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The Big Dry

Moving and storing
water requires innovative
power solutions

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Energy Power
Systems





Australia is a country that understands the impact of water. Australia's 'Millennium Drought' of 1997–2009 was the worst on record, severely affecting the Murray-Darling Basin and our largest cities. A decade on we're living it again.

Australia's fast-growing population is putting increasing demand on our utilities and services

This is especially so with urban sprawl commanding new housing developments and high-density inner-city living. What was once a three-bedroom house on a quarter-acre block now supports multiple level townhouses or units with a ten-fold demand for energy and services for residents.

Demands on water utilities for freshwater supply and sewerage removal is rapidly increasing

Yet ageing infrastructure, unreliable sources of supply, emerging regulations and rising customer expectations are also increasing the pressure. There is a huge need to pursue water use efficiencies - from home to commercial, industrial and environmental including irrigation in the agricultural and farming sector. Direct use, reuse and desalination options can all contribute to water options in the future.

Climate change and weather events have also increased the pressure on our utilities

Grid supply shortage and weather challenges, especially across eastern and southern Australia in the last few years have seen multiple incidents of mains power outages. 1.7 million residents of South Australia were without power when severe storms damaged critical infrastructure in September 2016.

Then just five months later, when parts of NSW reached 42 degrees, declining wind and solar generation forced load shedding to balance the network. And power station closures are part of the challenge too.

Moving and storing water requires pumps and energy, no matter the weather

From fresh water to sewerage, water is essential, yet much of Australia's infrastructure is no longer adequate to service our population. Upgrades to larger or more intelligent pumps and reservoir capacity has seen a shift with many facilities implementing or upgrading their standby power systems to cope with this demand. Connecting these assets in the age of technology for 24/7 status monitoring is crucial for utilities to guarantee supply to customers.

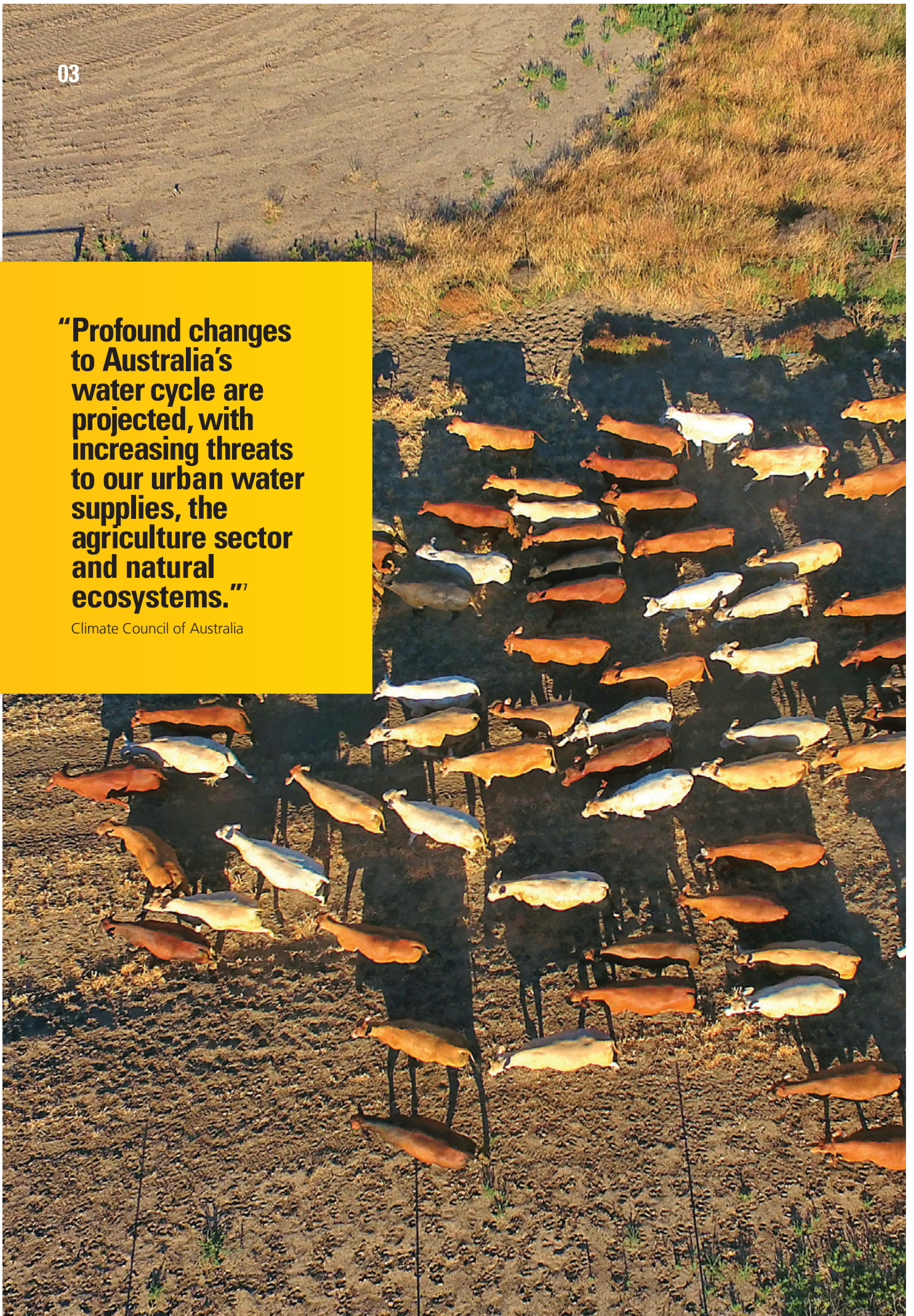
EPSA is taking a leading role in the supply of these alternative power systems

When it comes to reliability and uninterrupted power supply, EPSA provides industry leading Cat® diesel generators to all aspects of the water and sewerage treatment utilities, including hybrid renewable energy power. Whether it's a fixed installation at a local storage reservoir, or mobile trailer mounted sets for emergency deployment during times of unexpected outages, dependability is crucial – and so is the product backing. You can rely on EPSA and Cat® to deliver.

Chris Murray, Managing Director

“Profound changes to Australia’s water cycle are projected, with increasing threats to our urban water supplies, the agriculture sector and natural ecosystems.”

Climate Council of Australia



Drowning in drought

Severe droughts are expected to become more frequent in Australia, especially across the south according to new research from the Climate Council of Australia.¹ Extreme rainfall events are also predicted to become more intense almost everywhere. And it's a storyline playing out to devastating results right now.

On one extreme, the Murray-Darling Basin, which is the lifeblood for so much of Australia is drying up - streamflows have declined by 41 per cent since the mid-1990s.² Towns across inland NSW reliant on the Murray-Darling supply are facing acute water shortages if the drought fails to break. For example the 500 residents of Mendooran near Dubbo are living with level six restrictions, the highest possible in NSW, and their emergency bore water supply is contaminated with blue-green algae.

At the same time, the flood gates were opened fully at Townsville's Ross River dam on February 3rd, releasing about 1,900 cubic metres of water per second³ as a result of one of the worst rain events in Australian history. A warmer atmosphere can hold more water vapour, contributing to an increase in heavy rainfall events and an increased risk of flash flooding.⁴

There's a big health impact to consider too – severe droughts, heavy rainfall and floods can contaminate water supplies, increasing mosquito-borne diseases such as Dengue and Ross River viruses, and adding to the stress in rural communities.⁵ Ultimately, with Australia's population expected to grow to over 30 million by 2031,⁶ there will be additional demands placed on cities and regions as we face new and emerging environmental challenges and greater risks of extreme weather.

1. Climate Council of Australia, Deluge and drought: Australia's water security in a changing climate, 2018, accessed 25 February 2019, <https://www.climatecouncil.org.au/wp-content/uploads/2018/11/Climate-Council-Water-Security-Report.pdf> 2. Climate Council of Australia, *ibid.* 3. Reuters, Australia's Queensland flooding worsens with dam release, February 4, 2019, accessed 25 February 2019, <https://www.reuters.com/article/us-australia-weather/australia-queensland-flooding-worsens-with-dam-release-idUSKCN1PT04Z> 4. Climate Council of Australia, *ibid.* 5. Climate Council of Australia, *ibid.* 6. Australian Government Infrastructure Australia, Australian Infrastructure Plan Priorities and reforms for our nation's future Report, February 2016, accessed 25 February 2019, https://infrastructureaustralia.gov.au/policy-publications/publications/files/Australian_Infrastructure_Plan.pdf



23,500 GL

Estimated water usage across Australia in 2013–14

(17% used in urban areas and 60%+ in irrigation)⁸

The impacts of climate change are becoming more apparent, yet the increasing automation of infrastructure services is changing our built environment. Big data and connectivity are providing us real-time information that can have a huge impact in planning infrastructure, especially water utilities.

The price of clean water

Australia has long been implementing water sector reforms including transforming water allocation, environmental water management and dealing with over-commitment of water resources, pricing and service delivery, and managing both urban water and irrigation practices.⁸ However, water quality in parts of regional Australia does not meet relevant drinking standards.⁹

The Millennial Drought amplified decisions to use non-potable water supplies for uses such as irrigation. Urban water supplies became increasingly reliable on desalination, recycled water and storm water, while new housing developments were designed with alternative water sources for sustainable liveability and green spaces – but this caused water prices to rise significantly.¹⁰

And the costs will continue

Infrastructure Australia predict household water and sewerage bills will increase in real terms, and is critical to address in the context of rising energy costs. Below average increases in real wage growth is also a key factor. Ageing assets and development aligning with population growth will command significant investment – 2017 industry data suggests around 35 per cent of forecast expenditure over the following five years will be to service growth.¹²

But, cost-effective solutions to improve the efficiency of networks exist across the infrastructure sectors according to the Australian Water Partnership.

In water, “...supply may be readily expanded without constructing new dams. Depending on the local environment, recharging suitable aquifers, making better use of surplus water produced by industry, or smarter use of stormwater flows can supplement supply or change patterns of demand.”¹³

8. Australian Water Partnership, Building Resilience to Drought: The Millennium Drought and Water Reform in Australia, August 2016, accessed 25 February 2019, <https://waterpartnership.org.au/wp-content/uploads/2016/08/AWN-Building-Resilience-to-Drought.pdf> 9. Australian Government Infrastructure Australia, *ibid.*

10. Australian Water Partnership, *ibid.* 11. Aither, Urban water sector: future cost and affordability analysis, June 2017, accessed 25 February 2019, http://infrastructureaustralia.gov.au/policy-publications/publications/files/Aither_Future_Cost_and_Affordability_Analysis.pdf 11. Aither, *ibid.*

12. Australian Government Infrastructure Australia, *ibid.* 7. Australian Water Partnership, *ibid.*

Pumping water the renewable way

Water pumping contributes a major portion of energy use in irrigation and agriculture – and is the most significant energy use component of urban water supply and distribution, notably wastewater. Yet, renewable energy can help offset the energy supply.

Approximately half of Australia's wastewater treatment plants are capturing biogas produced from the anaerobic digestion of wastewater sludge and generating bioenergy. Advanced battery storage systems can also help integrate solar and wind power by managing frequency variations and handling peak loads.

According to the Australian Renewable Energy Agency (ARENA), the water sector has demonstrated flexibility in the ability to shift loads for demand management for variable electricity tariffs" and "has a unique ability to use water as a storage medium to change the timing of pumping activities to take advantage of lower cost off-peak electricity for pumping, to replenish high level storages."¹⁵

The renewable way

Sydney Water's Bondi-based wastewater treatment plant is powered by 100 per cent, self-generated renewable energy. This was

after the installation of a cogeneration plant at the facility that captures waste biogas and uses it as a fuel to produce electricity – generating 13 per cent more electricity than it consumed in 2016.¹⁶

A 1MW solar farm sends power to the Barwon Water Black Rock water reclamation plant – reducing operating costs by more than \$200,000 a year. The largest ground-mounted array in southern Victoria is Barwon Water's first large-scale renewable energy endeavour and supplies about 15 per cent of the electricity needs of the water reclamation facility, equivalent to that used by 300 homes. The emissions reduction equates to taking 450 cars off the road. A second stage expansion of the solar farm has been approved to deliver an additional two megawatts capacity by 2020.¹⁷

15. Beca Consultants Pty Ltd REPORT: OPPORTUNITIES FOR RENEWABLE ENERGY IN THE AUSTRALIAN WATER SECTOR, Australian Renewable Energy Agency Australia, November 2015, accessed 25 February 2019, <https://arena.gov.au/assets/2016/01/Opportunities-for-renewable-energy-in-the-Australian-water-sector.pdf> 16. S Vorrath, Bondi water treatment plant now 100% renewable – powered by Sydney waste, One Step Off The Grid, July 2016, accessed 25 February 2019, <https://onestepoffthegrid.com.au/bondi-water-treatment-plant-now-100-renewable-powered-by-sydney-waste/> 17. E Iannunzio, Solar farm powering water reclamation plant, Utility Magazine, May 4 2018, accessed 25 February 2019, <https://utilitymagazine.com.au/solar-farm-powering-water-reclamation-plant/> 18. Beca Consultants, ibid. 19. ABS 2014 cited Beca Consultants, ibid.



20,000 GL+

**The predicted amount of bulk
water used on Australian farms
alone by 2050¹⁹**



**“...our climate
and country
specific conditions
means that the
interdependence
of energy and
water has its own
unique challenges
and opportunities
in Australia.”¹⁸**

ARENA

09 WASTEWATER TREATMENT

Sustainable power using biogas

Biogas, derived as a by-product of many agricultural, food processing and industrial processes, can be used as a fuel source for Cat® generator sets.

These generator sets, specifically designed to operate on low-energy biogas, can reduce total operating costs. They are also engineered to handle fuel with variations in methane content typical of biogas operations. Cat® switchgear and master controls parallel the generator set to the local electrical grid to export renewable power at a premium to the local electric utility, otherwise power can be distributed and used locally. For more remote installations, the power produced can be consumed by the facilities on site.



Sewage gas for power production

Many wastewater treatment facilities use waste methane gas from plant processes as a fuel source.

This gas is comprised of methane and carbon dioxide generated by wastewater digesters used in the water treatment process. Cat® gas gensets utilise the fuel to provide the plant with electricity and heat to serve plant thermal loads and accelerate the wastewater treatment process.

Wastewater treatment processes include energy-intensive operations such as aeration and pumping. As the cost of energy rises and emphasis on renewable sources increases, economical and environmental solutions to energy efficiency can be maximised through the use of anaerobic digestion.

The methane produced when the sewage sludge is digested can be used to power a combined heat and power generator. This in turn provides electricity for the site and the hot water that can be passed through a heat exchanger to assist the digestion process, eliminating need to purchase fossil fuels for plant heating processes and significantly reducing costs.

Featuring electrical outputs from 400 to 4,300 kWe, the Cat® CG range of generators can operate on gases of varying quality, including digester and sewage gas. The units are designed for maximum efficiency and provide a renewable energy solution for long-term savings.

All weather support

Moving and storing water requires pumps and energy, in all weather environments. Fresh water to sewerage water is essential, yet much of Australia's infrastructure is just no longer adequate to service our growing population.

Upgrades to larger or more intelligent pumps and reservoir capacity has seen a shift with many facilities implementing or upgrading their standby power systems to cope with this demand. Connecting these assets for 24/7 status monitoring is crucial for utilities to guarantee supply to customers.

EPSA is taking a leading role in the supply of these power systems. When it comes to reliability and uninterrupted power supply, EPSA provides industry-leading Cat® diesel generators to all aspects of the water and sewerage treatment facilities. During times of unexpected outages, dependability is crucial, whether it's a fixed installation at a local storage reservoir or mobile trailer mounted sets for emergency deployment.

Many facilities are located in close proximity to residential housing across suburban Australia. As a result, this requires site compliance and noise attenuation to eliminate the impact on residents. Aspects like 48-hour fuel storage, attenuation, exhaust discharge, security, aesthetics on the site, plus noise from the generating set at the boundary fence are critical considerations. Each location is evaluated to ensure customer needs are wholly met while minimising these impacts – both on the local environment and on neighbours sharing a boundary.

Product support is critical

The level of engineering support varies from a standard Cat® genset to complex structures built onsite with full output connectivity to customer monitoring. EPSA can provide monitoring of the facility 24/7.

Vandal and tamper-proof designs plus common keyed barrels are readily available. This ensures continuity across multiple plant assets. Tamper-proofing the package and securing the control panel functionality prevents diesel fuel loss from theft given most sites are unmanned. Additional security can be engaged with the use of door reed switches back to monitoring devices for notification.

Advancements in soft starter VSD for a pump motor start is complemented by the quality of power with Cat® Integrated Voltage Regulator fitted to most models with permanent magnet excitation to assist electric motor starting.

Generators can be set up with remote outputs via Modbus, SCADA or on-board modems to fixed or mobile devices for status monitoring of key information crucial to the facility.

Standby power generation is critical for operational success. Cat® generators up to 715kVA come with a warranty of four years or 2,000 hours, along with outage support with from our rental team and the Cat® dealer network. "

Jason Martin, EPSA





Cat[®] power solutions

EPSA and Caterpillar[®] are at the forefront of the development and facilitation of renewable and alternative sources of energy.

The Cat[®] CG range is designed for maximum efficiency in extended-duty distributed generation and cogeneration applications. Already operating in 5,800 installations worldwide, the range uses the very latest gas engine technology with electrical outputs from 400kWe to 4,300kWe.

The CG sets can operate on gases of varying quality, including natural gas, biogases such as landfill, digester and sewerage gas, coke gas and coal mine methane.

Off-grid redundancy

EPSA offers dependable Cat[®] diesel generating sets to support remote area and off-grid standby power. Sized from 7.5kVA and upwards with both single and three phase models available, the range can be provided as an open package or in sound attenuated canopies. EPSA's offering can include full installation and commissioning services as well as competitive finance options from Cat[®] Finance.

Cat® generators provide a reliable, fully backed solution to any off-grid system, in all-weather scenarios.

The landfill-gas-energy cycle

Landfill gas is captured through a perforated well pipe and gathering system with the gas extracted from the landfill into a compressor station, processed, and then used as a fuel source.

Modern landfills install gas collection systems to capture and destroy the naturally produced methane where it is turned into a renewable fuel via a gas-fuelled generator that produces electric power.

Cat® generators turn waste into electricity

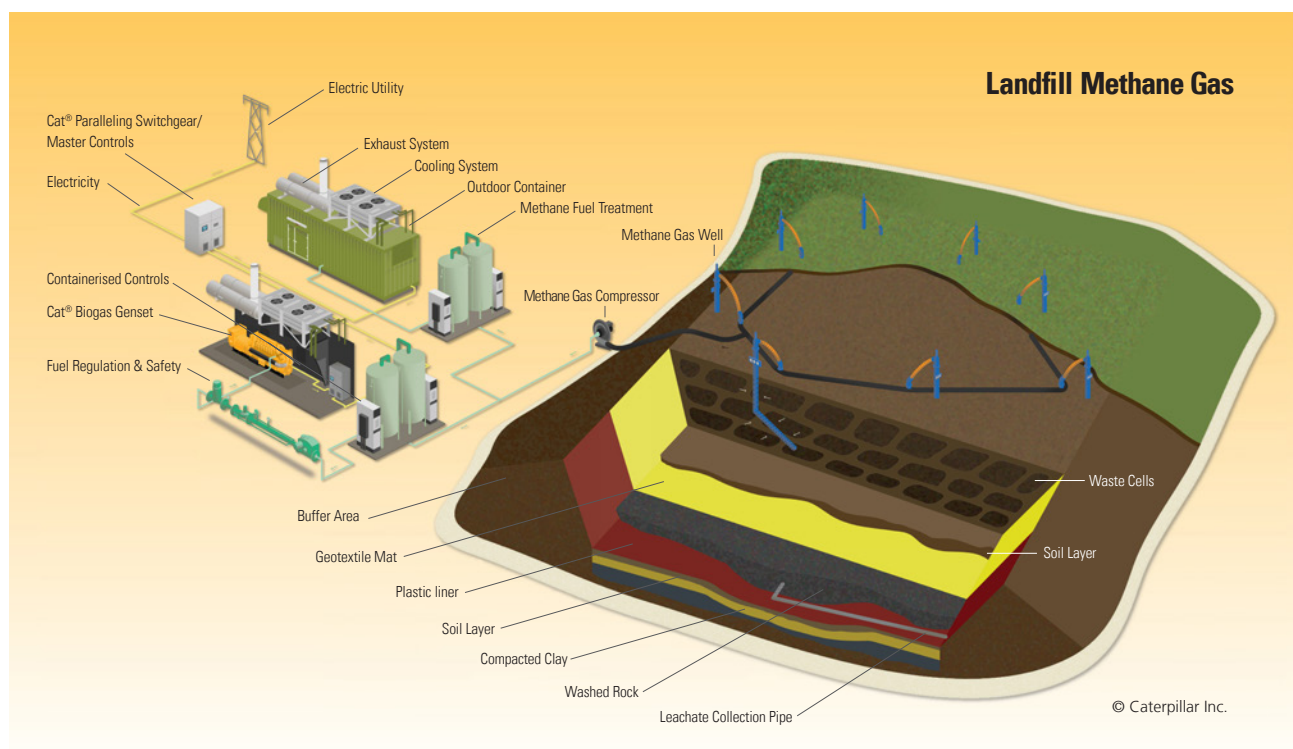
Landfill gas is a cost-effective and reliable renewable base-load power source. The substantial methane content of landfill gas makes it a powerful power generation

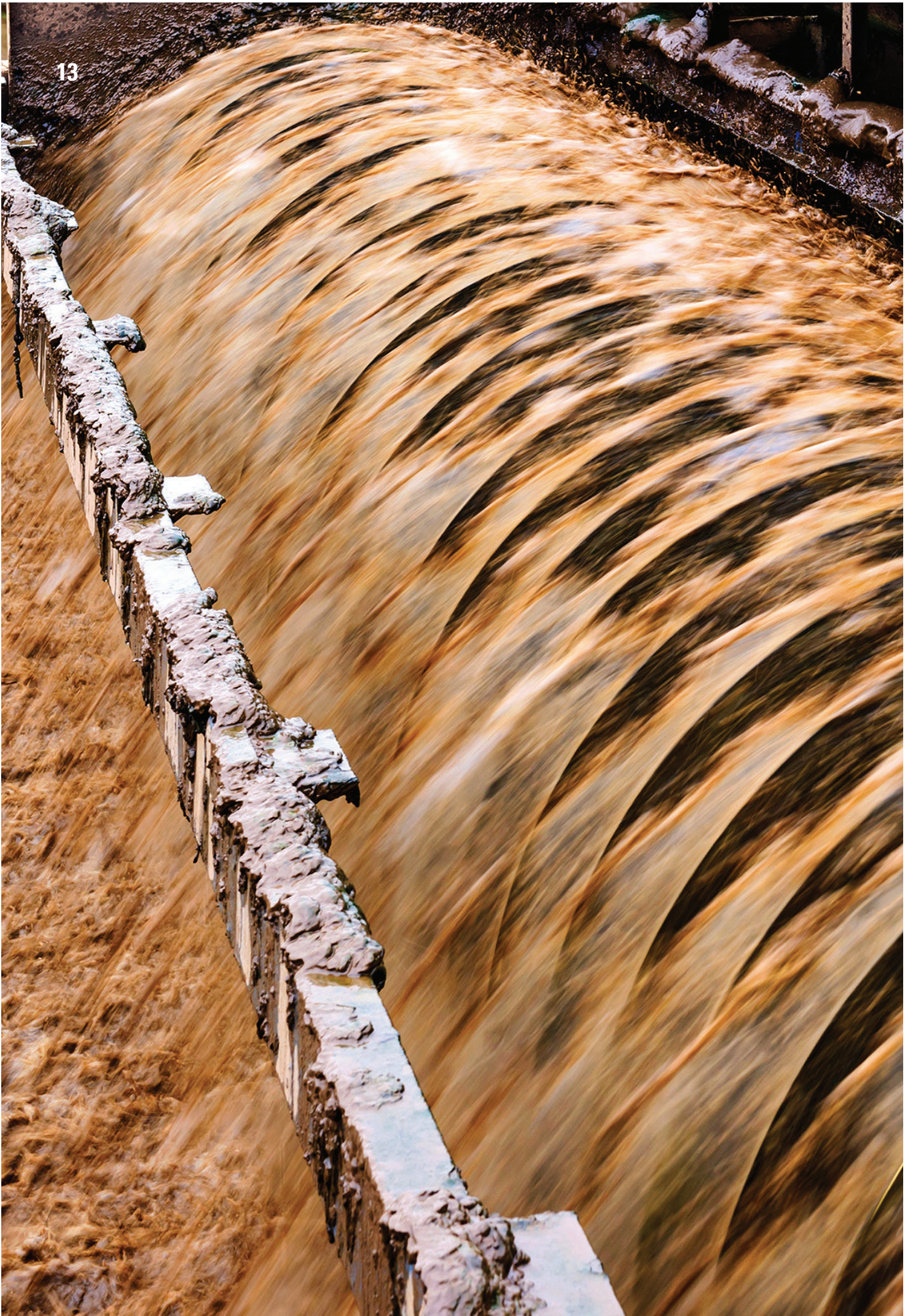
fuel with a big focus on renewable energy and reducing carbon emissions. Turning waste into economically viable electricity is an important and growing application within the world's power generation mix for the collection, processing and treatment of this gas for use in generating electricity.

Cat® Hybrid Microgrid Systems

Cat®'s technologies deliver an innovative, cost-effective way to incorporate renewable energy sources into traditional power generation for diesel and gas applications.

- » Microgrids are independently functioning forms of distributed energy generation.
- » Operating costs are cheaper compared to conventional power generation.
- » Microgrids can deliver grid stability and energy security.
- » Digital controls and smaller-scale storage enable consistent voltage and frequency.





Supporting peak shaving agreements in water treatment

To meet their commercial peak shaving agreements (reducing energy use by shedding loads or by using onsite standby generation facilities during peak times) with the local power company, Yarra Valley Water's Brushy Creek Sewerage Treatment Plant required a generator upgrade.

In late-2017, the Electrical Engineering Department approached EPSA for technical advice, and along with collaborative input from our Sales, Engineering and Project Services Departments we were able to come up with a "best value solution" for the customer, says Paul Rushbrooke, in EPSA's Electric Power division.

"Project installation was completed in the last working week of 2018, with final commissioning in January, comprising a Cat® 3512 Diesel Generator rated to 1,500kVA housed in a custom-made enclosure to address the limited footprint available on site.

"The ability of the 3500 series to take the extreme load steps required at high ambient conditions was a major factor in selecting this series engine. This importance of having reliable quality equipment to the customer was highlighted on the day of final completion testing, when the generator was called on to

perform 'peak shaving' from the power company in 45-plus degree ambient conditions. This generator performed faultlessly at full load for extended periods of time as we claimed it would."

Yarra Valley Water own and operate a network of sewer pipes and pump stations to collect sewage from customers. The treatment plant at Brushy Creek treats up to 13 million litres of sewage a day. It uses a form of the activated sludge treatment method to remove organic material and nitrogen from the sewage. Activated sludge treatment, introduced over 80 years ago, is one of the most common sewage treatment processes in use worldwide.

Market-leading technology solutions



With Cat Connect®, we help customers with their equipment management to be more productive, more safe and provide more sustainable solutions.

The goal of our team is to make our customers more successful just with the information we are gathering from equipment. We provide our customers with a complete fleet solution, regardless of what assets they have. We are monitoring equipment for customers in the mining and construction industries through to power systems, energy and transportation, and even down to service vehicles.

The reality is we have assets that we can connect to any piece of equipment – even down to a toolbox you may want to track. We also have the benefit of Cat Connect® service and connectivity when providing analysis to support customers.

Our value is more than just the data – it's the people sitting behind the data making informed decisions and helping our customers to what they do better every day.



JEVAN DAVENPORT, CAT CONNECT® CUSTOMER SOLUTIONS CENTRE, WILLIAM ADAMS, MELBOURNE

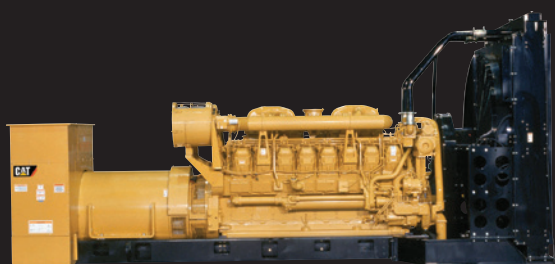


Connect with Cat® – smart use of technology

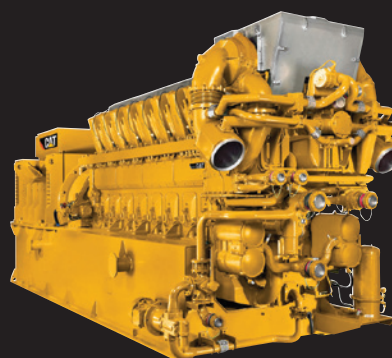
Cat Connect® is a global suite of integrated equipment and asset management services and solutions. It makes smart use of technology and services to improve jobsite efficiencies and deliver insights.

THINK CAT® G3516**Specifically designed for landfill gas**

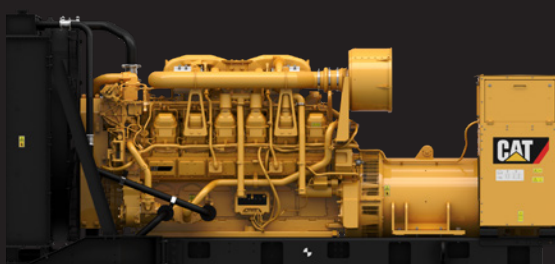
To be economically viable, landfill gas energy must produce electrical energy at a market competitive price and the Cat® G3516 delivers with the right mix of longevity and low maintenance operation. It maximises output and engine life simultaneously and is a traditional lean burn spark ignited engine that operates similarly to many vehicles.

**THINK CAT® CG RANGE****A smarter energy solution**

The Cat® CG range is designed for maximum efficiency in extended-duty distributed generation and cogeneration applications. Already operating in 5,800 installations worldwide, the range uses the very latest gas engine technology with electrical outputs from 400kWe to 4,300kWe. The CG sets can operate on gases of varying quality, including natural gas, biogases such as landfill, digester and sewerage gas, coke gas and coal mine methane.

**THINK OFF GRID SOLUTIONS****Lowering your operating costs**

Caterpillar's 7.5kVA to 26kVA small diesel single-phase Cat® generators meet the requirements of most Remote Area Power Systems (RAPS). Generators come as open engine and sound attenuated canopy versions. The units and installation can be fully financed by Cat® Finance.

**THINK CAT® FINANCE****Landfill gas-to-energy and biogas project solutions**

Cat® Finance understands how to put capital to work in any regulatory environment with decades of experience developing unique financing packages for landfill developers, owners and managers, including total project financing. They also support biogas projects large and small – from wastewater treatment plants to agricultural and industrial processing facilities. They streamline the process to be up and running fast.



Powering front-end engineering and design

EPSA deliver bespoke design work for any site and application with in-house capabilities to perform a range of engineering tasks from front-end engineering and design (FEED) through to detailed design, ensuring the experience of reliable power products that integrate seamlessly with the balance of plant.

Using information prepared during a client feasibility study and conceptual design, EPSA acts on behalf of the customer to conduct further investigations based on technical requirements, says Engineering Solutions Manager Craig Waddell.

“This information provides a basis for detailed engineering, procurement, construction and management by EPSA’s in-house engineering consultants.”

“We also have the expertise to provide high quality specification documents to utilise in

request-for-tender scenarios. These enhance existing consultant relationships by providing expertise in power generation in addition to full consultancy services as design partner.”

“Working with a longer-term project view, EPSA provides a solution that enhances efficiencies and identifies opportunities to minimise costs.” adds Craig.

“We understand the importance of client engagement in delivering site-based project specifications that utilise the latest technology and avoid over-engineered solutions.”





"We take pride in our design work, highlighted by the number of long-term relationships we have and I believe this stems from the bespoke nature of our solutions – they deliver real value to our customers."

Craig Waddell, Engineering Solutions Manager

Choose EPSA and the global reputation of Caterpillar® to experience reliable performance and the lowest total cost of ownership and operation.

There are thousands of Cat® generators providing prime power, standby, hybrid, critical, continuous and emergency power in regional, remote, commercial and residential operations across Australia provided by Energy Power Systems Australia (EPSA) – the exclusive provider of Cat® Power Systems in Australia.

EPSA is proud to offer purpose-built products and project services, purchase options, finance and warranty - all backed by the global power of Caterpillar®.

Experience EPSA's world-class technical knowledge and engineering expertise, and benefit from over 100 Cat® Dealer Partners for service and support across Australia.



GLOBAL COVERAGE, LOCAL SUPPORT.

For new and used engine sales, rental and renewable energy solutions call Energy Power Systems Australia.

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