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Revolutionising renewables

How energy storage and microgrid technology are innovating Australia's tumultuous energy sector.

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> **"As more large businesses switch on to the idea of creating and storing their own electricity, this will fundamentally change the way we think about our energy system.[1]"**
>
> **Kane Thornton, Chief Executive, Clean Energy Council**

The next generation of energy storage

In 2016, the Federal Government ratified the Paris Agreement* on climate change setting self-described "strong, credible and responsible targets to reduce emissions to 26–28 per cent below 2005 levels by 2030 – a halving of emissions per person, putting Australia among the strongest targets of any major economy."[2]

The Government is also implementing the National Energy Guarantee recommended by the independent Energy Security Board (formed out of the Finkel Review). It comprises reliability and emissions guarantees that together require energy retailers and some large users across the National Electricity Market (NEM) to deliver reliable and lower emissions energy generation each year. It aims to integrate energy and climate policies to deliver a more affordable, reliable and lower emissions energy system.

The transformation is real

In our electricity generation sector, the intensifying energy transformation process will involve (among other things) a greater reliance on renewable energies and a relocation of where energy is generated and distributed.[3] Changing economics and technologies will also have an incredible impact; yet the very nature of renewable resources means they can't be instantly generated – the sun must be shining so to speak. However, storage provides a whole new world of opportunity.

The numbers are powerful

Electricity produced from solar is now at cost parity with the electricity grid in many markets. The International Energy Agency predict the sun could be the planet's biggest source of electricity by 2050, while the World Energy Council reveals renewable sources of power now represent around 30 per cent of the world's total capacity and 23 per cent of total global electricity production.[4]

The influence of renewables on electricity generation cannot be underestimated and the emergence of battery storage options will become more prevalent in our public discourse.

The future is now

Today, Caterpillar® is a global leader in the development of innovative energy solutions that can offer lower operating costs than conventional fuels in some cases. At Energy Power Systems Australia, we're proud to be part of hybrid microgrid solutions that incorporate renewable resources and combine with traditional power generation. These initiatives result in lower electricity costs for industries, businesses and communities.

Phil Canning
Managing Director

*2015 United Nations Climate Change Conference in Paris (Paris COP21)

> **Microgrids are in their early stages in Australia, but the country is swiftly taking a world-leading position, making the nation a renewable innovation hub.[5]**

COLE LATIMER, THE SYDNEY MORNING HERALD, JANUARY 3, 2018

The rise of renewables

17.3% | Renewable energy provided 17.3 per cent of Australia's electricity in 2016 – the most of any year this century.[6*]

50% | South Australia's energy equation was around 50 per cent, largely from wind and PV.[7]

17% | Australia has the highest number of solar panels on people's roofs per capita anywhere in the world at 17 per cent** – that's more than 1.76 million units across Australia.[8]

12 | The Federal Government has supported 12 new large scale solar farms across Australia, which together will triple Australia's large scale solar capacity.[9]

1/2 | Renewables is now the cheapest kind of new power generation that can be built today. For example, large-scale solar is almost half the cost it was just a couple of years ago.[10]

79 | Wind power generation is currently the lowest cost, low emissions technology available that can be rolled out on a large scale.[11]***In 2016, Australia's 79 wind farms generated a combined capacity of 4,327 MW.[12]

*2016 statistics are the most current available by the Australian Clean Energy Council
** As at 1 November 2017
*** Of the renewable technologies, wind power has the lowest LCOE in 2015.

The story of storage

> **Energy storage is critical to a successful transformation as it provides the vital link between energy production and consumption and allows for greater penetration of both utility scale variable renewable generation and distributed energy generation.[13]**
>
> AUSTRALIAN COUNCIL OF LEARNED ACADEMIES

Energy storage has the clear potential to support two critical elements that Australia's electricity system desperately needs – security and reliability.

It also can deliver significant economic and environmental benefits. For example, the Australian Renewable Energy Agency (ARENA) is providing $17.4 million funding support to a solar energy plant that will also include lithium-ion battery storage, located in Far North Queensland while the South Australia state government has announced plans for another 'big battery' (post the Tesla agreement) to be installed next to a new 44MW solar farm. It will be accompanied by a 21MW battery storage system adjacent to the a wind farm in the state's mid-north.[15]

Storage comes in many forms—notably, large-scale grid, microgrid, battery and individual solar generation—and when it comes to renewables, storage is incredibly important once the variable renewable energy component of electricity production rises above 50 per cent – a mark that South Australia has already reached.

Global energy storage for microgrid power capacity is expected to grow by over 1,200% in the next decade.

2017 238.4 MW

2026 3,291.8 MW

Driven by: the desire to improve the resilience of the power supply, the need to expand reliable electricity service to new areas, rising electricity prices, innovations in business models, and financing.

SOURCE: NAVIGANT RESEARCH[16]

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Spotlight on microgrids

Microgrids are a very important energy supply solution in Australia. In particular, they provide a smart option for remote communities, those on the fringe of the grid[17] due to vast distances, and to support extremes in temperatures and the increasing number of unexpected weather events. All these elements place highly variable loads on our grid systems.

There are now more options for energy distribution via solar, wave, wind, waste and energy storage projects; and in a hybrid microgrid, renewable sources of energy can account for any percentage of the load depending on conditions.

Excess energy produced by renewables is stored for stabilisation as well as for use during unfavourable conditions. In addition, the genset supplements the system by powering the microgrid when that other energy is unable to be produced.

Although not essential for their operation, the integration of renewable generation into microgrids highlights the benefits of energy storage systems.[18] For example, when a microgrid is in grid-connected mode and connected to an energy storage system, it has the ability to assist with demand charges through peak shaving – the smart grid system of California's Santa Rita Jail integrates all of its on-site generation and advanced energy storage systems and can power 100 per cent of the jail's electrical needs during daylight hours.[19]

> **"With the declining cost of renewable energy sources and rapid advances in energy storage technology, the time is right to provide an integrated application for remote power.[20]"**
>
> RICK RATHE, GENERAL MANAGER – NEW VENTURES, CATERPILLAR® ELECTRIC POWER

THINK CAT® HYBRID MICROGRID SYSTEMS

Cat® Microgrid technology is an innovative suite of power systems that adds environmentally-friendly solar panels, state-of-the-art energy storage, and advanced monitoring and control systems to Caterpillar's® traditional line of reliable power generation equipment, including Cat® generator sets, switchgear, uninterruptible power supplies and automatic transfer switches. Cat® Hybrid Microgrid System uses thin-film solar, advanced monitoring and control systems, Caterpillar® diesel and natural gas generators, and energy storage devices such as ultracapacitors and lithium-ion batteries.

"Microgrids are autonomous energy distribution systems that can generate power from its users and operate off the main grid, or connect to existing grids, and support different generation assets and load demand. This market is forecast to increase to more than $20 billion annually, with around half of all Australian homes expected to have rooftop solar panels installed, by 2024."[21]

COLE LATIMER, THE SYDNEY MORNING HERALD, JANUARY 3, 2018

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Sunshine and waste

In early 2017, EPSA was engaged by Joule Energy in their partnership with Northern Adelaide Waste Management Authority (NAWMA) on an innovative first-of-its-kind project to combine solar and methane gas in an energy production farm. EPSA provided a turnkey solution for the 1.15MW(ac) PV solar plant providing engineering, design, construction and commissioning.

The collective electricity generated from both the landfill gas and solar sources is expected to be over 11,000 megawatt hours per annum of renewable energy, enough to power more than 1,900 homes in South Australia 24/7.[22]

- The solar plant captures energy from the sun and converts it directly to DC power. A solar inverter then converts the power to AC electricity.The power is then exported to the national grid through an interconnect shared with the Cat® gas genset.
- The waste creates methane gas formed by the breaking down of organics in the garbage, the Cat® gas generator converts this methane into electricity that's also exported.

Solar generation systems on landfills and neighbouring buffer zones provide an economically viable reuse for sites that may have significant clean-up costs and little potential for commercial or residential development.

Joule Energy is a new, wholly-owned subsidiary of LMS Energy – a partnership combining over 35 years of landfill gas, renewable energy generation and carbon abatement experience. With a multi-faceted approach to clean energy, Joule is centred on the development of solar power generation systems, both on and adjacent to landfills across Australia.

As landfills have very little utility once capped, due to issues of land settlement and landfill gas, they are ideal locations for solar development.

Joule has essential knowledge and experience to safely manage the complications of interacting landfill gas and solar infrastructure, within a shared landfill environment. With a successful track record for designing and implementing seamlessly cohabiting landfill gas and solar power systems, Joule is an industry leader in this now emerging field.[23]

Cat's® first solar plant in action on Australian soil

11,040 Cat® PV solar modules are mounted on fixed axis steel frames that contour the challenging terrain of the Adelaide foothills.

The PV solar modules are arranged into 46 strings each feeding a dedicated 25kW (SMA) inverter – the strings are then split into three separate arrays, with AC output from each collected to supply the EPSA-supplied HV transformer kiosk. The kiosk transforms the voltage to 11,000V AC for supply to the grid via the client-operated power station.

Control of the plant is achieved using the 4G wireless network to communicate between the power station and a Cat® (SMA) Cluster Controller, which relays the information back and forth to each of the 46 inverters. The controller features a web-connected online portal to provide the client with up-to-date information on the solar plant status including current plant output, daily yield and alarms.

A key feature of the solar plant control is the dynamic reactive power control – since this solar plant is exporting to the grid, the grid voltage is affected with higher export values. To counter the ever growing problem of grid voltage stability, the solar plant is able to dynamically change the output power factor to import or export 100 per cent of the plant's output in reactive power in a trade-off for active power. This means that the plant can help stabilise the local grid voltage throughout the day.

The solar plant has been successfully exporting green energy into the South Australian grid since it was commissioned in late-October 2017 – Cat's® first solar plant on Australian soil.

When compared to a traditional coal-fired power station generating the same amount of electricity, the NAWMA renewable energy facility will save approximately 24 million litres of water each year and prevent 63,500 tonnes of carbon (CO_2-e) from being emitted into the atmosphere.[24]

Choose EPSA and the global reputation of Caterpillar® to experience a superior investment and reliable performance.

There are thousands of Cat® generators providing prime power, standby or emergency support in commercial and residential operations across Australia provided by Energy Power Systems Australia (EPSA) – the exclusive Cat® dealer in Australia.

Caterpillar® is leading the integration of renewable power with smart energy storage and conventional diesel or gas-fuelled power generation. As global fuel prices fluctuate and renewable technologies become increasingly more sophisticated, the Cat® Hybrid Microgrid System delivers a fully customisable and scaleable hybrid power solution to meet your power needs today and for future expansions.

- **Classic diesel generation, renewables and battery storage**
- **Battery integration provides stability and reliability to a remote plant**
- **Significantly reduce your fuel expenses**
- **Decrease harmful emissions**
- **Lower your total cost of ownership**
- **Achieve favourable payback periods**
- **Experience clean, cost-effective electricity**

As the only fully-integrated service provider of hybrid systems in Australia, EPSA is proud to be the exclusive Australian distributor of the Cat® Hybrid Microgrid System from 10 kW–100 MW. We offer purpose-built products, project services, 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.

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