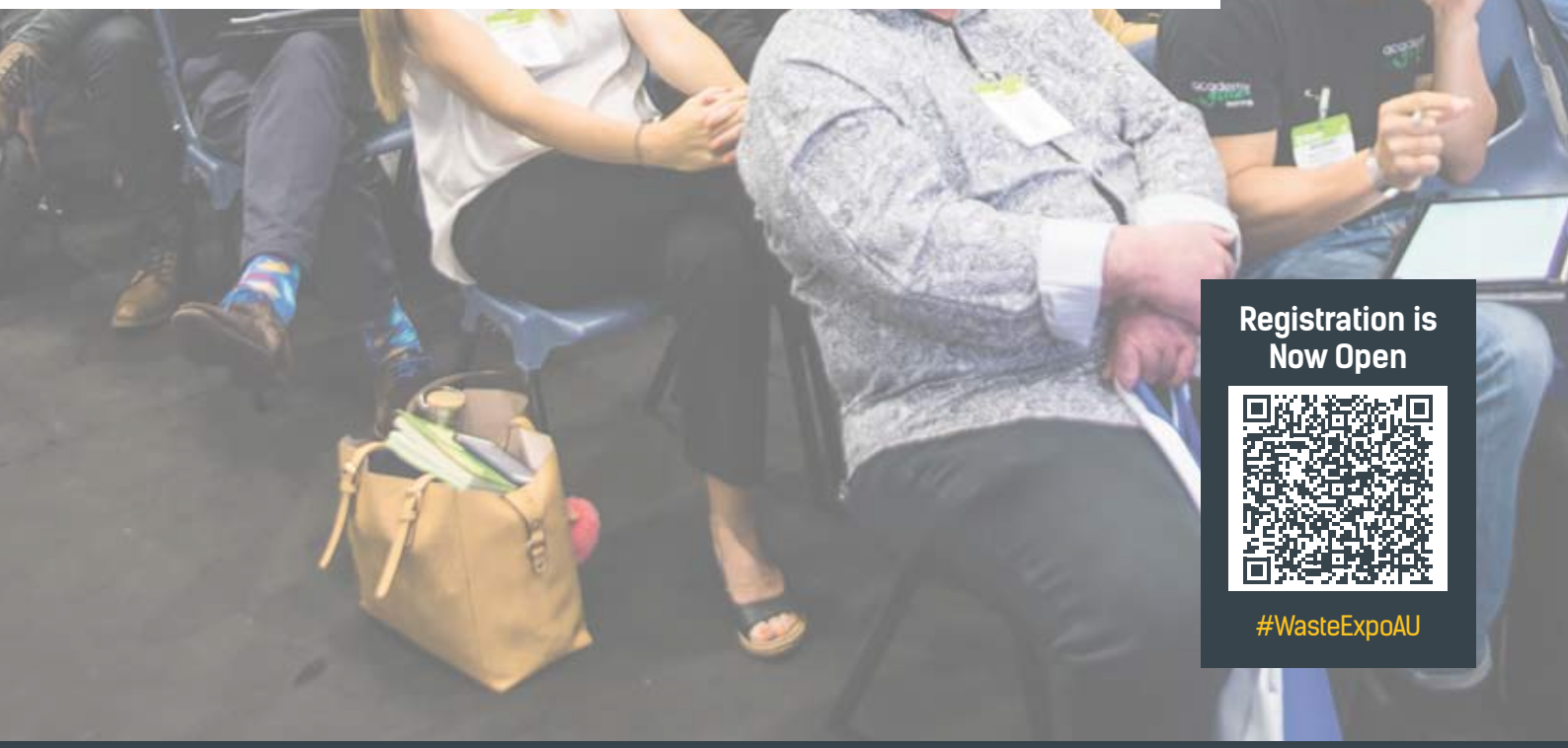

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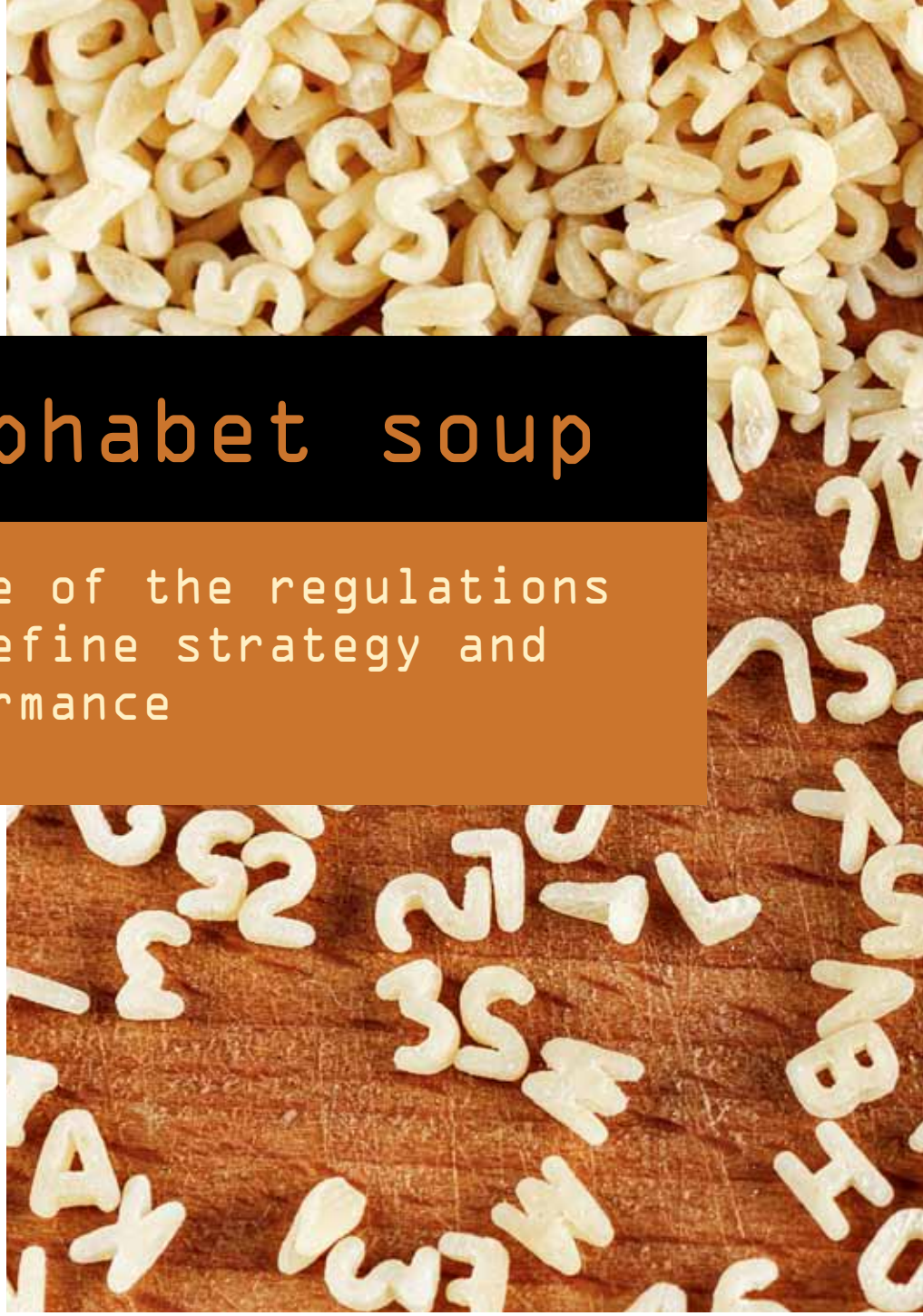

ESG alphabet soup

Making sense of the regulations that will define strategy and drive performance

SAI360

Comparing ESG standards begins with reciting the sustainability alphabet.

In 1988 Friedman's doctrine that favours profits for shareholders over social responsibility was challenged by a concept called social capital, which meant that a company's public image could affect profitability as much as the cost of production.

After the Exxon Valdez oil spill in 1997, most companies became acutely aware that environmental disasters not only threatened the ecosystem, the costs of remediation and penalties jeopardised their bottom line. Growing concern about climate change added pressure to reduce a company's carbon footprint. But it took the financial crisis of 2007 to turn the spotlight on excessive risk and expose whole industries to accusations of corruption and greed.

The need for organisations to assess environmental, social and governance (ESG) impact on financial performance is matched by the demands of stockholders and the public for transparency and accountability. Over the decades, companies have obliged. In 2021, 95% of S&P 500 companies published detailed ESG data and the rest made high-level policy information available to the public on their websites.

What are ESG reporting frameworks?

The complexity of the issues and the difficulty of comparing performance among companies required standardisation of reporting. Investor groups, NGOs, advisory organisations and quasi-governmental agencies stepped up to offer numerous frameworks for identifying issues and recommend standards for implementing programs. The resulting avalanche of acronyms for the numerous and varied standards can overwhelm both companies and interested stakeholders.

Comparing widely used standards can be helpful, and starts with identifying their common purpose. All standards aim to establish transparent, reliable and credible methodologies for analysing ESG best practices and measuring organisations' performance. Most specify the type of relevant information companies should disclose and offer a framework for accurate and timely disclosure. They enable stakeholder engagement and comparative analysis across target industries.

Standards vary in compliance requirements and comprehensiveness, the scope of ESG issues they target or the type of organisation they address. Fundamentally, standards differ in their methods of achieving sustainability: whether they help companies improve operations and mitigate risk, or require them to disclose financial impact to investors or comply with government regulation.

The following list includes key ESG standard-setting frameworks to track.

GRI — Global Reporting Initiative

The Global Reporting Initiative assesses company activities and supply chains for a wide range of ESG impacts:

- Environmental: climate change, resource depletion, waste and pollution, deforestation.
- Social: working conditions, local communities, conflict, health and safety, employee relations and diversity.
- Governance: executive pay, bribery and corruption, political lobbying and donations, board diversity and structure, tax strategy.

GRI Standards focus on sustainable development rather than financial disclosure. They identify issues, analyse the social and economic impact, and assess governance costs and benefits. The methodology quantifies and compares ESG performance among companies and over time to measure sustainability development. Reports describe what companies are doing and evaluate how well they are performing, which companies use to benchmark their progress.

The standards apply to any organisation in all sectors, public or private, regardless of size. GRI functions as a platform for cooperative effort among thousands of organisations in more than 100 countries that self-assess their ESG impact and report sustainability efforts. Stakeholders use the information in numerous ways.

GRI Standards are mandated by the European Commission for public companies with more than 500 employees and are required by legislation or regulations in the US, France, Brazil, Canada, China, Denmark, Finland, Germany and South Korea. They are also required by many leading institutional investors and development organisations.

SASB — Sustainability Accounting Standards Board

The Sustainability Accounting Standards Board analyses how companies manage pertinent ESG issues and the effects on financial performance. SASB Standards are designed for disclosing financially material sustainability information to investors and other capital providers, specifically ESG issues that have a direct financial impact on companies or affect long-term enterprise value.

SASB was initially motivated by climate change but now concentrates on the subset of ESG issues relevant to each industry. The Standards are used to implement the framework established by the Task Force on Climate-related Financial Disclosures (TCFD) discussed next and align with GRI Standards.

Any company required to disclose the impact of ESG issues on financial performance and enterprise value can use the SASB Standards. Investors, financial regulators and policymakers rely on SASB to identify and measure ESG impact on an industry or a company's operations and long-term value.

These standards are not mandated by legislation or regulation but are used to identify and report financially material issues subject to mandatory disclosure.

TCFD — Task Force on Climate-related Financial Disclosures

The Financial Stability Board established the Task Force on Climate-related Financial Disclosures to create guidelines for disclosing a specific ESG issue to financial entities. Climate-related risk arises from increased operational costs due to a range of threats, including scarcity of resources and disrupted supply chains. TCFD aims to make climate change mitigation efforts an integral part of companies' risk management and strategic planning. ›

Any company exposed to climate-related financial risk can use TCFD guidelines to report to investors, lenders and insurance underwriters that assess value and price risks.

Mandatory reporting requirements aligned with TCFD were introduced in the United Kingdom and New Zealand. By 2025, 1300 registered companies in the UK must disclose climate-related financial information. TCFD is endorsed by the G7 and G20 and supported by more than 2200 organisations. The International Sustainability Standards Board (ISSB) uses TCFD recommendations.

SFDR — Sustainable Finance Disclosure Regulation

The Sustainable Finance Disclosure Regulation imposes ESG disclosure obligations on asset managers and other financial advisors in the European Union and United Kingdom.

SFDR requires transparency of a range of ESG risks impacting the financial industry but focuses on "climate change, resource depletion and other sustainability-related issues". It aims to eliminate the "greenwashing" of financial products and advice and steer investments towards a sustainable economy by enabling informed financial decisions. SFDR classifies funds from those that do not consider sustainability risks to those that have sustainability as a core objective.

All EU and UK financial funds and firms are mandated to disclose ESG impacts to investors and improve operations to comply with SFDR terms. SFDR doesn't apply to the US financial market, but all asset managers who raise money, offer funds or market their products in the EU or UK must comply. Furthermore, SFDR is a model for ESG disclosure that encourages US regulators and other governments to develop similar standards.

GHGRP — Greenhouse Gas Reporting Program

The US Environmental Protection Agency instituted its Greenhouse Gas Reporting Program to require the submission of relevant information about greenhouse gas (GHG) emissions from 8000 sources. The GHGRP aims to monitor 85% of emissions in the country, supplying data for analysis by all stakeholders and policy decisions by legislative and regulatory agencies. Reports are required annually and made publicly available. The data can be sorted by facility, location, industry or gas.

Reporting is mandatory for vehicle and engine manufacturers, industrial and fossil fuel suppliers, and any facility emitting 5000 metric tons or more of GHG annually. The extensive list of regulated entities includes commercial, industrial, residential and agricultural facilities.

PCAF — Partnership for Carbon Accounting Financials

The Partnership for Carbon Accounting Financials is a worldwide group of 269 banks, asset managers and insurance companies that collaborated with stakeholders to develop greenhouse gas disclosure guidelines for their industry. Their Global GHG Accounting and Reporting Standards help financial institutions assess and disclose greenhouse gas emissions of entities receiving their loans and investments.

Although the standards are not mandatory, the SEC is proposing to mandate climate-related disclosures that include GHG emissions in registration statements and periodic reports. Worldwide, other regulators are considering similar steps.

GFANZ — Glasgow Financial Alliance for Net Zero

Another effort by the financial industry to reduce carbon emissions is the Glasgow Financial Alliance for Net Zero. GFANZ specifically pressures financial service firms and G20 governments to achieve the objectives of the Paris Agreement (Paris Climate Accords). It focuses on reaching investment benchmarks and issues reports on progress. GFANZ offers a Net Zero Financing Roadmaps tool for analysing financial industry support, organised by financing types, sectors and geography.

GFANZ is not mandatory, but the Paris Agreement is a legally binding treaty negotiated by 196 parties and ratified by 193, including the EU and United States.

Your organisation

Understanding your social, financial and regulatory obligations and the operational benefits of sustainable practices can be overwhelming. Fortunately, specialists that have studied ESG impact and standards can help define your ESG strategy and improve performance.

SAI360

www.sai360.com

SUCCESSFUL EMISSIONS MONITORING WITH CAC GAS SPECIALTY GASES

A "*greenhouse gas is any gas that has the property of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases. To a lesser extent, surface-level ozone, nitrous oxides and fluorinated gases also trap infrared radiation. Greenhouse gases have a profound effect on the energy budget of the Earth system despite making up only a fraction of all atmospheric gases*." (Source: https://www.britannica.com/science/greenhouse-gas)

These greenhouse gases are all considered to be contributors to climate change, which in turn can lead to changes in ecosystems.

Australia's very high level of emissions per person reflects the nation's heavy reliance on fossil fuels as a primary energy source.

Australia had the highest greenhouse gas emissions per inhabitant of all OECD nations in 2019, at 21.63 metric tons per capita. (Source: www.statista.com)

Stack gas, flue gas and fugitive emissions from oil & gas production, cement, power processing plants, pulp and paper, wastewater treatment plants and landfills all emit greenhouse gases.

However, there is an increasingly strong drive to decarbonise across all industries and transition to a circular, low-carbon economy.

Carbon capture and storage (CCS) involves capturing, transporting and storing greenhouse gas emissions from energy intensive industries, and then injecting the captured greenhouse gases back into the ground. CCS contains CO_2 but may also contain trace levels of toxic chemicals such as CO, NO_x or SO_x.

Energy from Waste (EfW) projects have the potential to divert immense amounts of material going to landfill and reduce harmful emissions, such as methane and CO_2.

Thermal energy from waste is becoming a preferential option for treatment of residual waste to create clean energy and divert waste from landfills. This process captures landfill gas (methane) that is treated to generate electricity. In addition to creating electricity for homes, some companies experience cost savings as the electricity can be used in their own manufacturing and operational processes.

Bioenergy technologies like anaerobic digestion also support decarbonisation and can produce clean energy. This process produces two valuable outputs — biogas (composed of methane, carbon dioxide and hydrogen sulfide) and digestate.

Whilst these processes can curb the production of greenhouse gas emissions, they still produce them, albeit it at reduced levels.

Critical to the success of emissions reduction is the ongoing or continuous emissions monitoring and analysis of these greenhouse gas emissions. Apart from any regulatory obligations, it is paramount that operators monitor their concentrations to ensure that there are no gas leaks that will cause health and safety risks. Monitoring and analysing also enables operators to take quick and effective corrective action when necessary.

As part of that process, high-quality specialty gas/calibration gas mixtures are essential to ensuring that the gas analysers are measuring those greenhouse gas emissions accurately.

At CAC GAS, we assist companies across all market sectors by providing calibration and specialty gases for monitoring and analysing emissions. CAC Gas is also a global supplier of gas control equipment.

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CAC Gas & Instrumentation
www.cacgas.com.au

ON-SITE WASTE MANAGEMENT SYSTEM

The Firefly (MMAD_5) Digester System is a small-scale, modular, on-site waste management system that has been specifically designed to meet the needs of commercial waste producers. Applications include universities, shopping centres, military facilities, remote mine sites, zoos, amusement parks, small farms, and small food and beverage factories.

With a waste throughput of 200–500 t/year, the system uses dry anaerobic digestion/aerobic composting technology to produce biogas, biogas and compost, and compost.

The 20 x 20 m modular plug-and-play solution is easy to expand with the capability for two to eight modules. The unit is configurable in multiple ways to meet users' requirements and it has an optional compost module for digestate treatment (pending confirmation of EOW requirements).

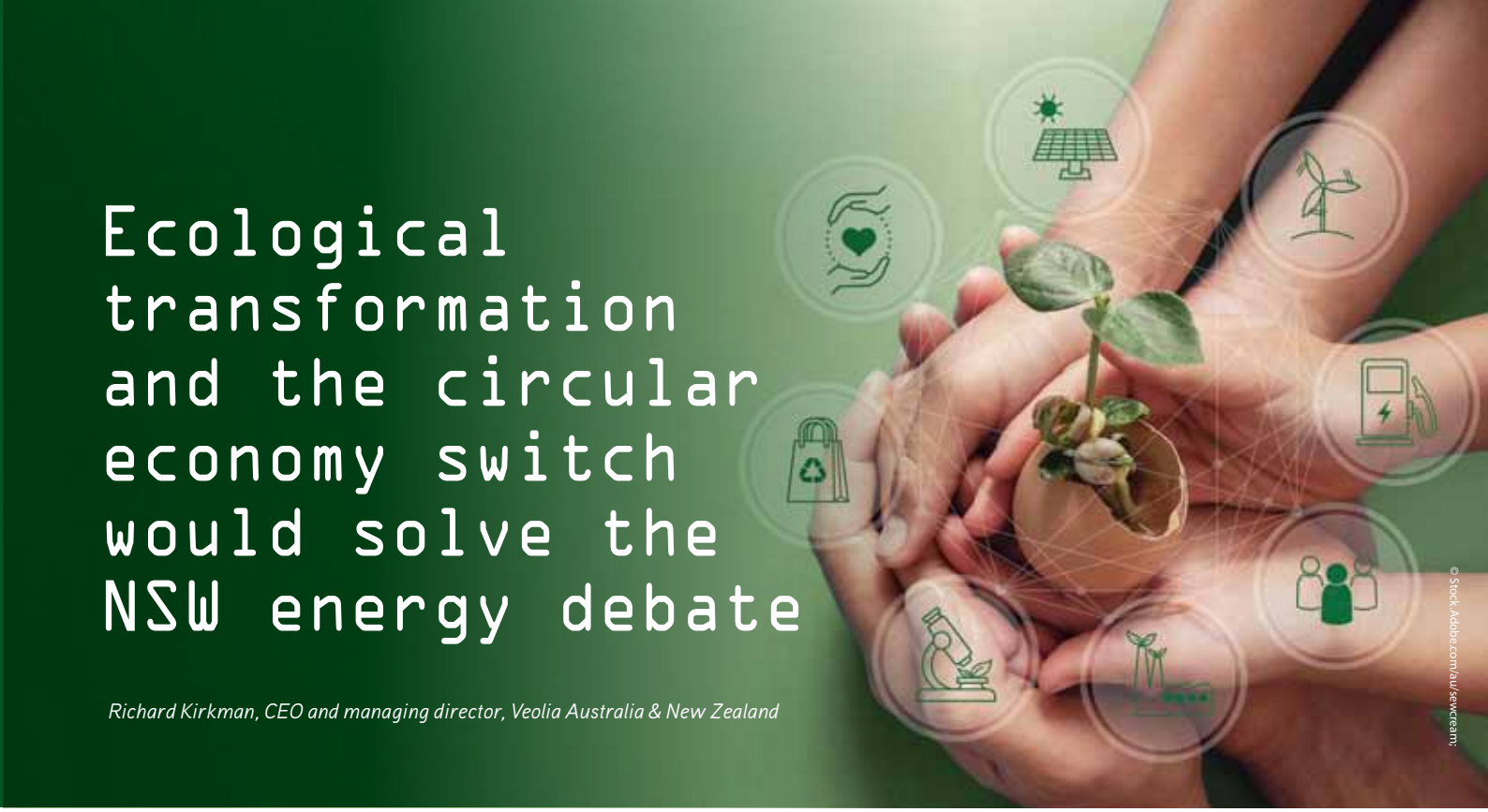
Features include: empowers businesses to divert organic waste from landfill; transforms organic waste into energy; produces a fertiliser substitute; the CHP (combined heat + power) generator has the capacity to generate electricity + hot water; and integrated SCADA system control panel for automated operating and data collection.

Suitable for vegetable and fruit scraps, bread, rice, grains, egg shells, paper/cardboard, cooked meat, newspaper, small cooked bones, coffee grounds, and hair and nail clippings, the system is compliant with all Australian standards.

The product is expected to be launched by early 2023.

Finn Biogas Pty Ltd
finnbiogas.com

Ecological transformation and the circular economy switch would solve the NSW energy debate



Richard Kirkman, CEO and managing director, Veolia Australia & New Zealand

Unlike most major challenges faced by modern society, I believe there is a silver bullet for the NSW energy crisis that maintains consumer affordability and protects the environment.

Providing more than 10% of Australia's energy production from new shovel-ready bio-renewables would create the additional network capacity needed to avoid brownouts and blackouts, prevent price disturbances caused by energy shortages, and provide the energy volume needed for more electric vehicles.

A combination of recycling and bioenergy technologies would also increase the grid mix of renewables and put more people in sustainable jobs.

Producing energy from new renewable sources like energy recovery facilities, anaerobic digestion, sewage sludge and biomass is the answer.

The real butter in the parsnips here is that we don't need to wait to implement them because these low-carbon solutions already exist and are proven to be safe. All we need to do is execute at pace and scale, from a range of available sources.

What's more, as energy is generated from renewable sources such as sewage sludge, food waste, biomass residues and non-recyclable waste, it's a better outcome for the environment on all fronts.

Veolia is obsessed with the dynamic we call ecological transformation, a way to adapt to climate change pressures whilst maintaining quality of life, the natural environment and wealth of citizens. A concrete example is food waste into renewable energy. If we all reduce, separate and collect food waste it becomes cost neutral and highly environmentally beneficial.

The move wouldn't just be more sustainable. Alongside traditional renewable technologies, such as solar, wind and hydropower, it can harness a triple bottom line effect, solving climate change, the energy resilience crisis and price in one big bang.

Renewables are cost effective, especially as Australia's unique climate of sun, wind, forestry and access to bodies of excess water make the perfect recipe for successful adoption. This is the future resource rush for Australia, harnessing natural resources whilst preserving them at the same time.

There is no reason why Australia can't be the world leader in a new portfolio of renewable energy production, relying on non-recyclable wastes, waste food, sewage and renewable biogas.

The net zero roadmap

Switching to 10% novel renewables is no mean feat, but there are some quick wins that Australia could implement to reach the goal more quickly:

- Fast-tracking plans to deliver food and garden organics recycling for all households.
- Producing energy from sewage sludge, an everlasting supply of energy.
- Generating energy from non-recyclable wastes, replacing fossil fuels and producing green energy for electric vehicles.
- Recycling, renewing and replenishing natural resources, which will reduce consumption of energy.
- Energy efficiency using AI and machine learning to optimise use in buildings.
- Installing passive and active CO_2 reduction in new buildings and materials. Veolia is considering how to install synthetic trees on all its sites to suck in CO_2 and clean the air.

The roadmap can be crystallised as moving to a circular economy in water, waste and energy, in line with government policy.

Now is the time for business and industry to take advantage of this opportunity.

Making this shift would enable people to continue to live as they do, but more sustainably. Australia can continue mining, manufacturing and managing its economy for the betterment and wealth of citizens, as well as the natural environment. This would allow us and our children to enjoy the Australian lifestyle we have today for generations to come.

Ecological transformation of energy would drive us closer to the government's 43% emission reduction targets by 2030.

Veolia Australia and New Zealand

www.veolia.com.au

Lighting up water treatment in Happy Valley

Operating for more than six months, Xylem's ultraviolet disinfection system has kept pathogens at bay to protect the supply of safe, clean drinking water for nearly half a million South Australians.

Commissioned in December 2021, the system was retrofitted to SA Water's Happy Valley Water Treatment Plant as part of a $26 million upgrade to ensure the utility's continued compliance with Australia's world-leading drinking water standards, while enabling community access to green open spaces.

Four reactors with a combined 624 ultraviolet (UV) lamps enable the system to treat up to 600 ML of water each day instantaneously — designed with additional treatment capacity to maintain network flexibility and support demand changes.

SA Water's Senior Manager of Capital Delivery Peter Seltsikas said secondary disinfection with ultraviolet light provides an additional layer of water quality protection against potentially harmful pathogens.

"Our new UV disinfection system at Happy Valley is another line of defence protecting the quality and safety of our largest drinking water supply to metropolitan Adelaide, while enabling kayaking and fishing at the adjoining reservoir," Seltsikas said.

"Pathogens come in a range of forms and can be found naturally in water sources. The catchment area that supplies Happy Valley Reservoir, via Mount Bold Reservoir, is significant and covers the Mount Lofty Ranges.

"From a water quality perspective, this particular catchment is challenging given the presence of agriculture, so there's an ever-present risk of pathogens, such as cryptosporidium, finding their way into our reservoirs.

"To manage these risks, our Happy Valley Water Treatment Plant adopts a series of conventional treatment processes including coagulation, flocculation and filtration to trap and remove dissolved organic matter or other solid particles.

"Disinfection of the water with chlorine occurs after filtration, to destroy any microorganisms that may not have been captured, however cryptosporidium can be resistant to chlorine and evade treatment.

"When pathogens like cryptosporidium and giardia are exposed to and absorb the high-powered ultraviolet light, it destroys their structures and inactivates the microorganisms' cellular function.

"Each reactor has 13 independent rows of 12 UV lamps, which are automatically operated and are capable of turning themselves off based on the instantaneous treated flow and incoming water quality.

"The lamps are powered by the latest electronic ballast technology — regulating the lamps' output from 50 to 100% — and harness a sophisticated UV intensity sensor that significantly reduces energy consumption.

"These two features make it one of the most energy-efficient UV systems, and when combined with our solar array at Happy Valley capable of producing more than 17,000 megawatt hours of energy per year to help power the wider plant, ensures we're meeting the system's energy demands and operating it sustainably."

More than 200 people worked on the project across SA Water and its construction partner, John Holland Guidera O'Connor joint venture, with 60 full-time employees working onsite at the height of construction.

SA Water

www.sawater.com.au

Using waste as a renewable energy source

Jemena is working with Sydney Water and Eneraque to upgrade a wastewater treatment plant so that it can convert wastewater into usable gas.

The $16 million biomethane project will be located at Sydney Water's Malabar Wastewater Treatment Plant, in South Sydney. The project is co-funded by the federal government through the Australian Renewable Energy Agency (ARENA). It will use biomethane upgraders to remove water, carbon dioxide, other gases and contaminants from wastewater to produce renewable biomethane. This will then be used in the local gas network. Eneraque will be fabricating the upgraders, which use a number of processes for the conversion process such as dehumidification, activated carbon filters and compression.

"Fabricating the upgrader package in Australia is a great step towards helping to build a new design and manufacturing industry which will support our renewable energy transition," said Gabrielle Sycamore, Jemena's General Manager of Renewable Gas.

"We're excited about the potential for bioenergy and biofuels to help decarbonise sectors of our economy, like manufacturing, which rely on gas as a feedstock, as well as provide renewable gas for customers to use at home.

"Biomethane production is a great example of creating a circular economy — it keeps products and materials in use, reducing the production of new waste and pollution, and regenerating natural systems."

The project will remove 5000 tonnes of carbon emissions, which is equivalent to taking 4500 cars off the road, and if scaled up to its full potential could remove a further 6000 tonnes. The facility is expected to be running and injecting biomethane into the Sydney gas network before the end of the year.

Jemena

www.jemena.com.au

Using green infrastructure to fight extreme weather

South East Queensland water management company Urban Utilities has announced that it will invest over $65 million in a project to reduce the impacts of extreme weather on the wastewater network in the Northgate and Banyo areas.

The project will begin construction in July. As part of the Cannery Creek Upgrade, a new wetland will be created that filters and controls wet weather flows from the wastewater network, which can be affected by the rainy weather in the area, thus protecting nearby properties and introducing liveability and environmental benefits.

The project was shaped through collaboration between local residents, with a group of 23 local parties in a Community Planning Team (CPT) helping to develop community, environmental and operational outcomes.

Urban Utilities Executive Leader Integrated Solutions Chris Bulloch said that the upgrade's use of green engineering was useful to manage the sub-tropical region's intense rain.

"Northgate and Banyo are low-lying areas of Brisbane, which means the local wastewater network can become inundated with stormwater during extreme weather, causing wet weather overflows which can sometimes impact private properties," Bulloch said.

"While this part of our network has capacity to cater for growth, the impact of climate change means we're likely to experience more frequent and intense rainfall, so we need to think innovatively about how we deal with water management.

"Urban Utilities is committed to working with our customers and communities to help create solutions that not only manage water sustainably, but add value to our city and its communities. By working with the local residents, we've come up with an approach that is better for the community and environment, and is more cost-effective than traditional engineering solutions."

The project will use a mix of green and traditional infrastructure including a wet weather pump station, and a 2 km pipeline that will divert flows to the new wetland and away from private properties.

"During wet weather, the diluted wastewater will be screened and then diverted along the underground pipeline to a new wetland and bioretention basins, which will act like nature's filter, trapping sediment and absorbing nutrients," Bulloch said.

"Nearby, Cannery Creek is fed by stormwater and we'll rehabilitate it by creating a series of sediment basins to manage and filter flows, to protect downstream waterways and Moreton Bay from the impacts of soil and sediment.

"The design integrates a number of community aspirations including beautifying the creek banks and surrounding area and providing shared paths and seating, to help transform Cannery Creek and provide an area for the community to enjoy."

Bulloch expressed appreciation for the community involvement in the project, with the CPT having shaped the project's plan.

"We formed a Community Planning Team in 2019 which saw residents collaborate with planners and engineers and they considered a number of options over many workshops and site visits. The community-led design process played a key role in the final concept for the project and we'll continue to keep the CPT updated as the project progresses.

"We'd also like to thank Brisbane City Council, the Queensland Government and the many other agencies and organisations which have been engaged and contributed to this project so far."

The project is being delivered with Urban Utilities' partner Fulton Hogan, and construction is expected to be completed in 2024.

More information about the project is available online: urbanutilities.com.au/cannerycreek.

Urban Utilities

www.urbanutilities.com.au

Safer solid-state batteries may be on the horizon

A team of scientists from Australia and America have developed a non-flammable electrolyte material for sodium batteries, which are claimed to be safer and cheaper than their lithium-ion brethren.

Liquid electrolytes currently used in lithium and sodium batteries can be flammable if exposed to particular conditions. Therefore, they can pose a safety risk for applications such as in electric vehicles.

Now, a team of researchers from Deakin University's Institute for Frontier Materials has been working on a solid polymer electrolyte material that replaces the flammable solvents. These developments may serve as a pathway towards a safer form of battery.

An important component in the electrolyte was developed by Dr Cheng Zhang and Professor Andrew K Whittaker from the University of Queensland's Australian Institute for Bioengineering and Nanotechnology. Researchers from the University of Illinois Chicago and the University of California Santa Barbara also contributed to the research.

"Most industries that develop sodium batteries generally use carbon-based electrode and liquid electrolyte, which has low capacity and also can fuel a fire if the battery overheats," said Dr Xiaoen Wang, who is leading the research.

"We are taking a different approach, using reactive sodium metal as an anode to increase battery capacity and in the process are developing safer electrolytes to ensure the safety of sodium batteries."

The researchers have stated that this is the first time that a fluorine-containing polymer has been used in solid-state sodium batteries before, with its use allowing them to be solvent-free and therefore less likely to be set alight spontaneously.

Additionally, one particular advantage of sodium batteries is that they have a low production cost, with sodium being plentiful and cheap.

"As lithium could become a rare commodity, the price of lithium batteries is high, while on the other hand, sodium resources are more abundant," Wang said. "Our polymer will support the use of sodium batteries, which are low-cost when compared to lithium batteries."

The use of the electrolyte material is helping to counteract another problem of sodium-based batteries, which is their reduced lifespan and lower energy density; by adopting it the scientists have found that their batteries have been able to reach 1000 cycles, which is comparable to a lithium battery.

Having done small-scale testing, the researchers are continuing their research, and larger models and prototypes will be moved ahead with soon. They are also hoping to utilise the batteries in solar energy storage or for electric cars in the future.

The full paper describing the electrolyte material is available from the journal *Nature Materials*.

Deakin University

www.deakin.edu.au

What does ESG and urban growth mean for waste operators?

*Alex Zamudio**

How waste management operators are building trust and renewing their social licence to operate as residential areas encroach and the spectre of land conflicts arises.

The world's megacities are expanding. Urbanisation is engulfing city fringes with challenging urban planning decisions made years or decades ago, and landfill operators are bearing much of the brunt.

According to the UN, the proportion of the global urban population is expected to rise from 46.6% in 2000 to 58.2% in 2025 and 66.4% by 2050.

Impact on urban livability

New arrivals to the city fringes come chasing open spaces and livability, but their moves are bringing them in closer contact with waste management sites, and this is increasingly a cause of community conflict.

Environmental impact from waste management sites affects urban livability. It's the reason for a large number of complaints made to environmental authorities and 'ill will' in communities, with landfills often listed as the top source.

Even one complaint directed at a site can lead to significant issues for operators; however, sites with odour issues can generate hundreds of complaints a month. These complaints are often supported by a range of external data, from odour diaries and sniff tests to formal air quality monitoring systems set up by investigators.

Communities are increasingly impatient about slow and indecisive responses to odour complaints, so it is more important than ever that operators minimise uncertainty and reduce the time between a problem occurring and a solution being actioned.

Air quality and odour emissions are still a challenge for waste management operators today despite a wide range of abatement options. Lack of knowledge on when to engage critical controls can lead to impacts on nearby communities, which creates costly investigations and disruptions from lawsuits and fines. Outside factors such as meteorological conditions play a part in management approaches, and need to be modelled with internal data to make abatement and control measures effective.

Data-driven approaches pay off

Employing environmental modelling capabilities and effective odour management best practice solutions is critical to avoiding negative attention and fines. But more importantly, at a time of heightened awareness and sensitivity to climate and sustainability, it is about demonstrating a commitment to social and environmental responsibility, and to keeping communities onside.

People are decentralising, environmental justice laws are passing and landfills are becoming part of the city's sprawl

As the nature of work changes, people are expanding their horizons. Where they once lived close to a physical workplace, they can now live much further away from the city centre where there's more space. As outer-metropolitan perimeters are extended, residential populations are brought into closer proximity to previously isolated waste and industrial facilities. Once in the middle of nowhere, more landfills now have residential premises near their boundaries, and some will eventually be ringed by new developments. As communities form, they have high expectations of their neighbours.

The passing of environmental justice (EJ) laws both in the United States and in other countries also brings increased oversight on existing industrial facilities in locations identified as 'overburdened communities'.

EJ laws can subject facilities to closures or even permit denials if they are found to be

producing negative impacts to human health and the environment. For waste operations, this can be focused on operational odours and community complaints.

Some landfills are already on borrowed time

Residential areas are encroaching landfill sites decades after these facilities were approved. Original permits were granted and conditions set based on minimal residential growth in the area. Permits vary between jurisdictions, states or countries; were designed for a point-in-time policy position; and are often pegged to minimum regulated environmental standards. But the world has changed since these permits were issued. Expanding existing facilities or building new ones requires much higher standards to be met. As communities draw near, they bring quality-of-life expectations with them. Legacy permit holders are under community pressure to modernise.

Outside pressure is building

External researchers are also pouring into the space to pore over these issues. A recent study from Canada found locations for waste transfer stations are sensitive to increased population density.

Researchers are using geographic information system (GIS), census and satellite data to assess the suitability of locations for solid waste management. Operators are countering with their own use of environmental intelligence and — in some cases — 'digital twins' of their environments for scenario modelling.

Air quality concerns are mainstream

Smoke from forest fires in Australia and North America; 'yellow sand' in East Asia; harmful levels of air pollution in Europe — have made air quality a concern for citizens globally. Weather forecasts in many parts of the world show air quality index measures. Government authorities also offer their own measurements and historical data.

As city sprawl envelopes waste management centres and industrial sites, the latter's influence on local air quality faces increased scrutiny. In the middle of nowhere, without a community nearby, there's less pressure to address temporary elevated odour levels. Newfound proximity to communities means change is necessary to avoid a collision course with community.

This won't be like other times that residents came into contact with landfills.

Residential encroachment of landfill has been an issue since at least the 1970s. Not all communities historically reported ill-effects while from close proximity, though it's clear the experience is far from uniform. As one resident in 1977 said: "I never thought anything about what they do with garbage before I moved here. Now I think I've learned more about it than anyone would ever want to know."

Fifty years on, the situation is far different. Prospective residents can research suburbs on the internet and instantly find rankings, positives, negatives and reviews. The existence and location of any landfill is no secret, nor is its track record on odour control and addressing local complaints.

Rewriting the rules for co-existence

Innovative recycling programs and technologies are helping increase profitability of waste sites while extending their operational life. 'Circular economies' are now at the centre of most waste management programs.

However, the truth is that waste management remains a critical service for communities to function. Communities are redefining their relationship with waste. There's a greater awareness for how much waste individuals produce, and how much of it is — or can be — diverted from landfill to recycling or reuse. This is coming in part due to concerns with climate and the environment, and also in part with the practical realities of city life. Residents may live close to a landfill, or more likely close to a waste transfer station. Communities and waste facilities must co-exist, with an appropriate set of ground rules.

A virtuous circle of harmony

For progress to occur in this space, the needs of three different sets of stakeholders — communities, industrial operators and regulators — must be met. If a community is happy, they won't pressure operators to change or regulators to intervene. Operators are happy because they can manage environmental expectations themselves without regulatory involvement, and regulators are happy because the industry is self-regulating and no complex intervention is required. That clearly is not the case now, where landfill operators may face rising complaint numbers, rezoning rules that impact future expansion, and community pressure to modernise their operations. How we bridge to that ideal world where all parties are happy is a challenge now confronting all of us.

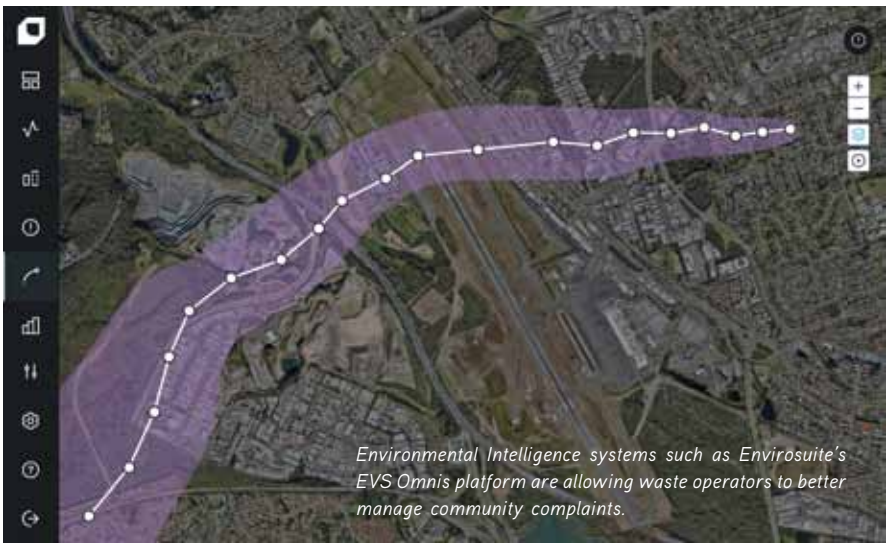
(Re)building trust

Regulators, communities and industry need to be able to trust each other that they are doing the best they can for the benefit and in the best interests of everybody. That requires an open conversation and an end to negative actions. Communities lose faith in operators that are perceived to care only about money, and not about community safety or environmental concerns. Likewise, communities can erode trust by suing industrial facilities and calling in regulators prematurely, without providing an opportunity for open discussion or for grievances to be addressed. If everyone starts trusting each other, then they can move forward and address the root cause of any issues.

Engage the community

Communities know they need to become a more constructive part of the solution, and we are starting to see this take shape. In California, Assembly Bill 617 and actions stemming from it — like the community air protection program or CAPP — aim to give communities the opportunity to help improve air quality in a given area. Expect to see this concept spread to forward-facing communities worldwide. Communities that have a voice, an open opportunity to engage with a waste facility operator and the ability to suggest actions or influence operations are more likely to accept the facility's ongoing presence. They are also less likely to lodge complaints with authorities, since they can be confident of gaining a direct audience with the operator, with a high likelihood of open dialogue and positive action or redress. By collaboratively meeting the unwritten set of expectations that communities have of industrial facilities in their midst, operators are underwriting their social licence to operate (SLO). Expect concepts like CAPP to become a model for more aligned operator community engagement worldwide.

Envirosuite provides environmental intelligence tools that enables operators to comply with permitted conditions, optimise odour mitigations.


Environmental Intelligence systems such as Envirosuite's EVS Omnis platform are allowing waste operators to better manage community complaints.

ESG encourages performance above minimum levels

2020 was "a watershed year" for environmental, social and governance (ESG) disclosures by businesses, but the broad consensus is more can be done to demonstrate commitment to the cause. ESG puts a company's sustainability credentials on show. It drives companies to do more than the minimum when it comes to meeting the environmental conditions of their permits. When companies do more and publicise it, regulators are able to observe and take notes on where industry leaders are headed. This is reflected in revised permit requirements, raising the standards of the entire sector.

Tech mitigation has come in leaps and bounds

Over the past five years we've seen a significant change in the technologies available for odour detection. Only a decade ago, odour detection and management required specialist precise equipment. Now, operators can use small, cheap sensors and low-power communications for the same purpose. Data collected from these devices can be transmitted to a central point and run through environmental intelligence platforms to identify patterns and uncover insights that can inform interventions, such as misting controls, covers, methane management and other onsite mitigation techniques.

Bringing it all together

Sustainable landfill operations stand on three pillars — environmental compliance, optimisation and community engagement. As cities sprawl and communities come into closer proximity with waste sites, sustainable operations have never been more critical.

Envirosuite provides environmental intelligence tools that enable operators to comply with permitted conditions, optimise odour mitigations and hold conversations with government agencies and communities that build and engender trust in the handling of environmental concerns.

Learn more about how to simplify and improve community engagement and reporting at your facility: https://envirosuite.com/industries/waste-management

Alex Zamudio, Environmental Intelligence Advisor, is Envirosuite's leading Advisor in the Eastern USA region, helping organisations in waste, wastewater and industrial operations transform their business and increase value-creation across the board through environmental intelligence. Alex has over 15 years of experience helping clients succeed through digital transformation and continues to drive Envirosuite's growth in the region by providing operators with intelligent tools that help them maintain their social licence and increase operational efficiencies.

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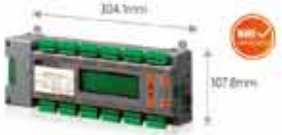

MODEL	EM133XM	BFM136	BFM-II
INSTALLATION TYPE	SMALL	MEDIUM	LARGE
*ELECTRICITIES Tenants	Up to 3	Up to 36	Up to 54
UTILITIES Water, Gas	Up to 14	*Up to 72 With BFM utility module	Up to 72

THERMAL FLOW METERS FOR HYDROGEN MEASUREMENT

The ST Series Thermal Flow Meters from Fluid Components International are precision hydrogen-calibrated for engineers and plant operators responsible for producing, using, dispensing or distributing hydrogen gas. The products suit many pipe diameters and installation conditions, and require minimal routine maintenance.

Hydrogen is receiving global attention as a renewable energy fuel resource. Production processes from fossil sources, biomass and waste and H_2O-splitting are capturing attention as brown, green, grey and blue alternative fuels. Hydrogen is also a key gas used in ammonia manufacturing for the agricultural chemicals industry, methanol production and other processes. Accurate, repeatable and reliable flow meters are an important component in the processes.

Hydrogen-calibrated thermal mass flow meters are suited to meet the conditions of these applications, working based on the principles of heat transfer. H_2 has a very high heat transfer rate and to measure it with high accuracy and repeatability, a thermal flow meter should be calibrated in actual H_2. Applying theoretical gas equivalency equations to correct real-world readings for H_2 is ineffective for this gas.

The products in this range are calibrated under customer installation conditions with actual hydrogen to achieve accuracy and repeatability. They are direct mass flow measuring and are multivariable, providing both flow and temperature outputs. Since there are no moving parts, wear, breakage and maintenance is also reduced. The range has a selection of process connections, including compression fittings, NPT male and female threaded connections, flanges, ball valves, hot taps and more to ensure installation site compatibility.

The range offers solutions from small, compact meters with basic 4–20 mA analog output to feature-enhanced versions with multiple 4–20 mA outputs, digital bus communications such as HART, Modbus, Foundation Fieldbus, and Profibus, in-situ calibration, self-checks and on-board data logging.

The flow meters carry approvals for installation in Div.1/Zone 1 environments, and offer superior ruggedness and long-life with NEMA 4X/IP67-rated low-copper content aluminium or 316 stainless steel enclosures.

Standard turndowns of 100:1 and flow ranges from 0.07 to 305 NMPS make them versatile. The transmitter/electronics can be integrally mounted with the flow body or may be remote-mounted to 305 m away. They are available in either DC- or AC-powered versions and their readout/display options include basic flow rate, totaliser, digital/graphic backlighted LCD and a through-the-glass activated 4-button array.

In hydrogen applications with limited straight-runs or for operating in transitional flow ranges that can adversely affect accuracy and repeatability, the flow meters are also optionally available with and calibration-matched to appropriate flow conditioners to ensure performance.

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

PFAS REMEDIATION TECHNOLOGY

EPOC Enviro (a subsidiary of Australian company OPEC Systems) has announced that its Surface Active Foam Fractionation (SAFF) PFAS remediation technology is able to remove almost all short-chain PFAS compounds from contaminated water, as well as long-chain PFAS compounds.

The solution uses air bubbles to remove PFAS down to C4, providing a sustainable PFAS remediation without the use of adsorbents, which require ongoing replacement and additional waste management.

Up until recently, the primary focus for remediators has been to remove long-chain PFAS compounds, but as the global regulatory environment has become more stringent with concerns around their long-term toxicity and mobility, there has been an expanded focus on also removing short-chain PFAS contaminants.

SAFF represents a sustainably engineered approach to PFAS remediation, where a combination of aeration and vacuum is used to rapidly 'foam out' >99 per cent of target long-chain PFAS molecules and now a significant majority of short-chain PFAS, enabling treated water to be safely returned to the environment.

The solution is designed to exploit the natural properties of PFAS compounds to preferentially bind to the air/water interface of a swarm of rising air bubbles. Once on the surface, the compounds are harvested as a waste froth/foam for permanent destruction using readily available partner technologies.

Short-chain PFAS removal is achieved by a combination of enhancements to the SAFF including manipulation of a PFAS compound's position on the adsorptive isotherm, vessel geometry and sequencing adjustments, and, where required, the addition of specific amendments.

OPEC Systems
www.opecsystems.com

REVERSE LOGISTICS: SOLUTIONS FOR END-OF-LIFE PRODUCTS

Ecycle Solutions leads the way in innovative recycling solutions for Expanded Polystyrene (EPS) waste, battery recycling and e-waste in Australia, providing the general public and small business' with a FREE collection & recycling solution for their end-of-life televisions and computers (e-waste) as part of the National Television and Computer Recycling Scheme (NTCRS), whilst recycling non-contaminated EPS and end-of-life batteries.

As Australia's largest NTCRS Co-Regulator, Ecycle Solutions offers the general public and small business' an avenue to recycle their end-of-life products through its 300+ permanent collection locations, which resulted in over 16,900 tonnes of e-waste being recycled in 2020/2021. This recycled e-waste has helped to achieve a recovery of more than 90% of reusable materials, equating to 16,300 tonnes being utilised as raw material to manufacture finished goods.

Ecycle Solutions is passionate about improving Australia's environmental footprint offering a free e-waste collection service. Partnering with some of Australia's largest electrical retailers, such as Harvey Norman, Betta Home & Living, Good Guys and JB Hi-Fi, it offers an extensive network of easily accessible drop off locations for the disposal of e-waste without any commitment to purchase in store.

All brands and models of compliant e-waste are accepted as part of the program, such as TVs, computers, laptops, printers, hard drives, keyboards & computer peripherals, and working closely with certified recyclers, all collected items are destroyed responsibly and securely, ensuring consumer confidence.

Since its inception in 2012 Ecycle Solutions has grown and increased its recycling service to include expanded polystyrene (EPS), and as of January this year, now includes the collection of end-of-life batteries.

EPS packaging is a lightweight, rigid, cost-effective packaging solution that can take in excess of 700 years to break down. As Australia's largest recycler of EPS, Ecycle Solutions is a 'one stop shop' for the collection and recycling of EPS.

Through hot press extrusion, the collected EPS is recycled and then repurposed into a range of household items such as outdoor furniture, picture frames, skirting boards, just to name a few. Annually, Ecycle Solutions collects and recycles enough EPS to fill the Sydney Cricket Ground, diverting this waste stream from landfill.

In January 2022 Ecycle Solutions was appointed as an Accredited collector for the Battery Stewardship Scheme (B-cycle). The Battery Stewardship is an industry-led initiative providing a free battery collection and recycling service to all Australians.

Australia imports approximately 17,500 tonnes of batteries every year with less than 10% of household batteries currently being recycled, where most end up in landfill. The Battery Stewardship Scheme is focused on reducing the number of batteries that go into landfill, by recycling and repurposing the reusable materials, and ultimately reducing the reliance on non-renewable resources.

Working together with Lions Australia, Ecycle Solutions will facilitate the collection of household batteries from all 1200 Lions Clubs nationally. The rebate received by Lions as part of the B-cycle scheme will be used to fund local community projects.

Ecycle Solutions is excited to extend their recycling services to include the collection of batteries and provide the public with another avenue to recycle end-of-life products into reusable materials and reduce the use of non-renewable resources.

As a wholly owned subsidiary of the QLS Group, Ecycle Solutions has a unique competitive advantage through utilising reverse logistics when it comes to recycling, whereby we can service Regional & Remote locations better than our competitors.

To find out more about Ecycle Solutions' recycling solution contact Chris Tangey, General Manager on +61 419 510 596.

Ecycle Solutions
www.ecyclesolutions.net.au

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Ewaste & Polystyrene Recycling
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All-Energy Australia returns to Melbourne

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All-Energy Australia

- 26–27 October 2022
- Melbourne Convention and Exhibition Centre
- www.all-energy.com.au

After the Renewable Energy Target was abolished back in 2015, there were serious doubts about whether the industry would survive let alone transform into the multibillion-dollar industry as we see it today. Within just six years, Australia has made active steps to becoming a global clean energy export superpower, signalling the inevitability of a clean energy future.

The Australian renewable energy industry generated and accounted for 32.5% of the nation's total electricity in 2021, continuing to break records backed by an impressive project tracker including various solar and wind initiatives that are currently under construction. Though our clean energy future has never looked brighter, there are still a number of challenges to address and overcome in the coming years.

With this topic in the crosshairs, All-Energy Australia is returning bigger and better than ever to Melbourne in October, shining a light on the nation's roadmap to a clean energy future and offering a networking opportunity for thousands of industry professionals.

Held in partnership with the Clean Energy Council and co-located with Waste Expo Australia, this free-to-attend exhibition and conference is where renewable energy professionals can get exclusive access to the latest technologies and trends. This year's program will host an impressive list of speakers discussing the latest in solar energy, energy storage, hydrogen energy, electric vehicles and bioenergy, alongside an expo floor with over 250 suppliers including the likes of GoodWe, Growatt, Nextracker and Sungrow.

Registrations for All-Energy Australia are now open, with the event set to take place at the Melbourne Convention and Exhibition Centre (MCEC) from 26–27 October 2022. VIP passes will be available for purchase, which includes access to video recordings of sessions in the plenary hall, speaker-approved PDF files of All-Energy Australia and Waste Expo Australia presentations and catering.

Reed Exhibitions

www.reedexhibitions.com.au

GOLD-PLATED DIAPHRAGM HYDROGEN PRESSURE SENSOR

Pressure transmitters from KELLER-Druck are designed with oil-based piezoresistive technology. This technology offers zero-point stability with high measurement sensitivity. The original stainless-steel diaphragm is modified with a gold-plated diaphragm to suit hydrogen pressure measurement applications. The modification is made to slow the hydrogen penetration rate, which may produce inaccurate measurement and potentially damage the sensors.

The parts of the transmitters that come in contact with the diaphragm are designed with elastomer-free materials, fully welded and metallically sealed to prevent the ingress of hydrogen. This also allows the users to clean the sensors with an oil- and grease-free solution regularly to prevent contamination of the hydrogen systems. All the hydrogen pressure sensors are made with intrinsically safe design for precaution as hydrogen is flammable and explosive.

These custom-designed, gold-plated diaphragm pressure transmitters can be used for pressure measurement of up to 1000 bar with a high level of measurement accuracy. They can be made to suit any types of measuring requirements depending on the application, encompassing measurement of low or high pressure outside of the standard measuring range.

Bestech Australia Pty Ltd
www.bestech.com.au

VICTORIAN CIRCULAR PLASTICS FACILITIES ENGAGE AEROFLOAT FOR WASTEWATER TREATMENT

Award-winning wastewater company Aerofloat is rising to prominence in the circular economy space. Its innovative wastewater technology for the plastics recycling industry is recognised by Pact Group for keeping pace with the rapidly growing industry.

Pact Group promises to create smarter ways of reducing waste through reusing and recycling resources. Its plastics recycling facility in Albury New South Wales demonstrates exactly how the circular economy should be working. The plant was a joint venture between Pact Group, Asahi Beverages, Coca-Cola Europacific Partners and Cleanaway Waste Management, with Aerofloat providing the wastewater design and technology.

Pact Group continues to prove its place as leaders of creating a circular economy through expansion into multiple ventures, including two upcoming Circular Plastics projects in Victoria. Following the success of the Circular Plastics facility in Albury, Aerofloat has been contracted to work with Pact Group on the two new Circular Plastics projects.

Circular Plastics (PET) Altona North is a new processing facility that is similar to the Albury facility. It will recycle the equivalent of approximately 1 billion 600 mL PET plastic bottles each year. Circular Plastics (PE) Laverton will process more than 20,000 tonnes of HDPE and PP (or the equivalent of over half a billion plastic milk bottles and food tubs) into food-grade recycled resins.

"Aerofloat's experience in advanced wastewater technology for Pact Group will ensure efficient and effective operations for both projects," said Aerofloat's general manager, Michael Anderson.

"Our knowledge in developing definitive designs to support production at the wastewater end is unique. We expect these two projects to be fast-paced given our experience in designing the ideal technology," he added.

Understanding the intricate details of the Circular Plastics sites and operations will also ensure a fast turnaround on the new projects.

"We understand the expectations and needs for Pact Group and its joint partners for these projects. This will hold us in good stead to get both plants installed and operational on schedule."

Paul Miskell, general manager for Pact Group, and site manager of operations at the Albury Circular Plastics Australia facility, is impressed with Aerofloat's expertise in providing advanced design technology for the Albury plant.

"Aerofloat have been very professional and have delivered exactly what we ordered for the Albury project. The proof being that we have lined up Aerofloat for future projects with the joint venture," said Miskell.

Aerofloat's technology has ensured compliant, efficient wastewater operations for Circular Plastics (PET) Albury.

Pact Group sees a circular economy as a systemic approach to economic development with benefits to a widespread community as well as the environment. The PET recycling plant at Albury has been operational since early 2022, and has already had a significant impact on the circular economy.

Working with Aerofloat to achieve its vision for creating a Circular Economy on the Laverton and Altona North projects was an obvious move for Pact Group.

"This is a once in a lifetime opportunity for companies like us where we have to solve for our own waste generation," said Miskell.

Just as Aerofloat was involved from the very beginning of the Albury project, it is already working alongside Pact Group from the start with the new Victorian projects.

"Aerofloat offered a professional process of engaging Council to deliver a Trade Waste agreement for our Albury facility that we have been able to achieve successfully," said Miskell.

"We look forward to working with Pact Group and its partners to ensure success at both Laverton and Altona North, helping Australia to move closer to that Circular Economy," said Anderson.

To find out more about Aerofloat's work in the recycling industry visit www.aerofloat.com.au.

Aerofloat
WASTEWATER TREATMENT SPECIALISTS

Aerofloat (Australia) Pty Ltd
www.aerofloat.com.au

Making plastic from garbage

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Researchers from Sweden's Chalmers University of Technology have developed a circular economy technique that sees mixed waste converted into raw carbon atoms to be used in the production of plastic.

Mixed waste usually ends up in landfills or being incinerated. The Swedish scientists were looking to develop a technology that could utilise molecules in plastic, paper, wood and food waste, all of which are full of useful carbon atoms that otherwise go unused.

"There are enough carbon atoms in waste to meet the needs of all global plastic production. Using these atoms, we can decouple new plastic products from the supply of virgin fossil raw materials," said Henrik Thunman, Professor of Energy Technology at Chalmers and one of the authors of the new study.

"If the process is powered by renewable energy, we also get plastic products with more than 95% lower climate impact than those produced today, which effectively means negative emissions for the entire system."

Plastic recycling is generally inefficient and only reclaims a relatively small amount of material for further use. The advanced recycling method proposed by the researchers uses thermochemical technologies and sees waste being heated to 600–800°C to convert it to gas, after which hydrogen is added to subsequently produce plastic.

"The key to more extensive recycling is to look at residual waste in a whole new way: as a raw material full of useful carbon atoms. The waste then acquires value, and you can create economic structures to collect and use the material as a raw material worldwide," said Thunman.

The researchers were inspired by the natural carbon cycle, whereby plants absorb CO_2 for nutrients and then release it back into the atmosphere when they die, where it is used again to grow more plants in the future.

"However, our technology differs from the way it works in nature because we don't have to take the detour via the atmosphere to circulate the carbon in the form of carbon dioxide. All the carbon atoms we need for our plastic production can be found in our waste, and can be recycled using heat and electricity," said Thunman.

The researchers suggest that renewable energy can be used to power this advanced recycling process, which would be more energy efficient that currently used methods for disposing of mixed waste. Unused heat from the process could be harvested for use elsewhere too.

The research was carried out as part of the FUTNERC project, which is helping the chemical industry reduce greenhouse gas emissions. The processes have been tested through collaboration with a plastic manufacturer, Borealis.

"Our goal is to create a circular economy for plastics," said Anders Fröberg, CEO of Borealis. "Our plastic products are key to the transformation to a sustainable society, so it's important for us to support research like this. We already have projects that create circularity for our plastic products, but more solutions are needed. Therefore, we are pleased with these excellent results, which can help bring us a step closer to our goal."

The study describing the technique was published in the *Journal of Cleaner Production*.

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