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WORDS FROM THE EDITOR

An international group of researchers led by The University of Sydney has quantified the socio-economic losses and environmental gains of the COVID-19 pandemic. The team found that consumption losses amount to more than US\$3.8 trillion, triggering full-time equivalent job losses of 147 million. While at the same time environment pressures are easing, with greenhouse gas emissions dropping 2.5 Gt (4.6%), which is said to be the largest drop in human history. Previous significant drops in greenhouse gas emissions were during the global financial crisis in 2009 (0.46 Gt) and as a result of land-use changes (under the Kyoto Protocol) in 1998 (2.02 Gt).

While in other research, two researchers from UNSW Sydney have revealed that a transition from fossil fuels to renewable energy will not lead to macro-economic damage, and that any claims to the contrary are exaggerated and based on decades-old data. The study focused on wind and solar, with the findings revealing that transitioning to renewable energy will reap environmental and long-term economic benefits, with the possibility of energy return on energy invested (EROI).

This issue has a focus on resource recovery following the Australian Government's recent announcement that it will invest \$190 million in the Recycling Modernisation Fund (RMF). With matched investment from state governments and industry, recycling resource infrastructure in Australia is set to be transformed to benefit the nation's waste and recycling capacity.

Enjoy the read and stay healthy!

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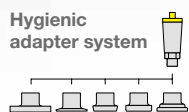


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\$190m "bonza" boost to recycling industry



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The Recycling Modernisation Fund (RMF) is set to generate \$600 million of recycling investment from federal, state and industry stakeholders.

The Australian Government will invest \$190 million in resource recovery infrastructure to transform the nation's waste and recycling capacity — a huge milestone for recycling, according to the Australian Council of Recycling (ACOR), the national peak body for the \$1.5 billion industry that employs 50,000 Australians.

The Recycling Modernisation Fund (RMF) is set to generate \$600 million of recycling investment from federal, state and industry stakeholders. More than 10,000 jobs will be created, with over 10 million tonnes of waste diverted from landfill for making useful products.

ACOR CEO Pete Shmigel said the environmental and employment benefits of recycling will be turbocharged by the RMF commitments.

"This bonza and unprecedented investment will transform Australian recycling and help make it domestically sustainable. RMF builds on our industry's own innovation and investment in making more recycled content products and generating high-vis regional jobs right here in Australia," he said.

"Full marks to Ministers, especially Commonwealth Ministers, in going where recycling policy has not gone before: real recognition of recycling's benefits, real coordination, real money and now real results," Shmigel said.

The RMF will support innovative investment in new infrastructure to sort, process and remanufacture materials such as mixed plastic, paper, tyres and glass, with Commonwealth funding contingent on co-funding from industry, states and territories.

The waste and recycling transformation is being further strengthened by an additional:

- \$35 million to implement Commonwealth commitments under Australia's National Waste Policy Action Plan, which sets the direction for waste management and recycling in Australia until 2030.
- \$24.6 million on Commonwealth commit-

ments to improve our national waste data so it can measure recycling outcomes and track progress against our national waste targets.

- The introduction of new Commonwealth waste legislation to formally enact the government's waste export ban and encourage companies to take greater responsibility for the waste they generate, from product design through to recycling, remanufacture or disposal (product stewardship).

The moves are part of a national strategy to change the way Australia looks at waste, grows our economy, protects our environment and reaches a national resource recovery target of 80% by 2030.

"As we cease shipping our waste overseas, the waste and recycling transformation will reshape our domestic waste industry, driving job creation and putting valuable materials back into the economy," Minister for the Environment Sussan Ley said.

"Australians need to have faith that the items they place in their kerbside recycling bins will be re-used in roads, carpet, building materials and a range of other essential items.

"At the same time, we need to stop throwing away tonnes of electronic waste and batteries each year and develop new ways to recycle valuable resources.

"As we pursue National Waste Policy Action Plan targets, we need manufacturers and industry to take a genuine stewardship role that helps create a sustainable circular economy.

"This is a once-in-a-generation opportunity to remodel waste management, reduce pressure on our environment and create economic opportunity," Ley said.

Assistant Minister for Waste Reduction and Environmental Management Trevor Evans said that the unparalleled expansion of Australia's recycling capacity followed close consultation with industry.

"Our targeted investment will grow Australia's circular economy, create more

jobs and build a stronger onshore recycling industry," Assistant Minister Evans said.

"Australian companies are turning plastics and household waste into furniture, decking, fencing and clothing, and we are developing new domestic markets for recycled materials by setting national standards for recycled content in roads and making recycled products a focus of procurement for infrastructure, defence estate management and general government purchasing.

"Our targeted investment will grow Australia's circular economy, create more jobs and build a stronger onshore recycling industry.

"Companies are already moving with The Pact Group announcing a \$500 million investment in facilities, research and technology; Coca-Cola Amatil committing to new recycling targets; and Pact, Cleanaway and Asahi Beverages establishing a \$30 million recycling facility in Albury."

The unparalleled expansion of Australia's recycling capacity follows the 2019 National Waste Policy Action Plan, Australia's government ban on exports of waste plastic, paper, glass and tyres, and this year's first ever National Plastics Summit.

According to Shmigel, "The next key step for the transformation of Australian recycling — and to meet Australians' expectation that their efforts stack up — is 'buying recycled' by governments, corporations and the community.

"More recycling factories only make sense when there is demand for their recycled-content products, such roads and packaging," he said.

"Lighthouse projects using recycled content materials are needed so that the community can see the positive results of their ongoing participation.

"With ambitious National Waste Policy targets only four years away, it's time governments further put money — such as from \$1.5 billion collected from the community in landfill levies — where their mouths are in that respect too," Shmigel said.

Closing the carbon loop

A team of chemical engineers has found a novel way to convert waste CO₂ into industrial products.

Chemical engineers from UNSW Sydney have developed a technology that helps convert carbon dioxide emissions into chemical building blocks to make useful industrial products like fuel and plastics.

The researchers have demonstrated that by making zinc oxide at very high temperatures using a technique called flame spray pyrolysis (FSP), they can create nanoparticles that act as the catalyst for turning carbon dioxide into 'syngas' — a mix of hydrogen and carbon monoxide used in the manufacture of industrial products. The researchers say this method is cheaper and more scalable to the requirements of heavy industry than what is available today.

The findings are published in the journal *Advanced Energy Materials*.

"We used an open flame, which burns at 2000 degrees, to create nanoparticles of zinc oxide that can then be used to convert CO₂, using electricity, into syngas," said co-author Dr Lovell from UNSW's School of Chemical Engineering.

"Syngas is often considered the chemical equivalent of Lego because the two building blocks — hydrogen and carbon monoxide — can be used in different ratios to make things like synthetic diesel, methanol, alcohol or plastics, which are very important industrial precursors.

"So essentially what we're doing is converting CO₂ into these precursors





Chemical engineers from UNSW Sydney have developed a technology that helps convert carbon dioxide emissions into chemical building blocks to make useful industrial products like fuel and plastics.

that can be used to make all these vital industrial chemicals.”

Co-author Dr Daiyan explained that, in an industrial setting, an electrolyser containing the FSP-produced zinc oxide particles could be used to convert the waste CO_2 into useful permutations of syngas.

“Waste CO_2 from, say, a power plant or cement factory, can be passed through this electrolyser, and inside we have our flame-sprayed zinc oxide material in the form of an electrode. When we pass the waste CO_2 in, it is processed using electricity and is released from an outlet as syngas in a mix of CO and hydrogen,” he said.

The researchers say that, in effect, they are closing the carbon loop in industrial processes that create harmful greenhouse gases. And by making small adjustments to the way the nanoparticles are burned by the FSP technique, they can determine the eventual mix of the syngas building blocks produced by the carbon dioxide conversion.

“At the moment you generate syngas by using natural gas — so from fossil fuels,” Dr Daiyan said. “But we’re using waste carbon dioxide and then converting it to syngas in a ratio depending on which industry you want to use it in.”

For example, a one-to-one ratio between the carbon monoxide and hydrogen lends itself to syngas that can be used as fuel. But a ratio of four parts carbon monoxide and one part hydrogen is suitable for the creation of plastics, Dr Daiyan explained.

In choosing zinc oxide as their catalyst, the researchers have ensured that their solution has remained a cheaper alternative to what has been previously attempted in this space.

“Past attempts have used expensive materials such as palladium, but this is the first instance where a very cheap and abundant material, mined locally in Australia, has been successfully applied to the problem of waste carbon dioxide conversion,” Dr Daiyan said.

Dr Lovell added that what also makes this method appealing is using the FSP flame system to create and control these valuable materials.

“It means it can be used industrially, it can be scaled, it’s super quick to make the materials and very effective,” she said.

“We don’t need to worry about complicated synthesis techniques that use really expensive metals and precursors — we can burn it and in 10 minutes have these particles ready to go. And by controlling how we burn it, we can control those ratios of desired syngas building blocks.”

Scaling up

While the duo have already built an electrolyser that has been tested with waste CO_2 gas that contains contaminants, scaling the technology up to the point where it could convert all of the waste carbon dioxide emitted by a power plant is still a way down the track.

“The idea is that we can take a point source of CO_2 , such as a coal-fired power plant, a gas power plant or even a natural gas mine where you liberate a huge amount of pure CO_2 , and we can essentially retrofit this technology at the back end of these plants. Then you could capture that produced CO_2 and convert it into something that is hugely valuable to industry,” Dr Lovell said.

The group’s next project will be to test their nanomaterials in a flue gas setting to ensure they are tolerant to the harsh conditions and other chemicals found in industrial waste gas.



recycling

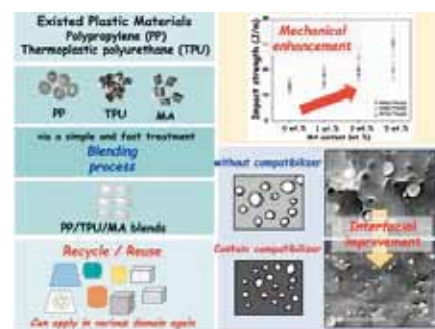
Reshaping plastics recycling

Plastics do not decompose like natural materials, which has led to a vast build-up of unwanted plastic in the environment. Plastic waste can be eliminated by melting or burning, but this results in other problems such as toxic fumes and contribution to global warming. A method to melt different plastics together could be a solution.

The varying properties of different plastics poses a challenge when it comes to recycling. Separating and treating each type of plastic adds to the cost of recycling, which reduces the incentive to do so, despite the irreversible and detrimental biological cost of plastics in the environment. But what if different plastics could be recycled together?

Researchers Tingan Lin and Limin Bao — along with their team at Shinshu University, Japan — have examined the recyclability and sustainable development of thermoplastic materials. Thermoplastic materials soften when heated and harden when cooled, and can be cooled and heated several times without any change in their chemical or mechanical properties. Used in many industry and household applications, thermoplastics can be moulded into any shape.

In the study, published in the *Journal of Materials Research and Technology*, the Shinshu University research team examined thermoplastic polyurethane and polypropylene — each plastic has a different melting point (at 145 and 165°C, respectively), so melting them together posed a challenge. To solve this issue, Lin and colleagues added a compatibiliser (polypropylene-grafted maleic anhydride) to act as a go-between, which enabled the plastics to be processed at the same time. The quality of the plastic was not undermined.



Scientists successfully blended different types of plastics to be recycled together, providing a solution to the environmental problem of plastic waste and adding economic value to plastic materials.

Using only a small amount of the compatibiliser, the researchers were able to efficiently produce thermoplastic blends using the melt extrusion and injection moulding processes.

The researchers hope their findings will allow unwanted plastic to be economically valued again and protect wildlife and the environment from further pollution. Professor Bao hopes to continue the study of thermal behaviours to see how they affect the reusability of thermoplastic-based materials.



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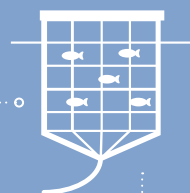
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Toxic wastewater cleaned up using electricity

Electricity could soon be used to clean up heavily contaminated industrial wastewater streams.

A team of engineers from the School of Chemical and Biomolecular Engineering at the University of Sydney developed an electrochemical oxidation process, with the aim of cleaning up complex wastewater that contained a toxic combination of chemical pollutants.

“Our study, published in *Algal Research*, involved industrial wastewater that had been heavily contaminated with a cocktail of organic and inorganic species during a biofuel production process,” said Julia Ciarlini Jungers Soares, who is completing a PhD in Chemical and Biomolecular Engineering.

The wastewater, which contained carbon, nitrogen and phosphorus, was generated in a pilot plant, designed by the team for the production of biofuels using naturally abundant microalgae.

The process involved treating wastewater with electricity using specialised

electrodes. They discharged electricity, then drove oxidation reactions near the electrode surfaces, transforming the organic contaminants into harmless gases, ions or minerals.

“We have employed an incredibly powerful process that eliminates even the most persistent non-biodegradable pollutants, such as pharmaceuticals and pesticides, as well as various classes of organic compounds that can be found in many industrial effluents,” she said.

“The process is relatively simple, does not require the addition of chemicals or severe operation conditions, and does not produce additional waste streams.

“Wastewater is a significant issue for our environment, as well as for many industries who use substantial volumes of water in their processes, such as in reactions, transport, and washing and cooling. Finding suitable solutions for re-use or disposal is often very challenging and costly.

“The electrochemical method that we used can be readily applied to industries that must comply with strict regulations for wastewater disposal, such as pulp and paper processing, wineries, as well as pharmaceutical production facilities.

“Worldwide, researchers are investigating methods for the development of biofuels from algae. Developing alternatives for the treatment and re-use of this industrial effluent is a hot research topic and can bring opportunities for energy and resource recovery within a circular bio-economy framework.”

The team will soon carry out research focused on specific contaminants to better understand the chemical transformations that take place during electrochemical oxidation and will upscale the process.

A 2017 UNESCO report found that the opportunities from exploiting wastewater as a resource were vast, and that safely managed wastewater is an affordable and sustainable source of water, energy, nutrients and other recoverable materials.

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Save our soil

The impact of climate change on soil remediation

Following extreme weather conditions across Australia, Daniel Webber, Business Development Manager at CDE, explains the reality of climate change and how it threatens to unearth the history of Australia's soil contamination, highlighting the remediation solutions that can remove toxins from the environment around us.

In the summer of 2019/2020, Australia faced devastation from harsh weather conditions, experiencing some of the worst bushfires on record, extreme dust storms across New South Wales, flash flooding in Queensland and long periods of drought.

Every day we are living with the reality of climate change and witnessing its impact on our environment — and without stark intervention, the consequences of global warming on our climate will be felt for decades to come.

Indeed, the Intergovernmental Panel on Climate Change (IPCC) reported temperatures could rise by 1.7°C by the end of 2100 and sea levels could continue to rise globally.

Daniel Webber, Business Development Manager at CDE Global, explained the delicate balance that exists between climate and our soil, revealing that the rate of change is having a profoundly negative impact on soil contamination levels.

"Contaminated soils are a key contributor to hazardous waste in Australia, yet the full extent of soil contamination is not yet fully known."

Webber said this is due to variants in reporting between districts and a lack of historical reporting.

The Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) reports over 160,000

contaminated sites nationally. Of these, it's estimated that less than 10% have been remediated.

"Australian soil has been contaminated with conventional and emerging contaminants for decades," Webber continued, "including heavy metals, hydrocarbons, organic matter and man-made chemicals."

Increasing soil temperatures from climate change and recent bushfires has led to increased soil toxicity and greater bio-availability.

"These weather patterns are having devastating effects on our soils and will unearth years of historical contamination."

Research has shown the long-term effects of climate change, with increasing floods and drought conditions facilitating the movement of soil-based contaminants and soil erosion.

A study by CRC CARE published in *Soil Systems* found soil erosion at a rate of 70–300 tonnes per hectare (tph), compared with what were defined as typical losses in the region of 60–80 tph.

According to Webber, our changing weather is causing the level of soil erosion to increase and dust storms will accelerate the spread of toxic pollutants in exposed soil.

One such consequence of climate change is the prevalence of dust storms, which, according to data from DustWatch, are occurring more frequently.

The movement of contaminants in dust storms presents huge health and environmental risks, as pollutants enter the air and water before finally settling into the soil again.

Many contaminants such as lead, mercury and arsenic can enter the food chain and be ingested by humans, and with dust storms there are even more risks from breathing in harmful toxins.

"Exposure to toxic contaminants can have a devastating impact on our health so we must find ways to diminish the risk," Webber urged.

"Many argue contaminated soil sites surrounding our waterways and agriculture lands are those which urgently require remediation. Our peers in the waste industry and local government are determined to clean up years of contamination and have already successfully remediated inorganic and organic materials.

"Yet we cannot do this alone, we need more to join us as we try to make Australia's soils safe again."

Successes have been reported. For example, the paper Soil: Formation and Erosion, published by Australia State of the Environment 2016, stated that soil erosion rates were equal to soil



formation rates. However, it remains to be seen how recent and unprecedented bushfires will affect this ratio, or by how much it will set remediation efforts back.

Outlining how CDE's bespoke soil washing solutions can support this effort, Webber said, "Our

technologies utilise a suite of mechanical, chemical and biological processes for recovering washed solids such as sand and aggregates. Contaminants are transferred into the water phase, which are effectively treated to produce recycled water for re-use within the process.

"CDE's bespoke solutions can be tailored based on tonnage and level of contaminants to ensure maximum efficiency within every project we deliver.

"Our systems provide savings on landfill charges, prevent extra investment in waste storage equipment and introduce new materials for re-use. We can no longer ignore soil contamination — we must utilise remediation technology to help us eliminate potential risk to human health and to protect the world around us."

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Flying Fish winery back in the air

One night, smack bang in the middle of vintage — the most hectic time of year — Hydro Innovations received a call from Damon Eastaugh of Margaret River winemaker Flying Fish Cove. Eastaugh's wastewater surface aerator had broken down. Not the most desirable situation to be in, especially in the midst of a pandemic that complicated the process of repairs or replacement.

Flying Fish Cove was in need of a simple, reliable and efficient replacement system, and fast.

Eastaugh had heard of bank-mounted aerators and was excited to learn how effective they could be and how much simpler the maintenance would be — he did not want to experience this annoying and costly situation again. Eastaugh also wanted to know if the bank-mounted aerator could be retrofitted to replace his existing surface aerator easily.

The team at Hydro explained the benefits of the Venturi Aerator — a bank-mounted aerator — and pinpointed the exact model to meet Eastaugh's requirements. The

benefit of the Venturi Aerator over a surface aerator is that the equipment is mounted on the bank of the lagoon. This makes maintenance and servicing simple and easy, which in turn means the equipment is more likely to be regularly serviced and have a longer life span than difficult-to-access aerators.

The Venturi Aerator does not need special equipment such as cranes or row boats, or any complicated annual certifications for servicing and maintenance.

Not only was Eastaugh happy with the pump and price, he was thrilled that Hydro could resolve his problem in less than four weeks, including transporting from the east coast to WA.

Eastaugh was not disappointed with the results of his new purchase. Shortly after installation, his biological oxygen demand had reduced by 1400 ppm from the previous month.



Hydro Innovations

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leak detection

Hounds hunt for leaks in water network

Hunting pedigree puppies are being trained to detect hidden leaks in city wastewater networks. Winnie, a highly intelligent Cocker Spaniel, and Ziggy, an energetic English springer spaniel, are the first dogs in Australia to detect leaks and odours in the wastewater network.

Minister for Water, Property and Housing Melinda Pavey said the puppies are being trained for a very important job.

"Winnie and Ziggy will help us to find and fix hidden leaks from the 26,000 kilometres of wastewater network, which if left undetected can lead to overflows into our creeks, waterways and the environment," Pavey said.

"As far we know, no other water utility around the world has trained dogs to detect leaks and odours at levels as low as these dogs can detect. Winnie and Ziggy are able to identify

the presence of sewage in minute concentrations, even when we might think it is okay.

"This is part of the NSW Government's ongoing commitment to protect our water, public health and the environment.

"These highly trained puppies will complement the existing approaches being used by our Sydney Water workforce, ensuring our water and wastewater services continue running reliably for the millions of people depending on these services every day."

The dogs have undergone months of intensive training with one of the country's leading dog trainers, Steve Austin, in Sydney. Sydney Water General Manager of Customer, Strategy and Engagement Maryanne Graham said these breeds are natural hunting dogs, historically used for hunting a variety of game.

"The dogs have an unbelievable sense of smell so when our regular methods are restricted by access for example, we can use the dogs to investigate and identify leaks," Graham said.

"Steve will also begin training a new puppy, Splash, who'll be taught to find leaks on the water network, using the smell of chlorine used to disinfect drinking water, which will be a first in NSW.

"Hidden leaks on the water network can turn into major breaks, and if we can identify them early, we can reduce water wastage, which is essential regardless of whether we're in drought or not."

During the drought, Sydney Water doubled proactive inspections on the water and wastewater network and increased its number of frontline crews responding to water main breaks caused by prolonged dry conditions and tree roots damaging pipes.

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Hairy solution for assessing water quality



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A team of researchers from Griffith University has used human hair waste to develop organic devices that test water quality.

Professor Qin Li and her team from the School of Engineering and Built Environment — in collaboration with Queensland University of Technology — synthesised highly fluorescent carbon dots from human hair waste with the ability to detect trace amounts of chloroform in water, a major by-product of water disinfection.

The carbon dots were created using a chemical-free process by heating up the hair to 180°C in an oxygen-deficient environment. The results are published in *Sustainable Materials and Technology*.

Carbon dots are small carbon nanoparticles (less than 10 nm in size) with varying functional groups on the surface with the ability to fluoresce when exposed to a range of chemical and biochemical contaminants. The intensity of the fluorescence changes when surface functional groups on the carbon dot interact with the particular chemical species, making them perfect for chemical sensor applications.

Professor Li said the contaminants the carbon dots target could be as unique as the individual whose hair from which they are made.

"It might sound strange, but hair is an extremely valuable waste product," Professor Li said.

"Being rich in protein and full of carbon and nitrogen, it is an excellent precursor for transformation into useful materials like carbon dots.

"Because hair is rich in nitrogen, when we altered the thermal treatment conditions, we produce carbon dots with different nitrogen-containing functional groups on their surface which bind specific contaminants."

Remarkably, the researchers also found that hair of different colours produced carbon dots that responded preferentially to differing pollutants.

Former Griffith University Research Fellow Dr Ehsan Eftekhari said, "The dark hair showed a high specificity for sensing chloroform pollution in water, while the blonde hair we tested was more sensitive to metal species like magnesium."

The carbon dots derived from dark hair, with nitrogen-based sensing antennas on the surface, were able to detect chloroform in as few as three molecules per billion water molecules.

"Chlorination is a widely adopted disinfection method in water treatment used to reduce pathogen risks and waterborne diseases, but it also creates by-products that have been linked to higher cancer rates," said study co-author Professor Fred Leusch, Chair of the Australian Water Quality Advisory Committee.

"So developing sensors to monitor the amount of chlorine used in treatment and the by-product concentrations in real time is of critical importance to public health," he said.

The carbon dot sensors could even tell the difference between very similar chemical contaminants.

"In this study, we found the nitrogen-based sensing antennae on the carbon dots' surface was sensitive to chloroform, but not to the chemically similar contaminant bromoform, due to the subtle difference in their electronic structures," Professor Li said.

"I'm constantly amazed by how much biological materials can teach us on designing functional products, such as carbon dots-based nanosensors.

"Using biowaste to make carbon dots for water quality sensors, without employing any harmful solvents, makes it a sustainable technology that truly adheres to the principles of green chemistry."



Managing saline effluent at CSG site

Concept Environmental Services (Concept) has completed construction of a 112-megalitre Saline Effluent Management System (SEMS) for a key CSG customer. The system consists of two Concept Tanks that each hold up to 56 million litres of brine produced by operations in the area.

This project is claimed to be the first of its kind in Australia, which will see a 30% reduction in brine processing time, meaning land can be returned to property owners years ahead of historical brine processes, providing considerable cost savings in land leasing fees.

The Lake Effect

Brine is a by-product of coal seam gas production, historically stored in massive brine ponds to evaporate and allowing sludge to be disposed of. However, this



method has proven ineffective, creating an ongoing concern for operators.

What is the problem with brine ponds?

Large bodies of naturally salty fluids (brine) are subject to the 'Lake Effect', which shows that the larger a body of water, the less effective evaporation becomes. Salt then creates a crust over the surface, further reducing evaporation and resulting in very large dams of stagnant fluid remaining unchanged indefinitely.

Saline Effluent Management System

The Concept's SEMS utilises the patented Concept Tank, which is a pre-stressed modular concrete structure taking up an area a third the size of a brine pond.

In addition, the 3-metre-high walls exclude ground animals from accessing the brine, protecting against poisoning as well as prohibiting damage to liners.

The Concept Tank is installed with double-lined leak detection and 24-hour monitoring, which notifies remote operators in the event of a primary liner breach, while the secondary liner acts as a 'closed loop', protecting the environment from contamination.

Concept Services

www.conceptservices.com.au/



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TasWater solves blockage and odour problem

Tasmanian water and sewage utility TasWater is responsible for providing drinking water across the state, as well as collecting and treating sewage.

The utility was experiencing issues with the magnesium hydroxide liquid (MHL) it was using at the Southern Wastewater Treatment Plant. The product was constantly blocking peristaltic pumps and dosing lines. Once blocked in the lines, the hardened, cement-like material had to be painstakingly chipped out of the pipework.

TasWater approached Netco Pumps, which ran a trial of Calix's ACTI-Mag product at the plant. This immediately proved successful as the product had a much finer molecular structure and was more viscous than the previous MHL. Overall, it proved much easier to pump and handle, and had a good reactivity time.

Several months later, TasWater experienced odour issues in the Hobart Eastern Shore network, where stations were being injected with oxygen. Netco ran a trial using ACTI-Mag dosing at four stations over the summer months to treat the odour and measure results. Dosing packages were installed and commissioned at each site, with spectacular results — the hydrogen sulfide gas



(H₂S) measurement at the receiving treatment plant was brought down to almost zero.

Netco Pumps General Manager Nathan Cruickshank said, "Calix ACTI-Mag ticked all our boxes for TasWater. While the dosing units were only supposed to be temporary, they are still in place today albeit [with] a few upgrades to make them more functional.

"The combination of an excellent product coupled with our unique delivery and maintenance service has resulted in a very painless experience for TasWater and its operators, at the same time solving odour issues and protecting

their assets from the stations through to the treatment plant."

ACTI-Mag has a higher neutralising value per kilogram compared with caustic and is reportedly safer to handle than other traditional alkalis, making it a good option for H₂S control in wastewater treatment. The product can also remove phosphorus from wastewater discharge, improving wastewater quality.

TasWater now has 14 ACTI-Mag dosing sites across its sites of various sizes.

Calix Limited

www.calix.com.au

No solvent, no effluent: a new approach to water treatment

A team of engineers from Swansea University's Institute for Innovative Materials, Processing and Numerical Technologies (IMPACT) has invented a machine — the Matrix Assembly Cluster Source (MACS) — that allows water to be treated without the need for solvents.

Research lead Professor Richard Palmer explained that removing toxic chemicals from water involves the destruction of harmful organic molecules by the oxidising agent, ozone, which is boosted by a catalyst. Usually catalysts are manufactured by chemical methods using solvents, which creates the problem of effluents.

"The Swansea innovation is a newly invented machine that manufactures the catalyst by physical methods, involving no solvent, and therefore no effluent," Professor Palmer said.

"Our new approach to making catalysts for water treatments uses a physical process, which is a vacuum-based and solvent-free method. The catalyst particles are clusters of silver atoms, made with the newly invented MACS machine."

Professor Palmer explained that the machine solves the longstanding problem of low cluster production rate, making it possible to produce enough clusters to study at the test-tube level, with the potential to scale up to small-batch manufacturing and beyond.

The clusters are approximately 10,000 times smaller than the width of a human hair and have been of significant interest to researchers because of their unique properties. However, due to the inadequate rate of cluster production, research in this area has been limited.



The MACS method scales up the intensity of the cluster beam to produce enough grams of cluster powder for practical testing. The addition of ozone to the powder then destroys pollutant chemicals from water — in this case, nitrophenol.

"The MACS approach to the nanoscale design of functional materials opens up completely new horizons across a wide range of disciplines — from physics and chemistry to biology and engineering. Thus, it has the power to enable radical advances in advanced technology — catalysts, biosensors, materials for renewable energy generation and storage," Professor Palmer said.

The research is published in *Applied Materials and Interfaces*.



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Landfill waste crisis the focus of new research hub



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A new research hub designed to address Australia's overflowing landfill waste is now being developed.

Minister for Education Dan Tehan announced the \$18 million collaboration, which will see the Australian Research Council (ARC) Industrial Transformation Research Hub focus on reducing landfill waste — as well as transforming reclaimed waste into new materials for use in construction and other manufacturing sectors.

Australia's landfill space is expected to reach capacity by 2025, with roughly 67 million tonnes of waste generated every year and 30% of that waste going to landfill.

The ARC Industrial Transformation Research Hub for Transformation of Reclaimed Waste Resources to Engineered Materials and Solutions for a Circular Economy (TREMS) will address the urgent waste crisis in Australia.

The new research hub will involve leading scientists, researchers and industrial experts from nine Australian universities and 36 state, industry and international partners, and will be led by RMIT University.

The hub will draw from expertise across multiple disciplines, including civil, chemical, materials and construction

engineering, artificial intelligence, behavioural sciences, environmental procurements, and policies and standards.

RMIT's Deputy Vice-Chancellor for Research and Innovation and Vice-President, Professor Calum Drummond, said the hub would deliver novel solutions for reclaiming Australia's waste resources and position Australia as a leader in research contributing to a circular economy.

"At RMIT we work closely with industry and other partners to tackle complex environmental, economic and social issues," he said.

"We are proud to be leading such a globally significant research hub that will help transformation towards a circular economy and contribute to the United Nations' Sustainable Development Goals."

Minister Tehan said the research hub will undertake research with applications in the real world.

"Our government is investing in research that will foster strategic partnerships between university-based researchers and industry organisations, to find practical solutions to challenges facing Australian industry," he said.

RMIT Professor Sujeeva Setunge, TREMS research hub lead, said the multisector collaboration would focus on holistic solutions to address the waste

crisis, co-designed in partnership with stakeholders.

"Our investigations will include changing behaviours, smart designs to minimise waste, optimum processing of waste and converting waste to energy, developing novel materials using recycling and upcycling technologies, and metrics and tools to encourage uptake of new materials and solutions," she said.

"There is currently a material shortage for Australia's \$14 billion heavy construction industry, so this research to reclaim waste and transform it into new materials will deliver benefits both economically and environmentally."

Partnering closely with the Deputy Director of the TREMS hub, University of Melbourne Professor Priyan Mendis, Professor Setunge said she is looking forward to working with local, national and international partners and acknowledged existing long-term collaborations with the Cities of Brimbank, Kingston and Hobsons Bay, as well as the Municipal Association of Victoria.

The new hub will focus on 10 challenging waste streams: textile waste, biomass, tyres, glass, paper and cardboard, construction and demolition waste, fly ash, plastics, biochar and timber.



SA WWTP sets sustainability record

SA Water's new Murray Bridge Wastewater Treatment Plant has received an 'excellent' design rating from the Infrastructure Sustainability Council of Australia (ISCA), with the score of 72 reported to be the highest design rating to date for a water or wastewater project in Australia.

With the ability to process up to 4.5 million litres of sewage a day, the plant replaces the previous facility, built in the 1970s, aiming to support local population and industry growth.

SA Water has worked with lead contractor John Holland to build the treatment plant and three connecting pump stations, lay 18 km of underground pipe and install around 420 ground-mounted solar panels at the site.

SA Water's Matthew Bonnett explained that sustainability and environmental management were at the fore during all stages of the project.



"This includes building climate change resiliency into the treatment plant's design; minimising waste, dust, noise and vegetation removal during infrastructure installation; sourcing local equipment and supplies where possible; and investing in innovative treatment processes for ongoing operation," he said.

"A big part of the project's success has also been working with the local community in the lead-up to and during construction, with site tours and tailor-made education workshops for local school students."

The plant has been designed to prevent operations from negatively impacting the surrounding community or Lower Murray environment.

It incorporates an odour control unit, which consists of a bio-trickling filter and activated carbon tanks, designed to remove 99.95% of odour from the plant. It also has an advanced biological treatment process called a 'moving bed biofilm reactor' that helps to break down sewage into sludge in a more compact, efficient and adaptable way than conventional methods.

"The plant will continue to recycle 100% of its treated wastewater for irrigation use at a Department of Defence training area and a nearby pastoral property, and the on-site solar array will ultimately generate 150 kWh per day, helping to power the treatment plant," Bonnett said.

SA Water
www.sawater.com.au

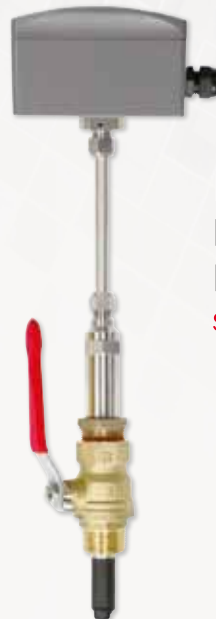
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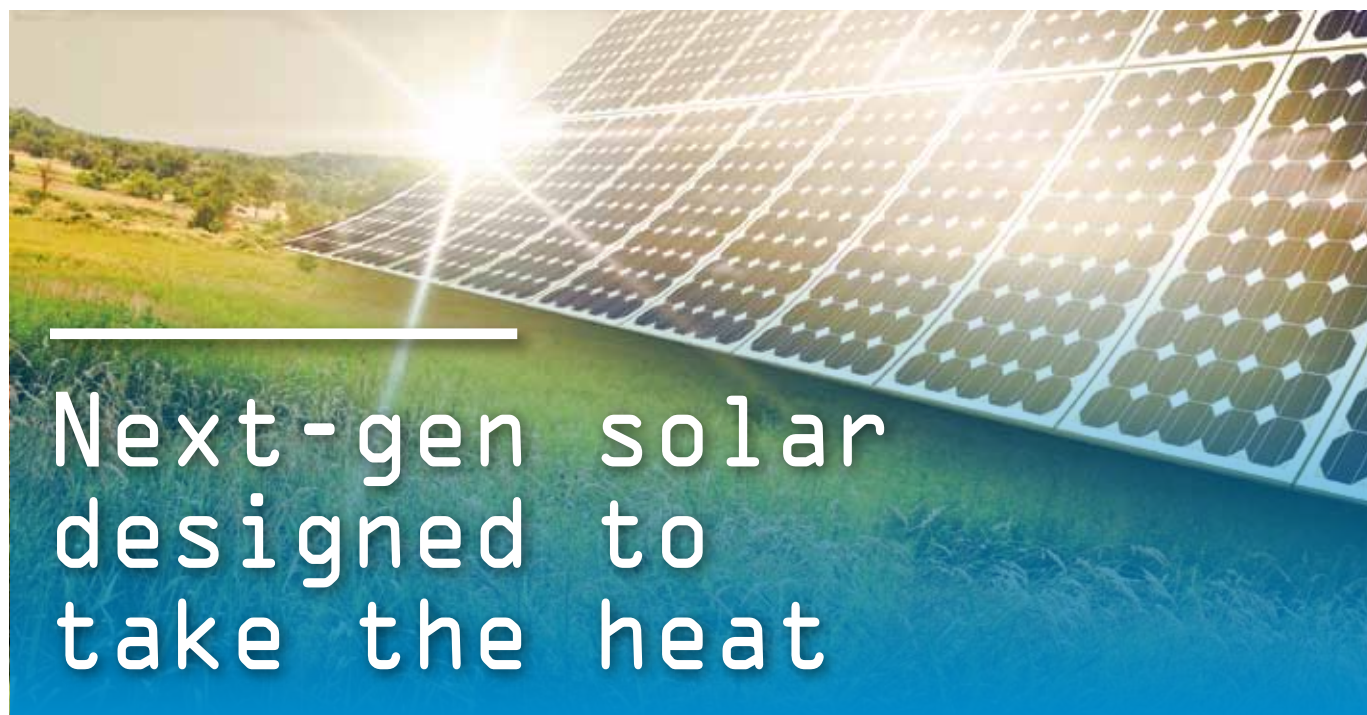


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Next-gen solar designed to take the heat

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A next-generation solar cell that can maintain efficiency in the heat has been developed by engineers at Iowa State University.

This solar cell takes advantage of the electro-optical properties of perovskite materials, and the materials are much more stable at high temperatures.

One problem with the current generation of silicon solar cells is their relatively low efficiency at converting solar energy into electricity, according to Vikram Dalal, the Director of Iowa State's Microelectronics Research Center.

The best silicon solar cells in the laboratory are about 26% efficient while commercial cells are about 15%. That means bigger systems are necessary to produce a given amount of electricity, and bigger systems mean higher costs.

That has researchers looking for new ways to raise efficiency and decrease costs. One idea that could boost efficiency by as much as 50% is a tandem structure that stacks two kinds of cells on top of each other, each using different, complementary parts of the solar spectrum to produce power.

The potential of perovskite

Researchers have recently started looking at hybrid organic-inorganic perovskite materials as a good tandem partner for silicon cells. Perovskite cells have efficiency rates nearing 25%, have a complementary bandgap, can be very thin (just a millionth of a metre) and can easily be deposited on silicon.

However, Dalal said researchers have learned those hybrid perovskite solar cells break down when exposed to high temperatures.

This causes problems when solar arrays are placed where the sunshine is — usually hot, dry deserts in places such as the American southwest, Australia, the Middle East and India. Ambient temperatures in such places can hit 48–54°C and solar cell temperatures can hit 93°C.

Iowa State University engineers, in a project partially supported by the National Science Foundation, have found a way to take advantage of perovskite's useful properties while stabilising the cells at high

temperatures. They describe their discovery in a paper recently published online by the scientific journal *American Chemical Society Applied Energy Materials*.

"These are promising results in pursuit of the commercialisation of perovskite solar cell materials and a cleaner, greener future," said Harshavardhan Gaonkar, the paper's first author, who is working in Boise, Idaho, as an engineer for ON Semiconductor.

Tweaking the material

Dalal, the corresponding author of the paper, said there are two key developments in the new solar cell technology.

Firstly, engineers made some tweaks to the make-up of the perovskite material. They removed organic components in the material — particularly cations, materials with extra protons and a positive charge — and substituted inorganic materials such as cesium. That made the material stable at higher temperatures.

Secondly, they developed a fabrication technique that builds the perovskite material one thin layer — just a few billionths of a metre — at a time. This vapour deposition technique is consistent, leaves no contaminants and is already used in other industries so it can be scaled up for commercial production.

The result of those changes?

"Our perovskite solar cells show no thermal degradation even at 200°C for over three days, temperatures far more than what the solar cell would have to endure in real-world environments," Gaonkar said.

"That's far better than the organic-inorganic perovskite cells, which would have decomposed totally at this temperature. So this is a major advance in the field," Dalal said.

The paper reports the new inorganic perovskite solar cells have a photo-conversion efficiency of 11.8%.

"We are now trying to optimise this cell — we want to make it more efficient at converting solar energy into electricity," Dalal said.

"We still have a lot of research to do, but we think we can get there by using new combinations of materials."

WATER ANALYSIS TOOL

The control of wastewater and drinking water has become increasingly important in these times of heightened microbial awareness.

The same applies to environmental control.

The mobile handheld measuring instruments of the SD 305 series from Lovibond are suitable for use in water analysis, where conductivity, dissolved oxygen, pH and redox potential are important parameters.

The new and improved SD 305 series is now available, which is more practical and functional.

With clear illustrative instructions in eight languages the series provides users with quick "click to results" with a simplified menu structure and a clearer keyboard design.

The meters also features a new electrode holder with a slimmer design, which holds the electrode securely, thus enabling one-handed operation.

Other features include: sensor self-diagnosis, data logger including alarm function, PC interface, pressure compensation and recognition of standard solutions included.

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SMART PV SOLUTION

Trina Solar has introduced the TrinaPro Mega, an ultrahigh-power smart PV solution featuring modules with power output exceeding 500 W.

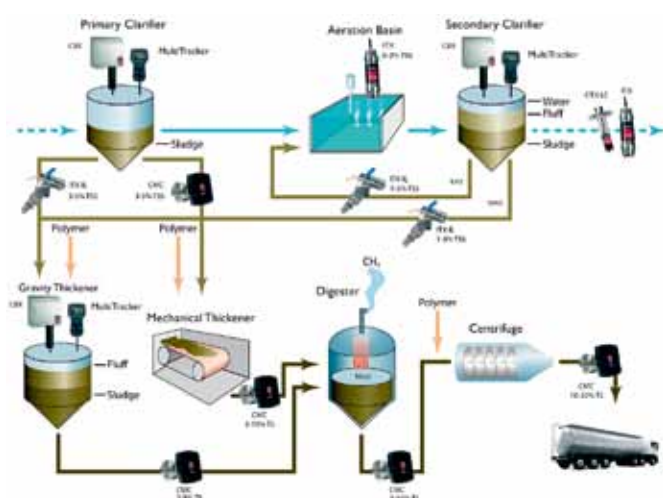
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Atmospheric water vapour used as renewable energy



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Water vapour from the atmosphere could be used as a source of renewable energy, according to a new study.

The research from Tel Aviv University — led by Professor Colin Price in collaboration with Professor Hadas Saaroni and doctoral student Judi Lax, all from TAU's Porter School of the Environment and Earth Sciences — is based on the discovery that electricity materialises in the interaction between water molecules and metal surfaces. It was published in *Scientific Reports*.

The search for renewable energy sources — which include wind, solar, hydroelectric dams, geothermal and biomass — has preoccupied scientists and policymakers alike, due to their enormous potential in the fight against climate change.

"We sought to capitalise on a naturally occurring phenomenon: electricity from water," said Price.

"Electricity in thunderstorms is generated only by water in its different phases — water vapour, water droplets and ice. 20 minutes of cloud development is how we get from water droplets to huge electric discharges — lightning — some half a mile in length."

The researchers set out to try to produce a tiny low-voltage battery that utilises only humidity in the air, building

on the findings of earlier discoveries. In the 19th century, for example, English physicist Michael Faraday discovered that water droplets could charge metal surfaces due to friction between the two. A much more recent study showed that certain metals spontaneously build up an electrical charge when exposed to humidity.

The scientists conducted a laboratory experiment to determine the voltage between two different metals exposed to high relative humidity, while one is grounded.

"We found that there was no voltage between them when the air was dry," Price said.

"But once the relative humidity rose above 60%, a voltage began to develop between the two isolated metal surfaces. When we lowered the humidity level to below 60%, the voltage disappeared. When we carried out the experiment outside in natural conditions, we saw the same results.

"Water is a very special molecule. During molecular collisions, it can transfer an electrical charge from one molecule to the other. Through friction, it can build up a kind of static electricity," said Price.

"We tried to reproduce electricity in the lab and found that different isolated metal surfaces will build up different amounts of charge from water vapour in the atmosphere, but only if the air

relative humidity is above 60%. This occurs nearly every day in the summer in Israel and every day in most tropical countries."

According to Price, this study challenges established ideas about humidity and its potential as an energy source.

"People know that dry air results in static electricity and you sometimes get 'shocks' when you touch a metal door handle. Water is normally thought of as a good conductor of electricity, not something that can build up charge on a surface. However, it seems that things are different once the relative humidity exceeds a certain threshold," he said.

The researchers, however, showed that humid air may be a source of charging surfaces to voltages of around 1 V.

"If a AA battery is 1.5 V, there may be a practical application in the future: to develop batteries that can be charged from water vapour in the air," said Price.

"The results may be particularly important as a renewable source of energy in developing countries, where many communities still do not have access to electricity but the humidity is constantly about 60%."

Panels power drinking water network

SA Water is implementing an ambitious renewable energy initiative that will see around 500,000 solar panels installed at 35 of its sites to produce a total of 242 GWh of electricity, along with 34 MWh of battery storage.

SA Water's intensive drinking water and wastewater pumping and treatment operations throughout a dry 2018–19 cost \$83 million, with the utility being one of the state's greatest electricity consumers.

In pursuit of a zero cost energy future, SA Water has installed more than 100 solar photovoltaic panels at its Mount Pleasant Water Treatment Plant to power the drinking water network.

The roof-mounted panels will help reduce SA Water's operating costs and carbon emissions by generating 58 MWh of green energy each year.

SA Water's Senior Manager Zero Cost Energy Future, Nicola Murphy, said the solar array is one of four being installed by the water utility across the Adelaide Hills area.

"Now in the ground and capturing the winter sun, electricity generated by our panels at Mount Pleasant will help reduce the plant's operating costs while reducing our carbon emissions by around 26 tonnes annually," Murphy said.



SA Water's Nicola Murphy said the Mt Pleasant site will reduce carbon emissions by 26 tonnes annually.

"A combined 3500 panels are also currently being installed at our Hahndorf Wastewater Treatment Plant, Summit reservoir and water treatment plant and water pump station at Lobethal, which will power our operations delivering clean, safe drinking water and sewage services to Adelaide Hills customers."

SA Water's initiative has already seen around 147,000 solar panels installed at sites like the Bolivar Wastewater Treatment Plant and major pump stations along the Morgan to Whyalla Pipeline, with the remaining panels due to be installed before the end of the year.

"Despite the current COVID-19 conditions, we've been able to continue making significant progress on our Adelaide Hills sites due to the advanced procurement of the required solar panels and plant while implementing hygiene and social distancing practices wherever possible," Murphy said.

"Not only does this keep our project on schedule, it also keeps our contracting partners and suppliers working on large-scale projects that have flow-on benefits to the South Australian economy.

"This initiative was designed by our people, and shows South Australians leading the way with the smarts and skills to integrate renewable energy and storage within the longest water network in the country."

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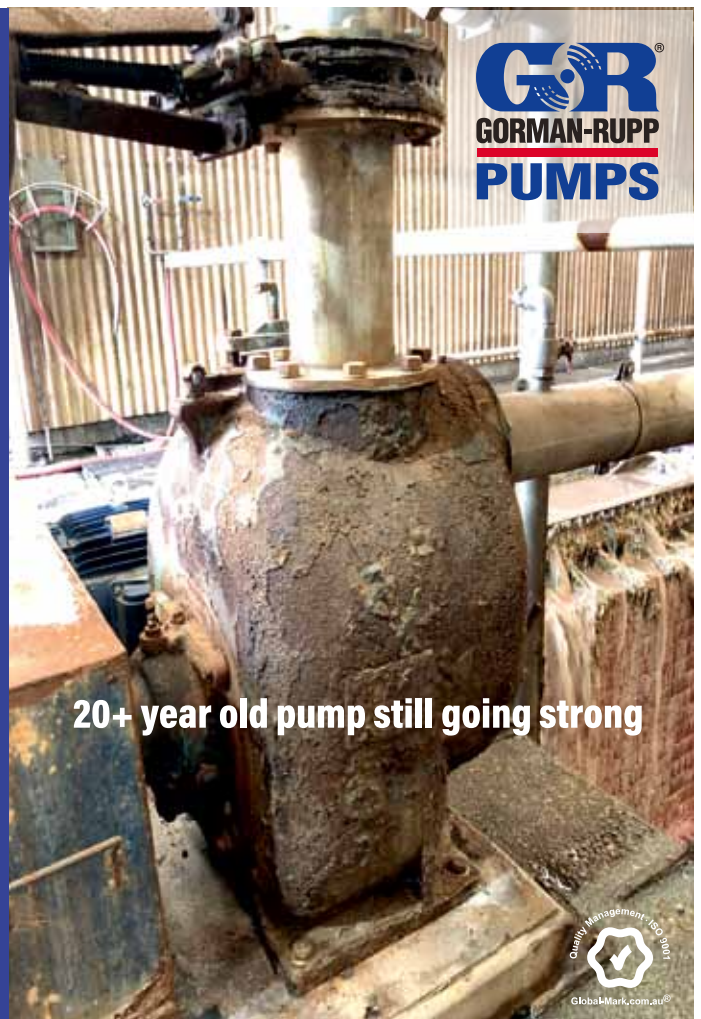
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Can residential solar be better integrated into electricity networks?

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A report released by ENEA Consulting reveals that a suite of technologies is required to address power quality issues caused by increasing electricity generation from rooftop solar photovoltaic (PV) systems.

This report is a timely addition to drive solutions for Australia's energy transition as consumers' appetite for rooftop PV continues to grow.

The Future Grid for Distributed Energy report — led by Victorian distribution company CitiPower and Powercor in collaboration with ENEA Consulting — is part of a project supported by the Australian Renewable Energy Agency (ARENA).

Recent modelling by the Australian Energy Market Operator shows that distributed energy resources, such as rooftop PV and residential batteries, could provide 13–22% of annual electricity consumption in the National Electricity Market by 2040.

ENEA Consulting Partner and report author Olivier Lacroix said, "The preferred solution(s) for enabling further rooftop solar installations will depend on local network characteristics.

"Smart inverters cannot be considered a 'silver bullet'. Electricity distribution companies will need to consider other solutions, including network upgrades, to complement smart inverters when managing high PV penetration," he said.

"Smart inverters can act as a safety net to ensure that voltage does not reach excessive levels in regions where a high number of rooftop solar systems are installed to protect electricity infrastructure and customer appliances. However, this

study found that at high PV penetration levels, smart inverters reduce voltage rise by significantly reducing the amount of consumers' electricity that can be exported to the grid.

"At this point, other solutions need to be considered, including investment in network assets.

"We encourage distribution companies to build a wide range of low-voltage network power flow models," Lacroix said.

"This will allow more confidence when inferring the networks' ability to manage a certain amount electricity generation at the consumer level. It will also enable more informed investment decisions to support future rooftop solar uptake."

Lacroix iterated that governments should also consider allowing dynamic export limits, which would mean that consumers' electricity exports would only be reduced when required by the grid. This would also provide more flexibility to maintain the grid and potentially avoid expensive network upgrades that could place upward pressure on electricity prices.

The report also recommended further topics for study to complement the findings:

- Explore the potential of a fleet of behind-the-meter batteries to mitigate high voltage levels.
- Explore the potential of additional technologies and/or combining technologies to mitigate high voltage levels.
- Explore the management of high-voltage and low-voltage networks in a coordinated fashion to identify the best solution where voltage issues are expected on both sections of the grid.

pH/ORP CONTROLLERS

Hanna Instruments' BL122 and BL123 controllers are designed to maintain constant pH and disinfectant levels in swimming pools, hot tubs and spas, allowing remote connection and access to devices via the Hanna Cloud web app.

Using the Hanna Cloud app, measurements, trends, history, device settings, alarms and messages from multiple BL122 or BL123 controllers can be accessed via the 'Dashboard'.

The controllers are available in two configurations: the basic version is an inline model that allows for direct installation of probe and chemical injection fittings into existing piping; the panel-mounted version with a bypass flow cell allows for calibration and maintenance of the probe without having to shut down the recirculation pump.

For compliance monitoring, BL122 and BL123 have a built-in datalogger, logging measurements every 10 s with a new log starting every day or when the instrument is calibrated. Logged data include pH, ORP and temperature values, last calibration data, set-up configuration and any event data. The BL123 model includes three 4–20 mA analog outputs to connect to an external datalogger.

Hanna Instruments Pty Ltd
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COMPACT THERMAL IMAGER

The TIM QVGA-HD-T100 from Micro-Epsilon is a compact thermal imager specifically designed for early fever recognition. By changing the camera lenses, the camera can be used for measuring the body temperature of a group of people or for targeted temperature measurement of an individual person. The software is set to automatically recognise and display the thermal image of people with elevated body temperature.

The device has a measuring range from -20 to 100°C with high thermal sensitivity of 40 mK. This improvement is made to address the limitation of the existing thermal imager where the temperature range and thermal resolution are not deemed accurate for body temperature measurement. The optional ambient temperature radiator TM-BR20AR-TIM can also be used with the camera to increase measurement accuracy by approximately 0.5°C.

The TIM-QVGA has an optical resolution of 382 x 288 pixels. It is suitable for monitoring public places such as entrances to workplaces or institutions, airports, train stations, hospitals, supermarkets, shopping malls as well as schools and universities. The existing thermal imaging camera TIM640 is also well suited for this type of measurement application.

The Micro-Epsilon TIM-QVGA-HD-T100 compact thermal imager is available from Bestech Australia.

Bestech Australia Pty Ltd
www.bestech.com.au

TURBIDITY SENSOR

Endress+Hauser has introduced the Turbimax CUS50D sensor, a robust turbidity and suspended solids measurement tool for industrial applications.

The sensor is designed to withstand aggressive media in a wide range of applications such as solids measurement in industrial wastewater.

The sensor measures turbidity and suspended solids in accordance with ISO 7027, even in very dark liquids and sludges.

Measurements are based on the attenuation of light and can be achieved, for most applications, from a single-point calibration. The sensor is pre-calibrated for turbidity and absorption measurements and includes various application models.

The Teflon-derived sensor head of the Turbimax CUS50D minimises the risk of dirt accumulation. Surface contamination is removed by the sensor's air-cleaning system to allow planning of maintenance intervals and uninterrupted turbidity measurements. The plastic version of the sensor is especially resistant to chemicals and is therefore suitable for measurements in media with a low pH value or high salt content.

Endress+Hauser has developed a solid-state reference to verify that the sensor is functioning correctly and to check the long-term stability of the device. The solid-state reference is simple to use and is designed to provide consistent, clear results for every turbidity measurement.

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



AI breakthrough in Tassie salmon farming

In recent decades, world population growth has outpaced the growth in land-based agriculture. At the same time the use of aquaculture has grown: world aquaculture production has risen from 7% of fisheries to 40% worldwide since the 1980s, according to Deloitte.¹ The growing demand for farmed seafood has led fisheries to adopt increasing levels of automation to help the industry grow and increase efficiencies, while minimising environmental impact.

Established in 1986, Huon Aquaculture has grown to become a salmon producer that is recognised around the world for the quality of its produce and the ingenuity of its operations.

The company is seen as an ethical business and a respected Tasmanian brand — part of a sustainable industry and a company that is focused on the safety of its employees, as well as the welfare of the fish and the wildlife around its farms.

Huon Aquaculture is fortunate to farm in Tasmania's healthy marine environment, allowing them to raise salmon and ocean trout in locations best suited to optimal growth. From the time their fish start their life in hatcheries, up until they are harvested, their environment plays a vital role in their health, growth and quality.

Huon is a fully vertically integrated company, meaning that the company does everything from selectively breeding brood stock for egg production, to processing salmon ready for the consumer.

Rough conditions in Storm Bay

Huon's Storm Bay lease has the roughest farmable waters in the world. Located at the mouth of Tasmania's Derwent River and opening south towards the wild Southern Ocean, Storm Bay can regularly experience swells of 4–6 metres significant wave height. While these conditions can be dangerous for people, Huon has found that the swells regularly rolling through the pens is good for the fish as it closely mimics their natural habitat. It also means that the pens can be left fallow for a shorter time before restocking.

However, the rough seas are also one of the reasons that Huon embarked on a journey to find a way to reduce or eliminate the need for people to be manually operating feed barges in such rough and dangerous conditions. Huon looked into mirroring what companies

were doing around the world, where they were controlling their processes from a centralised location.

Consistency of yield depends on consistency of feeding

A major reason for automating fish feeding is the desire to maximise the consistency of the size and weight of the salmon at harvesting. Huon's pens are, according to Peter Bender, Chief Executive Officer and Managing Director, the largest ocean fish pens in the world, with circumferences of around 240 metres and holding over 100,000 fish. With manual feeding, there can be days when fish are fed less and days when they are overfed — and uneaten fish pellets fall to the ocean floor, which is not only wasteful, but pollutes the ocean floor environment.

Moreover, without an even distribution of feed, the result can be an inconsistency in fish size, as the larger fish continue to dominate and consume the most, while others remain small.

No out-of-the-box solution

As a result, Bender went to an exhibition in Europe, only to realise that none of the software displayed was going to be fit for purpose for Huon because of the way they feed and their stocking densities. Many of the systems were designed for feed pens close to shore, and not up to 50 km out to sea, exposed to the Southern Ocean.

The company realised that an out-of-the-box program was not going to meet their needs, so they knew they had to work from the ground up. The company's aims were to:

- move to a centralised control platform that would reduce man-hours out on the water and on the barges, improving personnel safety;
- achieve better control over feeding the salmon from the barges;
- develop innovation in aquafarming;



that the fish have an equal chance of receiving feed — resulting in a consistent 5 kg fish size at harvesting.

Harsh conditions require tough hardware

For the control system on the barge, Huon engaged Cromarty Pty Ltd, a specialist automation system engineering and design firm. Cromarty provided all the electrical and control system design. The design work was done over an 18-month period.

“When we were asked to get involved in the building of the barges, it was identified that there wasn’t a proper specification of the valves to be used for the various processes on the vessel,” said Andrew Palfreyman of Cromarty. “Basically the valves chosen were not up to the task of working reliably in the harsh and corrosive conditions expected.”

Andrew encouraged Haywards to contact Katherine George, Managing Director of Total Instrument Controls, to assist in specifying the right type of valves to be used in the elements of the Southern Ocean.

Total Instrument Controls are a supplier of instrumentation and control technology and are one of the leading Australian resellers of Bürkert’s valve systems and controls. Previously the company had supplied Huon Aquaculture with various Bürkert equipment for their hatcheries, including solenoid valves and actuators, as well as oxygen dosing systems.

“The various valves from Bürkert that we supplied for the project have a variety of tasks from moving fluids (air, water, fuel etc) around the barge, as well as controlling the feed spreader systems, deck wash systems and generator fuel shut-offs,” Katherine George said. “Any valves in contact with salt water use a particular grade of stainless steel called Duplex for the trim material, as it provides the best corrosion resistance.”

“Bürkert’s 3005 actuators with battery backup on top of butterfly valves and stainless steel ball valves were chosen. Battery backup was chosen to implement failsafe functionality in case of power loss or loss of communication to the barge,” he added. “Battery backup was a must as many of the valves have the potential to sink the barge in stormy weather if they are stuck open, allowing the seawater to continue to enter the vessel.”

AI the crowning achievement

The huge barge, the remote control and the innovative feed system are all achievements that Huon Aquaculture and its suppliers can be proud of. But the crowning achievement is possibly the artificial intelligence and machine learning that has been incorporated into the control system.

Rather than relying on human operators observing the video feed, as is done in European systems, Huon has achieved a system that uses the latest in AI and machine learning to automatically respond to fish behaviour, and can ‘learn on the job’. Managing Director Peter Bender believes the system may well be the first of its kind in the world — a world-leading innovation built on Tasmanian ingenuity.

Reference

1. Deloitte 2017, ‘The growth of global aquaculture - Fishy business’, Agribusiness Bulletin, <<https://www2.deloitte.com/au/en/pages/consumer-business/articles/the-growth-of-aqua-culture-fishy-business.html#>>>

Bürkert Fluid Control Systems
www.burkert.com.au

- have a positive environmental impact in reducing waste with controlled feeding.

The challenge was therefore to develop new technology and implement it on a larger barge that could be moored at sea for longer periods without replenishment.

Enter Hogan, the automated feed barge

Commissioned and launched in December 2018 by Tasmanian ship-builder Crisp Bros. & Haywards, Hogan is the first of two 600-tonne feed barges that will be used to manage the pens in Storm Bay. The sheer size of the barge is a result of it needing to not only withstand the sea conditions in Storm Bay, but also to remain autonomous for larger periods of time — both for feeding and waste recovery activities.

The significance of the barge is not so much due to its size, however, but due to its technology. Those staff that were once fish feeders are now control room operators and feed every fish in every pen from a control room in Hobart. They are able to do this as each pen has cameras that send real-time footage and data back via the barge to the control room. A pellet detection system that utilises artificial intelligence coupled with a remote controlled on-water feed delivery system makes feed delivery more effective than previous manual feeding.

The pellet detection system can detect as few as two uneaten feed pellets in the water column beneath the fish, and can automatically slow or shut off the flow of feed when the fish have stopped feeding — matching the feeding to the appetite of the fish while reducing wastage and potential impact to the sea floor.

In addition to the pellet detection system, Huon also developed a feed delivery system that spreads the feed evenly across the surface of the pen, by effectively ‘spraying’ it from a central point. This ensures

Expo targets energy cost savings for businesses

As the economy recovers from COVID-19, energy efficiency has become a top priority to help businesses lower their power bills and bounce back from economic impacts of the pandemic. The government is offering small businesses grants of up to \$20,000 under the Energy Efficient Communities Program to help reduce their power bills, which will ease financial pressure during these tough times.

Energy efficiency has a massive potential to create jobs, cut bills and address climate change. It is more important than ever for businesses and organisations to adopt energy efficiency practices and technologies to reduce operating costs and build greater resilience.

This October, the Energy Efficiency Expo is returning to Melbourne to help businesses discover the latest energy-saving technologies and unlock the full benefits of energy efficiency. The free-to-attend exhibition and conference, organised in partnership with



the Energy Efficiency Council, will showcase a wide range of energy-efficient products and services, such as LED lighting, energy management equipment and software, HVAC, thermal performance products and water-heating efficiency technology.

"The 2020 event takes place at a time where achieving energy efficiency is vital in Australia," Energy Efficiency Expo Exhibition Director Tim Rusbridge said.

"Action on energy efficiency would immediately help those affected by the economic

impacts of COVID-19. To help achieve this, Energy Efficiency Expo will provide businesses the opportunity to connect with innovative energy solutions suppliers and gain insights and strategies to empower better energy management at our conference and workshops."

Health and safety

The health and safety of exhibitors, visitors and staff is the Energy Efficiency Expo's number one priority.

The organisers of the event are actively monitoring the COVID-19 developments and working with the venue and relevant authorities to ensure the event will have the highest health and safety protocols in place.

What: Energy Efficiency Expo

When: 21-22 October 2020

Where: Melbourne Convention and Exhibition Centre

Web: energyefficiencyexpo.com.au

Waste expo supports industry transformation

Australia's waste management and resource recovery industry is experiencing significant transformation as new government strategies and policies are adopted and more investments are made to address the country's waste crisis. The federal government's recent commitment to \$190 million in funding for new recycling infrastructure provides opportunities for businesses in the waste and recycling industry and is expected to generate 10,000 jobs.

The 2020 edition of Waste Expo Australia arrives on the industry's calendar at an important time. Taking place on 21 and 22 October in Melbourne, Waste Expo Australia provides a platform for navigating opportunities and changes in the sector.

Featuring 100+ speakers across three theatres, the free-to-attend conference will cover the industry's most pressing issues, including impacts of COVID-19, approaches

to transition to a circular economy and initiatives to achieve government waste targets.

New this year, Waste Expo Australia will have a dedicated Thought Leadership stream that brings together innovators to share powerful stories and forward-thinking strategies that will help strengthen the sector.

"Waste Expo Australia is all about collaboration, and it provides a unique opportunity to bring the industry together and hear from some of the biggest names in the sector," Waste Expo Australia Exhibition Director Cory McCarrick said.



"The 2020 conference program was curated to deliver engaging and informative sessions and ensure that visitors can take these learnings back to their workplace and start implementing straight away. There is no other event that gives you access to this high-calibre content for free."

Health and safety

The health and safety of exhibitors, visitors and staff is of paramount importance to Waste Expo Australia. The organisers of the event are continuously monitoring the COVID-19 developments and working with the venue and relevant authorities to ensure that attendees can do business in a safe environment.

What: Waste Expo Australia

When: 21-22 October 2020

Where: Melbourne Convention and Exhibition Centre

Web: www.wasteexpoaustralia.com.au

October: All-Energy Australia returns to Melbourne

Despite unprecedented times, the future of clean energy in Australia remains promising. The renewable energy sector has boosted the country's economy during the past few years and is equipped to assist the national economic recovery effort from COVID-19. With an extensive pipeline of renewable energy projects and strong demand for rooftop solar and battery storage, the industry has the potential to create thousands of new jobs, lower energy costs and attract investment into the Australian economy.

For this reason, All-Energy Australia is gearing up for its 2020 event this October in Melbourne to support the industry in accelerating the country's transition to a clean, reliable energy system of the future.

This free-to-attend exhibition and conference, organised in partnership with the Clean Energy Council, is the only remaining industry event for the year where renewable energy professionals can get exclusive access to the latest technologies and trends, and discuss the opportunities and challenges in the sector.



"The 2020 event takes place at a crucial time in our country where Australia's clean energy transition is more important than ever," All-Energy Australia Exhibition Director Tim Rusbridge said.

"All-Energy Australia provides a platform for the industry to connect visitors with leading suppliers at our exhibition floor and drive conversations about the future of renewables at our multistream conference."

Health and safety

The health and safety of exhibitors, visitors and staff is All-Energy Australia's number one priority.

The organisers of the event are actively monitoring the COVID-19 developments and working with the venue and relevant authorities to ensure the event will have the highest health and safety protocols in place.

What: All-Energy Australia

When: 21–22 October 2020

Where: Melbourne Convention and Exhibition Centre

Web: www.all-energy.com.au

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Creating cost-effective waste reduction solutions

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educating waste is a critical environmental concern. Waste ends up polluting the environment, having a significant impact on plants and animals and contributing to climate change. Apart from ecological concerns, waste also has an impact on the economy.

Once waste is sent to landfill, it is a dead asset.

A circular economy, where items are recycled and re-used, creates jobs and ensures assets stay in the marketplace where they can continue to generate profit.

Despite the potential economic impacts, Australia is still struggling to reduce waste creation, on a private and commercial level. Between 2016 and 2017, we generated 67 million tonnes of waste, with two-thirds of that amount coming from the construction and demolition industry as well as the commercial and industrial sector.

Any waste reduction solutions aimed at businesses need to be cost-effective. Companies need to turn a profit, so if decision-makers see waste reduction as either a cost saver or profit generator, they will start to take the necessary steps.

George Tsiamis, National Sustainability & Procurement Manager at BIC Services, has been advising businesses on waste reduction for over 30 years. He shares his tips for delivering cost-effective waste reduction solutions to businesses.

Minimise waste creation

"The best and cheapest way to reduce waste is to avoid creating it in the first place," Tsiamis said.

"I often ask businesses to look at their supply chains and see if there are opportunities to opt for items that have less packaging. Most cleaning supplies will have refillable options, so by opting for those over single-use, businesses will usually make significant waste and cost reductions."

Opt for a zero-bin policy

"I encourage all clients to adopt a zero-bin policy. If there are bins under every desk or scattered throughout the building, there's increased risk of waste streams getting mixed and contaminated. It also adds to cleaning and waste collection costs.

"Centralised bins mean waste is pre-sorted, and it creates significant savings on waste collection," Tsiamis continued.

Stimulate awareness in the workplace

"Another drawback of desk bins is that employees have no awareness of how much waste they are creating," Tsiamis commented.

"If employees have to walk to the bin and sort their rubbish, they become more aware of what is going to landfill and what is recyclable. This could mean they bring food with less packaging, avoid printing or decide to re-use things before throwing them away.

"The less waste your employees create, the lower your waste collection costs are," Tsiamis said. "So educating your staff and encouraging a low- or no-waste workplace could create significant savings."

Waste isn't all about plastic bottles

"Conserving natural resources is just as important as limiting how much waste goes into the bin," Tsiamis urged.

"Water is our most precious resource, especially living in a country that is so prone to drought. Water is also expensive, so water-saving efforts should be included in any waste reduction plan."

Reporting is essential

"Every strategy needs to be measured," Tsiamis said. "It's impossible to tell how successful your efforts have been if you aren't collecting data on your waste production.

"Modern reporting technology means the whole process can be automated. You can even access detailed reports which show your recycling rates and total waste production. This information is vital in steering future waste reduction strategies and cost-saving initiatives.

"Ideally, this reporting will be customisable and capable of providing detail down to various areas within buildings," Tsiamis continued.

"This level of detail ensures strategies are targeted. So if a particular area of a building is producing more waste than others, reduction efforts can be placed there without wasting time on areas that are already delivering efficiencies."

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