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Apr/May 2018 Vol.11 No.5
PP100007399

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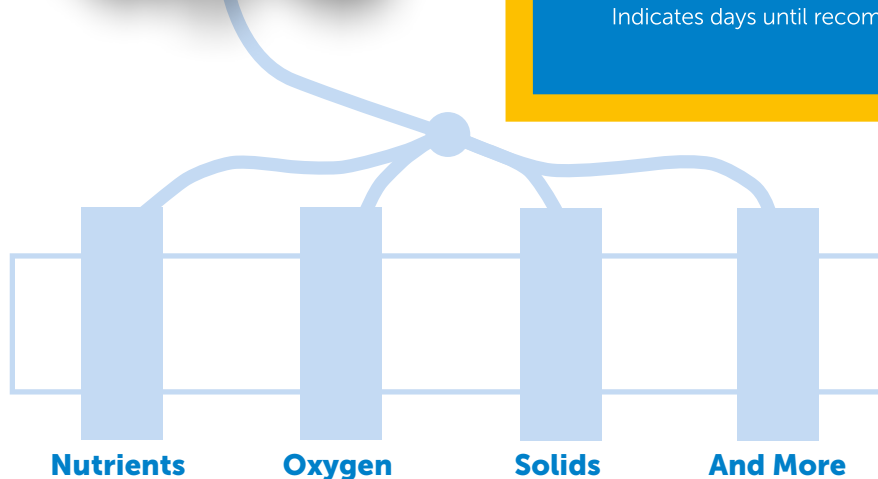
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WORDS FROM THE EDITOR

Although Australia is still always under the possible threat of drought, the millennium drought has taught us a lot and resulted in an infrastructure set-up that makes our citizens feel confident that we have a secure water supply. The sad reality is, the people in Cape Town don't have this same confidence. The Cape Town 'Day Zero' strategy is compared to an Australian approach to water restriction on page 8.

Another challenge facing the water sector is implementing climate change mitigation strategies and meeting state carbon reduction targets. The water sector is a major consumer of energy and generator of greenhouse gas emissions. As such, utilities have an important role to play in the transition to a low-carbon economy and this is explained in more detail on page 22.

The business case for microgrids that support a centralised energy grid is growing in momentum as more and more renewable sources of energy enter the market. This issue also looks at how our energy grid can cope with the transition to cleaner energy sources by using silicon thermal storage and solar mini-grid technology.

Our next issue will follow the energy transition theme with details on how electric vehicles may drive this transition even further. If you have a story to tell, please contact me on sm@wfmedia.com.au as I'd love to help you share your story with our readers.

Carolyn Jackson

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Subscriptions
For unregistered readers price on application.
Printed and bound by SOS Print+Media
Print Post Approved PP 100007399
ISSN No. 1834-917X



September 2016

total CAB Audited Circulation
4144 readers (85% personally requested)

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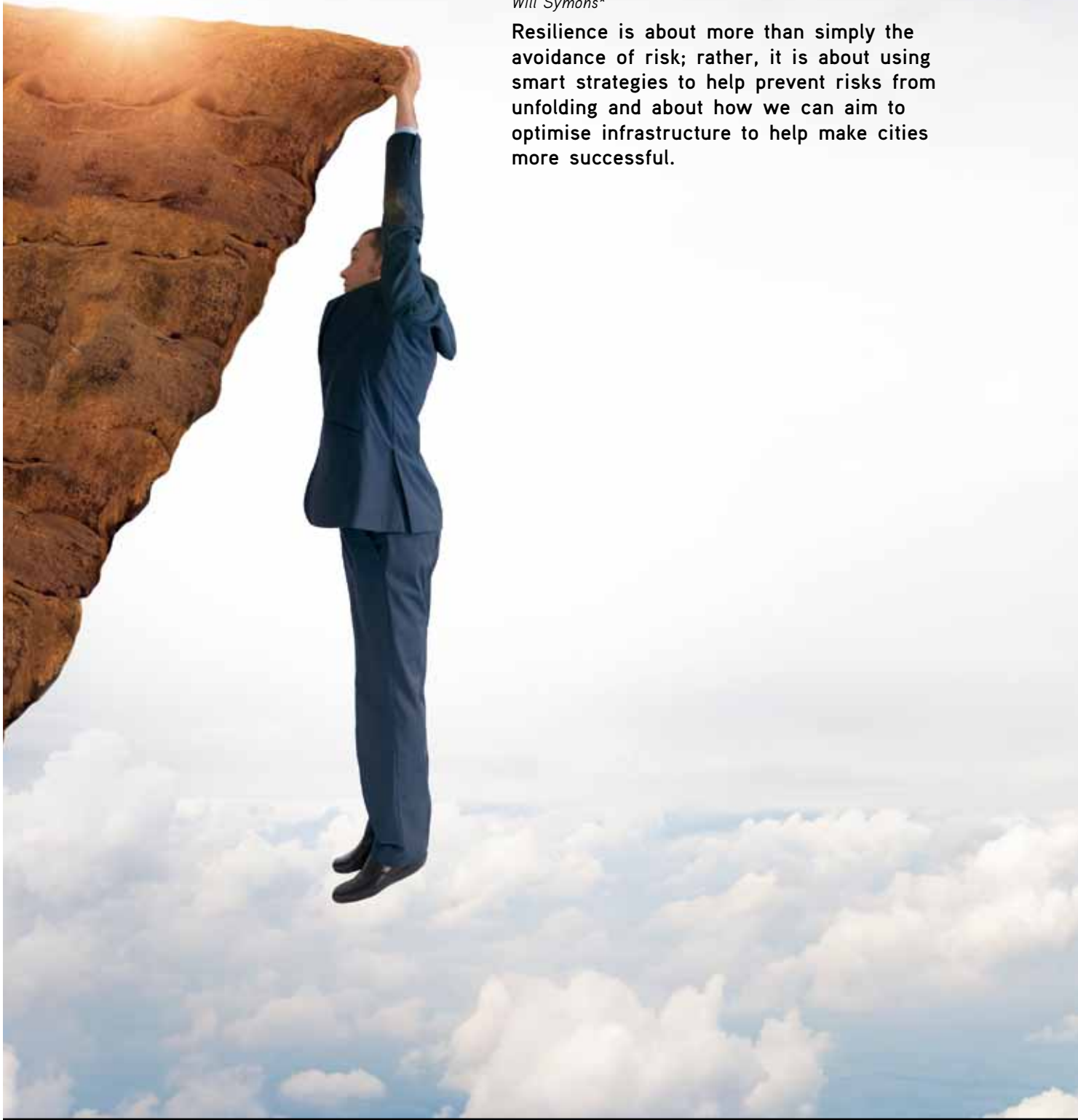
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Resilience in a changing world



*Will Symons**

Resilience is about more than simply the avoidance of risk; rather, it is about using smart strategies to help prevent risks from unfolding and about how we can aim to optimise infrastructure to help make cities more successful.





Infrastructure designed with resilience in mind is better able to cope with shock events, such as extreme weather.



Success can mean different things, but successful cities all provide a nurturing environment for their residents to lead healthy, productive and prosperous lives. In the future, this is going to become increasingly challenging as a result of climate change and other risks. Where to, then, for a forward-looking city?

Resilient infrastructure

Infrastructure designed with resilience in mind is better able to cope with shock events, such as extreme weather. Effective risk management helps us to prepare for predictable events and disruptions we've experienced in the past, such as coastal flooding from climate change-induced sea-level rise. However, we need to ensure that our infrastructure will continue delivering its services no matter what happens in future. Most infrastructure we are currently building will need to support community livability and economic success for the next 50–100 years.

No one can predict the social, economic or environmental disruptions and context in which infrastructure will need to provide this support — planners and designers 50 years ago couldn't have predicted that infrastructure today needs to cope with extremist acts, enable internet connectivity or support our transition to a zero-carbon future.

Ensuring that flexibility and robustness are core design principles, whilst always and tenaciously seeking to deliver co-benefits to communities, will help infrastructure cope no matter what disruptions the future holds, whilst supporting our cities to thrive each and every day. Delivering these 'resilience

dividends' to communities, now and across the design life of infrastructure, is the benefit of us taking this leap from risk-aware to resilient infrastructure.

It is always more cost-effective to design in elements (which often have only a marginal extra cost) that provide flexible use at the beginning of the design process than to retrofit complex infrastructure with needed changes later. For example, roads are being designed in open space-starved Jakarta to enable their adaptive use on weekends as community open space, which would be far more expensive post construction.

Resilient communities

In addition to being more resilient itself, infrastructure must better support the resilience of the communities it serves. Single-purpose, expensive infrastructure passing through communities with complex, multiple needs misses enormous opportunities to optimise scarce capital funding and lift communities above their challenges. At its worst, such infrastructure can solve one problem (eg, traffic congestion) whilst exacerbating others (eg, dissecting communities and discouraging active transport). These opportunities can be captured, and issues avoided, by applying a resilience lens to infrastructure projects early in their planning.

For example, it is likely to be necessary in future to provide emergency shelter for people during extreme heat events — we narrowly avoided a public health disaster in Melbourne in the days leading up to Black Saturday in 2009. This second use could be facilitated with some inexpensive design changes to the Melbourne Metro tunnel. Additionally, the tunnel could generate revenue

by leasing space for trunk infrastructure (eg, sewerage and water lines).

Furthermore, our mobility infrastructure can be better designed to facilitate community interaction, with our road and rail corridors being adapted to serve as shaded cycleways and pedestrian lanes, thereby providing co-benefits (ie, enhanced physical activity, community interaction and alternative mobility options).

Another example would be preserving a fuel corridor now to the future Western Sydney Airport, which could provide other uses, such as housing water pipes and electricity/fibre-optic cables, and providing above-ground parklands and cycleways. This would lead to efficiencies in construction and thousands fewer truck movements through residential areas. Failure to preserve such a corridor would lead to greatly elevated cost in the future if such a corridor is deemed necessary when land values are higher.

Finally, barriers (eg, waterways, motorways, etc) that separate groups of people from one another reduce social cohesion, so design and proper planning is needed in these cases to find ways around these impediments and to promote interaction.

Conclusion

We don't know what the future holds, but we do know that resilient communities — well connected, healthy, empowered and socially cohesive — are better able to cope with shock events, whilst being much nicer to live in. We have many opportunities to improve livability by making smart decisions about multi-use infrastructure, but only if we act early and consider resilience from every angle.



*Will Symons is a Technical Director at AECOM and is leading three projects related to The Rockefeller Foundation's 100 Resilient Cities initiative, which is helping cities around the world become more resilient to the physical, social and economic challenges. For more on this initiative, see www.100resilientcities.org. A recent AECOM report, 'The Future of Infrastructure', outlined many insights related to risk and resilience, whilst an accompanying article, 'Infrastructure resilience: in a shifting world', also delved in more detail into the management of risks related to cybersecurity, potential terror attacks and climate change. They can be viewed at infrastructure.aecom.com.

Coping with drought and water restrictions

Contrast Sydney's millennium drought strategy with Cape Town

*Andre Boerema**

Turning on a tap to get a glass of clean and safe water is something that households in the modern cities of Australia and globally have taken for granted for decades.

The current water crisis in Cape Town, a major city of South Africa, has placed the automatic right of receiving drinking water higher up our state of consciousness than it normally would.

Sydney's millennium drought

The millennium drought affected most of southern Australia from late 1996 to mid-2010. The water reserves for Sydney received a reprieve between 1997 and 2000 where close to average rainfall returned and storage levels rose. Coincidentally, during this period a new regulatory framework was introduced by Sydney Water's regulator, the





The fact that the regulatory mechanism was instigated very early, in what was to become a long-term drought, enabled Sydney Water to test a wide range of initiatives...

Independent Pricing and Regulatory Tribunal, or IPART, during its regular 4-yearly pricing review process.

The Demand Management regulation imposed a requirement for Sydney Water to reduce water use to 329 litres per person per day by 30 June 2011, which was a 36% reduction on 1999 water use levels of 506 litres. An interim target of a 28% reduction to 364 litres was also set for 30 June 2005.

The regulation required Sydney Water to demonstrate efficient allocation of resources to manage demand, but provided sufficient flexibility for Sydney Water to develop its own program of delivery. Annual reporting requirements were also included and the rigour of these increased dramatically as the millennium drought began to take hold once again in Sydney, which led again to declining storage levels amid an increasing population. Storage levels ultimately dropped to below 40% in June 2005, a point where the decision to build additional supply sources was made.

By 2002 the drought was having a significant impact on Sydney. Storage levels were at 70% but were to drop to 40% by 2005. Increasingly more demanding water restrictions were imposed from November 2002 through to June 2009. These focused primarily on outdoor and garden water use,

and as they became more severe, businesses were also required to contain their use of water outdoors for washing and cleaning activities. During this time there was significant growth in expenditure on water efficiency programs, recycled water projects, regulatory changes and the investigation of alternative water sources.

The most significant aspect of the Demand Management Regulation was that it allowed Sydney Water to recover the cost of its demand management activities through water price negotiations with IPART. These negotiations proved that Sydney Water's expenditure was efficient.

The fact that the regulatory mechanism was instigated very early, in what was to become a long-term drought, enabled Sydney Water to test a wide range of initiatives, rank them in order of the cost/kilolitres of water saved and then to increase the scale of the more promising projects. As positive data was gathered and the evidence base of successes was reported, a diverse and growing portfolio of programs were endorsed by key stakeholders. This iterative process engaged the community and built confidence. A solid foundation consisting of a broad portfolio of effective and scalable demand management activities was developed within 2 years and these continued to expand through to 2011 when,

finally, above average rainfalls restored storage levels to 100%.

The programs undertaken by Sydney Water to install water-efficient fittings, the improvements in water efficiency of dishwashers and washing machines, the introduction of subsidised rainwater tanks, the introduction of business water efficiency programs and the introduction of water efficiency measures in new building construction have all led to improved water efficiencies across Sydney.

What is pleasing is that the behavioural changes created by water restrictions and waterwise rules introduced during the millennium drought have been maintained and water consumption in total across Sydney, and also on a per capita basis, has remained at low levels despite an increase in Sydney's population of over 1 million people.

Cape Town's experience

The primary contrasts between Sydney's drought experience and South Africa's appear to be related to the advanced planning advantage Sydney Water had because of its Demand Management Regulation and the subsequent financial support for program development and delivery that it enabled.

In Cape Town the agriculture sector uses 30% of total water supplies and they receive subsidised water that during the current drought hasn't been exposed to restrictions. This is in contrast to the residential sector, which has been increasingly forced to comply with extreme restrictions on water use.

Cape Town is a significantly less developed economy compared with Sydney with GPD per capita of US\$15,918 compared to Sydney's per capita GPD of US\$62,340. The need to provide essential water supplies below cost to vulnerable communities is significant while there is a reluctance to negatively impact the intertwined agricultural and tourism sectors that drive significant economic growth in the region.

The water sector in Cape Town is regulated directly by the government, whereas in Sydney, IPART is an independent organisation that isn't directly influenced by political pressure. There are clearly resource constraints within the Cape Town Water

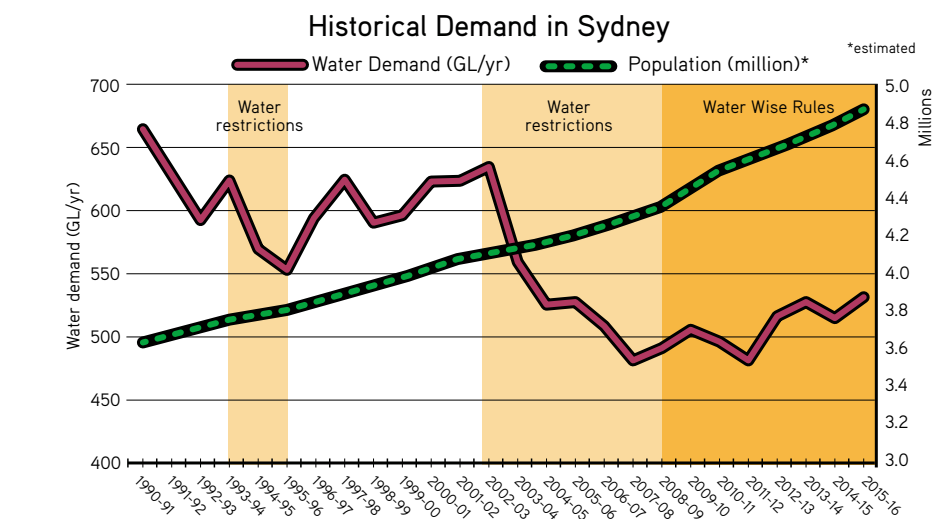


Figure 1. Total water use (excluding recycled water) in Sydney was around 558 billion litres a year in 2016-17. This is about the same volume used in 2003-04, despite a 20% increase in population.

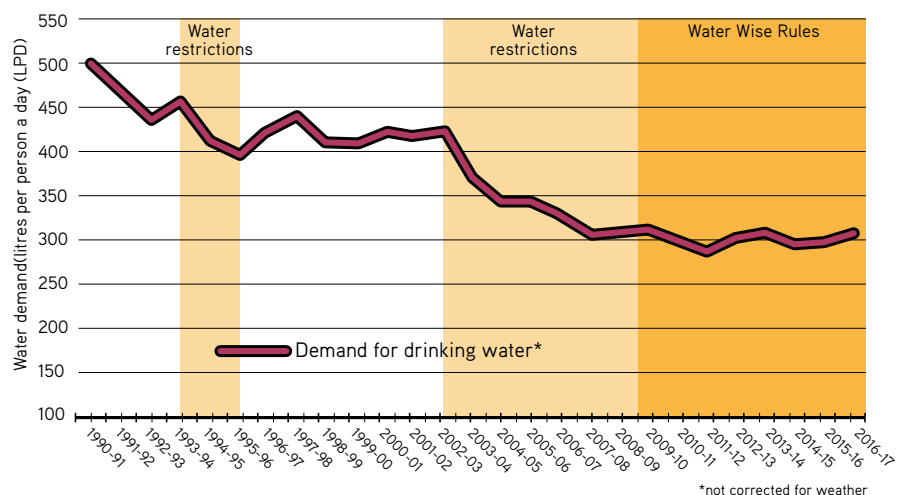


Figure 2. Total water use per person per day (excluding recycled water), not corrected for weather impacts.

and Sanitation Authority as it is suffering from reduced sales and increased costs of supply. The drought in South Africa comes at a time when the accelerating impacts of climate change are making historical experiences significantly less relevant than a decade ago. There has been little time for Cape Town to adapt.

Sydney is well placed to manage demand and respond to short- and longer-term climate impacts amid a steadily growing population. Sydney Water works closely with stakeholders across the water sector to understand both water demand and supply options to secure water supplies that are affordable and resilient to respond to the population growth and climate change.



*Andre Boerema is the Manager of Residential Product & Services Delivery at Sydney Water.



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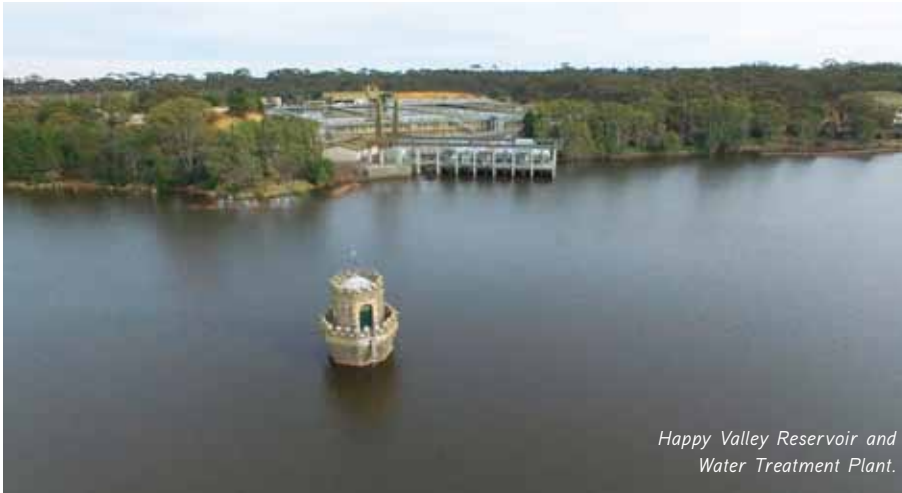
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SA Water aims for \$0 net electricity costs by 2020



Happy Valley Reservoir and Water Treatment Plant.

SA Water plans to reduce its demand on the grid and increase its renewable energy generation and storage capacity, in an ambitious plan to achieve zero net electricity costs within the next three years.

SA Water Chief Executive Roch Cheroux said 2020 target will be progressed through a range of complementary initiatives that will see mature technologies embraced for immediate impact. "A range of innovative emerging technologies will also be tested in partnership with local and international providers," Cheroux said.

The utility will initially invest \$10 million on up to 6 MW of solar photovoltaic panels to be installed across some of its large metropolitan sites, with the first installations expected to begin in the first half of next year.

A \$500,000 pilot 100 kW solar photovoltaic and 50 kWh battery storage system is also currently being installed at SA Water's Crystal Brook workshop, chosen for the size and orientation of its roof, and potential for high-quality solar irradiance.

The other pilot projects being funded by technology partners that will move into testing phases in 2018 include:

- **Floating solar photovoltaic arrays on reservoirs** — The arrays will be trialled on SA Water's Happy Valley Reservoir, with the installation of a 100 kW pilot system. As well as producing electricity to power the nearby Happy Valley Water Treatment Plant, the floating solar panels may also help reduce evaporation and the incidence of algal blooms. French company Akuo Energy will be provided access to Happy Valley Reservoir to implement the test program, which will initially use technology from Ciel et Terre. Should the pilot program be a success, Akuo Energy will investigate options to have floats manufactured in South Australia.
- **Silicon thermal storage to complement existing biogas generation** — SA Water will trial new silicon thermal energy storage technology at its Glenelg Wastewater Treatment Plant. Glenelg Wastewater Treatment Plant is already 80% self-

sufficient, burning the natural biogas created through sewage treatment processes to generate electricity through reciprocating gas engines that is then used in the facility. Adelaide-based company 1414 Degrees recently received a \$1.6 million grant from the State Government's Renewable Technology Fund to progress the pilot program. The technology will store latent heat in molten silicon at 1414 degrees Celsius to form a 10 MWh thermal storage device. This will release approximately 250 kW for six hours as well as heat which is returned to the plant's digesters.

- **Flywheel mechanical battery storage systems** — The 128 kW flywheel energy storage system will be trialled to capture energy generated by solar arrays at Hope Valley Reservoir. The flywheel technology forms a mechanical battery by converting and storing electrical energy in a rotating mass, and is fast to charge, has unlimited cycling capability and can discharge for up to four hours. In comparison to chemical batteries,

flywheels may also have other benefits such as low energy losses, zero capacity degradation, no chemical reactions or fire hazards, and no end-of-life disposal challenges. Should the trial prove successful, South Australian, Aboriginal-owned company Greenfields Energy will investigate options to manufacture them within the state.

Further capital investment will be guided by the outcomes of the pilot projects and be considered on a case-by-case basis to ensure the best return on investment and outcome for SA Water's customers.

"We've already been reducing our electricity costs by more than \$3 million a year since 2013, so we know that with a concerted push, our goal is ambitious, but within reach," Cheroux said.

SA Water's existing and successful energy management portfolio includes biogas power generation (a by-product of the sewage treatment process) and hydroelectric systems (harnessing the force of moving water within the network to generate electricity).

Through renewable energy generation, the utility's Bolivar and Glenelg Wastewater Treatment Plants are now 92 and 80% energy self-sufficient respectively.

Hydroelectric systems at Hope Valley, Seacliff Park and the Adelaide Desalination Plant (ADP) supply approximately 7000 MWh per year, equating to 14% of the total electricity produced by SA Water.

SA Water serves 1.6 million people across South Australia and is one of the largest electricity users in the state, with energy-intensive pumping and treatment operations consuming 220 GWh in 2016/17 at a cost of around \$55 million.



SA Water biogas engine.

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Waste-to-chemistry project kicks off in Rotterdam



A consortium of companies comprising Air Liquide, AkzoNobel Specialty Chemicals, Enkema and the Port of Rotterdam has signed a project development agreement covering initial investments in an advanced waste-to-chemistry facility in Rotterdam.

The facility is expected to be the first of its kind in Europe to provide a sustainable alternative solution for non-recyclable wastes, converting waste plastics and other mixed wastes into new raw materials. Using technology developed by Enkema, the facility will convert up to 360,000 tonnes of waste — the total annual waste of more than 700,000 households — into 270 million litres of 'green' methanol for use in the chemical industry and transportation sector.

The plant will have two production lines, or twice the input capacity of Enkema's commercial-scale plant in Edmonton, Canada. It is set to benefit from the state-of-the-art infrastructure available within the Port of Rotterdam, as well as synergies with Air Liquide (large industries) for supplying the required oxygen and, together with AkzoNobel, the raw material hydrogen. AkzoNobel also acts as a customer for the methanol.

The initial investments, which cover detailed engineering, the set-up up of a dedicated joint venture and completing the permitting process will be worth €9 million. The consortium aims to take the final investment decision for the estimated €200 million project later in 2018 and has appointed Rabobank as the lead advisor for the financing process.

Realisation of the project is supported by the Dutch Ministry of Economic Affairs and Climate Policy, which has agreed to

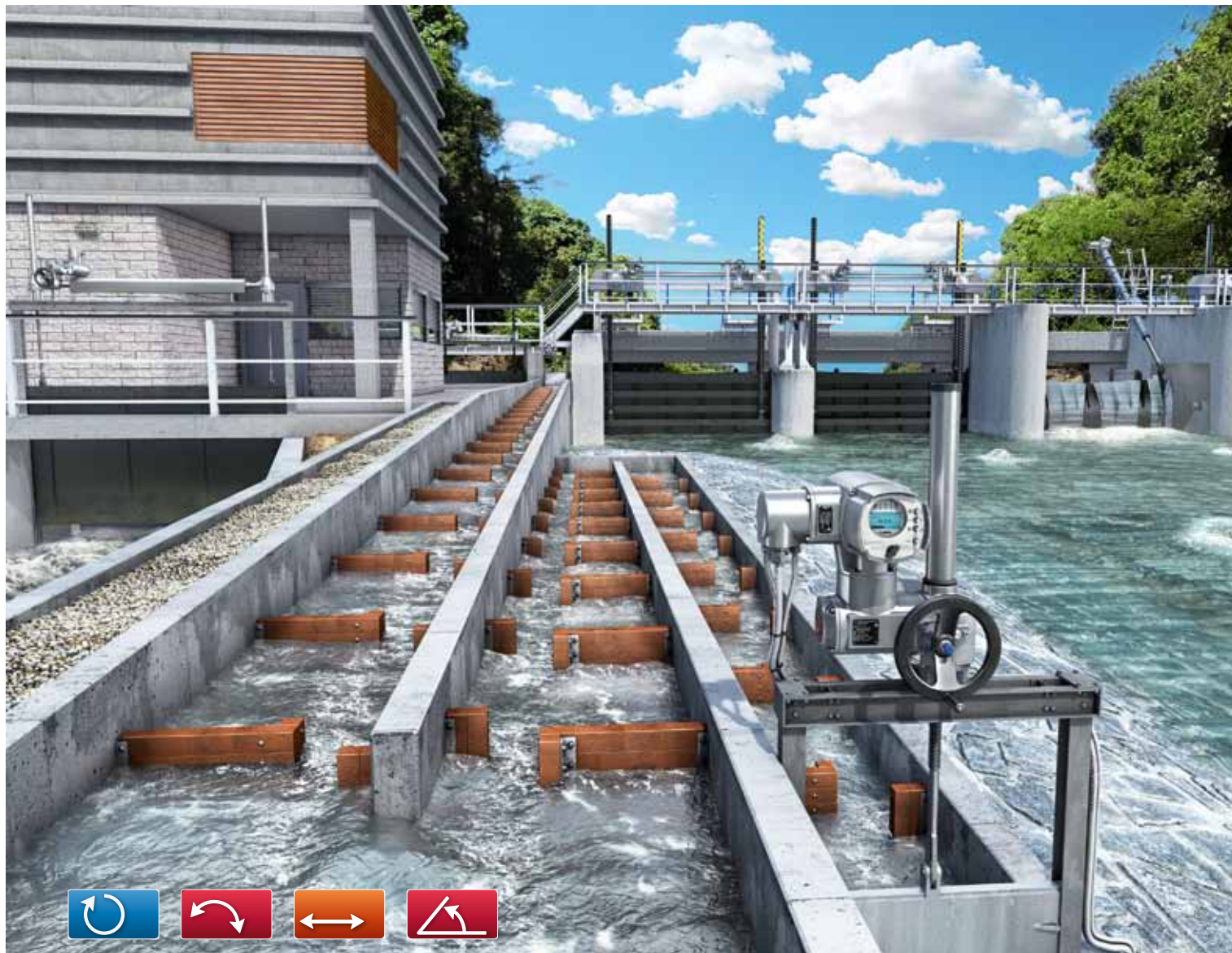


develop mechanisms and regulation that will help bring this new technology to full scale to support the low-carbon transition of the Dutch economy. The project is also supported by the City of Rotterdam, the Province of South Holland and InnovationQuarter, the regional development agency.

"This is an important milestone for the project and a significant step toward implementing a sustainable and circular chemical industry," said Marco Waas, director RD&I at AkzoNobel Specialty Chemicals, who leads the consortium's steering committee. "The agreement comes at a very appropriate time given the current challenges in plastics recycling in Europe.

"We can convert non-recyclable waste into methanol, an essential raw material for many everyday products, including sustainable transportation fuel. Not only can this be used in the existing supply chains and replace fossil sources, but it also avoids CO₂ emissions otherwise produced by burning waste."

"Waste to chemistry is a prime example of our collaborative approach to innovation, and driving sustainability to business value," said Peter Nieuwenhuizen, chief technology officer for AkzoNobel Specialty Chemicals. "We have made vital progress in the past months. The partners have agreed to their contributions and roles, we are very pleased with the collaboration with the Dutch government and we welcome Rabobank on board as a financing partner. We can now go full steam ahead towards a final investment decision later this year."



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Starting the clock on the 30-minute city

Stephen Taylor, City Executive — Sydney, Arcadis Global Cities Program

The '30-minute city' concept — the idea that we can engineer our cities so that home, work and play are all accessible within 30 minutes — is gaining currency around the world. But is the idea of the 30-minute city, as some have argued, simply a catchy slogan — or worse, a mere 'thought bubble'?

What we do know is that most cities are currently a long way from this ideal and will need innovation and the right ingredients to come even close to realising it, so perhaps a better question is: can we get there? And if we think we can, what are those ingredients?

Our recent Sustainable Cities Mobility Index, which ranked 100 cities globally, found that while the best cities focus on efficient and accessible integrated transport options, many — hampered by congestion, less-than-ideal modal share and long commuting times — are a far cry from a 30-minute city.

The answer to how we might address road congestion — a complex issue that can cost a given city billions of dollars per year in lost productivity and impact negatively on commuters' physical and mental health — is multifold. It includes consideration of a range of personal mobility trends, from shared mobility and autonomous vehicles to point-to-point drones and flying cars, as well as strategies for getting some vehicles off roads, particularly at certain times of day.

Shared mobility — which encompasses crowdsourced car-sharing schemes (such

as Uber), as well as membership-based car and bicycle sharing cooperatives — is on the rise and will undoubtedly continue to grow. In some dense urban centres, however, car-share options appear to be taking customers away from ageing and overcrowded public transit systems, thus putting more cars on the road, particularly at peak times. Nonetheless, point-to-point car- and bicycle-sharing options that get people to and from public transport hubs quickly and economically may be one key to tackling congestion.

In addition to shared mobility schemes and strategies, most commentators agree that growth in the accessibility and use of autonomous, self-driving vehicles (AVs) is not only inevitable, but just around the corner. Proponents argue that AVs have the potential to positively impact road congestion by reducing road accidents, while accessing real-time data feeds to redirect travel routes in accordance with traffic incidents and flows. However, they are still vehicles on roads; they will give many current non-drivers access to personal vehicles, putting even more vehicles on roads; and many AVs are likely to travel the same route not once but twice daily, as they ferry their owners to and from work, returning home in between.

In short, I believe that AVs are poised to create the congestion of the future.

If AVs will soon be common on our roads, will urban air mobility — ie, flying cars — be the next dimension in personal transport technology? While personal air travel would seem to be a long way off, point-to-point drone technology for small-scale deliveries (which has obvious scope for taking cars off roads) is being widely tested and will undoubtedly be commonplace before long. Other strategies for getting some vehicles off roads, particularly at certain times of the day, include: congestion charges, which are aimed at discouraging personal car use in city centres; implementation of more and higher road tolls, along with demand management pricing; time restrictions on provision of road-intensive services, such as garbage collection; and time restrictions on goods deliveries requiring oversize vehicles.

Regardless of which new personal mobility trends or technologies (or vehicle restrictions) we wish to consider, one common thread is the absolute necessity for solid data — both about current transport behaviour and the impacts of new modes or measures — if governments and transport authorities are to make sustainable plans and policies that



impact positively on both individuals and communities. What we most certainly do not want is increased inequality and stratification, with some people accessing new personal mobility options at the expense of public transport, others left to use ageing systems and governments left without the public will or means to invest in critical infrastructure.

However, road congestion and personal mobility considerations, while important, are only part of the picture. To get to the heart of our 30-minute puzzle, we also need to look at the reasons so many of us 'choose' to travel long distances from home to work. And when one considers the economic stratification present in nearly every large urban centre, it seems clear that most people get jobs where they can get them, but live where they can best afford to live — or at least where they can best afford to live while also accessing the things that are most important to them, such as good schools, health services and reasonable levels of public amenity.

Of course, better and faster road and public transit options along the right corridors, coupled with higher density housing and appropriate services along these corridors — as well as better access to



Shared mobility is on the rise and will undoubtedly continue to grow.

transport hubs and better integration across transport modes — are a start. Ensuring availability of a variety of housing options at different price points close to employment hubs — including affordable housing options for essential workers — is also key.

Then there are the things people will endure longer commutes to access. Social infrastructure, such as good schools and health services, are essential, as is open green space. Places to enjoy an al fresco meal while children play nearby, along with festivals and sporting events — the things that make a neighbourhood a community — are also important. These types of amenities also need to be tailored to different areas within cities, so that inequalities, such as climatic and socioeconomic variation, are softened.

And when all is said and done, people don't just need access to a job close to home, they need access to the next job and the one after that, with the average person in most countries changing jobs 10–15 times over the course of their working life.

For this reason, more strategies aimed at creating employment clusters, or 'centres of excellence', so that the bulk of similar types of companies and jobs are co-located within a city, are also warranted.

That's a lot of considerations and strategies that, even taken together, are probably just the tip of the iceberg. What is certain, though, is that better mobility — including integrated transit opportunities, seamless transport corridors, dynamic mobility hubs, and roads and regulations that will efficiently accommodate new technologies — are at the heart of the 30-minute city. In addition, cities must be ready to embed and capture digital data from a range of sources, including buildings, roads, vehicles, public transport facilities and smartphones, while building both public and private capacity to access, assess and act on this data to continually innovate and improve the way we live, work and commute.

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Solar-powered 3D printers trialled in Solomon Islands

Deakin University, in partnership with Plan International Australia, has successfully trialled technology capable of 3D printing plumbing and sanitation supplies using discarded plastics.

The university ran a crowdfunding campaign back in 2017 to help meet the costs of the printers' first prototypes. Plan International Australia contributed \$10,000 to the project, along with a donation from a private donor and additional financial support from Deakin's Centre for Humanitarian Leadership and School of Engineering.

Now, less than 12 months after completing funding, the research team has trialled the printers in the field in the Solomon Islands, where they were powered by solar energy — despite a week of cyclonic conditions and rain. The team also scavenged discarded hard and soft plastics, including keyboards, jerry cans and printer cartridges, to convert into plastic filament that was fed into the printer.

"Finding effective means of recycling is vital everywhere, but particularly in places like Honiara, where plastic waste is increasing and its management remains minimal," said Plan International Australia's manager for water, sanitation and hygiene, Tom Rankin.

"In the streets of Honiara, there is plastic literally everywhere. It clogs up the drains, causing flooding, and flows out into the sea, killing marine life. Our aim was to turn waste plastic into useful parts and we've achieved that."

Working with volunteers from local villages to identify leaks in rural water supply systems, the project team measured the pipes, designed a replacement part and 3D printed the part in hard plastics. The team also used soft plastics to 3D print seals for leaking taps.

"In the parts of the Solomon Islands we visited there is a significant need for customised sanitation parts," said Dr Mazher Mohammed, a senior research fellow in Deakin's School of Engineering. "We saw mismatched pipe everywhere, bandaged up with car inner tubes, bamboo and cloth. Some taps were leaking the equivalent of a bucket of water every few minutes.



1. Deakin staff Dr Mazher Mohammed and Daniel Wilson with Solomon Islands Development Trust (SIDT) volunteer: Davis Paia.

2. Rubbish, predominantly plastic, collects and blocks drains all over Honiara during and after rainy periods causing flooding and providing breeding grounds for mosquitos carrying malaria and dengue fever.



3. A component of a water supply fitting printed using 100% recycled plastics (in this case, old computer keyboards and printer cartridges).

4. The 3D printer used to print water supply parts using recycled filament and solar power.



"While in the Solomon Islands we also found we could use the reclaimed plastics for other applications, from jewellery making, basket weaving and even cutting dry grass. We believe we've only scratched the surface of the potential application for this equipment, helping turn trash into treasure."

Rankin described the trial as a "huge advancement" which saw the researchers prove that recycled plastics can be used to print useful parts.

"The next step is to get the technology working reliably and to consider what else we could use it for," he said, suggesting the potential applications of the technology are "limitless".

"It was amazing ... to test our equipment in the middle of the jungle in cyclonic conditions," added Dr Mohammed. "If we can make it work here, I truly believe we can make it work anywhere."

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Solar power successfully shared in mini grid trial

Power reliability is looking more promising after AusNet Services' mini grid trial in Mooroolbark, Victoria, recently passed a new milestone, demonstrating that batteries and solar shared on the network can be orchestrated to power nearby homes during power outages.

The milestone saw AusNet Services successfully separate the small, residential community from the main power grid for almost 22 hours, while enabling a steady and secure power supply to customers by sharing renewable energy.

The Mooroolbark mini grid is made up of individual households that have the capability to generate, store and manage power, and can be separated from the electricity network for periods. Only 14 of the 18 homes have solar panels and batteries, which are shared with the network.

During the trial event, AusNet Services used a combination of its central Distributed Energy Network Optimisation Platform (DENOP), the GreenSync MicroEM mini grid control platform and an advanced inverter and battery device known as a stabiliser,

provided by Power Technology Engineered Solutions, to separate the mini grid from the main grid and to operate it in a stable and secure fashion.

The DENOP used field data provided through the software interface with the GreenSync platform to issue commands to the local batteries, thus sharing the stored renewable energy among all 18 homes — even those without solar — before switching the homes back to the main power grid 22 hours later. The stabiliser, which has a very small battery, meanwhile smoothed out short-term variations in energy supply and consumption across the mini grid by either delivering or absorbing power.

AusNet Services Executive General Manager, Regulated Energy Services Alistair Parker believes this process could be adapted to reduce the impact of power outages — especially in remote and rural areas.

"The evolution of energy will enable communities to share stored solar with their neighbours when the power goes out," said Parker. "The technology developed through our innovative trial will help customers either share or sell their stored energy over the network to keep the lights on and costs down for everyone."

"The impact of extended power outages could become a thing of the past when we all work together. AusNet Services envisages a future where we help customers realise the value of their energy assets, for their own benefit and that of the wider community."



Cooking up a new method for mercury removal

An international team of scientists has devised a new way to extract the neurotoxin mercury from the environment — and their secret ingredient is cooking oil.

Led by Dr Justin M Chalker from Flinders University, the scientists combined second-hand cooking oil and sulfur — a common, low-cost by-product from petroleum production — to produce a new kind of polymer to use in remediation of soil, water and even the air. Writing in *Chemistry: A European Journal*, they revealed that their polymer can trap the most dangerous and common types of mercury pollution — mercury metal, mercury vapour and highly toxic organo-mercury compounds which harm both aquatic and terrestrial systems.

"We can use this material to protect the environment by capturing toxic mercury pollution — a pernicious problem around the world, causing brain damage and loss of IQ points in unborn children," Dr Chalker said.

"Mercury is encountered in several industrial activities, including oil and gas refining and coal combustion. Alarmingly, mercury and mercury-containing materials are still used intentionally at many chloralkali plants and in artisanal gold mining.

Additionally, mercury-based fungicides are still used in certain agricultural sectors."

After absorbing mercury pollution, the novel rubber-like polymer changes colour to indicate the job is done. More of the polymer mixture can then be placed in the area to continue to process.

Dr Chalker said the development will enhance sustainability and environmental protection, with few remediation methods readily and affordably available. He noted that "every atom of the mercury-binding material can be derived from industrial by-products, so this is also an exciting advance in recycling and repurposing waste".

Dr Chalker said the material is being tested in field trials at mining sites and areas where mercury-based fungicides are used. His team's eventual goal is to deploy the solution at goldmines, as the largest source of mercury emissions globally is due to artisanal goldmining.

The polymer is currently licensed for sale to Kerafast, a US-based reagent company whose primary aim is to make laboratory-made research tools easily accessible to the global scientific community.



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Pathways to decarbonisation in the water sector

Brendan Tapley, Associate Director — Sustainability, WSP Australia

There are a variety of challenges facing the water sector, not least of which is dealing with climate change. Net zero emission targets for 2050 are now in place in five Australian states and territories, with related regulation in the water sector likely to increase. Setting targets in line with the latest science is an effective way to ensure that your organisation stays ahead of the curve.

Setting the scene

According to the World Economic Forum's Global Risks 2018 report, water crises are identified as one of the top five global risks. Half of the top 10 risks are water related, including failure of climate change mitigation and adaptation, water crises, food crises and extreme weather risks. This requires innovation and investment in technology and processes that maximise value creation, while mitigating future risks and uncertainties. Here, we outline some of the significant trends and challenges faced by the Australian water sector.

Climate change

Today, we are seeing a rise in uncertainty around future water supplies, which is exacerbated by the risks of the physical impacts of climate change. The millennium drought was a reminder of Australia's vulnerability to the risk of water shortages. Transitioning to a low carbon economy is becoming more and more accepted as an imperative rather than a nicety. It is also being driven by increased regulation of greenhouse gas (GHG) emissions.

Infrastructure

At our current rate of population growth, Melbourne and Sydney will hit eight million in the middle of this century. Already, essential infrastructure is groaning under the strains of population growth, ageing infrastructure, and maintaining water security and quality. While the government's recent National Water Infrastructure Development Fund will be helpful to some water utilities, accessing finance continues to be a challenge.

Performance and reliability

Regulators have been moving to better incentivise water utilities to maximise customer outcomes including management of reliability, risk and performance. In Victoria, the regulator determines a water utility's financial returns depending on whether the utility's business cases are viewed to be 'leading', 'ambitious', 'standard' or 'basic'. This includes considering how GHG emissions and physical risks to assets will be managed.

Technology

Smart water networks and big data analytics can facilitate the management of complex processes and supply chains, offering

breakthroughs to use less energy, cleaner energy, scrutinise pricing, and reduce carbon and water footprints. A challenge for water utilities is to move beyond business as usual to embrace innovation and change.

The water services industry has significant opportunities for reducing energy intensity, particularly through innovative wastewater process technology and utilising sewerage for renewable energy generation.

Cost of energy

The water sector is a major consumer of energy and generator of greenhouse gas emissions. Energy is often one of the largest utility operating costs, along with labour. This has been emphasised by rising energy costs in Australia, driven largely by the provision of drinking water and treatment of wastewater. Carbon price-related costs are a future consideration, whether driven by new regulation or by an internal, voluntary adopted carbon pricing.

Affordability

Affordability of water services is a growing issue. Infrastructure Australia forecasts that a typical residential water and sewerage bill is estimated to increase by 50% from \$1226 to \$1827 over 2017–2027¹. We also face an ageing population with changes in the ways that water is used, and increased sensitivity with water affordability.

National carbon target

Australia has established a 26–28% GHG emission reduction target on 2000 levels by 2030. The aim of the Paris Agreement is to limit a global temperature increase to ‘well below’ 2°C, and to attempt to achieve a limit of 1.5°C warming above pre-industrial levels. The urgency is highlighted with Australia last year averaging 1°C warmer than the long-term average, according to the Bureau of Meteorology². Yet, Australia appears to be lagging. The United Nations Emissions Gap Report for 2017 states that Australia is ‘likely to require further action’ to achieve its 2030 goals, with government emission projections sitting at 30% lower than required.

State carbon targets

A review of state-based carbon and renewables targets is presented below. Many states have zero net emission targets in

State/Territory	Zero net emissions target	Renewable energy target
Queensland	By 2050	50% renewables by 2030
Victoria	By 2050	20% by 2020 and 40% by 2025
South Australia	By 2050	50% by 2025
ACT	By 2050	100% by 2020
New South Wales	By 2050	Former national target of 20% by 2020
Northern Territory	No target	50% by 2030
Western Australia	No target	Former national target of 20% by 2020
Tasmania	Proposed target by 2050	100% by 2022, aided by hydroelectricity

place for 2050 and now need to drive action to achieve them.

Science-based targets

As major energy users, water utilities have an important role to play in the transition to a low-carbon economy. Companies have conventionally set GHG emissions reduction targets in response to regulations or benchmarks. In contrast, science-based targets start from the premise that emitters must limit emissions within a certain cumulative threshold to mitigate the worst effects of climate change. Science-based targets are defined according to a share of the global emissions limit allocated to companies based on factors such as the company’s economic productivity, carbon intensity or a combination of both.

Origin Energy has science-based emissions targets, with a commitment to halve emission by 2032 in line with the Paris 2°C goal.

Setting science-based targets

By setting ambitious science-based targets, businesses can benefit from achieving emissions reductions ahead of future requirements.

1. Gather information

Setting science-based targets typically requires several company-specific baseline inputs, including: annual GHG emissions, activity level (a measure of output) and projected changes over time. Gathering information on baseline emissions would include:

- Water supplied, wastewater flows and loads treated, equivalent population (EP) serviced, recycled water produced, etc.
- Data for each of the water treatment plants and wastewater management facilities, other emission sources and their related technology such as aerobic and anaerobic digestion processes.

There is an opportunity for the water services industry to work together to form a Sectoral Decarbonisation Approach, agreeing on reporting scope and metrics for target setting. The activity level could be measured by metrics of supply (eg, volume of water supplied) or treatment (eg, loads from equivalent population treated). In addition to baseline information, several methodologies require that companies define the sectors they work in and/or state their contribution to national or global gross domestic product. This information helps to determine the share of the global emissions capacity — the carbon budget — that should be allocated to each company in proportion to its economic productivity. Many methodologies use economic intensity metrics as a basis for targets that seek to grow the economy while shrinking carbon emissions. For example, targets can be based on metrics of GHG emissions per unit of economic value added (eg, gCO₂e/\$).

2. Set targets and commit

To set targets, the first step is to select a methodology for calculating a carbon budget. Several methodologies have been developed, including:

- The Sectoral Decarbonisation Approach, based on the water sector’s contribution to global GHG footprint and your company’s contribution to the sector
- The Context-Based Carbon Metrics calculator
- Climate stabilisation intensity target — based on reducing emissions by 80% by 2050 from a 1990 baseline
- The 3% Solution calculator, which includes use of an online tool to calculate the target.

Take note of your business goals and characteristics against the available meth-

odologies and select the one that is most relevant to your business.

Some companies have developed their own target-setting methodologies based on climate science. This requires considering emissions thresholds or changes identified by the International Panel for Climate Change and others, then translating them into company-specific metrics and magnitudes of change over time. For water utilities, this might include reporting in kgCO₂e/L and related financial metrics.

When setting a science-based target, give some thought to:

- Scope — the emissions sources included
- Time frame — the duration of the target period and immediate, medium- and long-term actions
- Ambition — the slope of the reduction curve
- Type — whether to set absolute targets, intensity targets, or both.

3. Report and review

Science-based targets should be reviewed on an annual basis to track progress relative to the anticipated emissions reduction path, and to make adjustments and restatements as necessary. Effectively communicating this information to audiences including decision-makers in your business is important.

Opportunity action planning

Alongside setting a 'top down' science-based target, it can be useful to form a 'bottom up' view of how you might achieve a carbon target, and any gaps that will require addressing.

To achieve this, you will need to:

- Identify a list of relevant potential carbon mitigation opportunities
- Assess the opportunities against a set of criteria (emissions savings, financial impact, time frame, collaborative solutions, business capacity/resourcing, risks, etc)
- Forecast the emissions scenarios
- Prioritise the opportunities to be pursued

- Focus on more cost-effective initiatives first, such as energy efficiency programs.

An expanded version of this would be a carbon neutral strategy, for which emissions data would be collected, mitigation opportunities assessed and emissions trajectories identified for the business as usual against emission reduction scenarios.

It makes sense to begin by looking at existing opportunities that have already been identified, or else understanding potential barriers.

Collaboration can provide valuable sources of ideas, especially the ones already demonstrated by other water utilities. Sharing experiences helps to share the costs and risks of bringing new technology into practice.

Community collaborations can be explored such as for community scale and joint power purchasing agreements. Private sector collaborations can also be important, including understanding the needs of major energy and water using companies and collaborating on opportunities.

Conclusion

Now is the time to be planning for your organisation's approach to managing GHG emissions. Whether it is a net zero/carbon neutral or science-based target methodology, a structured approach will help to mitigate risks and maximise your opportunities.

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The author would also like to acknowledge Michelle Brownlie, Associate – Sustainability for her contribution.

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Deboratisation initiatives in the water sector include:

■ Energy efficiency measures

- Alternative water treatment processes eg, mechanical primary sedimentation, anaerobic sludge digestion, thermal hydrolysis sludge treatment
- Efficient pumping (including inverters and controls)
- Efficient buildings (LED lighting, air conditioning, etc)
- Efficient treatment plant blowers and aerators
- Waste heat recovery
- Considering Energy Performance Contracting as a delivery and financing vehicle
- Transport for biosolids disposal and other vehicle fleets

■ Renewable energy (including self-supply and purchase options)

- Co-generation ie, from anaerobic sludge digestion process
- Small scale hydro power and solar PV
- Offsite options eg, through Power Purchase Agreements

■ Scope 1 reductions

- Wastewater treatment fugitives, biosolids management, biogas and fleet
- Addressing the long-term challenges of fugitive emissions

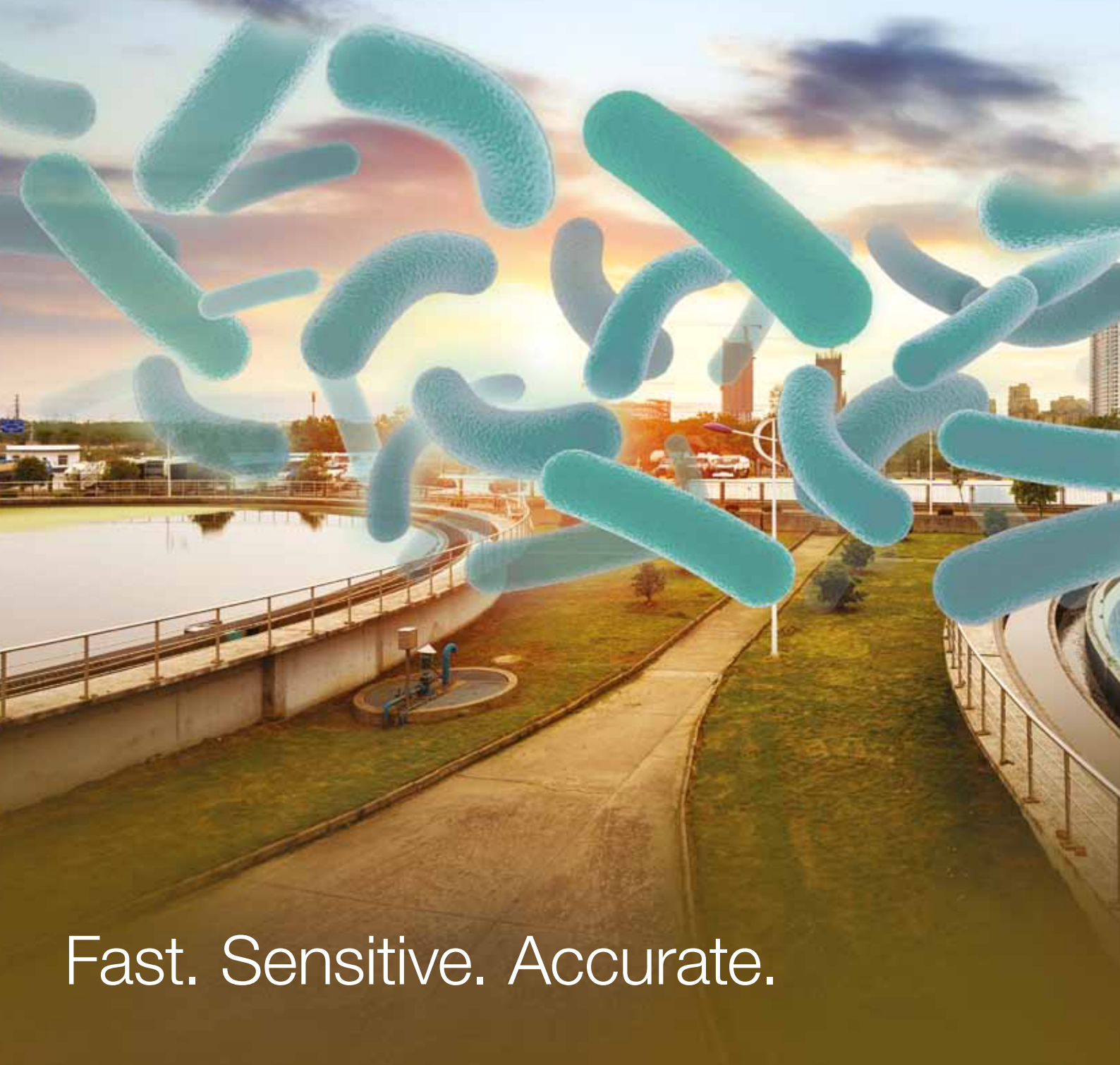
■ Carbon sequestration

- Including use of existing or unused land as a carbon sink

■ Utilisation of existing agricultural land to utilise treated wastewater

■ Utilisation of the 'air-space' over wastewater lagoons

- Floating solar on water reservoirs
- Options such as methane capture to power generation
- Power generation from bio gases



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Modular water analysis management with a future

The city of Öhringen in the Hohenlohe region of Germany has continuously invested in the modernisation of the water infrastructure for the past 25 years. When it comes to restructuring water analysis management, innovative online analysis systems play an important role.



Online analysis systems monitor all important parameters during operation and communicate with the higher-level controller and the control system.

Since 1955, the city of Öhringen has been a member of water utility company Zweckverband Wasserversorgung Nordostwürttemberg (NOW) and is committed to supplying its inhabitants with high-quality drinking water. In 1988, the city recognised the challenge of treating its own water resources by mixing the water with the soft water supplied from Lake Constance and other areas in order to reduce adverse effects on the pipelines. To ensure consistent supplies of high-quality water to all residents, the new Öhringen Waterworks and a new elevated tank were commissioned in 1995. Here, different types of water are mixed and the city's own water is treated using activated charcoal and chlorine dioxide disinfection. With a capacity of 320,000 m³ of drinking water annually, the plant currently supplies approximately 22,000 inhabitants of municipalities in the Hohenlohe district.

Optimised processes require new water analysis concept

To further enhance the operational safety and to optimise the operating procedures,



Öhringen continuously invests in the plant. Consequently, the old ozone plant was decommissioned, a new UV plant installed and the water analysis concept was also scrutinised in this context. Until now, it was assumed that the quality of the raw water was already sufficiently ensured by traditional regular raw water analyses of the wells. In the waterworks itself, only overall turbidity, pH value, residual ozone content and chlorine dioxide content at the inlet and outlet were continuously measured and the data transferred via analog signals to the process control system (PCS). This concept was no longer sufficient for the future.

Optimising the plant technology also required reorganisation of the water analysis management — also, in view of the increasing requirements pertaining to the monitoring

of drinking water quality. A new concept that provides information about the overall water quality was developed in close cooperation with a water management institute. The analysis equipment needed to initiate semi-automated or fully automated control and regulation tasks, introduce an early-warning and alarm system and monitor the condition of the treatment technology. When it came to selecting the measuring technology, the focus was also on a sustainable, economically expedient, reliable and holistic approach.

MEMS technology instead of glass probes

Based on these criteria, the city of Öhringen opted for the new Online Analysis System (Type 8905) from Bürkert. The com-

compact, modular and expandable system for water analysis employs MEMS technology (microelectromechanical systems). As a result, the measuring technology can now be designed in a practical and futureproof manner.

In contrast to the glass probes previously used, the microchips, for instance, do not need to be replaced as frequently. The extended lifetimes and long calibration intervals for the microchips help ensure maintenance-free and reliable operation. "This delivers clear cost savings thanks to fewer inspections of measurement points and lower maintenance expenditure," added Horst Geiger, technical director of the waterworks. "Staff members have more time for more important tasks."

From a total of 14 sensor cubes and two automatic purification units, a bespoke solution for the waterworks was developed within a very confined space. In the process,

the large 'measurement wall' was also replaced by a compact stainless steel cabinet. In total, seven different water samples with the matching individually combined sensor cubes are analysed in it for turbidity, pH value, redox potential, conductivity and chlorine dioxide. The purification units ensure that all parts in contact with water samples can be cleaned as and when required without manual intervention. With the previous analysis concept, on the other hand, the sensors used for water with a high propensity for fouling often had to be cleaned by hand, which meant shutting down the measurement cell.

In the new analysis concept, parameters are transferred to a display and displayed there. The operating displays of the Type 8905 are specifically adapted to the Öhringen waterworks and named after the sampling locations at the request of the waterworks supervisor. This eliminates the possibility of


confusing the parameters. The large 7" touch display can be configured both on the device itself and using a free software program. R-I diagrams, images or different parameter combinations can easily be visualised. The measurements are transferred directly from the sensor via a Profinet interface to a higher-level PLC.

Additional arguments in favour of the Online Analysis System are the low costs of operation and the minimum consumption of water samples. The internal water consumption of the old system was around 15 times higher. It also required high inspection expenditure and consumed significant quantities of reagent.

The waterworks in Öhringen are now well equipped for the future and the new technology platform is under constant development.

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ROTARY SCREW BLOWERS

Kaeser Compressors has announced the CBS series of rotary screw blowers. Complementing the company's existing range of energy-efficient screw blowers, the series brings the advantages of screw blower technology to lower flow rate applications such as those found in the wastewater treatment sector.

From bioreactors and flotation to the production of aeration air for municipal and industrial wastewater treatment plants, there are a number of applications where low-pressure compressed air with low flow rates is required. To meet these needs, Kaeser has extended its compact and turnkey range of rotary screw blowers. The CBS series of screw blowers deliver compressed air with differential pressures up to 1000 mbar, power from 7.5 to 22 kW and flow rates from 15.7 to 22.3 m³/min.

The company claims that the screw blowers offer significant energy advantages in the two-digit range compared to other screw and turbo blowers on the market, making them up to 35% more efficient compared to conventional rotary blowers. One of the models is said to be so powerful that it efficiently covers the control range of two or three rotary blowers.

This efficiency is achieved in part by the inclusion of Kaeser's screw compressor block, which features Sigma Profile rotors. This efficient screw compressor block includes a wide control range and ensures virtually constant specific power. Even at maximum speeds, the rotors ensure minimal transmission loss. The use of high-tech bearings and no need for ancillary equipment further minimises energy consumption.

With low maintenance, energy efficiency and the ability to set up units directly adjacent to one another, the screw blowers are especially advantageous for continuous operation. Delivered ready for immediate operation, the versatile turnkey blowers are equipped with a star-delta starter (or frequency converter). They therefore save time associated with planning, installation, certification, documentation and commissioning.

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ENTEROCOCCI ENA TEST

TECTA-PDS has launched the Enterococci ENA test for the TECTA B16 automated microbial detection solution. Exclusively from Thermo Fisher Scientific in Australia and New Zealand, the TECTA portfolio of testing *E. coli*, total and faecal coliforms is adding an Enterococci test that is claimed to offering significant advantages to the water testing market over conventional methods.

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The test is not affected by turbidity, sample colour or high concentrations of bacteria, with no need to dilute samples to reduce these properties.

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WATER DISINFECTION SYSTEM

Evoqua Water Technologies has introduced the OSEC L electrolyser, a water disinfection system that creates sodium hypochlorite on-site and on demand. Compact, easy to install and easy to use, the product offers push-button operation, plug-and-play installation and a footprint roughly 50% smaller than other on-site generators, according to the company.

An inherently safe alternative to chlorine, sodium hypochlorite and calcium hypochlorite, the system does not require handling of any hazardous chemicals. The generator produces a dilute hypochlorite solution <1.0 wt% concentration using saturated brine (salt), water and electricity in an electrochemical process. With an embedded process controller, the system is fully automated and can work in batching or direct feed operation modes.

The product offers up to 20 ppd chlorine equivalent with interchangeable OSEC cartridges. Treated water is certified to NSF/ANSI 61 drinking water standards. It has long service intervals.

Applications include: drinking water, remote chlorination stations and well sites; commercial aquatics, pools, theme parks, splash pads and spas; industrial process water, light manufacturing and cooling towers; healthcare and institutional facilities; agricultural, irrigation and water re-use.

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Helping to protect coral reefs in Fiji

Global environmental leaders have named 2018 the International Year of the Reef, in an effort to protect the planet's coral from the effects of rising water temperatures and ocean acidification. As part of this initiative, Fijian Prime Minister Frank Bainimarama has announced the nomination of large portions of Fiji's Great Sea Reef as a Ramsar site, designated under international treaty as a wetland important for the conservation of global biological diversity and for sustaining human life.

"We are engaged in a battle for the future of these reefs," Bainimarama said, claiming that threats to the reef include climate change, chemical and wastewater run-off from neighbouring urban settlement, and industry.

"We approved the nomination of large parts of the Great Sea Reef as a Ramsar site to protect it for future generations.

"Today I appeal to every single person on Earth to help us. We must replace the present culture of abuse with a culture of care."

But winning the battle for the future of the reefs is not quite so simple. While healthy coral reefs can exist over a wide range of natural nutrient environments, the heat and light stress tolerance of corals — and thus their bleaching susceptibility and recovery after bleaching events — is adversely affected by high dissolved inorganic nutrient loads.

Higher than normal inorganic nutrient loads disrupt the finely balanced environmental conditions necessary for coral to thrive via multiple pathways. Increased phytoplankton loads can supply more food for the larvae of the crown of thorns starfish, limit light penetration and cause an abundance of filter feeders. High algal growth, fuelled by the unnatural abundance of inorganic nutrients, meanwhile outcompetes and smothers both live and bleached coral, releases algal toxins and depletes oxygen, inhibiting growth and recovery.

Inorganic nutrients make their way into the coral reefs from a wide variety of sources, including fertiliser usage, deforestation, land use for grazing, urban stormwater pollution and lack of sewage treatment or poor nutrient removal in sewage treatment plants. Even mobilisation of sediments via trawling and dredging increases the levels of nutrients. Making

matters worse, nutrient stress on coral reefs often occurs a considerable distance from the source, via the movement of the increased phytoplankton loads.

Hydroflux Pacific, Hydroflux's latest addition to its environmental group, is located in the heart of Fiji's capital of Suva, and has already started helping with the battle for the future of the reefs. Bringing global technology to the country along with the necessary local support, the company is helping Fiji treat wastewater from both industry and resorts, all of which potentially makes its way into the local coral reefs.

The Hydroflux Group has a number of major projects underway in the region. This includes the provision of a wastewater treatment plant at the Musket Cove Island Resort, located in the remote Malolo Lailai, and several more packaged sewage treatment plants under construction for other major resorts in Liku Liku, Malolo and Matamanoa in the Fijian Mamanuca group of islands.



Musket Cove Island Resort, located in the remote Malolo Lailai, Fiji.



Stuart Petersen, Hydroflux Pte Ltd (Hydroflux Pacific) Director.

Hydroflux's range of packaged sewage treatment solutions treat wastewater generated by guests, in addition to that from the laundry and the kitchens, to a standard suitable for re-use in irrigation, thus ensuring the environmental sustainability of the resort and helping protect the fragile neighbouring coral reefs into the future.

Hydroflux Industrial is currently constructing a wastewater treatment plant for a multinational food and beverage company in Suva, taking significant pollutant and inorganic nutrient load off the local municipal sewage treatment plant. The plant incorporates the Hydroflux Group's HyDAF Dissolved Air Flotation, Hydroflux HUBER Screening and HUBER QPRESS dewatering, as well as Hydroflux HySMART SBR technology, all designed to treat high-strength industrial wastewater so that the discharge complies with Fiji's National Liquid Waste Management Strategy.

Hydroflux Pacific fully supports Prime Minister Bainimarama and his appeal to every single person on Earth to help save the coral reefs of the world.

Hydroflux Industrial Pty Ltd
www.hydrofluxindustrial.com.au

A new way to filter salt and metal ions from water

Australian and US researchers have discovered a way to utilise metal-organic frameworks (MOFs) — a next-generation material that has the largest internal surface area of any known substance — to make sea water suitable for drinking. The sponge-like crystals can be used to capture, store and release chemical compounds — in this case, the salt and ions in sea water.

The discovery was made by researchers at Monash University, CSIRO and The University of Texas at Austin, who found that MOF membranes can mimic the filtering function, or 'ion selectivity', of organic cell membranes. With further development, these membranes have the potential to perform the dual functions of removing salts from sea water and separating metal ions in a highly efficient and cost-effective manner, offering a revolutionary new technological approach for the water and mining industries.

Reverse osmosis membranes are currently responsible for more than half of the world's desalination capacity, and the last stage of most water treatment processes, yet these membranes have room for improvement by a factor of 2 to 3 in energy consumption. Furthermore, they do not operate on the principles of dehydration of ions, or selective ion transport in biological channels, and therefore have significant limitations.

In the mining industry, membrane processes are being developed to reduce



water pollution, as well as for recovering valuable metals such as lithium. However, at current rates of consumption, there is rising demand likely to require lithium production from non-traditional sources, such as recovery from salt water and waste process streams.

If economically and technologically feasible, direct extraction and purification of lithium from such a complex liquid system would have profound economic impacts. These innovations are now possible thanks to the new research, published in the journal *Science Advances*.

"We can use our findings to address the challenges of water desalination," said Professor Huanting Wang from Monash University. "Instead of relying on the current costly and energy-intensive processes, this research opens up the potential for

removing salt ions from water in a far more energy-efficient and environmentally sustainable way.

"Also, this is just the start of the potential for this phenomenon. We'll continue researching how the lithium-ion selectivity of these membranes can be further applied. Lithium ions are abundant in sea water, so this has implications for the mining industry who current use inefficient chemical treatments to extract lithium from rocks and brines.

"Global demand for lithium required for electronics and batteries is very high. These membranes offer the potential for a very effective way to extract lithium ions from sea water, a plentiful and easily accessible resource."



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Graphene membrane enables single-step water purification

CSIRO scientists have used their own specially designed form of graphene to make water purification simpler, more effective and quicker. Published in the journal *Nature Communications*, their breakthrough potentially solves one of the great problems with current water filtering methods: fouling.

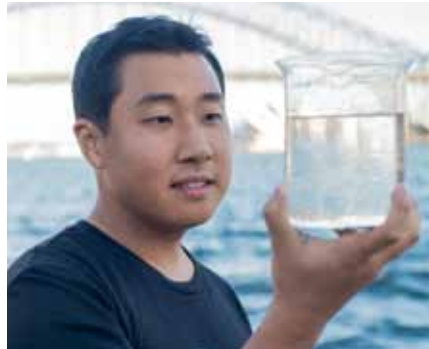
Over time, chemical- and oil-based pollutants coat and impede water filters, meaning contaminants have to be removed before filtering can begin. As the world's strongest material, graphene is an ideal candidate for filtering applications — or would be, if it wasn't typically water repellent.

Last year, the CSIRO team succeeded in creating a graphene film with microscopic nanochannels that let water pass through, but stop pollutants. According to lead author Dr Dong Han Seo, their 'Graphair' membrane can "replace the complex, time-consuming and multistage processes currently needed with a single step".

As an added advantage, Graphair is said to be simpler, cheaper, faster and more environmentally friendly than graphene to make. It consists of renewable soybean oil, more commonly found in vegetable oil.

Looking to prove their technology in a real-world setting, Dr Seo and his

colleagues took water samples from Sydney Harbour and ran it through a commercially available water filter that had been coated with Graphair. Researchers from QUT, the University of Sydney, UTS and Victoria University then tested and analysed its water purification qualities.



Dr Dong Han Seo.



A Graphair sample.

Without Graphair, the membrane's filtration rate halved in 72 hours. When the Graphair was added, the membrane filtered even more contaminants (99% removal) faster. Even when coated with pollutants, the membrane continued to work.

"Our graphene membrane enables 100% salt rejection as well as 100% rejection of household contaminants such as detergents and oil without fouling, which was tested over many days," Dr Seo said.

Dr Seo described Graphair as "a perfect filter for water purification" with an enormous potential impact, noting that "what we are talking about is eliminating all the expensive complex pre-treatment water treatment process".

"This technology can create clean drinking water, regardless of how dirty it is, in a single step," Dr Seo said. "All that's needed is heat, our graphene, a membrane filter and a small water pump."

CSIRO is currently looking for industry partners to scale up the technology so it can be used to filter a home or even town's water supply. It is also investigating other applications, such as the treatment of sea water and industrial effluents.

"We're hoping to commence field trials in a developing-world community next year," Dr Seo said.



RUGGED, AIR PRESSURE-COMPENSATED DATA LOGGER FOR WATER LEVEL MONITORING

Bestech Australia introduces Keller DCX-22 AA data logging probes to monitor groundwater levels and tank filling levels, which can be used under a wide range of conditions.

The design utilises two AA (absolute-absolute) sensors technology; hydrostatic and barometric probes. These probes offer fully autonomous operations, or they can also be used as an integrated data logger, wireless transmitter, an ambient-pressure compensating capillary or a separate absolute pressure sensor. The probes are designed for robustness and long-lifetime operations of 10 years.

The electronics employ the latest microprocessor technology for high-resolution reading from both hydrostatic and barometric sensors. The devices are highly resistant for use in humid and damp environments, and will not be affected by a short period of flooding.

The DCX probes can be adapted for event-controlled reading using the user-friendly GUI so that only useful data are stored in the probes. The captured data can be retrieved either by manual download using USB cable or through wireless GSM data transmission from the remote location. The data can also be sent to any mobile device as a short message (SMS).

Key features include: pressure range of 800–2300 mbar absolute; accuracy of $\pm 0.05\%$ of FSO; resolution of $\pm 0.0025\%$ of FSO; and a probe diameter of 22 mm.

Bestech Australia Pty Ltd
www.bestech.com.au



Major Victorian meat processor undertakes energy audit

With rising energy bills an issue for all businesses, one of south-west Victoria's biggest employers is taking steps towards reducing its energy costs.

Meat processor Midfield Group, whose energy costs have almost doubled in recent years, will work with Deakin University researchers to review its energy consumption and identify areas for improvement. Funded by Meat & Livestock Australia, Midfield Group Project Officer Kevin Banner said the project will go beyond a traditional energy audit.

"We're tracing all volumes of energy and doing individual metering in our separate departments to drill down further than simply interpreting a power bill," Banner said.

"It's critical that we understand in detail what our energy costs are and be mindful of opportunities to make improvements.

"This Deakin audit and reporting will tell us in detail where and how we use our energy and we can then review that and do business cases on all opportunities."

Postdoctoral researcher Dr Mahbub Rabbani, from Deakin's Faculty of Science, Engineering and Built Environment, will lead the study from the city of Warrnambool, where Midfield Group is based. Dr Rabbani has expertise in energy efficiency and will work with other research colleagues within Deakin's renewable energy department.

Banner said Midfield Group had looked at other consulting options for the project, but Deakin had all the capabilities. "We not only have Dr Rabbani's expertise, we can call on Deakin's



broad set of skills within the university's water, electrical and engineering departments," he said.

Deakin Warrnambool Director Alistair McCosh said the university aims to increase the number of postdoctoral research collaborations in the south-west and will explore further opportunities for industry collaboration in the region.

"This is an excellent opportunity to bring Deakin's broader research expertise to the region to support industry and business to build their capability and capacity," McCosh said.

"We can also use postgraduate researchers as part of their PhDs in a range of opportunities to make a real difference for local industries."

Deakin University

www.deakin.edu.au



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We call that teamwork: The collaboration between Siemens and Bürkert resulted in the Type 8647 AirLINE SP valve island, which is compatible with the Siemens I/O system SIMATIC ET 200SP. It is designed not only for fast installation, but also features numerous safety functions for drinking and process water processes, such as the new LCD with real-time status display of diagnosis data - accessible either via the integrated LC display or via the control system. Together with the pneumatic safety functions, this results in a solution for maximum process reliability.

AirLINE SP Type 8647

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FINGER VALVES

Despite continuous developments in the manufacturing sector, manually operated valves still

have their place in production. While many plants

desire upgrades and welcome more flexible solutions, manually operated valves still provide benefits and are still relevant for certain applications. These hard-working, robust valves offer both control and durability.

SMC's VHK series of finger valves enable ease of operation and visibility. The valve direction clearly indicates whether the valve is open or closed (shut to open is counter-clockwise) and the classification of the knob by colour helps in distinguishing between 2-port valves (grey) and 3-port valves (blue). In addition, the series features a sturdy construction to ensure no leaks, thus saving energy.

The robust valves offer a poppet valve construction and can operate at a maximum pressure of 1 MPa and an operating vacuum pressure of -100 kPa. The series begins with a minimum tube diameter of 4 mm and accommodates air at temperatures of between 0 and 60°C.

In addition to the standard VHK 2- and 3-port finger valve options, SMC also offers a flame-resistant version for harsher environments.

SMC Australia | New Zealand
www.smcworld.com



TANK LEVEL INDICATORS

KING-GAGE Tank Level Indicators are precision manometric instruments designed for continuous display of liquid level in storage or processing tanks. A vertical column of indicating liquid within a glass tube rises in direct proportion to the pressure applied. This analog display is read against a custom-calibrated scale graduated in one or more units of depth, volume or weight of tank contents.

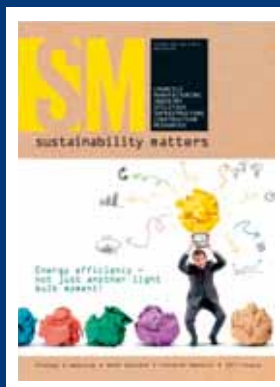
Working as a frictionless hydrostatic balance, these indicators have none of the mechanical parts common to most gauges. This is said to make the KING-GAGE Indicator an inherently accurate and rugged device. Used in conjunction with a pneumatic 1:1 output sensor, the indicator accepts a pressure signal that is directly proportional to tank depth.

Unlike electronic indicators or meters, KING-GAGE pneumatic indicators are designed to be inherently safe. Even in areas designated continuous explosion hazard, there are no intrinsic safety devices required.

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Lean and green thinking helps farmers do more with less

Queensland's farmers have been doing it tough over the past 10 years, but now researchers from QUT and Griffith University have unearthed a potential antidote to the problem. All that's required is a shift in investment decisions around equipment and processing.

According to lead researcher Savindi Caldera, a doctoral researcher from QUT, the strategic application of 'lean and green thinking' could enable farmers to make the most of precious capital and ongoing expenditure. Lean and green thinking is an integrated approach focused on resource optimisation and promoting activities to 'do more with less'.

The approach has already proved successful for the Keith family, a sugarcane farming family based at Woongoolba and who own the Rocky Point Sugar Mill. After identifying the appropriate tools to reduce waste and non-value-adding activities, the family diversified their business practice and now offer a range of sustainable



garden supplies for home garden projects, including organic gardening, potting plants, fruit and vegetable growing, suppressing weeds and more.

"We have realised that to complement our sugarcane farming, we can recycle urban waste destined for landfill, collecting pallets and crates and recycling them to produce 'urban timber mulch' which we then sell for use on gardens," said Lars Hall, business development manager at Rocky Point.

In recognition of Rocky Point's diversification of farming practice and sustainability focus, the Keith family won the 2016 Australian Farmer of the Year award. And according

to co-researcher Associate Professor Cheryl Desha, of Griffith's Cities Research Institute, the findings have implications for all farmers battling rising operating costs.

"Rather than buying into what's popular or relying on sales reps, farmers can now directly see which types of resourcing and energy efficiency tools and programs best suit them, depending on their priorities," said Desha.

The researchers' work has been published in the *International Journal of Cleaner Production*.

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Water applications under the radar

A new radar sensor from Vega has been optimised for the widely different applications in the water/wastewater industry.

VEGAPULS WL 61 uses short radar signals to measure the distance to the surface of the water and is suitable for all applications in level, gauge and flow rate measurement in water purification and sewage treatment facilities.

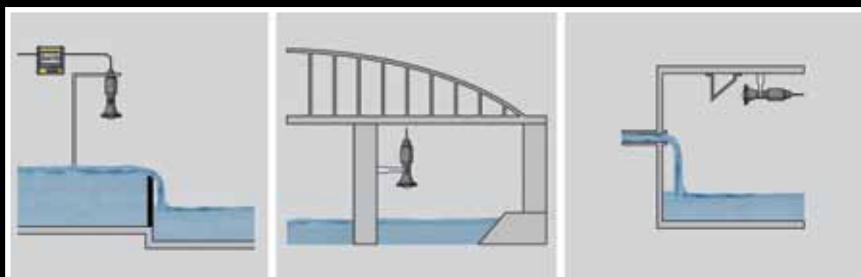
Unfazed by environmental factors such as fog, snow, rain and fluctuations in temperature, the radar measurement technology is designed to enable high-precision logging of water levels. Its precision remains unaffected under all operating conditions, which is said to be a critical advantage, especially for flow rate measurement in open channels, since differences of even a few millimetres can cause significant measurement errors.

Applications under control

The large number of mounting options and different connection concepts makes the sensor suitable for many water management systems applications, including: flow rate measurement in open channels and outfall weirs; level measurement of rivers and canals; floodwater in the stormwater overflow tank; flow measurement in a chamber outfall; level measurement in the pump shaft; and screw pump in the sewage lift station.

1. Flow rate measurement in open channels and outfall weirs

Unaffected by temperature, wind and weather, the radar sensor measures the actual flow with precision of ± 2 mm. Flow



From left to right: 1. flow rate measurement in open channels; 2. level measurement of rivers and canals; and 3. floodwater in the stormwater overflow tank.



From left to right: 4. flow measurement in a chamber outfall; 5. level measurement in the pump shaft and 6. screw pump in the sewage lift station.

measurement can be made in conjunction with VEGAMET 391.

2. Level measurement of rivers and canals

Due to the device's compact design, it lends itself particularly well for monitoring the levels of rivers, canals and lakes. The sensor can be simply mounted on different structures like bridges or sluices. Its unobtrusive design can provide for protection against vandalism.

3. Floodwater in the stormwater overflow tank

To optimally utilise the total capacity of a stormwater overflow tank, the measuring signal of the device can be easily deflected by a sloping metal plate. The sensor is submersible due to its IP 66/68 (2 bar) rating.

4. Flow measurement in a chamber outfall

Designed for more than just precision flow measurement, event-driven measured val-

ues can also be stored in the sensor and made available for later documentation. A data logger is available for up to 100,000 measured values.

5. Level measurement in the pump shaft

The device is also suitable in cramped spaces. The sensor is designed to work reliably, even if there is foam and build-up on the shaft walls.

6. Screw pump in the sewage lift station

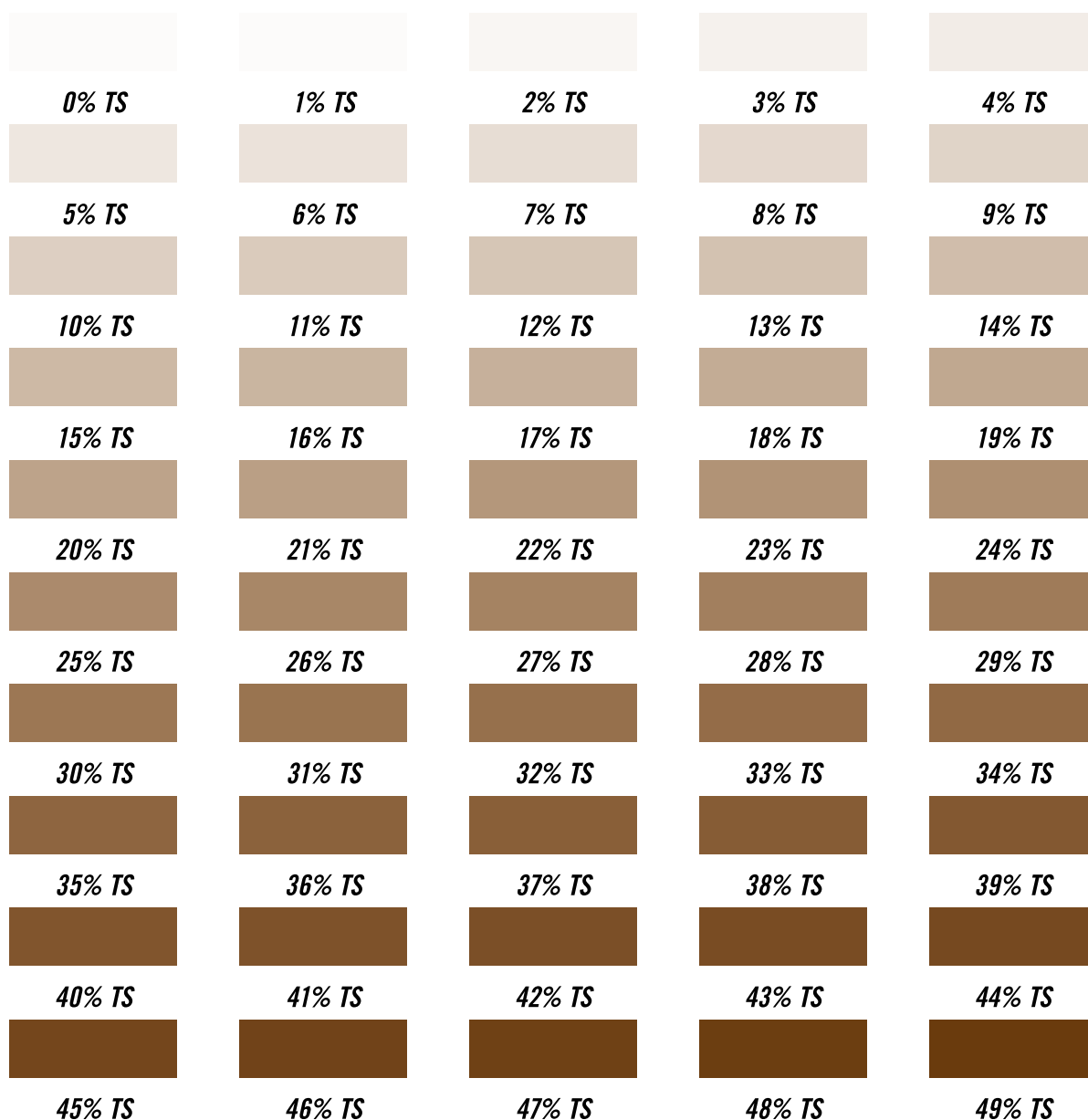
The device can be mounted above the intake of the screw pumps. It is designed to control the operation of the pumps reliably, even if the wastewater has a high solid content.

Regardless of how the measurement signals are to be further processed, the device can be integrated into an existing control system and infrastructure. Both analog and digital sensor versions are available.

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Protective coatings based on potato starch

Researchers at the Fraunhofer Institute for Applied Polymer Research IAP, in cooperation with the Fraunhofer Institute for Manufacturing Engineering and Automation IPA, are developing a cost-effective surface coating based on renewable raw materials. The focus of their research? Potato starch.

More and more industries are focusing on sustainable production, including the production of coatings such as paints and varnishes for protection against corrosion.

"Until now, traditional industrial fields of application of starch have been the paper/corrugated cardboard and adhesives industries," said Christina Gabriel, a scientist at the Fraunhofer IAP. "In the field of paints and varnishes on the other hand, starch was usually only used as an additive. With starch as the main component of a water-based dispersion, we now have very promising adhesion results."

At the centre of the research is the coating of metals for indoor use, for example aluminium, which can be used for fire doors, computer housings or window frames. Here, the use of starch as the main component of paints and varnishes posed various challenges to the scientists.

The scientists' solution involved an initial degradation step of the starch in order to improve its solubility in water and the subsequently associated solids content of the starch in water, as well as its film forming ability. However, in order to produce



In future, indoor aluminium surfaces could also be cost-effectively coated with paints based on potato starch.

©Fraunhofer IAP

a starch-based coating material, which is comparable with a conventional coating, this is not yet sufficient. Although the film former should initially be soluble or dispersible in water, the coating must subsequently no longer dissolve in water. The starch must therefore be modified further.

This modification takes place by way of a chemical process known as esterification. The resulting starch esters are dispersible in water, form continuous films and have very good adhesive properties on glass and aluminium surfaces. The esterified starch is then 'cross-linked', through which the sensitivity of the coating to water is reduced further. The stability tests to check the long-term stability are then carried out.

In these tests, the coated materials are exposed to rapidly changing temperature cycles in a time-compressed form to simulate the change from day to night and the course

of the seasons. In addition, the test objects are exposed to electrolyte-enriched water in order to see how the coating reacts to water and how resistant it is under extreme conditions.

In the next step, the resistance to corrosion and adhesion of the modified starch on different metal substrates is examined. New 'recipes' are also being tested, which are intended to optimise the properties of the coating even further.

"Apart from the already tested aluminium, two other important metals, steel and galvanised steel, are to be tested," said Gabriel. "Our investigations show that with its good film forming and very good adhesion properties on various substrates, starch esters have the potential to be future alternatives to petroleum-based film formers in the coatings industry."



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In a time of unprecedented change, it is difficult yet increasingly important to understand the potential impacts on and requirements for the workforce of the future. The Water Services Association of Australia and Water Environment & Reuse Foundation commissioned KPMG to review key workforce trends and future skills requirements driving change in the water sector to enable success to the year 2040.

SUSTAINABLY MANAGING THE WATER-ENERGY- CLIMATE NEXUS

Economic growth and development puts increasing stress on already scarce resources. The development of an integrated water-energy-climate nexus planning model, applied as part of the World Bank's Thirsty Energy program, shows the importance of taking into account regional variabilities in water availability, as well as highlighting how decision making in the energy sector could impact on future water resources planning.

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The SERIES IEF Insertion Electromagnetic Flow Transmitter, from Dwyer Instruments, is an adjustable insertion flowmeter featuring electromagnetic technology that measures fluid velocity in addition to providing several continuous signal outputs. The series is designed to offer good performance paired with simple installation and use.

The set-up wizard and installation tool are simple to use, allowing for quick and precise installation. The accessory set-up kit A-IEF-KIT is designed to ensure exact installation application depth with the included thickness gauge and measuring tape.

One unit is adjustable to fit pipe sizes from 102 to 914 mm. It offers several output options, including selectable BACnet MS/TP or Modbus RTU communications protocol over 2-wire RS485 in addition to the standard analog, frequency and alarm outputs.

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The device has a long life cycle and minimal maintenance requirements, with no moving parts to wear or break and electrodes that discourage fouling. Isolation valve accessory options allow for installation in operational systems via the hot-tap kit or easy removal without system downtime.

Applications include boiler feed water, chilled water, open- and closed-loop condenser water, irrigation systems, municipal water distribution, process and coolant flow, groundwater remediation, chemical processing, pump protection, wastewater and mining.

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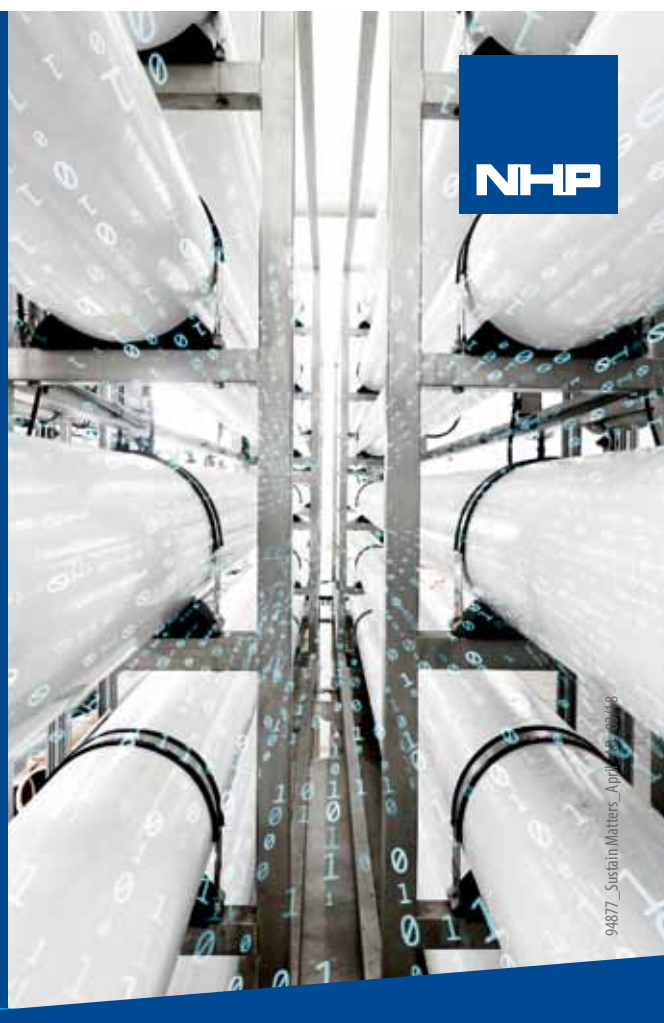
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Optimised chemical dosing results in savings for wastewater plant

With a continuing task of maintaining the good condition of the Glatt — a river that was once significantly contaminated — the Bachwis wastewater treatment plant in Fällanden, Switzerland, is constantly striving to optimise its operations.

The plant processes the wastewater of the four connected communities of Volketswil, Schwerzenbach, Fällanden and Maur. Designed for a population equivalent of 45,000, it treats a sewage volume of more than 5,500,000 m³ per year. A mechanical cleaning system transports the wastewater into the two-line primary sedimentation system. The water is biologically cleaned in the anoxic tanks and the three downstream aeration tanks with a post-aeration tank using alternating/intermittent aeration. The treated water is pumped from final sedimentation into a filtration facility before it is finally introduced into the river Glatt.

Problem

Previously, dosing of the precipitant was adjusted manually based on the laboratory measurement value of the daily composite sample and so was unable to respond to possible peaks. Although being compliant

with the effluent limits, the values observed fluctuate between 0.2 and 0.8 mg/L.

The precipitant was added at two points — to the return activated sludge and upstream of the filter. Dosing of the precipitant into the return activated sludge was adjusted using the laboratory measurements of the daily composite samples. Where the last laboratory samples showed an increasing or decreasing trend, the dosing quantity was increased or decreased accordingly. The dosing quantity in the filter was consistently maintained at 2 L/h.

Following an assessment of the plant's potential, it was revealed that further optimisation of the use and consumption of FeCl₃ was possible in the area of precipitant dosing.

A more detailed analysis of the operating data was then carried out in collaboration with Hach consultants. The plant was visited in order to gain an accurate insight into the current situation.

Solution

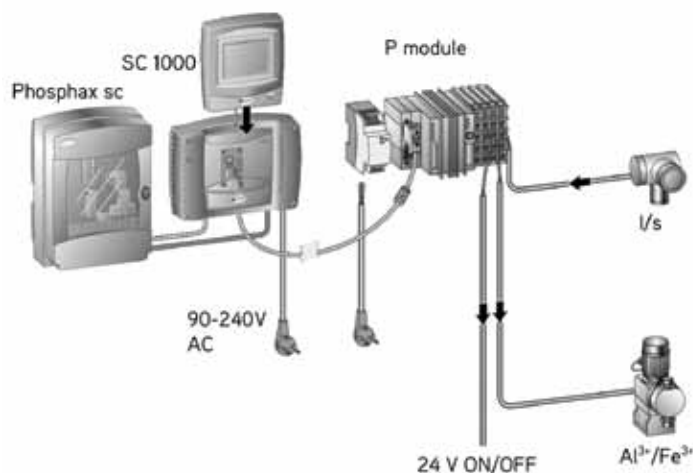
An initial proposal was to shift the variable precipitant dosing from the return activated

sludge to the final aeration of the alternating/intermittent tanks. A two-channel phosphate analyser with two sample preparation modules and the RTC-P control module for two dosing points was also recommended.

As a result of the initial proposal, initial optimisation and savings could be achieved even before the installation of the RTC-P control module. A six-month test phase was agreed and the equipment required for the optimisation process was installed.

The measured values and control values of the analyser and the RTC-P are first transmitted to the central control system, where the dosing can be controlled. This has the advantage that, in addition to the existing fallback level of the RTC-P, control of dosing can also be activated or deactivated at the control system (eg, when tanks are being cleaned). As the measurement is taken after dosing, the RTC-P was set to 'feedback control' with an initial set point of 0.5 mg/L.

Following the initial set-up, parameterisation of the system was continuously monitored via the GSM module of the SC1000 controller and adapted in each case in consultation with personnel at the wastewater treatment plant. It quickly became evident that the PO₄-P measurement with the Phosphax sc analyser at the plant provided additional useful data which had not been available previously. The decision was therefore made to keep the measurement long before the test phase ended. After the parameterisation of the RTC-P module underwent additional adjustments, the module

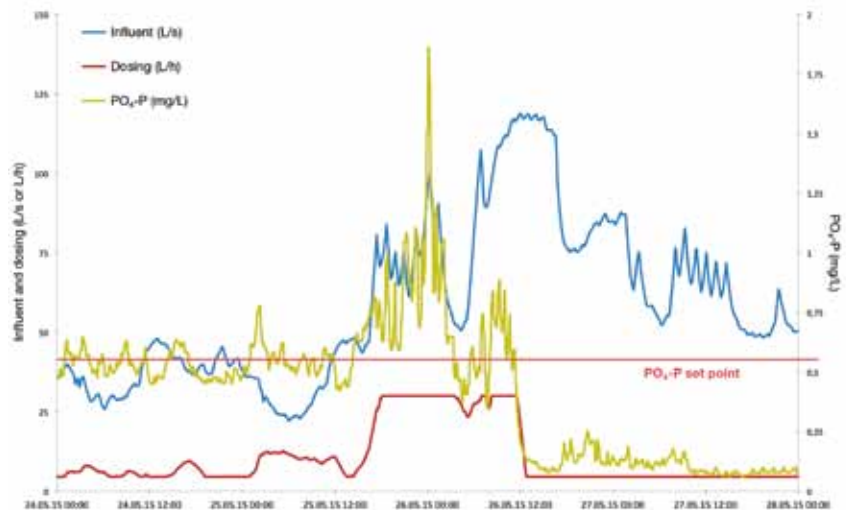


wastewater treatment

also demonstrated its usefulness and was acquired by the plant.

The module has now been running successfully for three years and can be operated by the plant personnel themselves if the parameterisation needs to be adjusted. The final steps carried out by Hach included installing the predictive diagnostic system Prognosis, as well as the new software for the RTC-P module. The new version of the software fulfils the requirements of the operations manager, who wanted the system to respond even more quickly to phosphate peaks — a specification that has been achieved with the update.

According to the operations manager at the plant, Martin Moos, the latest version of the software is helping the system to work even better than before. “The module is very intuitive to use and any necessary changes to the parameters can be carried out by my employees quite easily. The Phosphax sc analyser complies very well with the laboratory values and does not require any



time-consuming maintenance,” he said.

Results

Since the P module controlled dosing at the final aeration stage so effectively, dosing on the filter was initially reduced before finally being stopped completely. Compared with 2011, the 17% saving achieved in 2013 even exceeded the estimate made by Hach (10–15%). The measurement values of the daily composite samples in the procedure vary within a much narrower range of around 0.4–0.75 mg/L compared to the

previous range, which also means that the limits are always respected.

In the first year following the installation, the minimum dosing quantity was between 6 and 7 L/h. As personnel have built up their knowledge and gained experience of the module, this figure has now been reduced to 4.5 L/h, resulting in additional savings.

The latest version of the Hach RTC-P System is now available in Australia and New Zealand.

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Turning waste bread into beer

Edge Environment is celebrating its 10th anniversary by teaming up with 4 Pines Brewing Company to brew a very special birthday beer — made with bread as a key ingredient.



Beer and bread have had a deep historical relationship for centuries, so using bread left over from a local bakery to brew beer has been an idea that 4 Pines Head Brewer Andrew Tweddell had been playing with for years. Meanwhile, Richard Griffiths from Edge Environment was inspired by Toast Ale in the UK, which has championed using surplus fresh bread.

"Could we mirror that initiative here?" Griffiths asked in the Edge Environment blog. "After all, here in Australia we currently send in excess of 3 million tonnes of edible food to landfill each year, with breadmaking a significant contribution to that total. Turning some of that into tasty beer seemed like an appropriate nod to our mission, while also giving us something to drink at Edge's birthday party!"

After Griffiths got in touch with the team at 4 Pines, the two companies decided to come together to make the idea come to life. 4 Pines also brought to the table Provenance Flour and Malt, Brasserie Bread and the Crowe family of barley farmers.

Provenance Flour and Malt was established to develop pathways for single origin grain supply to bakers and brewers. Founder John Campbell explained that the use of these direct, traceable and transparent pathways "de-commoditises the grain and reflects the unique performance characteristics from

individual farms — determined by farming methods, minerals and nutrients in the soil and the local climate".

Thanks to Campbell, both 4 Pines and Brasserie Bread have relationships with the source of the grain they purchase. 4 Pines also has a strong relationship with barley farmer Andrew Crowe and his family, who champion efforts not only looking after their soil but also their local community.

"It's essential for 4 Pines to honour the regenerative farming practices that Andrew Crowe has worked hard to put in place, by not wasting any of their grain — even the spent grain left over from the brewing process," explained Kiera Murphy, 4 Pines' sustainability policy and planning manager. "100% of 4 Pines' spent grain is donated directly to an organic dairy and rescue farm in Kempsey, NSW, to support farmers to break cycles of debt and battle against the effects that climate change has on natural sources of feed."

Brasserie Bread also works with Campbell to do business with farmers in Australia's renowned wheat growing districts, with a focus on using single origin wheat that can be traced back to the source. Surplus bread is a reality in the baking industry but if there's no beer to brew, Brasserie makes sure that its leftover bread is used for livestock feed. The company also has a relationship with OzHarvest.

After making the bread-based brew, Edge

Environment conducted a life cycle assessment (LCA) of the beer to investigate the environmental benefits of using waste bread in the brewing process. The combined effect of avoiding sending the bread to landfill, reducing the amount of grain used in the brewing process and sending the spent grain to be used as livestock feed reduced the beer's carbon footprint by 24% compared to a regular craft beer. This was despite the additional electricity used to toast the bread in advance of it being used in the brew.

"Just for fun, we also calculated that drinking the beer on-site rather than bringing in a beer from another brewery in Sydney or Melbourne saved a further 1.5% or 62% respectively. Here's to local beer!" said Griffiths. "On top of which, 4 Pines volunteered to buy offsets to cover the brew's total footprint, meaning Upcycle Ale has the honour of being their first carbon-neutral beer."

Edge will be enjoying the beer for its 10th birthday celebrations and the beer will be on tap at 4 Pines venues across the Northern Beaches. 4 Pines and Brasserie meanwhile intend on exploring more ways to work together to upcycle both excess bread and spent grain for new product development, with 4 Pines looking to explore ways to welcome more suppliers and farmers into the Brew Pub for collaboration brews.

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WIRELESS SENSOR NETWORK FOR IN-TUNNEL AIR QUALITY MONITORING

Bestech Australia introduces the wireless sensor network from BeanAir, suitable for monitoring emissions and air quality in tunnels. The system consists of an AN420 wireless sensor, a BeanGateway wireless coordinator and BeanScape software for supervision, control and remote monitoring.

The AN420 is an analog wireless data acquisition system with an integrated data logger. It is compatible with any sensors providing 4–20 mA (current-loop) input and is able to measure air flow, CO, NO_x and CO₂ concentration. The sensor is directly powered by an adjustable DC/DC converter inside the device.

When multiple sensors are installed inside the tunnel, the BeanGateway wireless coordinator can easily manage queues for every BeanDevice, convert data, manage IP connectivity and control external access to the network through a highly secure authentication protocol. It is compatible with Ethernet and Modbus connectivity (RS232 and RS 485). It can also be used in conjunction with other BeanGateway devices and offers easy data export/import function for flexibility.

The BeanScape software offers a user-friendly interface and can be easily integrated to a third-party supervision software. It can also simultaneously handle several BeanGateway and automatically back up the flash memory of each device for easy maintenance. The software also offers comprehensive data analysis tools and automated exporting to standard report format (Excel, PDF and Word).

Other features include: autonomous monitoring with ultralow battery consumption (up to seven years); compatibility with several transmission protocols; and an integrated data logger, storing up to 1 million data points.

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Why building an 'active grid' is the key to renewable energy management

Giovanni Polizzi, Energy Solutions Manager, and Juan Prieto Vivanco, Senior Manager – Energy Modelling and Control Systems, Indra

Australia's national electricity distribution networks are experiencing a rapid and fundamental transformation. A rise in domestically generated power is causing disturbances in the network that go from voltage rise to rapid shifts in demand and, ultimately, to two-way flows of energy through infrastructure that was only ever designed for one-way distribution.

If not effectively coordinated, these new disturbance patterns have the potential to completely disrupt the operation of the networks and have a detrimental impact on the quality of service delivered to customers.

Historically, changes in demand have been solved through investment in additional generation, transmission and distribution assets. However, this is not going to overcome the challenges now being faced.

What's required is a capability for more dynamic network management that can deal with frequent changes in both the instantaneous supply and consumption of power. The infrastructure that's capable of achieving this has been dubbed the 'active grid'.

A shift in control

An active grid leaves behind current centralised control architectures in favour of a distributed and coordinated control, based on three main principles:

- **Dynamic and adaptive:** An active grid should be able to dynamically adapt to rapidly changing conditions and demands.
- **Flexible and interoperable:** An active grid needs to integrate into the existing power distribution network infrastructure across all voltage levels as well as end customers.
- **Intelligent:** The dynamic monitoring and control of the active grid requires the management and evaluation of vast amounts of data to support control actions in real time, to adjust the operation parameters according to the working conditions.

The dynamic control and monitoring of an active grid infrastructure cannot be achieved by following the traditional strategies of centralised control, even if this is supported by analysis and optimisation tools.

Rather, an active grid must operate in the same way as the human nervous system. It should be able to assess risks to its operation directly where changes occur, automatically reacting if needed to avoid damage and failures.

Shifting grid monitoring and control from traditional central dispatch centres to grid assets, such as substations and relevant customers, will allow local processing analysis of field information. As a result, the operator receives only valuable information

to ensure an efficient coordination of all available resources.

The role of IoT

Available IoT technologies, together with improvements in the capacity of field devices, already allow the distribution and automation of a significant part of the analysis and control functions across different grid levels. An active grid should make use of IoT technologies in a distributed architecture, including:

- Industrial IoT to allow the scalable, secure and reliable coordination of hundreds of thousands of devices deployed across the network infrastructure components.
- Edge intelligence so that connected devices capture, elaborate and react to the data associated to variable operational parameters, thus distributing data processing, analysis and control.
- Real-time integration bus where information can be published, transported and exchanged in a secure and efficient way between sensing devices, monitoring and control systems and operators in real time, and in a coordinated operation.
- Real-time and big data analytics allowing advanced grid analysis with real-time data and decision-making over models elaborated through the use of time series analysis of massive datasets.

Demand response, virtual power plants, distributed storage capacity, distributed voltage control and automatic service restoration are just the most immediate set of new services that could be monetised with appropriate market rules, through the use of IoT.

Rollouts have begun

Active grid architectures are already being piloted, enabling a whole set of advanced new functions.

In Australia, where very high levels of solar distributed generation (close to 50% in some areas in Queensland and South Australia) are significantly affecting grid quality and reliability, the application of an active grid architecture offers operators a complete framework to coordinate in real time customer demand, generation and storage facilities.

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Principal, Julian Cribb
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KEYNOTE SPEAKER

Paul Morris
First Assistant Secretary,
Federal Department of
Agriculture & Water Resources



Andrew Reynolds

Executive Director of River
Management, Murray –
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Andrew Chamberlin

Project Manager -
Energy, Queensland
Farmers' Federation



Dr Chantal Donnelly

Head of Water Resource
Modelling, Bureau of
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Sustainability a key topic

at 2018 Irrigation Australia Conference & Exhibition

Water — whether it's for growing food and fibre, on recreational venues or for environmental use, irrigators have an important role regarding sustainability. The 2018 Irrigation Australia International Conference & Exhibition will showcase the latest solutions, technologies and knowledge to help irrigators use water sustainably and responsibly.

The largest irrigation event in the Southern Hemisphere, the theme for this year's conference is 'Addressing the Big Issues', and will look at five key topics: issues for Australia, future planning, agriculture, turf and landscape, and international matters, with myriad subtopics under those.

Irrigation Australia's CEO, Bryan Ward, said: "This is the only event in Australia solely dedicated to advancing and promoting the entire irrigation industry value chain, presenting issues both relating to and impacting on irrigation in this country. The event brings together the irrigation industry's full ambit, from researchers and scientists to manufacturers, retailers, installers, designers and end users.

"As well as the conference's five key topics, the entire event will highlight and showcase

information and solutions around sustainability, energy-efficient irrigation, the future, rainwater harvesting, technology, productivity, education, and government and policy.

"Irrigation Australia has a responsibility to ensure that education on sustainability and caring for the environment are among our priorities. To this end, there will be many exhibitors and presentations on this area.

"We will also have a series of free-to-attend workshops on offer. These will cover a broad range of areas and are an excellent way for irrigators to keep themselves informed of issues."

Alongside the free exhibition and workshops, the conference will have with more than 80 local and international speakers. "Once again, we have an outstanding line-up of global leaders in their fields, stretching from research through to commerce, who will share their expertise on irrigation."

Speakers in the sustainability field include:

- Dr Chantal Donnelly, Head of the Bureau of Meteorology's Water Resource Modelling, 'How can weather, water and climate data contribute to irrigation decision making?'
- Michael Renehan, of Murray Irrigation Ltd, 'Murray Irrigation: kicking environmental

goals with our irrigation network'

- Prof Peter Coombes, Director of Urban Water Cycle Solutions, 'Rainwater harvesting, urban residential design specification'

"And because we see training and education vital for the modern, constantly changing workforce, Irrigation Australia's National Training, Certification and Marketing Manager, Geoff Harvey, will also talk about certification and training," said Ward.

"The Irrigation Australia International Conference & Exhibition has a proud history and reputation for delivering a quality program across a very diverse industry. We encourage all those involved in the irrigation, in their many capacities, to take advantage of the opportunity to keep up with the latest knowledge and solutions."

What: 2018 Irrigation Australia International Conference and Exhibition

When: 13–15 June

Where: International Convention Centre, Sydney

Exhibition entry: free

Conference early-bird rates end: 20 April

To register: visit <http://iaice.com.au>

Join the Evolution Revolution at Ozwater'18 in Brisbane

The Ozwater'18 Conference and Exhibition is Australia's international water conference and the largest in the Southern Hemisphere. Run by the Australian Water Association, the annual event is attended by over 4000 professionals from water utilities to local councils, universities to consultants. This year the conference is being held at the Brisbane Convention & Exhibition Centre from 8-10 May.

The first official keynote speaker for the conference is Dr Adriana Marais, currently one of the 100 Mars One project astronaut candidates in the running to move to the red planet in the next decade. Dr Marais is passionate about exploring innovative applications of emerging technologies to solve challenges facing the continent.

At the conference, attendees will find out about solutions for a sustainable wa-

ter future across nine different technical streams including: Community Health & Wellbeing, Global Perspectives, Strengthening Communities, and Inspiring Change in the Water Sector.

The Trends and Opportunities in Governance, Policy, Regulation & Structure stream will include a presentation delivered by EY on how the water sector is supporting and creating sustainable communities through integrated urban water management (IUWM) solutions. Attendees will also hear from CSIRO on scenario planning for an uncertain future and the Victorian Government Department of Environment, Land, Water and Planning on getting investment right.

The Community Health and Wellbeing stream will include a presentation by KPMG and the Water Services Association

of Australia on key workforce trends and future skills requirements driving change in the water sector to enable success to the year 2040.

The Strengthening Communities stream will give attendees a chance to hear about sustainably managing the water-energy-climate nexus, highlighting the importance of considering regional variabilities in water availability and how decision-making in the energy sector could impact on future water resources planning.

What: Ozwater'18 Conference and Exhibition

Where: Brisbane Convention & Exhibition Centre

When: 8-10 May 2018

Web: www.ozwater.org



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Silicon thermal storage supporting renewables in the grid

The last few years have seen a significant increase in renewables and their implementation into the grid. However, the intermittent nature of solar and wind power has been a major roadblock to the uptake of renewable energy. Dr Kevin Moriarty, Executive Chairman at 1414 Degrees, explains how storage can help, in particular the benefits of silicon thermal energy storage.

It's no secret that Australia's energy industry has become a much politicised arena, with government and industry struggling to find the best way forward to ensure a reliable, clean and, importantly, cheap energy supply.

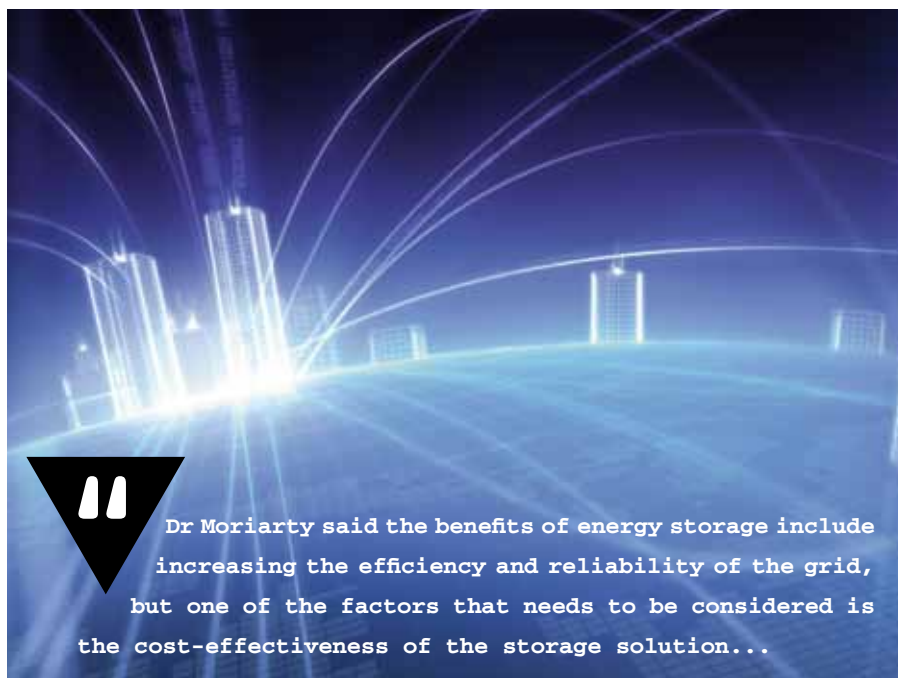
Renewables, whether they are solar, wind, hydro, bioenergy or geothermal, use natural processes so their supply is dependent on conditions that are inherently unstable. However, renewables also create more distributed generation, which Dr Moriarty says can be strengthened through the implementation of energy storage.

"We in South Australia experienced a huge long-lived blackout with quite a loss to the domestic product," said Dr Moriarty. "When we had big power stations, initially they were centred in one spot. So, if a tornado did come through, as happened in the middle of 2016, you're still going to lose a lot of power because your lines go down. There's nothing you can do about that until you rebuild them. Therefore, when you have a few big centralised power stations you do have a vulnerability, particularly in a small state like South Australia.

"However, with the rise of renewables, we now have distributed generation so you're less dependent on any [one source], so that's a positive.

"And then if you can distribute storage through the grid as well, you no longer have the exposure to any one big outage."

Dr Moriarty said the benefits of energy storage include increasing the efficiency



Dr Moriarty said the benefits of energy storage include increasing the efficiency and reliability of the grid, but one of the factors that needs to be considered is the cost-effectiveness of the storage solution...

and reliability of the grid, but one of the factors that needs to be considered is the cost-effectiveness of the storage solution — this is the area where he believes silicon thermal energy storage excels.

"If you have a bunch of storage and generation distributed around the grid, it will become more reliable. But it's also got to be low-cost."

While batteries have a place and can provide good fast-frequency response, Dr Moriarty believes they are not good at providing grid-scale storage. He said thermal energy storage systems are compact, have a long life and the more you cycle them, the better the outcome.

"There wasn't really a need for it before we started introducing a lot of renewables

on the grid, but now that we have a lot of renewables, we need a product that you can put anywhere and doesn't mind how many times it's cycled. Ultimately, if we're going to keep energy costs low, [it] is low cost."

Dr Moriarty said the main driver when it comes to energy supply is it must be reliable, because people want to keep the lights on. The other driver is it must be at a lower cost.

"We're probably going in the wrong direction with both of those at the moment. If you're going to make a change...with so much new renewable going in, you're going to need a lot more storage, but it needs to be economical if you're going to keep prices down."



Dr Kevin Moriarty will be speaking at the upcoming Australian Energy Storage Conference and Exhibition, being held from 23–24 May at the Adelaide Convention Centre. To register for the conference or free exhibition, visit www.australianenergystorage.com.au/register.



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