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WORDS FROM THE EDITOR

After news of a Victorian recycling plant shutdown, recycling being diverted to landfill and stockpiles of recycling being sent back from Indonesia, it appears as though there is a waste crisis in Australia. As a result, many of us are starting to question whether or not it's worth the effort to sort out our recycling. But with the average Australian generating around 2.7 tonnes of waste a year, waste management is everyone's responsibility and the waste industry is definite in its messages to the public that recycling is the right thing to do.

Australia traditionally responds well in a crisis, so now is the time for action. Industry and the general public needs to look at ways to reduce the amount of waste being produced. Government needs to step up to the plate with some serious investment in systems and processes to keep the nation on track with our waste management. This includes consulting with industry to identify suitable technologies and strategies to implement in order to achieve the most sustainable outcomes.

In this issue, we cover the recycling industry response to the crisis as well as some solutions being implemented. As part of its responsibility for the improvement of recycling, ACOR is developing an app to help householders keep their recycling cleaner, and an industry accreditation approach — read more about this on page 14.

This issue also looks at new technologies and products across water, waste and energy, as well as global efforts to create a circular economy.

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Creating a sustainable global circular economy

Jane Allman

How international standardisation will facilitate the shift to a global circular economy.

World economies can no longer ignore the consequences of basing economic growth on material consumption and resource depletion. Every country should be concerned about climate change and the possibility of resource scarcity. But how do organisations go about taking steps in the right direction — towards economic frameworks that are restorative and regenerative?

A newly appointed International Organization for Standardization (ISO) technical committee (TC) aims to make the global circular economy a reality by steering projects towards a sustainable agreed global standard. Known as 'ISO/TC 323 — Circular Economy' the committee will develop requirements, frameworks, guidance and support tools, with the aim of ensuring implementation of the UN Sustainable Development Goals (SDGs). The TC comprises experts from over 65 countries, with Australia sitting as an observer member.

Any organisation, or group of organisations, wishing to implement circular economy projects, for example, commercial organisations, public services and not-for-profit organisations, is welcome to benefit from the deliverables available from ISO.

Committee Chair Catherine Chevauché commented that although many organisations 'do their bit' in terms of recycling or sourcing locally, we are far from a world where the economy is truly circular. "In order to have a new economic model, businesses need a new business model — what has been lacking is a truly global vision of what a circular economy really is and a model that any organisation can adopt."

> **"The global circular economy will be a powerful player in the fight against climate change.**

Establishment of the technical committee

AFNOR, the French national standards body and appointed secretariat of the ISO TC, made the original proposal to ISO for the establishment of a TC to focus on standardisation in the circular economy, recognising the need for a dedicated generic standard involving all countries.

In their proposal to ISO, AFNOR outlined that applying circular economy principles in processes, products and services would enable organisations to optimise resource management and implement new business models to improve resilience to environmental, social and economic challenges.

The standard is based on seven areas of action of the circular economy to create a working roadmap:

- Sustainable procurement
- Eco-design
- Industrial symbiosis/ecology
- Functional economy
- Sustainable consumption
- Extension of service life
- Effective management of materials and products at the end of their life cycle.

Committee targets

A key target for the TC is to develop standards for future management systems and to provide organisations with a clear vision of the circular economy. With this in mind, the ISO/TC 323 aims to lead organisations towards favourable strategic choices.

A set of standards will help organisations integrate new economic models led by the circular economy; facilitate communication between stakeholders via shared dialogue and communication tools; allow sharing of experiences to contribute to a collective, pooled knowledge base; and steer focus towards concrete actions.

Although some international standards related to the circular economy are already in place, the new TC will develop a holistic and international approach for circular economy projects by considering interactions between all the elements contributing to sustainable development. For example, public procurement, production and distribution, resource end of life, as well as areas such as behavioural change and assessment will be addressed.

The circular economy and sustainable development

A circular economy can contribute to the achievement of several SDGs including clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; sustainable cities and communities; responsible consumption and production; and climate action.

In the context of the Paris Agreement on Climate Change and the UN SDGs, economies worldwide must transform existing linear 'make, consume, throw' systems to models that focus on waste reduction, recycling and, where possible, transformation of waste into new products.

The global circular economy will be a powerful player in the fight against climate change, with waste reduction and recycling having the potential to reduce greenhouse gas (GHG) emissions from combustion (CO_2) and decomposition (methane).

Chevauché stressed the urgency to move towards a circular economy in response to the effects of resource and biodiversity depletion, climate change and the growing inequalities across countries related to the world's production and consumption patterns.

"The members of the committee agree that there is a need to act now to develop standards in this area as quickly as possible," she said.

"This is particularly true in developing countries, who have tended to bear the brunt of inequalities of wealth and waste in the developed world."

Improving quality of life with urban resilience

Piet Dircke, Global Leader – Water Management, Arcadis

> **By embracing a resilient approach... business leaders, shareholders and stakeholders can improve not only their bottom lines but also the lives of those in the communities around them.**

From flooding to cybercrime and from earthquakes to terrorism, in today's uncertain world, resilience is more important than ever. Resilience is the ability to overcome shocks and stresses, to cope with uncertainty and to be prepared for whatever challenges the future brings.

In a world that is increasingly urban — with buildings and other assets being operated as part of the inter-related and inter-dependent systems that keep society running smoothly — resilience is an essential quality to have.

Where to start?

I believe city officials, business leaders, investors, transportation and utilities operators and other asset owners should place resilience at the heart of any planning process. But I also know that while many of these decision-makers understand the need to make their assets and cities more resilient, they also struggle to identify concrete steps they can take to do so. In order to get started, they need answers to important questions:

- Where and when should we invest in resilience?
- Where can resilience investments add the most value?
- How can we reap both short- and long-term benefits?
- How can we move from risk identification to starting actionable projects?

Holistic thinking is the key

Resilience is my passion. I've spent my entire career working in cities to make them better equipped to deal with climate change, extreme weather and rising sea levels. Perhaps the most important lesson I've learned in that time is that true resilience comes from connecting the dots in urban environments.

What I mean is this. If a business leader comes to me asking how she can best protect her data centre from the threat of flooding, and ensure business continuity, part of my job is to get her to understand that merely erecting high walls around her offices won't do the trick.

Focusing only on preventing a specific building asset from flooding is unlikely to ensure business continuity, because if disaster strikes, a whole host of issues may well come into play. For instance, if the city is flooded, how will her workers make it into the office? Will the area around her data centre be safe enough for her workers, even if they can travel to the office? Will there be electricity coming to her facility?

In order to achieve the goal of ensuring business continuity, the business leader in this hypothetical will need to engage with all stakeholders (the local government, employees, other business leaders and citizens living near her facility) to make her city resilient. But this is easier said than done.

Moving from strategy to implementation

Although resilience is often framed within the context of disaster or distress, at Arcadis we believe that resilience provides an overwhelmingly positive opportunity for the world. By embracing a resilient approach, national, regional and city administrations can improve quality of life for citizens, while business leaders, shareholders and stakeholders can improve not only their bottom lines but also the lives of those in the communities around them. But the challenges we're facing are only getting bigger and if we don't prepare for what the future holds, we will regret it. The time for action is now, but too few organisations have taken up this call.

In our latest paper, 'The business case for resilience', we examine resilience from the perspective of cities, industries, utility companies and mobility operators. We also delve into digital and financial resilience. Throughout the paper we grapple with the myriad issues that are preventing action and we demonstrate how we help our clients overcome these issues and implement real projects that make a difference.

Ultimately, we are excited by the many opportunities that being resilient brings to improve quality of life and we look forward to exploring these opportunities with you.

For more information, visit: www.arcadis.com/en/global/arcadis-blog/piet-dircke/improving-quality-of-life-with-urban-resilience/

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NZ biorefinery turns e-waste into valuable metal

Mint Innovation has constructed a working biorefinery to demonstrate technology that can recover valuable metals from e-waste. With backing from the New Zealand Government via the Ministry for the Environment's Waste Minimisation Fund, the demo plant will be open to recycling industry stakeholders across the world.

Mint expects to recover about US$10,000 in metals from each tonne of crushed and powdered e-waste supplied by New Zealand's leading IT recycler, Remarkit. Gold, palladium and copper will be the first metals extracted from the e-waste.

Mint Innovation CEO Dr Will Barker said that now the company has scaled to a pre-commercial stage, it is looking for a potential location for the first instalment of its bioprocessing technology.

"The world has an e-waste problem that is compounded by both consumer demand for the latest electronic gadgetry and more countries refusing to import e-waste," he said.

"Approximately 50 million tonnes of e-waste was generated worldwide last year, with the metallic value alone estimated to be close to US$50 billion. This includes US$22 billion in gold, found primarily in circuit boards. That 'urban ore' is attractive feedstock for us.

"The primary advantage of Mint's technology is the scalability — enabling deployment of city-scale plants that can recover value from e-waste in the city of collection."

Mint plans to fund and build its plants in cities and regions such as the Birmingham–Manchester–Liverpool triangle, where annual e-waste streams range from 1000 to 50,000 tonnes.

Recyclers will first sort e-waste into the various value streams and send the circuit board stream direct to a local Mint Innovation plant near them. Mint plans to deal directly with recyclers with transparent payments based on metal value recovered.

"Our world-first biorefinery uses microorganisms to scavenge precious metals from complex waste streams," Dr Barker explained.

"It is cyanide-free and the process streams themselves are recycled, providing an environmentally responsible solution for the particularly noxious waste stream. Residual inert waste from the process is available as an aggregate or filler and any remaining grey water is chemical-free."

NSW EPA boosts circular economy with $7 million in grants

The NSW Environment Protection Authority (EPA) has pledged over $7 million in grants to boost NSW recycling rates and encourage innovation in the waste industry.

EPA Executive Director of Waste Operations and Programs Carmen Dwyer said, "These grants can help reshape our waste and recycling industry in NSW, which is undergoing significant change. Already, previous grant recipients have diverted thousands of tonnes of waste from landfill and are continuing to take major strides forward in reshaping the way we deal with waste. We're seeing crushed glass used to make roads, industrial plastic wrap made into park benches, and broken and discarded furniture made into new office furniture," she said.

Funded through the NSW Government's Waste Less, Recycle More initiative and run by the NSW EPA, the Product Improvement Program and Circulate grants are in place to stimulate local remanufacturing capacity and generate new industries and jobs.

Under the Product Improvement Program, a total of $6.3 million is available via grants of up to $1 million each. This funding aims to fund innovative new recycling solutions via infrastructure or research and development. In 2018, Unilever received $500,000 under the program to install new infrastructure at its North Rocks Factory, allowing a minimum of 25% recycled material to be included in its personal and home care range. In the Riverina region, Lockhart Shire Council has received $221,850 to use crushed glass from its recycling facility in a gravel mix to create local roads.

Circulate grants are awarded to projects that prolong the life of resources or give materials a second life, keeping them out of landfill by their re-use in industrial or construction processes. $1.2 million is available under this program until 2021, with individual grants of up to $150,000 available. Under this program, Cross Connections Consulting received $150,000 to reprocess soft plastic waste from local businesses into park benches, garden beds and fencing. The Winya Indigenous Furniture project received a $75,000 Circulate grant to transform broken and tossed out furniture into new office pieces.

The Product Improvement Program and Circulate grant programs are currently open to applications from businesses, councils and not-for-profit organisations.

For further information, visit www.epa.nsw.gov.au/working-together/grants/.

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A place for waste

The search for a long-term alternative to landfill

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As the nation continues to recognise waste management as an essential provision by local councils, waste processing innovations are emerging and developing rapidly. In planning waste management strategies and infrastructure, it is critical that local governments and relevant stakeholders consult industry to identify opportunities for adoption and regional rollout.

Western Australia's South West Regional Waste Group (SWRWG) has called on the commercial waste management sector to submit proposals on waste management strategies and technologies that will divert the region's waste from landfill. In addition to reducing the volume of waste sent to landfill, the group aims to explore technologies that could turn waste into valuable resources.

Securing feedback from the private sector on how companies can optimise current and future waste market conditions is an important step to inform future decision-making. Local governments are striving to align their waste management approaches with the state government, moving towards a circular economy where waste generated from one business becomes a resource for another business.

Submissions from the commercial waste sector will identify operational and commercial arrangements and will allow the SWRWG to gather technical/technological information associated with market conditions, revenue/cost recovery models and the allocation of risk. The project also aims to define a proposed project's size, capacity and scope, with provision of technical requirements, financial models and potentially a preliminary contract structure. It is hoped that this stage will identify the economies of scale and how best to leverage these for the benefit of regional waste management practices.

In addition to sounding out the waste industry, the SWRWG will review regional waste management practices. This will involve comparing current waste and resource recovery issues against new technologies or management techniques. The capacity of waste management infrastructure will be assessed against demand, and strategies for ongoing waste stream processing will be addressed.

An alternative to landfill

The Kwinana Waste to Energy Project is one example of a landfill-free initiative, currently in progress, that will thermally treat waste to generate about 36 MW of baseload power for export to the grid each year. The ARENA-backed project will use moving grate technology to process approximately 400,000 tonnes of municipal solid waste, commercial and industrial waste and/or pre-sorted construction and demolition waste per annum, converting recovered energy into steam to produce electricity.

The thermal waste-to-energy facility is expected to divert approximately 25% of Perth's post-recycling rubbish from landfill sites. In addition, the plant will recover and recycle metals, and re-use the remaining ash residue as construction materials.

Solutions such as this are what the group is striving for.

Project information memorandum

SWRWG has drafted a project information memorandum (PIM) to assist prospective technology and service providers. The group hopes that responses to the PIM will:

- identify suitable landfill-diverting waste management technologies that can be deployed on a regional scale in the South West of Western Australia;
- explain the technical and operational aspects of each of these technologies so that SWRWG can form a layman's understanding of the technology in question;
- investigate and advise SWRWG on the proposed technology's commercial, environmental and social viability, sustainability, practicality and cost-effectiveness;
- investigate and advise SWRWG on options for legal/ownership structures and/or business models and/or commercial arrangements between SWRWG (or its individual members) and an operator or supplier for implementing the recommended solution.

A review of the current waste processing and management market, as well as the PIM, is available here.

Industry suggestions should be put together as a written submission and emailed to Altwaste@busselton.wa.gov.au for the attention of Nick Edwards.

Submissions are open until 30 November 2019.

Tech transforming textile manufacturing

A $3.4 million research and development project is aiming to upscale manufacturing of a newly developed advanced coating technology for textiles. The atmospheric plasma coating system — developed by researchers from Deakin University Institute for Frontier Materials (IFM) and textile technology company Xefco — is set to improve durability and reduce energy, water and chemical consumption during the manufacturing process.

Co-funded by the Innovative Manufacturing Cooperative Research Centre (IMCRC), the next stage of the three-year Atmospheric Plasma Coating System project involves IFM and Xefco collaborating with engineering equipment specialists Proficiency Contracting to shift the technology from a lab-scale operation to a commercially viable textile coating system.

Project leader and IFM Senior Research Fellow in Plasma Dr Weiwei Lei said that the team was looking forward to taking the technology to the next level.

"What we've managed to develop is a coating system that reduces the costs and complexities of existing equipment used to apply coatings, such as those that make textiles water-repellent, absorbent, flame-retardant or odour-free," Dr Lei said.

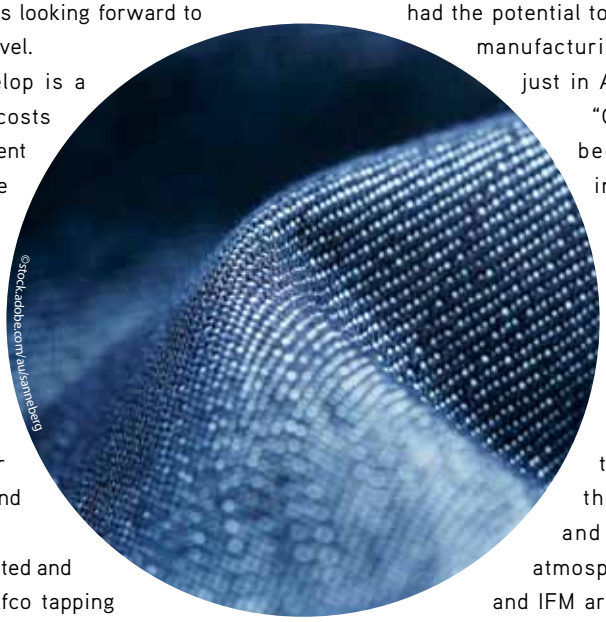
"Thanks to support from our partners and IMCRC, we will now aim to improve and optimise the functional coating process to get this lab-scale technology ready for production testing at a textile mill and global commercial use by 2021."

The system will be developed, tested and manufactured in Australia, with Xefco tapping into a local network of manufacturers to establish a supply chain that provides local manufacturers with new opportunities in the sector.

Xefco CEO Thomas Hussey said the technologies will bring much needed change to the textile processing industry by elevating performance and reducing the environmental footprint of a traditionally unsustainable sector.

The partnership with the IMCRC, Deakin and Proficiency Contracting is a major step forward for the development of innovative technologies for the global textile industry. The project amalgamates a broad spectrum of scientific and engineering expertise together with the required resources to rapidly elevate the technology to commercial readiness.

IMCRC CEO and Managing Director David Chuter said the project was a great example of how research-led innovation had the potential to disrupt and transform the textile manufacturing and processing industry, not just in Australia, but globally.



"Over the past decade there have been significant developments in the application technologies, machinery and processes for textile coating that have enhanced and extended the range of functional performance of textiles," he explained.

"The next decade will be about innovative textile manufacturing technologies and processes that are environmentally friendly and resource-efficient. The novel atmospheric plasma system that Xefco and IFM are developing will set the path for the future viability of the industry."

Is our recycling heading to Indonesia?

The Australian Council of Recycling (ACOR) has confirmed that the Indonesia-bound shipping container at the centre of recent media reports was sent by an Australian recycling company and is one of several companies to export similar material to Indonesia.

The shipping container, holding approximately 13 tonnes of mixed plastic material, was rejected by Indonesian authorities and sent back to Australia. It is reported that the waste originated from household kerbside recycling in suburban Melbourne.

ACOR was advised that the material in the shipping container was not 'toxic' but is in fact material that householders have put in their council recycling bins, such as plastic containers for motor oil and food products.

ACOR noted that one shipping container (or potentially eight) does not define any one company or the Australian recycling system. It does however reflect the reality of what is collected from Australian ratepayers via council kerbside recycling programs, and industry's attempts to do something useful with heterogeneous material.

Similar container loads of exported mixed plastic have met all expected requirements under both Australian and Indonesian law and policy. However, across Asia, authorities are changing their approaches in line with their own domestic circumstances.

Of the 37 million tonnes diverted from landfill in a typical year in Australia, some 4 million tonnes are exported, the majority consisting of metal, pulp and paper.

According to the 2016–17 Australian Plastics Recycling Survey, 415,200 tonnes of plastic are collected for recycling, with 43.4% of this amount reprocessed in Australia and the remaining 56.6% (235,100 tonnes) exported. According to Australian Government figures, approximately 60,000

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> "Of the 37 million tonnes diverted from landfill in a typical year in Australia, some 4 million tonnes are exported

tonnes have been exported to Indonesia in the last 12 months.

Plastic exported to Indonesia is approximately 1.5% of the total amount of material exported for recycling and less than 0.2% of all material recycled.

Recyclable material has historically been exported because overseas buyers pay for it as inputs to make useful products. In the case of mixed plastics in particular, robust markets and infrastructure have historically been under capacity in Australia. In Europe, there are specific policies in place to promote domestic recycled content manufacturing. Without export, our recycling rate for plastics could fall to as low as 5%.

ACOR welcomes recent action by governments and industry to further develop Australia's domestic recycling capacity and the opportunity to keep more material onshore. As part of its responsibility for the improvement of recycling, ACOR is developing an app to help householders keep their recycling cleaner, and an industry accreditation approach.

Industry accreditation approach

ACOR is developing a voluntary Recyclers' Accreditation Program (RAP). The accreditation initiative was approved as part of ACOR's Agenda 19 workplan of projects to foster domestic demand and markets for collected recyclate.

According to ACOR, the program will aim to ensure:

- high standards of operational performance and accountability in Australian recycling activity;
- stakeholder, community and investor confidence in Australian recycling activity;
- complementary arrangements to policy directions and regulatory obligations for Australian recycling activity;
- continual improvement in recovery rates from Australian recycling activity.

What RAP aims to cover

The program aims to address the collection and transport of recyclable materials from the Australian domestic, commercial and industrial, and construction and demolition sectors; the sorting, pre-treatment and storage of collected recyclable materials from those sectors; the remanufacture of collected material into recycled content products; and the management of supply chain relationships, including those with export partners.

RAP will reference the following to develop the program:

- International practices in accreditation and performance standards for the recycling industry, including existing and emerging schemes.
- Existing and/or overlapping Australian schemes such as those for tyre and e-waste recyclers, as well as product stewardship schemes.
- 'Spheres of influence' in the recycling supply chain and what Australian recyclers can or cannot directly control in performance terms, including 'loss' rates to residual waste from collected material that is contaminated.
- The 'proximity principle' in relation to waste management.
- Establishment of industry benchmarks for the purposes of the Queensland waste disposal levy's concessional arrangements for recycling residuals and other potential public policy arrangements.
- Local, state, federal, international and trading partner legal, regulatory and policy requirements, including those regarding the international movement and handling of materials.

RAP design

The recycling sector will be extensively consulted in the design of the program. Independent third parties will be involved in determining accreditation achievement and its maintenance, which will include regular non-notified and notified inspection audits of facilities. Regular public reporting of accreditation scheme results and achievements will be incorporated into the system and alignment with an accreditation services provider is an option for consideration.

ACOR added that in applicable cases, export documentation and supply chain provenance arrangements will be reviewed as part of the accreditation process, as well as material mass balance calculation and analysis.

Mussels flex their surface engineering muscles

Chemical analysis of the sticky threads contained in mussels is inspiring engineering innovations to address problems including oil spills and water contamination. The adhesive properties of mussels, and the possibility of their use in a wide range of surface engineering applications, have been detailed by US and Chinese researchers in a review published in the journal *Matter*.

Mussels attach themselves to rocks using clusters of thin, hardy byssus threads, allowing them to withstand powerful currents and waves. These threads have adhesive capabilities thanks to an amino acid group called dihydroxyphenylalanine (DOPA), which clings to the surface by performing a series of molecular processes, including hydrogen bonds and hydrophobic and electrostatic interactions.

Chemical engineers have found that dopamine — a molecule with a similar structure to DOPA — can adhere to many solid substrates through these molecular interactions. Research suggesting that dopamine can form a universal coating on a wide range of substrates spurred the growth of mussel-inspired chemistry as a tool for material surface engineering and environmental science.

"Mussels are broadly regarded as a nuisance in marine industries because they will colonise submerged surfaces," said researcher Hao-Cheng Yang, from the School of Chemical Engineering and Technology at Sun Yat-sen University.

"But from another point of view, the robust attachment of mussels on substrates under water has inspired a biomimetic strategy to realise strong adhesion between materials in water."

Several mussel-inspired innovations are already in progress. A research team in China has developed a universal red blood cell that can be accepted by individuals of every blood type. The blood cell works by using mussel-inspired coatings to shelter the cell from detection by the body's immune system, thereby preventing the destructive immune response that would result.

Other research has succeeded in developing materials for separating oil and water, which could help to mitigate environmental damage to marine environments after oil spills. Researchers believe these innovations may be suitable for large-scale production.

Mussels have also led to advancements in water purification technology. For example, materials capable of removing heavy metals, organic pollutants and pathogens from wastewater are being developed from polymerised dopamine, which easily binds to these contaminants.

Although the binding properties of mussels show potential for future technologies, several challenges must be overcome before they can be applied in the real world. Researchers are studying the structure–property relationships of mussel-inspired chemicals such as polydopamine to better understand the complex web of interactions between amino acids, which influence their adhesive properties.

"Despite simplicity and effectiveness, there are still some inherent limitations," said Yang. "Alkaline conditions are usually needed to realise the polymerisation of dopamine, so it cannot be applied to materials that are unstable under alkaline conditions. Moreover, the deposition of PDA [polydopamine] is a time-consuming process — it takes tens of hours to form a uniform coating on most material surfaces."

Some researchers are looking for low-cost, stable and safe substitutes to polydopamine, such as polyphenols, in the hope of overcoming these challenges.

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Window film stores solar enegy

A window film made from a specially designed molecule has the potential to take the edge off the most intense midday heat by absorbing and storing solar energy for later, even distribution.

Researchers from Chalmers University of Technology, Sweden, have demonstrated that the molecule can capture energy from the sun's rays and release it later as heat. The team's findings are published in the journal *Advanced Science*.

On sunny summer days, heat radiates into homes or cars, creating an unpleasantly high indoor temperature. When the research team's molecule is struck by the sun's rays it captures photons and simultaneously changes form — it is isomerised. When the sun stops shining on the window film, the molecules release heat for up to eight hours after the sun has set.

"The aim is to create a pleasant indoor environment even when the sun is at its hottest, without consuming any energy or having to shut ourselves behind blinds. Why not make the most of the energy that we get free of charge instead of trying to fight it?" said chemist and research lead Kasper Moth-Poulsen.

At dawn, when the film has not absorbed any solar energy, it is yellow or orange because these colours are the opposite of blue and green, which is the light spectrum that the researchers have chosen to capture from the sun. When the molecule captures solar energy and is isomerised, it loses its colour, becoming entirely transparent. As long as the sun is shining on the film it captures energy, which means that not as much heat penetrates through the film into the room. At dusk, when there is less sunlight, heat starts to be released from the film and it gradually becomes yellow again and is ready to capture sunlight the following day.

"Airports and office complexes should be able to reduce their energy consumption while also creating a more pleasant climate with our film, since the current heating and cooling systems often do not keep up with rapid temperature fluctuations," said Moth-Poulsen.

The molecule is part of a concept the research team calls MOST, which stands for Molecular Solar Thermal Storage. Previously the team presented an energy system for houses based on the same molecule. In that case — after the solar energy had been captured by the molecule — it could be stored for an extended period, such as from summer to winter, and then used to heat an entire house. The researchers realised they could shorten the time to heat release by optimising the molecule for a window film as well.

The research team is working on increasing the concentration of the molecule in the film while retaining the film's properties, as well as reducing the cost of the molecule.

"The step to applying our film is so short that it could happen very soon. We are at a very exciting stage with MOST," said Moth-Poulsen.

The research has been funded by the Australian Research Council, The Knut and Alice Wallenberg Foundation and the Swedish Foundation for Strategic Research.

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Success in wastewater sustainability

A Sydney Water infrastructure project has received an excellent design rating from the Infrastructure Sustainability Council of Australia.

Sydney Water's Lower South Creek Treatment Program has received what is claimed to be the highest rating ever achieved for an Australian water infrastructure project from the Infrastructure Sustainability Council of Australia (ISCA), earning an 'Excellent' IS Design rating of 69.7 points. The ISCA aims to enable sustainability outcomes in infrastructure, with a rating scheme that evaluates sustainability across the planning, design, construction and operational phases of infrastructure programs, projects, networks and assets.

Sydney Water's Lower South Creek Treatment Program will involve the installation of new and upgraded wastewater infrastructure to improve quality, capacity and reliability at three wastewater treatment plants (WTPs) in Sydney's north-west — Riverstone, Quakers Hill and St Marys — to support the additional half a million people projected to be living in the region by 2040.

The $450m upgrade of facilities at St Marys and Quakers Hill will see the adoption of innovative process technologies to make water treatment more sustainable, cost-effective and efficient.

ISCA CEO Ainsley Simpson said, "This is the highest IS rating ever achieved for a water infrastructure project and includes numerous innovations and sustainable outcomes which other water utilities can follow and learn from. A tremendous achievement for Sydney Water."

ISCA Case Manager Kieren Heikkinen added, "The outcomes were particularly impressive considering the IS rating was initially undertaken as a benchmarking exercise with little additional effort expended on sustainability, which reflects Sydney Water's focus on sustainable outcomes. Learnings from the project and IS rating can and should be applied across Sydney Water."

Energy and carbon forecast modelling for the project estimates that the Sydney Water program will achieve a reduction of 870,000 tonnes (or a 42% reduction) of greenhouse gas total emissions during construction and across the 50 years of operation. This reduction includes embodied CO_2 emissions from construction materials and treatment chemicals.

On-site renewable energy use is a core objective of the project's strategy, with the transfer of biosolids from Quakers Hill WTP to a regional biosolids hub at St Marys WTP creating feasibility for a new anaerobic digestion plant with thermal hydrolysis pretreatment (THP). This will deliver processing efficiencies and allow for cogeneration with energy recovery from the biogas produced. On-site thermal energy recovery and electricity generation will allow the program to self-generate 69% of its electricity demand.

The IS Rating Scheme

The Lower South Creek Program is Sydney Water's first project to trial the ISCA's IS Rating tool and certification process. This process has provided independent third-party assurance of sustainability outcomes in delivery of the project.

Sydney Water Lead Environmental Scientist Gill Fowler said, "Embarking on the IS journey provided greater incentive and opportunity to challenge current process thinking and explore new ways of operating. This helped drive sustainability benefits and reduced energy demand and our carbon footprint.

"Sydney Water has committed to obtaining a sustainability benchmark for all its major infrastructure projects," she said.

To achieve Sydney Water's first IS Rating, the program deployed several innovative processes and technologies, including the transfer of sludge for consolidated biosolids processing and installation of mechanical primary sedimentation screens, reported to be Australian firsts.

Other innovations included anaerobic digestion with THP at St Marys, with the secondary treatment process modified to a Nereda aerobic granulated sludge bioreactor after a successful pilot trial at the Quakers Hill plant.

This series of innovations helped to deliver industry-leading sustainability benefits, which resulted in an ISCA score of 10/10 for innovation; two of the innovation points were awarded for renewable energy supply and exceeding the benchmarks for energy and carbon reduction.

Benchmarking sustainability performance

The Lower South Creek Treatment Program used a novel approach to forecasting and benchmarking energy and carbon under the IS Rating tool. This involved comparison against robust energy benchmark data published by the Water Services Association of Australia from 245 WWTPs across Australia and New Zealand. The Lower South Creek Treatment Program's delivery partners (WSP and UGL) put forward the IS tool to benchmark the project's sustainability performance without incurring additional capital costs. This process has provided insights into how Sydney Water policies and procedures align with best practice in the IS Rating tool.

Image courtesy of Sydney Water.

WSP Senior Sustainability Consultant James Logie said, "This is an amazing result for Sydney Water's first IS Rating and highlights the impressive efforts from Sydney Water to plan and deliver innovative and more sustainable wastewater solutions."

Program Director Anthony Korbel said, "ISCA certification of the Lower South Creek Treatment Program is a further step by the infrastructure industry, and in particular Sydney Water, in recognising the importance of sustainability in the delivery of large capital programs. It's been both an interesting and rewarding process for the [WSP/UGL] team and I'm delighted to see such a fantastic result."

Sydney Water Corporation

www.sydneywater.com.au

Image courtesy of City of Sydney.

Sydney trials concrete made from industrial waste

The City of Sydney is trialling concrete made from industrial waste, replacing a 30 m section of road along an inner-city street in Alexandria. A busy road leading to Sydney Airport, Wyndham Street services high volumes of traffic and is thus considered a good candidate for trialling the integrity of the sustainable road material, which is made from a blend of concrete and industrial waste from coal-fired power stations and steel manufacturing.

Made from fly ash and blast furnace slag, the green construction material, known as geopolymer, generates 300 kg of CO_2 per tonne of cement compared with the 900 kg created by traditional cement production. The low CO_2 concrete has the potential to put the 400 million cubic tonnes of globally documented waste from the coal and steel industries to good use.

To assess durability, 15 m of traditional concrete has been laid alongside 15 m of geopolymer concrete, with nine sensors positioned under the concrete to monitor and compare how the material performs.

Researchers from UNSW Sydney will monitor the road performance for up to five years and, working with the CRC for Low Carbon Living (CRCLCL), will use the trial results to create industry guidelines for geopolymer concrete.

Professor Stephen Foster, Head of the UNSW School of Civil and Environmental Engineering and CRCLCL project lead, described the trial as "a huge step forward".

"This trial will help drive step change in the industry. Many concrete companies are already doing a lot to change, but this trial really gives it another push," Prof. Foster said.

"Concrete contributes 7% of all greenhouse gas emissions and in 2018 the world produced about 4.1 billion tonnes of cement, which contributed about 3.5 billion tonnes of CO_2. Alternative, low CO_2 concrete materials offer potential benefits in reducing the greenhouse gas emissions associated with conventional concrete.

"This trial is important because we need demonstration projects to accurately assess the performance of geopolymer over time so that there can be broader uptake," he said.

City of Sydney Lord Mayor Clover Moore said the city was committed to finding new ways to lower carbon emissions. "Projects like this geopolymer trial can result in new products that make a real difference in slashing carbon emissions," Moore said.

"Local governments are responsible for maintaining local roads, so if we can purchase more environmentally sustainable materials, we can fight climate change and provide quality infrastructure for our community," she continued.

"We're continually working with concrete suppliers to reduce the amount of pollution and greenhouse gases emitted during the production of concrete for our local roads, and we already use sustainable green concrete for all our footway renewal works — which adds up to 25,000 m^2 per year."

Industry partner Craig Heidrich, Executive Director of the Australasian (iron & steel) Slag Association and Ash Development Association of Australia, said the benefits of the trial will be far-reaching.

"Our collaboration with organisations such as the City of Sydney and the publication of the research findings will further demystify and promote the use of geopolymer concrete in construction. Geopolymer concrete has great engineering properties. It is a durable, high-performance product that has a low carbon footprint when used in construction," Heidrich said.

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Can distributed ledgers technologies help you decarbonise your business?

*Jack Krutak**

Digital ledger technologies are decentralised and distributed digital ledgers of transactions or contracts, providing secure record keeping and transparency. Distributed ledgers are harder to attack than centralised ledgers because data is maintained in a decentralised form across different locations, making it secure and resilient to retrospective changes.

In terms of the potential of blockchain to support environmental sustainability, it comes down to the ability to provide a verifiable record of who exchanges what with whom. The Internet of Things (IoT) plays a crucial role, providing the data that must be associated to the transaction. An example is peer to-peer energy trading from solar panels — blockchain enables people to trade excess energy with their suppliers and neighbours, while IoT allows the necessary data to be cheaply and reliably obtained. This is becoming more important as businesses are being held to account on all of their dealings, including reaching far into the supply chain to maintain sustainability and fairness.

Steps towards decarbonisation

Decarbonising your business makes sense as a moral imperative and a cost-control strategy. The Global Greenhouse Gases (GHG) Protocol is a good place to start. The protocol sets standards to measure and manage emissions, classifying emissions into three 'scopes': scope 1 emissions are direct emissions from owned or controlled sources; scope 2 emissions are indirect emissions from the generation of purchased energy; and scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value or supply chain of the reporting company, including upstream and downstream emissions.

By embracing all three scope levels, companies can better understand their full value chain emissions and then tailor their efforts to the greatest GHG reduction opportunities. It enables companies to enforce the principles of sustainability throughout their supply chain by looking at where materials are coming from, whether they are sourced responsibly, whether people are being paid fairly, how the raw materials are transported and what level of emissions are involved in the process. It gives companies a much broader and deeper look at their actual carbon footprint.

This approach is also good for a company's brand. We know that more consumers are looking holistically at brands and their values, and will often make purchasing decisions based on these factors. You can create a competitive advantage by showing that your company is tracking emissions and working to decarbonise throughout the supply chain in a transparent and secure way.

Strategic objectives to decarbonise

All decarbonisation initiatives should begin with the company's strategic objectives in mind. If one of the company objectives is to decarbonise, then the company can investigate what enabling technologies are available (such as distributed technology ledgers), start engaging vendor ecosystems, look at developing hypotheses that can be pilot tested and running those tests.

People who want to learn more and be at the forefront of these new and emerging technologies have the opportunity to engage with vendors, partners, thought leaders and end users at IoT Impact 2019, a conference organised by IoT Australian Association (IoTAA), to be held in October. The event will allow people to engage with companies experienced in applications of digital ledger technology and decarbonisation, and will help to demystify some preconceptions about new technologies.

About IoT Impact

IoT Impact 2019 brings together technologies, strategies and case studies for industries implementing IoT.

Over two days, you will meet 1000+ business and technology leaders interested in propelling IoT adoption globally and specifically in Australia. The ultimate opportunity is for delegates to build fruitful connections.

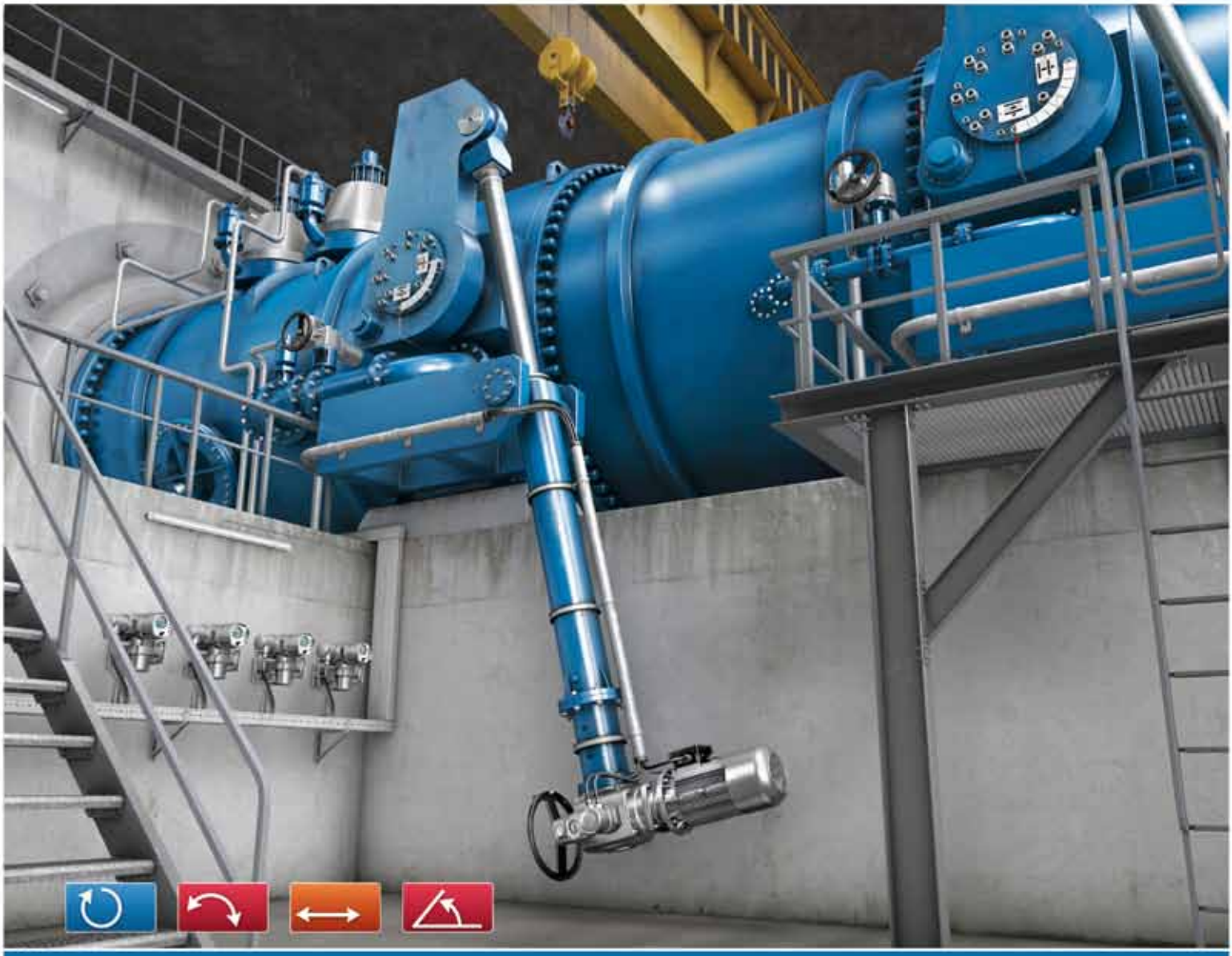
The conference includes keynotes, sessions, awards and workshops covering industry sectors and technology-focused sessions. The content is designed for those considering or scaling IoT projects. The ultimate take home is to leave with a 'can do' approach to IoT implementation and ensure organisations are IoT ready.

Key conference themes include:

- Smart grids, water, cities and prop tech
- Advanced manufacturing and robotics
- Next-generation vehicles
- AgTech and supply chains
- Circular economy
- HealthTech
- Cybersecurity, blockchain and data use
- AI and 5G.

What: IoT Impact 2019 Conference & Exhibition
When: 15–16 October 2019
Where: Hyatt Regency, Sydney
Web: www.iotimpact.com.au

**Jack Krutak is a member of the IoTAA Executive Council and Digital Services Director, Industry Business, Pacific, Schneider Electric.*



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High-spec fuel from waste using mobile shredder

The UNTHA XR3000C mobil-e shredder is now operational at KTS Recycling in Melbourne. The Austrian-made machine will handle up to 30 tonnes of commercial, industrial and wood waste per hour, to manufacture the Energy from Waste resource — Process Engineered Fuel (PEF).

Previously unable to produce this high-specification fuel with only one machine, the KTS team accompanied FOCUS Enviro on several site visits across Europe, to see the UNTHA shredder in action. Impressed by the single pass shredding capabilities of this robust technology, FOCUS Enviro then set about configuring a solution that could achieve KTS's refined <50 mm output particle requirements, with ease.

Commenting on the project, FOCUS Enviro's Director Robbie McKernan said: "We have seen what the XR mobil-e is capable of, as it has continued to transform the throughputs, fuel quality and energy efficiency of facilities worldwide. We've therefore worked hard to bring this pioneering UNTHA innovation to Australia, so that it can start to revolutionise how we — as a nation — manufacture PEF."

Mark Jeffs, owner of KTS, added: "Alternative fuel production is becoming more and more important in Australia, and as a progressive environmental company we want to be ahead of the curve.

"We acknowledged that by investing in world-class PEF production technology, we could produce a high-quality resource, efficiently, and hopefully really drive the market for this crucial energy source."

Gary Moore, UNTHA's Director for Global Business Development, concluded: "We know how to process a plethora of waste materials

effectively, and whether the resulting fuel is going to a local cement kiln or the export market, we always work with the client to optimise throughputs, minimise impurities and maximise margins.

"Australia is one of the world's most exciting countries when it comes to Energy from Waste potential, and it's great to now be a part of it."

FOCUS enviro

focusenviro.com.au

Reducing the safety risks of aerating wastewater lagoons

Traditionally, water authorities and industrial enterprises in Australia have adopted surface aerators for water oxygenation at municipal and industrial wastewater treatment plants (WWTPs). A large percentage of these WWTPs are based on earthen lagoons, with aeration being the main energy consumer associated with the treatment processes.

Surface aerators exist in various forms. There are high- or low-speed 'splasher' types, draft tubes, 'brush and blade' or paddlewheel aerators. All have reasonable oxygen transfer efficiencies of around 1.5 kg O_2/kWh. The challenge lies in the position of these surface aerators — all sit or float on the surface of the water, requiring operators to 'boat' to them for maintenance. For units that require pontoons, there is a risk of capsizing in strong winds.

A different approach is to use a Venturi Aeration unit in conjunction with a self-priming pump. The pump draws water from the lagoon or tank, accelerates it through the aerator then pumps highly oxygenated water back into the lagoon. The aerator uses the Venturi effect to draw over 2.2 times more air than the volume of liquid pumped before intensely mixing the air and water in the unit's oxidising zone.

Venturi Aerators with Gorman-Rupp self-priming pumps

Image © Hydro Innovations.

In addition to delivering up to 1.86 kg of O_2/kWh, a major benefit is the reduced risk of work health and safety issues. Because all monitoring and maintenance is done on the bank of the lagoon or at the side of the tank, the risks associated with 'boating' to units or the risks associated with the use of overhead cranes to access them is eliminated.

Another advantage of aerating with this system is the installation simplicity. Some aeration upgrades to lagoons can take weeks or months to complete, along with the risks associated with working over polluted water. The Venturi Aeration system with pump only requires a slab at the side of the lagoon.

Hydro Innovations

www.hydroinnovations.com.au

Developing the next generation of solar cells

A team of researchers is investigating the use of phospherene, a nanomaterial made from phosphorus, in the next generation of perovskite solar cells (PSCs). With findings published in the journal *Small Methods*, the research team led by Professor Joseph Shapter has developed thin phosphorene nanosheets for low-temperature PSCs using the rapid shear stress of Flinders University's vortex fluidic device (VFD).

Image courtesy of Flinders University

University of Queensland research leaders Dr Munkhbayar Batmunkh and Dr Abdulaziz Bati, who are continuing research into improved solar cells.

Professor of Clean Technology Colin Raston, Dr Kasturi Vimalanathan and Dr Gibson from the Flinders Institute for Nanoscale Science and Technology are part of the team looking to improve solar cell efficiency with alternative and improved solar cell materials and processing systems.

"Silicon is currently the standard for rooftop solar and other solar panels, but they take a lot of energy to produce," said adjunct Prof. Shapter, now at University of Queensland (UQ). "They are not as sustainable as these newer options. Prof. Shapter is continuing the pioneering solar-cell research at the UQ with Dr Munkhbayar Batmunkh and Abdulaziz Bati.

"Phosphorene is an exciting material because it is a good conductor that will absorb visible light. In the past, most non-metallic materials would have one property but not both," Prof. Shapter explained.

"We've found [an] exciting new way to convert exfoliated black phosphorus into phosphorene, which can help produce more efficient and also potentially cheaper solar cells," Dr Gibson said.

"Our latest experiments have improved the potential of phosphene in solar cells, showing an extra efficiency of 2–3% in electricity production."

Research into the large-scale production of high-quality 2D phosphorene — along with other future materials such as graphene — is underway to explore efficient and sustainable production, with the use of the VFD, near-infrared laser light pulses and even an industrial-scale microwave oven. The addition of different atoms to the matrix is also being investigated, which has generated promising results in catalysis, particularly in the area of water splitting to produce hydrogen and oxygen.

With the ability to artificially produce perovskite structures, and once production of the PSCs can be successfully upscaled, commercial viability is closer to being realised. Meanwhile, global research continues to investigate how to improve and optimise perovskite cell performance.

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Successful and proven track record within the Australia water utility sector

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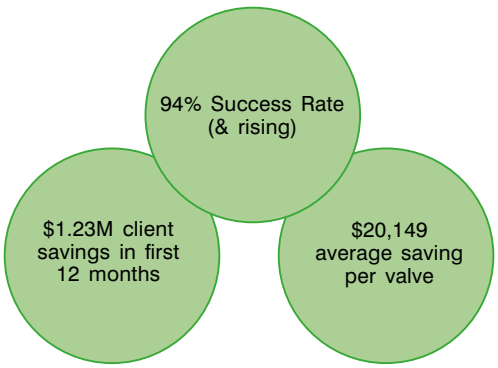

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New water purifier inspired by a rose

Inspired by a rose, researchers at The University of Texas at Austin have developed a new device for collecting and purifying water. The device removes any contamination from heavy metals and bacteria, and removes salt from seawater, producing clean water that meets drinking standard requirements set by the World Health Organization. Each flower-like structure costs less than 2 cents and can produce more than half a gallon of water per hour per square metre.

In a paper published in the journal *Advanced Materials*, the authors outline how an origami rose provided the inspiration for developing a new kind of solar-steaming system made from layered, black paper sheets shaped into petals. Attached to a stem-like tube that collects untreated water from any water source, the 3D rose shape makes it easier for the structure to collect and retain more liquid.

The team, led by Associate Professor Donglei (Emma) Fan at the Cockrell School of Engineering's Walker Department of Mechanical Engineering, developed a new approach to solar steaming for water production — a technique that uses energy from sunlight to separate salt and other impurities from water through evaporation.

The device looks like a black-petaled rose in a glass jar, and the resemblance is no coincidence.

"We were searching for more efficient ways to apply the solar-steaming technique for water production by using black filtered paper coated with a special type of polymer, known as polypyrrole," Fan said.

Polypyrrole is a material known for its photothermal properties, meaning it's particularly good at converting solar light into thermal heat.

The team experimented with different ways to shape the paper to achieve optimal water retention levels. Fan was inspired by a book — *The Black Tulip* by Alexandre Dumas — which inspired her to try a flower-like shape, and she discovered the rose to be ideal. Its structure allowed more direct sunlight to hit the photothermic material, with more internal reflections, than other floral shapes and also provided an enlarged surface area for water vapour to dissipate from the material.

The device collects water through its stem-like tube, feeding it to the flower-shaped structure on top. It can also collect raindrops coming from above. Water finds its way to the petals where the polypyrrole coating turns the water into steam. Impurities naturally separate from water when condensed.

PhD candidate and lead author Weigu Li said, "We designed the purification–collection unisystem to include a connection point for a low-pressure pump to help condense the water more effectively. Once it is condensed, the glass jar is designed to be compact, sturdy and secure for storing clean water.

"Our rational design and low-cost fabrication of 3D origami photothermal materials represents a first-of-its-kind portable low-pressure solar-steaming-collection system," Li said. "This could inspire new paradigms of solar-steaming technologies in clean water production for individuals and homes."

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Wastewater BOD testing – is it time for a change?

More than 120 years ago, English water authorities realised that there are thousands of different organic molecules to test for and that testing for each one would be prohibitively expensive and time consuming, if not at that time, impossible.

In response, they devised the 5-day biochemical oxygen demand (BOD) test. This test became a global standard as an indirect method to test the quantity of organic matter in water, and in fact it is still used today by many water authorities and governments worldwide.

The BOD test measures the quantity of dissolved oxygen needed by microorganisms to degrade organic compounds. The result is given as mg/L dissolved oxygen. The higher the organic load or strength of the water, the higher the quantity of dissolved oxygen required by the bacteria hence the higher the BOD result.

The 5-day BOD was a good test in the 19th century, especially as it was relatively low cost and simple to perform. Over time, the acronym BOD almost became a standard word to describe organic contamination in water. For example, water with a high BOD result was considered highly contaminated with organic matter; conversely water with a low BOD reading was considered to be low in organic material. Unfortunately, this converse sentence may be quite incorrect, as water with a low BOD result may still be highly loaded with organics.

Of all the contaminants that the Hydroflux Group tests for, BOD is the least targeted and least reproducible measure. A BOD result can be generated by thousands of different types of organic molecules, not just one or two different kinds. Hence the test gives us clues as to what organic molecules are in the water. Give the same sample to two laboratories and the chances of the results coming back the same are almost nil. Hence the results, at best, are only indicative of high, low or medium strength water, and even this may be incorrect.

Apart from temperature and time being critical factors in BOD testing, the test is greatly affected by contaminant type and particle size, the quality of the bacterial seed and the matrix of the water sample. If for instance the water contains any slightly toxic compounds then the final BOD result will be artificially low. Conversely, samples with a high organic nitrogen component may give an artificially high BOD result.

As our understanding of water chemistry and biology has increased since the inception of the 5-day BOD test, the inherently insurmountable shortcomings of this test are becoming more apparent.

So what can we do to overcome or even replace the 5-day BOD test?

The simple answer is a chemical oxygen demand (COD) test. While this test also has some shortcomings — for example a handful of recalcitrant organic compounds (particularly those found in the petrochemical and coal industries) may not register properly during the test — it accurately and reproducibly measures more than 95% of the oxidisable organic material found in almost any domestic or industrial waste stream.

The reliability and reproducibility of this method is low cost, and a two-hour turnaround test is why COD is making an ever increasing mark on today's modern wastewater analytics.

Hydroflux Industrial Pty Ltd
www.hydrofluxindustrial.com.au

Clean energy transition

2019's All-Energy Australia Exhibition & Conference, to be held in Melbourne this October, will showcase clean and renewable energy.

Attended by over 8500 local and international energy industry professionals in 2018, All-Energy Australia is a free-to-attend conference and exhibition focused on the immense opportunities for the clean energy sector.

Held in partnership with the Clean Energy Council, this year's event is themed 'Advancing Australia's transition to a clean energy future', which will focus on driving the sector's continued growth and working together to create a nation powered by clean energy.

Attendees will have exclusive access to the latest technology and trends relevant to professionals working or investing in the renewables sector, from over 200 expert speakers across seven conference streams.

Distributed energy resources (DER)

Presenting within the conference program at All-Energy Australia this year will be Dr Phil Blythe, CEO of GreenSync, who will discuss the pathway to decentralise flexible grids in his session titled 'Market Mechanisms: A Global Shift to DER Flexibility Markets'.

"While our energy systems have been traditionally centrally operated and managed by our generators and networks, there is now a need for a new market architecture that allows its newest investors — households and businesses — to participate and be rewarded for contributing to a range of grid services at times of need by the network," Dr Blythe explained.

"There will not be a single market for flexibility, but rather multiple (parallel) markets for specific services provided by customers' energy assets. Irrespective of the jurisdiction, markets for things such as emergency capacity, ancillary support and voltage management are likely to evolve in response to what DER can do. As this evolution continues, the need for a centralised digital exchange to host these individual markets becomes greater," he said.

"To achieve flexible grids that facilitate customer participation and reward for DER services, while providing the visibility and coordination required by governments and system operators, we must move to a digital architecture that supports all stakeholders in the energy system — from networks to technology vendors to customers."

Microgrids

Microgrids will also feature significantly in the 2019 program. Acciona Energy and Deakin Energy will share their insights on establishing a successful microgrid. In their joint speaker session, Belen Linares Corell (R&D and Innovation Director at Acciona Energy) and Dr Adrian Panow (Director at Deakin Energy) will cover the development of microgrids, how to maximise their benefits and what is required from a safe and functional microgrid.

"Major investment globally is being directed towards distributed energy resources. We must understand the impact and opportunities of DER on existing grids," Dr Panow said.

"Moving to a DER environment does not reduce the need for safety, reliability, affordability and social equity. At Deakin, we are demonstrating through construction of our own 7.25 MW solar and storage microgrid that delivery and retention of research, cost and sustainability benefits can all be achieved together," he said.

All-Energy Australia 2019's exhibition will feature over 250 industry-leading companies, from market leaders to start-ups, showcasing innovations and emerging technologies and offering expert advice.

Companies with confirmed attendance include ABB, NEXTracker, Fronius, Growatt, LONGi Solar, Array Technologies, Risen Energy, Soltec, Samsung SDI, Senec, SMA Australia and BayWa r.e.

Visitors to All-Energy Australia will have access to the co-located and inaugural Energy Efficiency Expo, a new free-to-attend industry event launched to help organisations solve their energy productivity and affordability challenges.

Details at a glance

What: All-Energy Australia
Where: Melbourne Convention & Exhibition Centre
When: 23–24 October 2019
Web: www.all-energy.com.au

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Carbon capture and transformation into product

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As governments around the world search for ways to reduce carbon outputs and slow climate change, an Australian company has developed a way to generate money from the process.

Canberra-based Mineral Carbonation International (MCi) has developed a technology that can capture carbon and transform it into building materials such as cement and plasterboard.

"When we started out back in 2007, there wasn't a market for carbon, but we knew that one would come," MCi Chief Executive and Managing Director Marcus Dawe said. "However, everyone expected that it would be in the form of a tax or some sort of carbon credits system. Our approach is to have things that make economic sense to adopt so you don't have to rely on subsidies."

Last year, MCi completed a five-year pilot involving the design and construction of a carbon reactor system. The facility is a purpose-built research plant for CO_2 mineral carbonation and its construction was supported by funding from the federal and New South Wales Governments and explosives company Orica.

Dawe said the technology involves a process of treating rocks that enables them to become super absorbers of carbon. Once captured, the gas is solidified, thereby removing it from the atmosphere.

Dubbed mineral carbonation, the process has the potential to store millions of tonnes of carbon indefinitely.

"We are using the same process that's used by nature," Dawe said. "The key difference is that we can achieve in an hour what would take nature thousands of years."

For Dawe, a key part of the development of MCi was ensuring its technology had the potential to scale and make a significant difference in the push to lower global carbon emissions. The company is currently in talks with large building products companies about how its technology could be put to work.

"What we have done, along with a range of other companies, is to create an industry for carbon," he said. "We are going to use

carbon as the basis for making a range of new products."

The company is currently focused on designing a demonstration plant that could process between 5000 and 10,000 tonnes of CO_2 each year. The aim is to then scale this by a factor of 10 every three years. Eventually, it is anticipated each plant will be able to process 1 million tonnes of CO_2 annually.

Dawe said MCi is working with a range of organisations to confirm the economics of the process. He estimated that a commercial mineral carbonation plant could be built for around $50 million and will have the potential to generate $30 million worth of building materials each year.

"We didn't know, going into this, how the economics would stack up. Now we know that, if we build one of these plants, it could pay for itself with[in] 18 months."

Dawe is no stranger to emerging technologies and start-up businesses. Since the early 1990s, he has built a range of successful businesses in areas such as software development and internet publishing. He is currently Entrepreneur in Residence at the Canberra

Innovation Network where he works with start-ups in a mentoring capacity.

"Canberra is very much a global village when it comes to entrepreneurship," he commented. "It's become a touchpoint for what is happening in many places around the world. It's very much an innovation capital in its own right."

Dawe pointed to the powerful mix of universities, research facilities, government and foreign embassies. All have combined to create a community where people are highly educated and very well connected.

"When people come here, they find Canberra is not the city they expected. It's small enough to have great quality of life but at the same time large enough to have all the facilities you require together with great links to the rest of the world. It might not be a New York or London but certainly like a Seattle or San Francisco."

Dawe said he is very bullish about the entrepreneurial future of Canberra as the city has attracted large numbers of people with big plans. "I am a believer in the idea that necessity is the mother of invention. I've always been a problem finder because, when you find a good problem, that's where the value of good innovation can really be focused. That is what is happening in Canberra."

Canberra Innovation Network Chief Executive Officer Petr Adamek said MCi is a great example of what can be achieved when great ideas are supported. "Here we have a company that's going to have a significant impact around the globe," Adamek said. "Its success is due in no small part to the critical mass of talent and support that exists in Canberra."

Mineral Carbon International

www.mineralcarbonation.com

NSW school commits to long-term renewable energy

Ascham School has made a long-term commitment to renewable energy by signing a corporate renewable power purchase agreement (PPA) with business energy retailer Flow Power.

Under the agreement, the Sydney-based school aims to reach a 90% renewable energy target, with power sourced from a combination of wind and solar farms. The school is claimed to be the first school in NSW to enter a deal of this kind.

The agreement will help Ascham School achieve its ambitious sustainability targets, contribute to a lower carbon economy and reduce overall emissions, as well as offset electricity consumption from the grid. Real-time monitoring of renewable energy, calculated at 30-minute intervals, will allow the school to control and optimise its use of renewable power.

Ascham School Business Manager Candice Heapes said, "Late last year we felt pressured by another provider into accepting significantly higher energy retail prices when our three-year agreement with them ended. This, along with our growing focus on sustainability as part of our strategic plan, spurred us on to look at alternative options and sources of energy. At Ascham, the whole school is committed to sustainable actions, so drawing energy from wind and solar farms is a terrific step in greening our future."

Flow Power first introduced corporate renewable PPAs to the Australian market in 2017 and now counts Olam Orchards Australia, ANCA Machines and Burra Foods as customers. The latest agreement with Ascham School highlights the growing appetite for PPAs in the Australian market.

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Flow Power Managing Director Matthew van der Linden said, "We're thrilled to welcome Ascham School as a customer, and applaud their leadership in taking on an agreement of this kind.

"The education sector is uniquely placed to benefit from corporate renewable PPAs, due to the longevity of its schools and of the PPAs themselves. We look forward to collaborating with Ascham School throughout the duration of this agreement to deliver an energy solution that evolves to fit the school's needs."

Flow Power

www.flowpower.com.au

2019 Australasian Waste & Recycling Expo

The Australasian Waste & Recycling Expo (AWRE) is where the waste, recycling and resource recovery sectors come together to find solutions for a cleaner, more sustainable future. This year's event will be held in October at ICC Sydney.

The need for new and better waste solutions has never been more crucial, with Australians looking to the waste and recycling industry to drive positive change.

Up to 3000 waste management professionals, business leaders and government representatives are expected to attend the two-day live event, making AWRE 2019 the ultimate showcase of today's global waste and recycling industry.

With over 120 brands represented, attendees can expect to discover a world of solutions from industry leaders like Wastech Engineering, Turmec Teoranta, Wastemaster Pacific, Steinert, Hitachi Construction Machinery and WTT Australia to name a few — all showcasing innovative products, sustainable solutions and cutting-edge technologies to collect, process and recycle waste across sectors such as machinery and equipment, software and technology, food and organics, and more.

Waste and recycling communities use this event as a platform to learn and collaborate, with the AWRE Speaker Series tackling the industry's most challenging and compelling issues. Presented over two dedicated stages in 2019, Industry Forum (presented in partnership with NSW EPA) attendees will discover the latest trends and insights affecting the wider industry, as well as practical and tangible solutions from innovators shaping the future direction of Australia, through carefully curated seminars and panel discussions.

The 'Food Waste Stage' will debut this year, facilitating discussion and focus on the national issue of food waste. Featured speakers will include food waste pioneers Katy Barfield, Founder and CEO of Yume Food Australia, and Ronni Kahn, CEO and Founder of OzHarvest. Session topics will address 'Australia's Best Practice Food Services Guidelines' plus 'the role of packaging in minimising food waste', plus much more.

The 2019 Speaker Series program will be released in August.

What: Australasian Waste & Recycling Expo
When: 30–31 October 2019
Where: ICC Sydney
Web: www.awre.com.au

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ULTRASONIC WATER METER

The Qalcosonic W1 water meter from AMS Water Metering has received approval from the National Measurement Institute (NMI). The NMI certificate of approval marks a significant step forward in supplying the smart water meters to the Australian market.

Using a static method to measure hot and cold water consumption, the unit has no moving parts and is sensitive to low flows, down to 1 L/h.

The unit eliminates measuring deviations caused by sand, suspended particles or air pockets and features 9 digits, multi-line LCD, and total volume and instantaneous flow rate indication. It is IoT and AMR, NFC, LoRa technology ready.

The NMI certificate approval number for the Qalcosonic W1 water meter is NMI 14/3/43.

AMS Water Metering
amswatermetering.com

RECYCLING PROCESS

The NOREC Recycling Process produces recycling material that is suitable for re-use in consumer and other types of packaging. With the NOREC recycling process, bags are made of primarily recycled content and are themselves recyclable, producing fewer CO_2 emissions and making them suitable for closed loop systems.

The film acts similarly to bags made from virgin (unrecycled) materials providing product protection and high-quality printing for effective branding. The durability of the recycled bags makes them suitable for mini-bales and handled bags.

Synergy Packaging Pty Ltd
www.synergypack.com.au

FREE CHLORINE SENSOR

The Memosens CCS51D amperometric sensor from Endress+Hauser measures free chlorine in drinking water, process water, water and wastewater treatment, cooling water and all utilities requiring clean and treated water. The device features a membrane design that provides a fast response time, helping plant operators run their disinfection processes quickly and efficiently, while also saving on chemicals.

The sensor's convex membrane is made from dense, dirt-repellent material that prevents soiling and makes it resistant to biofouling. Ultrasonic welding of the membrane to the sensor cap ensures its integrity, preventing dilution of the electrolyte and thus a drift of the measuring signal. This guarantees long-term stable measurements and gives water plant managers the security that the disinfection process is running smoothly and that the required disinfection results are achieved.

The device is equipped with Memosens technology, allowing for direct commissioning of new sensors without further calibration. During ongoing operation, plant operators can pre-calibrate sensors in the lab, swap them into the process with plug and play, and thus continue measuring faster. Finally, non-contact data transmission eliminates all measurement errors or failures caused by humidity or corrosion.

Memosens CCS51D is connected to the Liquiline multiparameter transmitter that can serve up to eight sensors simultaneously, and the Flowfit CCA250 flow assembly offers mounting space for a simple installation of the additional pH sensor.

Endress+Hauser Australia Pty Ltd
www.au.endress.com

Ensuring our energy future with energy efficiency

at October's Energy Efficiency Expo

Businesses and governments looking to reduce their energy costs have their sights set on the inaugural Energy Efficiency Expo in Melbourne, taking place alongside All-Energy Australia.

Energy Efficiency Expo is a free-to-attend industry event, launched to help organisations take control of their energy costs and improve their energy productivity. Created from a partnership between Reed Exhibitions and the Energy Efficiency Council, this year's theme is 'Ensuring Australia's energy future', recognising the importance of innovative energy efficiency solutions in a transforming energy landscape.

The exhibition will feature smart energy products and services to quickly drive down energy costs and improve energy productivity. The conference program will focus on ready and practical measures to manage the rising cost of energy, from the industry's leading experts on energy efficiency.

Energy Efficiency Council CEO Luke Menzel said the time was right to launch this new event for business and government to get across the latest developments in energy efficiency and how to manage rising energy bills.

"As energy costs have skyrocketed, businesses and governments are looking to energy efficiency and energy management to take control of their energy costs," Menzel said.

"In turn, they are recognising that the available solutions are evolving quickly, and they need to be on top of the latest technology and service offerings. Energy Efficiency Expo will be a one-stop shop for them to get across all this, so they are in the best possible position to deal with the transforming energy market and get on with their core business."

Speakers and program focus

A complete speaker line-up will be announced shortly for the conference program, with sessions focusing on energy management fundamentals for business and the opportunities for sectors such as manufacturing, food processing, commercial buildings and local governments.

The conference program will kick off with a joint opening plenary on Day 1 in partnership with All-Energy Australia.

Menzel said there will be a strong focus on case studies that show how leading businesses and governments are approaching energy management.

"Importantly, the conference program will feature real-world case studies from businesses and governments that are ahead of the curve in adopting smart energy solutions, so that attendees can learn what is working for others, and start taking action as quickly as possible," he said.

The Exhibition Director at Reed Exhibitions Australia, Robby Clark, explained the purpose of Energy Efficiency Expo is about providing Australian organisations with a platform to tackle one of the largest current operational challenges.

"At Energy Efficiency Expo, organisations will have access to the latest expert insights and leading solutions to evolve their energy management and reduce costs. We're proud to be partnering with the Energy Efficiency Council in delivering this industry event focused on making impactful change," Clark said.

Energy Efficiency Expo's exhibition will focus on showcasing low-carbon and energy cost-reducing solutions. These include innovative technologies across areas including energy-efficient lighting, energy management equipment and software, energy-efficient HVAC, thermal performance products, microgrid technology and water heating efficiency technology.

Companies with confirmed attendance include Alinta Energy Geothermal, Beovista, Eco Light Up, Lightsource BP, National Carbon Bank of Australia, Omniflow Australia, Rexel Australia, Stiebel Eltron, T4E, Wattly and Wattwatchers.

Visitors will have access to the co-located All-Energy Australia and Waste Expo Australia, offering visitors Australia's most comprehensive opportunity to learn about renewable energy, energy efficiency and sustainable solutions.

What: Energy Efficiency Expo
When: 23–24 October 2019
Where: Melbourne Convention & Exhibition Centre
Web: www.energyefficiencyexpo.com.au

Upgrade for Macarthur Water Filtration Plant

Sydney Water's Macarthur Water Filtration Plant (WFP) in Appin, NSW, will be upgraded by the company's long-time partner, TRILITY.

The upgrade to the 24-year-old WFP will ensure continued reliability and quality of water supply to the Camden, Campbelltown and Wollondilly areas of NSW, and will guarantee Sydney Water's compliance with Australian Drinking Water Guidelines.

Commissioned in 1995, the Macarthur WFP was Sydney Water's first public–private partnership, involving the design, build, finance and 35-year operation and maintenance of the 265 mL/day plant. Following a lengthy collaborative planning process, the project commenced in 2019, with works expected to be complete by the end of 2020.

Sydney Water and TRILITY's partnership is based on achieving long-term, affordable water treatment solutions for the community. Both companies are committed to the continual improvement of drinking water quality to Sydney Water's 300,000 customers.

Kevin Conna, Acting General Manager of Customer Delivery for Sydney Water, said, "We're delighted to continue our collaborative working relationship with TRILITY. Together we will continue to deliver high-quality drinking water to the residents of Camden, Campbelltown and Wollondilly."

TRILITY Managing Director Francois Gouws said, "We are very proud of the partnership we have built with Sydney over the past 24 years. It's a partnership built on collaboration and the exceptional services provided by the Macarthur Operational team.

"The award of this upgrade is a testament to the relationship, and together, we will continue to deliver quality water to the Camden, Campbelltown and Wollondilly areas of New South Wales," he said.

Ceremonial smoking ceremony conducted by Daniel Chalker. (Macarthur region Aboriginal Elder Glenda Chalker gave the Welcome to Country address and the smoking ceremony.)

Image : ©TRILITY.

Renewable hybrid microgrid to power WA goldmine

A renewable hybrid microgrid incorporating wind, solar, battery and gas power is under construction at a WA goldmine. Claimed to be the first Australian mine to be powered by a microgrid, the system at the Gold Fields-owned Agnew Gold Mine is expected to provide 55 to 60% of the mine's energy requirements, with the potential to meet almost all energy requirements at certain times.

The Australian Renewable Energy Agency (ARENA) is providing $13.5 million in funding to develop the microgrid, which will consist of a 18 MW wind farm powered by five wind turbines, a 10,000-panel 4 MW solar farm and a 13 MW/4 MWh battery energy storage system. To ensure security and reliability, the microgrid will be underpinned by a 16 MW gas-engine power station.

ARENA CEO Darren Miller said the project marks a growing shift in thinking around powering mine sites.

"The project Gold Fields is undertaking will provide a blueprint for other companies to deploy similar off-grid energy solutions and demonstrate a pathway for commercialisation, helping to decarbonise the mining and resources sector," he said.

"ARENA is continuing to help build a business case for renewables in mining, which has been underlined by other successful projects such as Rio Tinto's Weipa project and Sandfire Resources' DeGrussa Solar Project, reducing their fuel consumption by up to 20%.

"We're excited to see more mining companies taking up renewable options and Gold Fields' project comprising solar, wind and battery is helping to position into a more reliable and sustainable energy supply to call upon for the life of the mine," Miller said.

Gold Fields is set to adopt operational practices such as dynamic load shedding, renewable resource forecasting and IPP-controlled load management to maximise renewable energy use while maintaining system security.

Gold Fields Australia Executive Vice President Stuart Mathews said, "The Agnew hybrid microgrid project reflects the company's strategic objective to strengthen energy security, optimise energy costs and reduce its carbon footprint through innovation and the adoption of new technologies. The ARENA contribution significantly supports and encourages our efforts."

Sustainable distributed energy producer EDL will design, construct, own and operate the microgrid to power the Agnew Gold Mine in two stages, under a 10-year agreement with Gold Fields. The first stage involving a new off-grid power station incorporating gas, diesel generation and solar is due to be completed in mid 2019. The second stage including the wind, battery and microgrid system recently started construction and will be completed in 2020.

EDL CEO James Harman said the company had seen increasing momentum towards hybrid energy solutions, particularly in remote off-grid locations.

"EDL is pleased to be an active contributor to Australia's transition to sustainable energy," Harman said.

"Our strong base of knowledge and experience from our successful hybrid renewable projects will enable us to provide Agnew Gold Mine with greater than 50% renewable energy over the long term, without compromising power quality or reliability."

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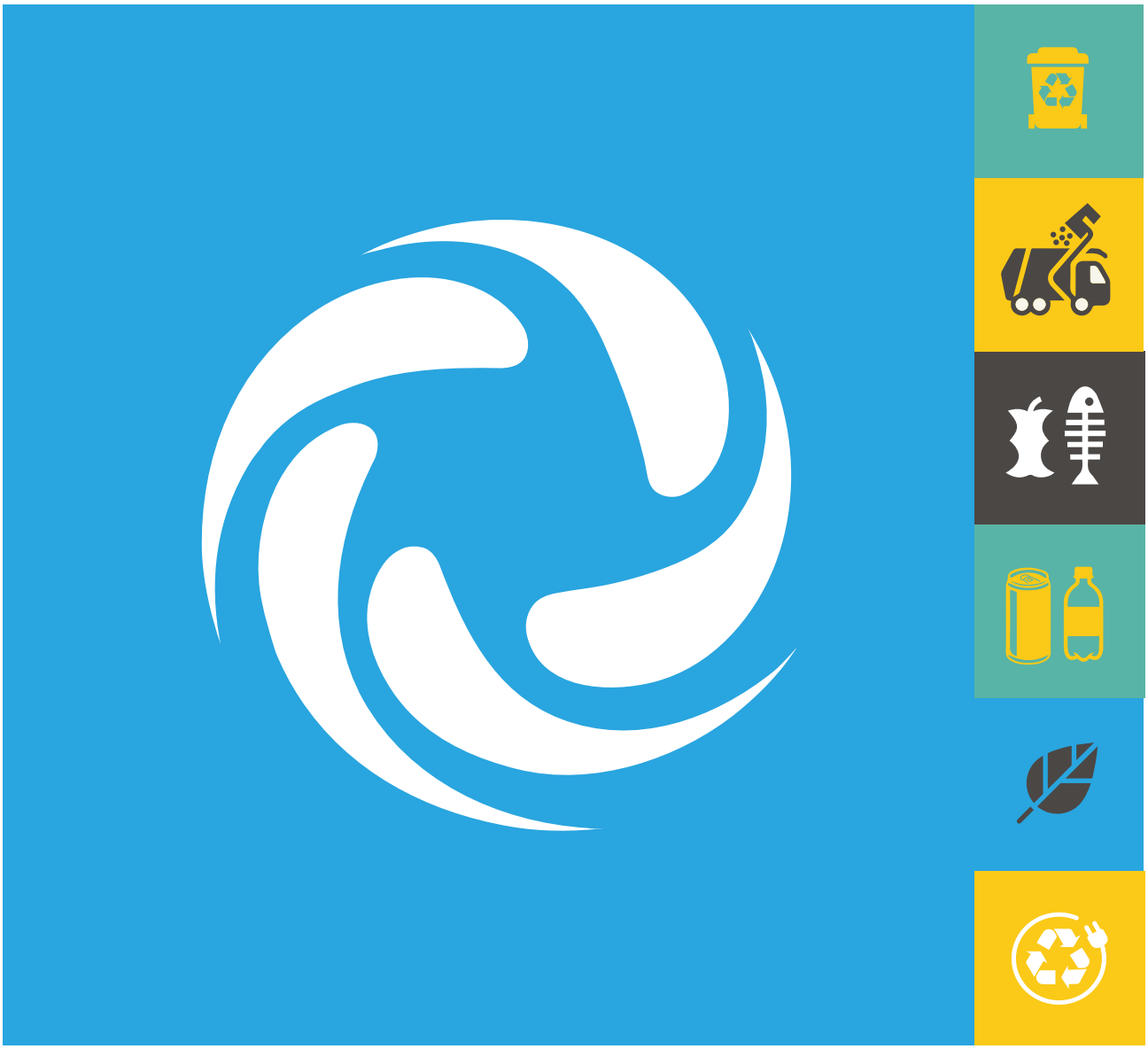

The need for new and better waste solutions has never been more crucial. Australians are looking towards the waste and recycling industry to drive positive change. As the premier business event for the waste, recycling and resource recovery sector, AWRE is where the best come together to join forces for a world of solutions towards a cleaner, more sustainable future.

Tenth Edition

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Concrete evidence that glass can replace sand

Researchers from the Deakin School of Engineering have discovered that recycled or waste glass can substitute sand when making polymer concrete, a material often used in the construction industry.

Image: Donna Squires, Deakin University.

Samples of ground glass used in polymer concrete.

Polymer concrete is a type of concrete that uses polymers, typically resins, to replace lime-type cements as a binder. This produces a high-strength, water-resistant material suited to industrial flooring and infrastructure drainage, particularly in areas subject to heavy traffic such as service stations, forklift operating areas and airports.

Senior engineering lecturer Dr Riyadh Al-Ameri explained that, according to the World Economic Forum, the construction industry represents 6% of global GDP.

"Concrete is a major construction material and sand is one of its primary components, so finding an alternative to sand makes good economic sense. This research provides the evidence the construction industry needs to see the potential of glass as a substitute for sand when making polymer concrete and, potentially, concrete," Dr Al-Ameri said.

"Mined sand requires washing and grading before it is added to aggregate, cement and water to make concrete. We have found that substituting sand with ground recycled glass makes the polymer concrete stronger and is a sustainable use of one of the major types of recyclables in the domestic waste stream.

"Any changes that reduce the cost of production will lead to significant gains across the industry, potentially on a global scale," he continued.

Deakin Engineering student Dikshit Modgil worked with Melbourne-based Orca Civil Products as part of his Masters research into the suitability of recyclable glass in polymer concrete production.

Orca Civil Products Director Alan Travers said the research partnership had produced results that would be useful in taking the concept further towards commercialisation.

"The specific type of waste glass used in this project was unsuitable for recycling back into glass and the amount that is stockpiling is becoming a community problem," Travers said. "The concept has even more appeal to us because of predicted shortages of natural, mined sands in the medium term."

Dr Al-Ameri said the next stage of Deakin's research would examine substitutes for the aggregate in polymer concrete, optimising the substitution rate, assessing durability and the commercialisation of the new product.

WA's City of Cockburn trials recycled asphalt

The City of Cockburn in Western Australia is trialling the use of recycled asphalt in a new coastal community south of Perth.

Selected roads in Frasers Property's newly developed Port Coogee will be sealed with Reconophalt, a road-surfacing material made from plastic bags, toner cartridges, crumb rubber from car tyres and recycled asphalt pavement.

Claimed to be a WA first, the trial is an example of how local government and the private sector can collaborate and innovate with new environmentally friendly methods.

City of Cockburn Waste Education Officer Nicki Ledger said, "The City is proud to support this trial by Frasers Property and Densford Civil, the first of its kind in WA, and will certainly be looking to continue using Reconophalt in Cockburn in the future.

"We believe it is vital to encourage the use of recycled materials wherever possible, to stimulate the development of recycling industries here in Australia," she said.

Downer Group will supply the road-surfacing material for the project, which will be installed by Densford Civil.

Reconophalt comprises a variety of recycled waste materials including: recycled plastic bags collected through the REDcycle program in supermarkets; waste toner from printer cartridges, collected through Close the Loop collection points; crumb rubber from car tyres; and recycled asphalt pavement. In addition to its environmental benefits, Reconophalt lasts longer than standard asphalt, with a 65% improvement in durability.

Stuart Gardiner, General Manager — Residential WA at Frasers Property Australia, said innovations such as this could generate positive waste minimisation implications.

"This progressive environmental solution in the waterfront community at Port Coogee demonstrates the importance of sustainable partnerships to create economic, social and environmental value for materials that would more than likely end up in landfill, or as pollutants in our natural environments.

"We look forward to monitoring the trial of this recycled asphalt and how the new surface performs over time," Gardiner said.

Cecilia and Skerne Lanes in Port Coogee, WA, will be sealed with recycled asphalt.

©Frasers Property Australia.

Waste Expo Australia

Waste Expo Australia is a comprehensive, free-to-attend conference for the waste management, resource recovery and wastewater sectors.

The conference program will feature the Waste Summit Conference, brought to you by Oceania Clean Energy Solutions, which will cover six targeted streams covering resource recovery, waste-to-energy, collections, landfill and transfer stations, construction and demolition waste as well as commercial and industrial waste. In this program you will hear from The Hon Lily D'Ambrosio MP, Dr Cathy Wilkinson (Chief Executive Officer, EPA Victoria), Matt Genever (Director, Resource Recovery Sustainability Victoria), Dr Kar Mei Tang (Acting Executive Director, Waste Strategy and Policy NSW EPA), Barry Cosier (Director, Sustainability Australian Food and Grocery Council), as well as case study presentations from councils.

Waste Expo Australia will also feature the Wastewater Summit, brought to you by EnviroConcepts. This targeted conference will address the challenges and opportunities in wastewater treatment and will feature speakers from leading water utilities.

Waste Expo Australia Event Director Cory McCarrick recognised the importance of experts in waste management and business coming together to discuss how best to overcome Australia's challenges in waste disposal.

"Waste Expo Australia is about pushing boundaries and challenging operations and businesses across the entire value chain to innovate its waste management practices. There is no other event that gives you access to this calibre of content or suppliers for free," McCarrick said.

Another significant benefit of Waste Expo Australia is its co-location with All-Energy Australia, Energy Efficiency Expo and ISSA Cleaning and Hygiene Expo, forming the nation's most significant showcase for the waste, recycling, wastewater, renewable energy, energy efficiency and cleaning industries.

Across the two days at Melbourne Convention and Exhibition Centre, attendees will have unrivalled access to industry speakers and suppliers across waste management, wastewater treatment, energy generation, energy efficiency, and cleaning and hygiene. Registration gives you access to all four events.

To register for this ultimate conference and exhibition showcase, visit www.wasteexpoaustralia.com.au.

Reed Exhibitions

www.reedexhibitions.com.au/

West Melbourne welcomes paper sorting facility

A $2.5 million paper sorting facility has opened in Truganina, West Melbourne, to process 39,000 tonnes of recycled paper a year. The Australian Paper Recovery facility received an injection of $475,000 from the Labor state government as part of its $2.6 million investment in Recycling Industry Transition Support Grants, which aim to help transition Victoria's resource recovery and reprocessing industry after the collapse of the export market to China.

The Truganina recycling facility will provide separation of kerbside and commercial mixed paper and cardboard — the graded paper will then be reprocessed locally and recycled into products such as newspaper and packaging. Additional materials from regional and metropolitan kerbside recycling, including plastics and metals, will also be accepted for processing.

Launching the new recycling facility, Minister for Energy, Environment and Climate Change Lily D'Ambrosio said, "Facilities like these are a crucial part of reducing the amount of waste that goes to landfill — it's fantastic to see Australian Paper expand their operations to accept more materials.

"A circular economy will not only improve Victoria's waste and recycling systems — it will support local businesses and create local jobs here in Victoria," she said.

The Victorian State Budget 2019/20 is investing $35 million to strengthen and diversify the state's waste and recycling industry.

UNSW Sydney will operate as a sustainable 'city'

UNSW Sydney has launched a three-year strategy to deepen its commitment to environmental sustainability. Launched on this year's World Environment Day (5 June 2019), UNSW's Environmental Sustainability Plan (ESP) 2019–21 details how the university plans to switch to 100% renewable electricity, expand solar energy generation and improve energy and water efficiency to reduce its environmental footprint. The aim is to make onsite buildings free of greenhouse gas emissions by 2020.

UNSW President and Vice-Chancellor Professor Ian Jacobs said the plan sets out a roadmap for best practice in the higher education sector.

"Our planet is currently facing a series of complex environmental challenges, from pollution of land and oceans to biodiversity loss and climate change," he said. "UNSW is a major investor, consumer and landholder, and our Sydney campuses form part of the daily lives of some 62,000 students and more than 6700 staff. The university has the scale of a small city, so it is right that we grow and invest like any sustainable city would, with a responsible and clear plan."

Under the new plan, UNSW will increase its onsite solar energy generation through the university's solar energy agreement, design new buildings to operate emissions-free and introduce centralised waste collection in offices to save an estimated one million plastic liners annually. Energy efficiency upgrades will target the least efficient buildings on campus, saving enough electricity to power around 400 homes by 2022. Improvements to water efficiency on campus will save 12,000 m^3 of water per year.

UNSW has also committed to integrate best practice environmental, social and governance principles within investment activities by establishing a Responsible Investment Framework. This will allow the university to invest in climate change solutions and align its investment portfolio with the Paris Agreement.

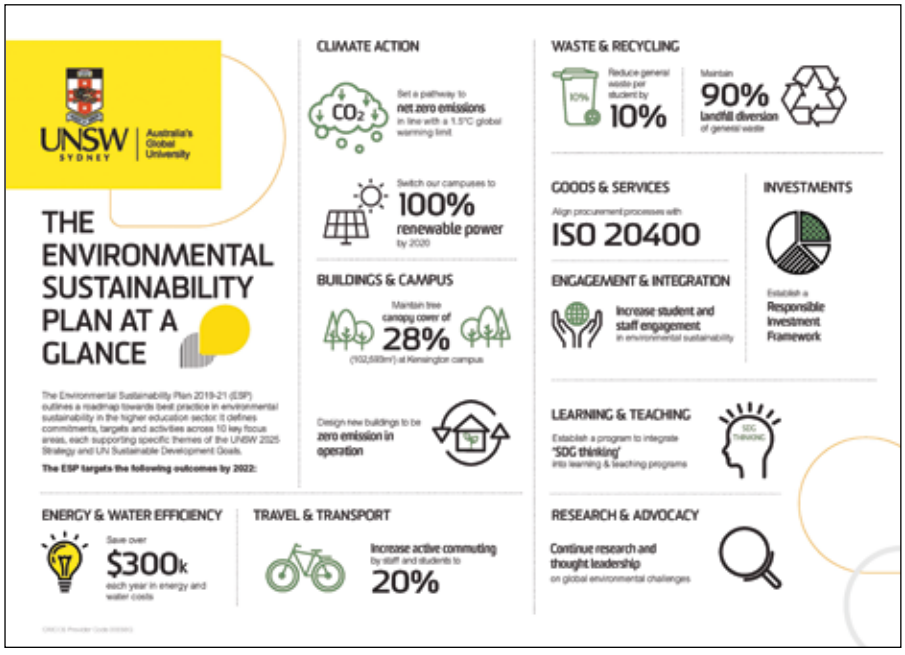
Prof. Jacobs said UNSW has a history of environmental stewardship across research, learning and teaching and campus operations. "About 50% of the solar panels sold worldwide today use UNSW-designed technology, and our alumni are at the forefront of the photovoltaics and energy transition industries globally. Our new plan builds on these achievements while significantly raising our levels of ambition to respond to the scale of environmental challenges we face today," he said.

The ESP addresses key environmental issues, defining commitments, targets and activities across 10 focus areas that support the UNSW 2025 Strategy and United Nations Sustainable Development Goals (SDGs).

"UNSW's research, learning and teaching programs aim to address environmental challenges that are critical to the future of our planet," UNSW Head of Environmental Sustainability William Syddall said. "Under this plan, we will develop a set of resources that engage the student and staff community in the SDGs through learning and teaching programs, while making sure academic staff are able to decide how to include SDG thinking within their courses.

"Once UNSW has eliminated greenhouse gas emissions from building energy use by 2020, our focus will turn to indirect sources of emissions such as travel, embodied emissions and purchased goods and services," he said.

"We hope this plan inspires not only our university community but the wider community to take action for a sustainable future."



Construction costs cut with on-site recycling

The latest in mobile crushing technology has been deployed on a steep and challenging residential building site in the southern Sydney suburb of Sylvania, where it has been used to crush demolition spoil for recycling via an innovative new process.

An MB C50 crusher bucket, fitted to an 8-tonne Kubota hydraulic excavator, was utilised on the Sylvania site, which presented challenges in terms of gradient and need for stabilisation. The crusher processed tiles, bricks, mortar and foundation concrete that was recycled in situ, resulting in large and stable foundations on which two new homes are being built.

Thanks to Soilstone technology, unwanted or excess soil material, demolished concrete and brick material can be engineered to form a mass-engineered soil structure for use and function on construction sites. The technology uses mechanical and natural chemical processes to treat native spoil to produce the properties of rock that can be formed into a structure.

Instead of building foundations from purchased concrete, the natural site material is crushed together with additive chemicals that recycle the spoil into a durable and progressively hardening rock-like mass. The process has been tested, evaluated and approved by the NSW building regulator.

The engineered in situ soil and processed waste aggregates mix provides a simple alternative in ground improvement that minimises the use of material grading and compaction requirements, yet attains the properties of varied shear, compressive and bonded strength of stone. The process has been used successfully for mitigation of soil erosion, improved bearing capacity or subgrade reaction, improved resistance to water permeability and improved resistance to ground movement and vibration forces.

A major benefit of the site drainage design is the ability to form multiple drainage lines while retaining structural mass and stability. The environmentally sustainable material is moisture-impervious, meaning it can be used to form drainage and other structures in a way that would be difficult or more expensive than if using poured concrete. The material is also not prone to corrosion like steel.

Retaining walls produced from crushed and treated recycled demolition spoil on site.

The process is suitable for applications such as slope embankment stabilisation, buttressing to halt and remediate coastal erosion, complex construction, flood mitigation and management, and the prevention and repair of flood damage to buildings. It can also be used as an alternative material in waffle pods; foundation works retrofitting and stabilisation; road base materials; mine site erosion control; landfill contamination control; and other in situ ground improvement works.

MB crusher and screening buckets allow operators and contractors to reprocess materials in situ, helping reduce the load on the environment by making useful by-products of otherwise low-value raw feed. In urban areas the carting and dumping costs alone often mean a fast ROI, and in rural areas it can mean producing useful and valuable materials in places where buying materials is often prohibitively expensive.

In the case of the Sylvania site, the Soilstone process not only provided a suitable engineering solution, it also saved the customer in excess of $36,000, which would have been required for material removal and disposal costs.

"Typically, you save around 50% of the material that has to be removed off site," said Soilstone's developer, consulting and research engineer Edgar Agda. "This means all construction materials can be minimised. The reconstituted material is extremely stable yet can be drilled easily or have sections cut out to add or retrofit service lines.

"In addition, there is virtually no limit to the type of material that can be used for the process. Sand, gravel, clay rock recycled bricks, tiles, tyre waste and processed plastic can be used."

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Are virtual power plants the solution to our energy challenges?

Fundamentally, the electricity grid has always been about keeping demand equal to supply. However, our electricity system is being disrupted. Australians are installing solar set-ups at record rates. Home owners no longer want to sit on the sidelines, they want to participate.

With the introduction of distributed renewable electricity and advancements in technology, electricity supply has become variable and unreliable. As a result, we're transitioning from a top-down centralised fossil fuel system with only a single direction of power to a distributed renewable bidirectional system.

Energy Networks Australia predicts that by 2050 between 30–45% of Australia's entire electricity needs will come from customer-owned generators. This added generation comes with a whole new set of problems.

Energy now comes from the sky for free, converted by solar panels, and it will continue to come from the sky for free in greater volumes. The problem is that it comes whenever it wants to.

We're now focused on finding solutions that are power focused not energy focused. Solutions that can generate at specific times, that can react/adapt when market prices change and when fuel sources change. To overcome this change we've created a new type of generational asset — the virtual power plant (VPP).

VPPs can exist at a scale similar in size to that of traditional spinning generators. In fact, they behave in much the same way as those large-scale generators, delivering energy on demand, responding to market triggers for delivery of energy services and providing grid-balancing services.

VPPs have the ability to alter the relationship between the energy consumer and the energy they consume. No longer will households passively devour energy without thought of the goings on in the grid.

Smart tech companies like Reposit Power are changing the Australian electricity system by enabling energy companies and home owners to collaboratively solve grid issues for mutual benefit and the greater good of our planet.

> **"VPPs are not just about creating smart tech; they are also about facilitating agreements between retailers, networks, government, solar installers and, importantly, home owners.**

VPPs are not just about creating smart tech; they are also about facilitating agreements between retailers, networks, government, solar installers and, importantly, home owners. Everyone has a vested interested in futureproofing Australia's electricity system and only through collaboration can we achieve this.

In late 2017, together with government, the local retailer, network, installers and home owners, Reposit Power launched a VPP in Canberra. The success of the Canberra VPP has come not just from some clever engineering, but from smart collaboration.

The VPP was about removing barriers to home owners by unlocking extra value from their solar battery set-ups; finding ways to deliver positive outcomes for market participants by using existing regulatory frameworks; being holistic and building solutions to futureproof our system rather than solving single, isolated issues; and investing in the skills and knowledge of solar installers.

The VPP started with 250 home owners and, in just 18 months, the Canberra VPP has almost 1000 home owners actively participating.

These home owners regularly demonstrate that everyday Australians with smart solar battery technology can not only change our reliance on coal-generated energy to renewable energy, but change our electricity system to one where everyone shares in the value.

Reposit now operates 12 VPPs throughout Australia.

Dean Spaccavento, CEO and co-founder of Reposit Power, has a passion for energy, sparked from a technology career in the finance sector. Dean has followed the evolution of renewable energy and storage, building a mathematical model with his co-founder to muster support from the banks, leading to the development of software to integrate solar battery systems and build VPPs.

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